ERASMUS UNIVERSITY ROTTERDAM

ERASMUS SCHOOL OF ECONOMICS

MSc Economics & Business

Master Specialisation Financial Economics

CEO COMPENSATION INCENTIVES

Firm performance & investment strategies

ERASMUS UNIVERSITEIT ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS

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Finish date: August 2016

PREFACE AND ACKNOWLEDGEMENTS

The writing process of this dissertation has been a long *intense* journey and a fruitful *experience*. The first step, i.e. the choice of my research topic, followed from the seminar empirical corporate finance. During this seminar, I experienced my first actual research in the academic area of CEO compensation. The fascination for this topic grew whilst I was reading the related academic literature. Therefore, I decided to write the end piece of my financial economics master about the, in my opinion, most interesting and relevant relationships within the CEO literature. I chose to explore both the relationship between firm performance and CEO compensation and the relationship between CEO equity compensation and investment strategies. These two topics clearly connect, although researching two different streams requires a strong structure. It was difficult to find the right structure and a specified research question. The current literature includes a broad variety of relevant variables to include into both analyses, which made it even harder to be specific. Through this preface, I want to express my sincere gratitude to Dr. J.J.G. Lemmen for his professional support and advice. The advice allowed me to focus on the most important relationships and variables in the excess of different variables. Hence, I was able to conquer the most difficult parts of the writing process. Furthermore, I learned that the data collection could be tough but satisfying when you arrive at the results. Although there were different struggles, I developed myself strongly by tackling these problems. I am proud of the final output and I classify this dissertation as one of the biggest achievements during my study. A key lesson from the whole process is that substantial effort, professional advice and motivation are the key drivers of great results. This lesson will be extremely useful during my professional career. Finally, I want to express my gratitude to my parents and my girlfriend for their mental support during the complete writing period. Overall, I am ready and fully motivated to take the first step in my career and I will remember all the experiences I gained during the writing process.

ABSTRACT

This study examines two major issues in the CEO compensation literature in a contemporaneous period (2006-2014), considering 1176, S&P listed, U.S. firms. Firstly, this study examines whether firm performance systematically affects the level of CEO compensation components. Secondly, this study examines whether changes in the value of the CEO equity portfolio have a significant impact on the implemented investment policies of the firm. The analysis contains different firm, industry and year fixed effects regression models. The models capture that market-based firm performance (stock returns) affects the level of all the CEO compensation components positively, after controlling for firm-, CEO- and board-characteristics. Nonetheless, the results do not indicate a strong and consistent relationship between the different CEO compensation components and accounting-based firm performance (return on assets). Therefore, this study provides evidence on the importance of market-based firm performance indicators in the determination process of CEO compensation contracts. Furthermore, the results indicate that the sensitivity to risk of the CEOs' option and stock portfolio values significantly affects the risk level in the investment choices of the CEO. A higher sensitivity to risk leads to more investments in research & development (R&D) and less investments in capital.

Keywords:

CEO incentives, firm performance, investment strategies, delta, vega

JEL Classification:

G30; G32; G34; D86

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1. INTRODUCTION

CEO compensation has always been an important factor in the financial path of a firm. The firm's performance and the business strategy heavily depend on the daily decisions made by the CEO. These decisions should aim at increasing the market value of the firm, which makes the CEO an agent of the shareholders, who in fact own the firm. Historically, CEOs are known for maximizing their own financial wealth at all costs even if their firm suffers from it. Therefore, the shareholders must incentivize CEOs to execute strategies and investments that serve shareholder value. The board of directors, representing the shareholders, incentivizes CEOs to align their self-interest with the goals and desires of shareholders, by means of compensation contract. A compensation contract consists of different components; the most common components are salary, cash bonus, restricted stock and stock options (Murphy, 1999). The latter two, i.e. equity-based compensation, gained popularity since the 1990s because they establish a direct link between CEO wealth and the shareholder value (Bryan et al., 2000a).

Over the last 30 years, the average CEO compensation at the largest U.S firms increased with approximately thousand percent. This is an extraordinary high percentage in comparison with the corresponding growth of the S&P 500 index, which is around five-hundred percent (Mishel & Davis, 2015). *The large difference in growth raises questions about the actual importance of firm performance in the determination of the CEO compensation level*. Furthermore, the increase in stock-option pay from 1992-2002 contributed significantly to the total compensation growth. The average value of stock options, at grant date, was $800.000 in 1992 and grew to $7.200.000 in 2000 (Hall & Murphy, 2003).

Several scandals, Enron (2002) amongst others, showed the huge impact of flaws in the executive compensation structure. At Enron, executives received substantial stock option packages, which made them extremely focused on increasing stock prices and excessively risk-taking (Madrick, 2003). The accounting/reporting trick to issue stock options instead of cash compensation was one of the main causes for Enron to go bankrupt. The former CEO of Enron Jeffrey Skilling articulated this phenomenon as follows: "Essentially what you do is you issue stock options to reduce compensation expense, and therefore increase your profitability." (Hitt & Schlesinger, 2002).

These dubious reporting and compensation practices resulted in various legal changes by the U.S. government in the reporting rules and requirements. The first major act of the 21st century was the Sarbanes Oxley (SOx) act in 2002, which was a reaction to the fall of Enron and several other companies. The SOx act contains strict guidelines for the reporting of securities as executive compensation, i.e. stocks and stock options (Volcker & Levitt JR., 2004). In 2006, the U.S. Security and Exchange commission (SEC) adopted additional changes in the disclosure requirements, i.e. FAS 123R. From then on, firms had to report complete and clear-cut information about the compensation, especially options, of both top executives and directors (Hayes et al., 2012). Transparency of the outcomes from contract negotiations between CEOs and the board of directors, representing the shareholders, became a key focus point for the U.S. government (Bebchuk, 2009).

The board of directors has the difficult task to monitor the CEO on behalf of the shareholders. Hence, the board of directors bears the final responsibility to assess the right level and structure of the CEO compensation contract. The compensation committee within the board of directors solely consists of non-executive directors, according to the Securities Exchange Act of 1934 (Dodd-Frank Wall Street Reform and Consumer Protection Act, 2011). Non-executive directors work at outside firms, whereas executive directors are employees of the firm. All U.S. firms have a one-tier board of directors in this system non-executive and executives take place in a single board together (Brick et al., 2006). The various characteristics of the board affect the compensation level of the CEO. Therefore, these characteristics have to be taken into account when analyzing CEO compensation.

This study combines two different literature streams in order to cover the topic of executive compensation as completely as possible. The first literature stream, which covers the vast majority of the academic CEO compensation literature, focuses on the *relation between firm performance and the various CEO compensation components*. Although the seemingly small magnitude, the relationship between firm performance and CEO compensation has been significantly positive over time (Jensen & Murphy 1990; Rosen, 1990; Conyon & Murphy, 2000; Conyon, 2006). An important note here is that the determination of CEO compensation most likely changed after the SOx act of 2002 and the SEC amendments in 2006. Research by Mishel & Davis (2015) shows that the compensation of CEOs grew with 54% from 2009-2014, whereas the S&P 500 index grew with 85%. These findings might confirm that the legal changes have caused a closer alignment of CEO compensation with the shareholder value[1]. This research also adds the most relevant board characteristics to the performance analysis, in order to see if the relation between firm performance and CEO compensation still holds under certain circumstances.

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[1] The growth of the S&P index since 2009 is most likely influenced by the market recovery after the global financial crisis of 2008.

The second literature stream, which received less attention in the historical CEO compensation literature, *explains the effects of changes in the stock return volatility on the value of CEO equity holdings, in relation to the firm's investment policies*. The equity-based CEO incentives are associated with CEO risk-taking in the long-term strategy, especially the stock options. Core & Guay (1999) conceptualized the sensitivity of the CEOs option portfolio to stock return volatility into a variable called vega. Coles et al. (2006) utilize vega to study relationship between stock-option incentives and the firm's business strategies. They found significant patterns of risk-taking when CEOs have a higher vega. This literature stream will be the most innovative part of my study, I establish a relation between CEO equity holdings and firm's investment strategies, i.e. capital expenditures and research and development (R&D) expenditures.

The theoretical and empirical build-up of the research has to be clear, since this study addresses two highly connected but different literature streams. The build-up will be as follow: firstly, I consider the different components of CEO compensation and the underlying incentives. The first part also contains a discussion about the connection of these different components with firm performance. Secondly, we discuss the influences of board characteristics on the compensation of the CEO. Thereafter, the effect of the equity-based incentives and the corresponding pay-risk sensitivities on the investment strategy of the firm will be covered. After covering all these topics, we will be able to provide empirical evidence in order to answer the research question of this paper:

"To which extent does the board of directors incentivizes the CEO to increase firm performance and to implement profitable investment strategies?"

By answering the abovementioned research question, this paper aims at making a threefold contribution to existing literature stems:

- This study tends to establish a relationship between firm performance and the levels of total compensation, cash compensation and equity-based compensation, in a contemporaneous time frame (2006-2014). Therefore, this study contributes to the literature about the relation between firm performance and CEO compensation, which surprisingly contains few studies on the existence of this relationship a recent time frame.
- This study tends to establish a relationship between the sensitivity to risk of equity incentives and investment strategies. Core & Guay (2002) have set the basis for this

literature stem, which is highly relevant in the current CEO compensation literature since the awards of equity-based incentives became increasingly popular since the 1990s (Bryan et al., 2000a; Hall & Murphy, 2003).

- This study incorporates relevant board characteristics, derived from the existing literature, to the analysis of CEO compensation and firm performance. While Fama (1980a) explored the agency theory of the firms, he discovered that boards play a major role in the alignment of shareholder interests and CEO interests. Therefore, many researchers implement board characteristics into their CEO compensation models (Yermack, 1995; Brick et al., 2006; Ozkan 2011).

The use of different methods from the fundamental CEO literature, to analyze the concept of CEO compensation in a broader perspective, characterizes the *additional value* of this study.
The remainder of the paper is organized as follows. Firstly, section 2 provides a review of the fundamental CEO compensation literature. Secondly, section 3 elaborates on the data collection and variable construction for the research purposes. Thirdly, section 4 describes the implemented methodology for the analyses. Thereafter, section 5 discusses the empirical results from this study. Finally, section 6 contains the conclusion of the study, further research recommendations and the limitations of the paper.

2. LITERATURE REVIEW

2.1 Firm Performance & CEO compensation

This section contains a broad overview of the existing literature about the most important components of CEO compensation and their relation with firm performance. Firstly, this section discusses agency theory since it provides a theoretical foundation for the relation between firm performance and the CEO compensation contract. Secondly, the design of the compensation contract and the included performance measures will be discussed. Thereafter, we discuss the CEO pay-performance relationship. Finally, this section emphasizes the incentives for performance, underlying the different compensation components, and the corresponding empirical findings of the earlier literature.

2.1.1 Agency theory

The curiosity towards the relationship between firm performance and CEO compensation finds it origins in incentive theory. Barnard (1938) was the first explorer of incentives in a managerial context. He defines the moral hazard problem, which implies that managers and employees should receive objective incentives to align their efforts to the overall performance of the firm. These incentives can be either monetary or non-monetary (Laffont & Martimort, 2009). Monetary incentives relate to the specific case of the CEO compensation contract.

In response to Barnard's theory and several other studies about the moral hazard problem, Ross (1973), amongst others, discusses agency theory. Agency theory describes the relationship between the actions of an agent (CEO) and the interests of a principal (shareholder). The shareholder is the risk-bearer in this relationship, since failure of the CEO directly influences the price of the stocks owned by the shareholder (Fama, 1980a). Two agency problems in the shareholder-CEO relation arise because of the following reasons:

- There is difference between the CEO's goals and the shareholder's goals, while the actions of the CEO are difficult to observe for the shareholders (Eisenhardt, 1988).
- The shareholder and the CEO differ in their attitudes towards risk-taking, which often results in decisions by the CEO that are suboptimal for the shareholder (Eisenhardt, 1988).

Nevertheless, there are two solutions for these agency problems. Firstly, the CEO compensation contract has to be aligned with accounting and stock return performance, since shareholders benefit from high firm performance (Jensen & Meckling, 1976). Where, the compensation of the CEO has to be an outcome of the performance in the previous period, since this improves the involvement of the CEO in the success of the firm (Fama, 1980a). Value-maximization arises when the interests of shareholders and executives are aligned optimally (Yermack, 1995). Hence, a strong connection between CEO compensation and the performance measures implies proper incentive alignment and higher accounting and market returns. Therefore, it is beneficial to compensate a CEO according a pay-performance mechanism (Perry & Zenner, 2001).

Secondly, a third 'independent' party has to monitor the CEO's decisions and performances. The board of directors functions as the third party in this principal agent relationship. Therefore, the board control is described as an information system for the shareholder to gain knowledge about the actions of the CEO (Fama & Jensen, 1983). The remainder of this section focuses on the alignment of the compensation contract with firm performance.

2.1.2 Design of the CEO compensation contract

The compensation contract of a CEO consists of fixed components and variable components. Fixed components are the basic compensation components that a CEO receives, which includes base salary, pension and other forms of compensation, such as cars, travel allowances and accommodations (Balkin & Gomez-Mejia, 1987). These components can be classified as the essential earnings of the CEO. Variable components are the compensation components that CEOs receive in order to incentivize their performance: cash bonuses, restricted stocks and stock options (Hubbard & Palia, 1995). The major components fall under *cash-compensation* or *equity-based compensation* (Cooper et al., 2009). The variable compensation components have different underlying incentives, i.e. long-term and short-term incentives. *Table 1* shows the major components of cash- and equity-based compensation, their definition and an indicator for long- or short-term incentives.

Table 1: CEO compensation components

Components	***Definition***	***Incentive***
Cash compensation		
Salary	Base Salary.	Fixed
Bonus	Annual performance-based bonus.	STI
Other Annual	Pension, cars, accommodations, travel.	Fixed
Equity-based Compensation		
Restricted stock	Stock (locked up for 1+years) grants.	LTI
Stock-options	Stock-option grants (vested for 1+years).	LTI
Total Compensation		
TC	Salary, bonus, other annual, restricted stock grants value, option grants value.	Both

'Fixed' stands for compensation without a real incentive, 'STI' stands for short-term incentive, 'LTI' stands for long-term incentive, 'Both' stands for a combination. Locked-up = untradeable, Vested = is not exercisable. *Deferred compensation and long-term incentive plans are not included in the table, since these compensations fall under the categories bonus, restricted stock and stock options. I do not consider these compensations separately during this paper.

The variable part of the CEO contract includes several firm performance measures and corresponding targets to receive the actual compensation, these performance measures are mostly accounting-based (Murphy, 1999). *EBITDA, Return on assets (ROA) and return on equity (ROE) are the most commonly used accounting-based measures to assess the performances of the CEO.* These accounting-based measures have several advantages (Merchant, 2006):

- *Accuracy*: accounting measures are reliable and accurate, since firms have to report their accounting statements according to strict guidelines. Furthermore, these statements are under strong surveillance of outside auditing firms.
- *Frequently measurable*: most firms measure the return on assets/equity and EBITDA on a weekly, monthly and yearly basis. Therefore, these measures are frequently available.
- *Seemingly compatible with stock returns*: most of the CEOs believe that stock prices reflect positive accounting information, since investors react to accounting announcements. Therefore, the CEOs perform to increase accounting returns.

Nevertheless, the literature distinguishes between accounting-based performance standards and market-based performance standards to analyze the role of firm performance in the determination of CEO compensation. Inevitably, there is a debate about these standards and their applicability to CEO compensation contracts. Although the advantages of accounting-based performance measure as an achievement tool in the compensation contract, accounting-based standards have some significant disadvantages compared to market-based standards. Firstly, accounting-based standards solely reflect the management of the assets in place during the previous year, i.e. short-term decisions (Bushman et al., 1995). Therefore, accounting measures have a backward looking character, which causes CEOs to focus on increasing the short-term accounting profits at the costs of neglecting long-term value creation (Murphy, 1999). Secondly, accounting-based measures do not take into account intangible assets, e.g. growth opportunities and the value of brands (Merchant, 2006). Finally, accounting-based measures (ROA/ROE) are often sensitive to manipulation, the significant amount of corporate scandals, due to accounting fraud, illustrates this sensitivity (Pérez-González, 2006).

Stock return is the major market-based performance standard to assess the CEO compensation – firm performance relation. According to Bushman et al. (1995), stock returns have a main advantage over the accounting-based standards, since the stock price reflects the quality of long-term decisions by a CEO. Long-term decisions involve business strategies, strategic planning, investments in R&D and the utilization of the present growth opportunities. This major advantage, together with the three disadvantages of accounting-based measures, creates a general preference for market-based or mixed measures, amongst academics. Nevertheless, the market-based measures have a disadvantage too, namely that the stock prices are sensitive to macroeconomic factors. CEOs have no control over macroeconomic factors, for example a financial crisis, which creates noise in the performance measure (Merchant, 2006). Most studies prefer the use of stock return over ROA since they are more important for the shareholders, and both measures are often positively correlated (Murphy, 1999).

Tobin's Q is a proxy for future growth opportunities and firm performance, this measure combines market data and accounting data to estimate the potential of a firm. Therefore, it is considered as a mix of accounting and market-based measures. Several studies use Tobin's Q in combination with stock returns or ROA as a control variable for the growth opportunities of the firm or even as a firm performance measure (Mehran, 1995; Pérez-González, 2006; Ozkan 2011).

2.1.3 Pay-performance relationship

The historical CEO literature often establishes a relationship between the accounting- and market-based performance standards and the total CEO compensation level, for publicly listed U.S. firms (Murphy 1985; Jensen & Murphy, 1990; Kostiuk 1990; Rosen, 1990; Conyon & Murphy, 2000; Conyon, 2006; Ozkan, 2011). However, there are two different ways to measure the pay-performance relationship. Firstly, Jensen & Murphy (1990) connect the different compensation components to the firm's market value (shareholder wealth). They measure the dollar change in the compensation level when the rate of return on stocks times the market value of the firm changes with $1, i.e. the *pay-performance sensitivity*. Hence, the model consists of the dollar value of yearly CEO compensation and the dollar market value of the firm times the yearly return rate. Secondly, Rosen (1990), amongst others, measure the percentage change in the compensation level when the stock returns change with 1%, i.e. the *pay-performance elasticity*. Hence, the model consists of the natural logarithm of yearly CEO compensation and the natural logarithm of continuously compounded yearly stock returns. There is no clear consensus which of these two measures is optimal. However, Murphy (1999) argues that the elasticity measure has a more suitable model, since return rates explain more variance in the natural logarithm of CEO compensation, than absolute changes in market value explain of the cross-sectional variance in CEO compensation. Furthermore, the ROA can replace the stock return in both measures to estimate the accounting-based performance sensitivity and elasticity (Murphy, 1985).

Jensen & Murphy (1990) establish a significant positive relation between the changes in stock performance and the total level CEO compensation, for 1400 publicly listed U.S. firms from 1970-1988. Nevertheless, they find that total CEO wealth has a relatively low sensitivity for changes in shareholder wealth, i.e. an increase of $1000 in shareholder wealth is followed by an increase in CEO wealth of $2.59. According to the authors, the government causes the relatively low sensitivity, due to the high amount of regulatory rules for the CEO compensation contract. Furthermore, Rosen (1990) finds a pay-performance elasticity of 0.1 for large U.S. public firms, which implies a 1% increase in total compensation for a 10% increase in shareholder return. This elasticity has a significantly higher magnitude than the performance sensitivity found by Jensen & Murphy (1990). Another interesting insight from the research by Rosen (1990) is the change in pay-performance elasticity to 1.0 when he replaces stock returns with ROA. Hence, a 10% increase in ROA will lead to an approximate 10% increase in total compensation.

The pay performance relationship has become stronger since the 1990s. Conyon & Murphy (2000) estimate the performance elasticity for U.S. firms and U.K. firms. Firstly, they find that U.S. CEOs receive higher cash (+45%) and total compensation (+190%), compared to U.K. CEOs. Considering the pay-performance relationship for U.S. CEOs, they find a significant 1.48% increase in total compensation for each 10% increase in shareholder wealth. In addition, Conyon (2006) measures the pay-performance elasticities for S&P listed firms from 1993 to 2003 and he finds a 1.35% increase in total compensation per 10% increase in stock returns, after controlling for firm size and the affiliation of the compensation committee with the firm.

Recently, Ozkan (2011) uses Tobin's Q, which is a proxy for future growth opportunities, and stock-returns to analyze the relation between total CEO compensation and firm performance in U.K. firms. Her findings were in line with Conyon & Murphy (2000) and Conyon (2006). She also finds a significant positive effect of stock returns on the total CEO compensation level, after controlling for board, firm and CEO characteristics. Although she argues that Tobin's Q is not a significant determinant of the CEO compensation level because the addition of this variable does not enhance the model.

It appears that there are different findings on the magnitude of the relationship between different firm performance measures and the total level of CEO compensation. For example, Jensen & Murphy (1990b) earlier drew the conclusion that the level of CEO compensation is related to ROA but it is weakly related to stock returns. Furthermore, bonus contracts often drive accounting earnings, whereas they do not drive the stock returns (Murphy, 1999). Nevertheless, most studies establish a significant relationship between CEO compensation and stock-returns.

Tosi & Gomez-Meija (1989) already concluded that the different findings, despite the wide variety of available data, are often conflicting with each other. In addition, Tosi et al. (2000) summarize that firm size explains around 40% of the variance in total CEO compensation, while firm performance explains only about 5% of the variance. Several other studies also find that firm size is a large determinant of the total compensation level. Kostiuk (1990) argues that there is a stable relationship between CEO compensation and firm size, which holds over time and for different countries. Hence, the elasticity of CEO income to firm size in the 1970s is similar to the elasticity in 1930.

Furthermore, Gabaix & Landier (2006) document a six fold increase in CEO pay from 1980-2003, which they contribute to the fact that the average firm size also increased in six fold. Furthermore, the low dispersion and scarcity of CEO talent increase the compensation level. Therefore, the difference in talent between two CEOs might be small but the compensation difference is bigger. This difference in payment is multiplied by the firm size since they assume that the best CEOs work at the largest firms.

Gabaix et al. (2014) find more evidence for the hypothesis that the size of a firm and the level of talent are reflected by the level of CEO compensation. Since the time frame 2004-2011, which includes the crisis years, was not used in the previous study they researched their earlier theories with new positive and negative shocks from this period. Executive compensation follows an identical path compared to the evolution of average firm value. Between 2007 and 2009, the firm value dropped with 17% and CEO compensation with 28%. In the subsequent period from 2009 until 2011, firm value has gone up again with 19% and CEO compensation increased with 22%. Their findings indicate that the firm size is indeed an important determinant in the decision process of the CEO compensation package.

Tosi et al. (2000) contribute the different findings to different data collections, different firm/time-samples, different (in) dependent variables, different statistical analyzes and different research approaches. Besides, they think that the previous literature has relied heavily on traditional scientific approaches, because previous studies incorporate many different methods due to criticizing parts of the existing methods.

Besides the importance of firm size, the relationship between firm performance and CEO compensation has a dual causality, since firms with higher performance pay more and firms with larger CEO payments perform better on average. Mehran (1995), amongst others, examines the executive compensation structure of U.S. firms and provides significant evidence for the usefulness of incentive/performance-based compensation. Mehran (1995) uses ROA as measure of firm performance, when analyzing the relation between total compensation and firm performance. He finds a positive incentive effect of the level of total compensation on the firms' ROA. He also implies that the form of compensation is the key to increasing the manager's motivation to create shareholder value. Nonetheless, this paper focuses on the causal effect of firm performance on the compensation levels.

2.1.4 Short-term incentives

Short-term incentives drive the CEO to achieve the annual business goals of the firm. They can be classified as annual performance-based incentives. The major part of these incentives is cash-based, i.e. annual cash bonus (Lerner & Wulf, 2007). The previous literature about the effectiveness of the short-term incentives is not unanimous. Hence, *equity-based compensation* is considered as a more effective tool to incentivize the CEOs' interests to create shareholder value than *cash compensation*, on the short- and the long-term (Frydman & Jenter, 2010).

Annual cash compensation (base salary plus bonuses) has a small positive effect on the ROA of the firm in the subsequent period (Gerhart & Milkovich, 1990; Jensen & Murphy, 1990). However, Gerhart & Milkovich (1990) find that the level of the base salary has no significant effect on the performance. Therefore, a combination of base salary and annual cash bonus can be described as a strategic choice compared to an adjustment in the level of base salary. Jensen and Murphy (1990) discover that the annual salary and bonuses increase with 1% per 10% increase of the growth in firm value. This indicates that last year's market performance is a significant determinant of this year's cash compensation.

On the other hand, Bebchuk and Fried (2004) examine cash bonus compensation and suggest why cash compensation has a weak connection with the CEOs' performances. Firstly, many firms use subjective criteria considering a part of their bonus compensations. Although, these criteria could be useful to align shareholder interests, boards utilize the discretion of these plans in order to please their favored CEOs by paying them healthy salaries while the firm-performance is below average. Secondly, if the firm uses objective criteria they often tend to adapt the criteria to lower levels when a CEO does not match the firm performance according to the initial criteria. These shifting criteria are mainly caused by the fear to lose the CEO and the scarcity of CEO talent (Gabaix & Landier, 2006). In addition, Mehran (1995) discovers a negative relationship between the percentages of cash compensation in total compensation and the firm performance, measured as ROA.

2.1.5 Long-term incentives

Long-term incentives align the CEOs' interests and shareholder value in a structural and forward-looking manner. Most previous studies focus on the long-term incentives, which are usually equity-based, and the relationship with performance (Bryan et al., 2000a; Aboody et al., 2004; Frydman & Jenter, 2010). The use of equity-based compensation as long-term pay incentive is effective, since it connects the CEO wealth directly to changes in the market value of a stock (Bryan et al., 2000a). Contract theory implies that shareholders prefer equity-based compensation, since a CEO with less share ownership percentages of the firm behaves more opportunistic (Conyon, 2006). Share ownership improves the *principal-agent relationship*, because it links the CEOs' financial interests with the shareholders' needs of a long-term firm performance to increase shareholder wealth. Bebchuk & Fiend (2010) complement that firms should avoid rewarding the CEO based on short-term performances. They state that the equity-based compensation is the crucial component of the CEO pay package. Hence, compensation contracts have to incentivize the CEO towards long-term value creation. Total equity-based compensation exists of (restricted) stock grants and stock option grants.

The effect of stock options grants and CEO stock-option holdings on the shareholder wealth became a widely researched topic especially in the 1990s. Since, the payment structure has changed from cash-bonus oriented to equity-based compensation, in order to achieve optimal contracting. This research stream tends to measure the sensitivity of a stock option's value to changes in stock prices (Jensen & Murphy, 1990; Yermack, 1995; Core & Guay, 1999; Coles et al. 2006). Core & Guay (1999) calculate this sensitivity by taking the partial derivative of the stock-option value in relation to the stock price, i.e. stock-option delta. One can measure the effect of a 1% change in the stock price on the option value, in U.S. Dollars, by multiplying the stock-option delta with 1% of the stock price.

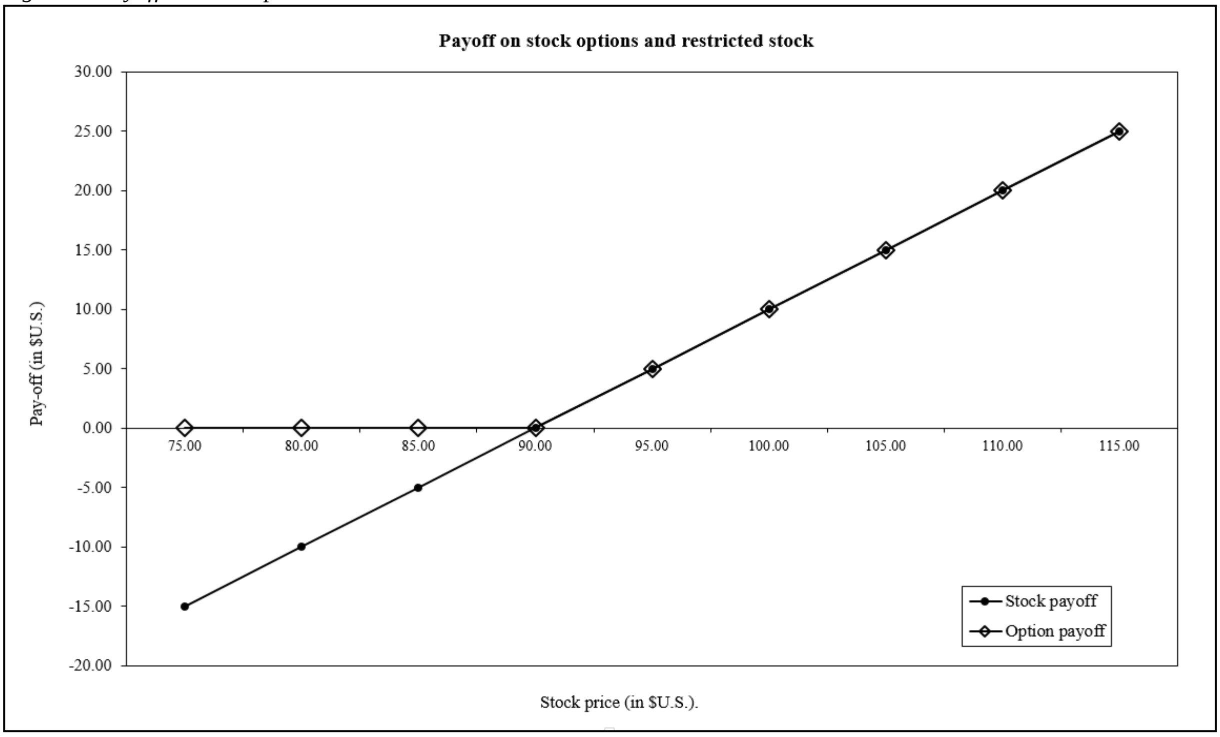
According to Jensen & Murphy (1990), stock options are an important component of CEO compensation, because option values respond instantly to changes in the stock price. Nevertheless, a stock option provides different incentives than holding a stock. Stock ownership implies rewards when the stock price increases or when receiving dividends, whereas option holdings only reward when the stock price increases. Jensen & Murphy (1990) were the first researchers to explore the stock-option delta. They analyze 15 years of data on CEO compensation of the 250 largest publicly listed firms in the U.S., and find that the CEOs' stock-option values increase with around $0.60 for each $1000 increase in the stockholder wealth.

In the extension of Jensen and Murphy, Yermack (1995) finds a similar pay-performance sensitivity of stock options awards, i.e. $0.59 per $1000 increase in stockholder wealth. However, he argues that the stock-option delta is not related to the percentage of equity owned by the CEO. This implies that the actual percentage of equity owned by the CEO does not enhance the performance incentives behind stock option awards. Yermack (1995) assigns this finding to the possibility that CEO equity ownership is an exogenous outcome of the contract negotiation process. Furthermore, his findings indicate that Tobin's Q is positively related to the stock-option delta. This implies that the incentives of stock option awards will grow when the future growth opportunities are better.

Another difference between stocks and stock options is the amount of risk that is associated with the award. Stock options have zero downside risk, this becomes more clear when analyzing the pay-offs of stock options and stocks, which are displayed in *figure 1*. The pay-off graph of the stock option does not go below the zero pay-off border. If the stock price becomes lower than the exercise price of $90.00, the option is out-of-the money. However, there is nothing to lose because there is a choice to call the option and if the option is out of the money one should never call it. The restricted stock has a downside risk since the value of the stock can drop until it is zero and then you lose all the value of the earned restricted stocks. Henceforth, stock options reward CEOs when stock prices increase and they do not punish CEOs when stock prices decline, whereas stocks punish CEOs for declines in stock prices (Sanders, 2001).

Since 2001, the awards of restricted stock have become a more important determinant of CEO performance-base pay and the importance of stock options has become smaller (Conyon, 2006). Restricted stocks are stock packages a CEO receives, however he/she receives the profit on the stock after a vesting period of at least one year. The profit is calculated by subtracting the grant date value of the stocks from the market value of the stock on the vesting date (Hall & Murphy, 2003). Henceforth, Hall & Murphy (2003) find that restricted stock awards have an advantage over stock options awards, especially when it comes to maximizing the CEO incentives. The awards of restricted stock incentivizes the CEO to maintain or increase the current stock price level. However, stock options incentivize the CEO in a way that is dependent on the stock price's relative position towards the exercise price of the option. When the market price is higher than the exercise price, the incentives of an option will be comparable to the restricted stock. Whereas, a low market price relatively to the exercise price will lead to a situation where the CEO might have low incentives since he/she does not expect a substantial payoff anymore. Hall and Knox (2002) call these low incentives options 'underwater options'. The main problem with these options is that the respective firms need to grant new options with a lower exercise price to replace the low incentive options, whereas restricted stocks do not have such problems (Hall & Murphy, 2003).

Figure 1: Payoff on stock options and restricted stock



The graph displays the payoffs for a restricted stock without dividends that is valued at $90.00 and a stock option with an exercise price of 90.

2.2 The influence of the board on CEO compensation

The board of directors decides about the level and the structure of the compensation package for the CEO. More specifically the compensation committee within the board, which solely consists of outside directors, determines the compensation package (Dodd-Frank Wall Street Reform and Consumer Protection Act, 2011). The decision process behind the CEO compensation package depends on several factors. These factors play an important role in the academic literature about the effectiveness of CEO compensation and they influence the monitoring task of the board. If the board executes a weaker governance on the CEO by paying him/her too much, this will hurt the firm performance (Core et al., 1999). In this section we will discuss the three-tier agency model, which builds further on the agency theory that is discussed in section 2.1.1 and this model clarifies the role of the board as a supervisor in the agency model. Furthermore, we will discuss the factors that might influence the decision process of the compensation committee, i.e. board composition, board size, inside/outside director compensation and share ownership structure.

2.2.1 Three-tier agency model

The original agency theory model describes the relation between a principal and an agent. The principal is the owner of the firm (shareholders) and the agent is the decision maker (CEO). In this traditional model, the risk-neutral shareholders have to incentivize the risk-averse CEO to make decisions that increase shareholder value (Jensen & Meckling, 1976). One of the problems, which connects to this relationship, is the difficulty to observe the decisions of the CEO for the shareholders (Eisenhardt, 1988). The shareholders usually appoint a board to diminish agency problems and the difficulty to monitor the CEO's decisions. In the optimal situation, the board/compensation committee is responsible for monitoring the CEO's decisions and the determination of the CEO compensation contract (Fama & Jensen, 1983; Core et al., 1999).

The addition of the compensation committee adds a new layer to the agency model, since the relation between shareholders and the compensation committee becomes important. Henceforth, the traditional agency model changes into a three-tier agency model. The most important adjustment is the change in structure from principal-agent to principal-supervisor-agent (Conyon & He, 2004). The self-interested compensation committee members (supervisors) have to act in the interest of the shareholders (principal) in order to design the optimal contract for the CEO (agent) and in order to supervise the decisions of the CEO (Conyon, 2006).

The board of directors appoints the outside directors in the compensation committee themselves. Hence, the shareholders have to make a thought-out decision about the board size, board composition and the compensation of the board members. All these factors might directly influence the compensation contract of the CEO. Several studies incorporated these factors to their models when analyzing the CEO pay-performance relationship (Core et al., 1999; Brick et al., 2006; Conyon, 2006; Ozkan, 2011; Lin et al., 2013). The remaining paragraphs of this section discuss the empirical findings on the effects of different board characteristics on CEO compensation.

2.2.2 Board size & composition

Core et al. (1999) , amongst others, argue that the characteristics of the board of directors have a substantial influence on the level of CEO compensation after they controlled for the economic determinants of the CEO compensation level, e.g. the firm risk, the simultaneous firm performance and the firm size. They find that CEO compensation is significantly higher when the board-size is larger. The composition of the board also has an impact on the level of CEO compensation. For example, when there is a higher percentage of outside directors the CEO compensation level increases.

Conyon & Murphy (2000) contribute that the board size has a significant positive impact on the level of CEO compensation when they analyzed cross-sectional compensation data of 1997 for 1666 U.S. and 510 U.K. companies. A more recent study by Lin et al. (2013) shows that there is no significant evidence of the size of the board on the level of total CEO compensation. Whereas, earlier theories argue that board size affects the effectiveness of the board in monitoring the CEO (Fama & Jensen, 1983). When board size grows, there might be more professionals with independent and different views. Nevertheless, this advantage often disappears due to a lack of efficiency from difficulties in the communication and the coordination of the decision-making process (Ozkan, 2011).

2.2.3 Director compensation

As mentioned at the start of this chapter, the board of directors bears the responsibility to determine the level and form of the CEO compensation. Therefore, the compensation for the directors also plays a role in the effectiveness of the monitoring process. When the directors receive the right compensation incentives, they will align the compensation of the CEO with the shareholders' interests (Fich & Shivdasani, 2005). However, when the compensation of the directors is excessive there might be a situation of cronyism between the directors and the CEO (Brick et. al, 2006).

The previous literature shows the existence of an optimal contract for outside directors. The size, the amount of assets and the market to book ratio of the firm have a significant effect on the presence of outside director compensation plans (Bryan et al., 2000b). In addition, Linn and Park (2005) find a positive relation between investment opportunities and the total and equity-base level of compensation, for directors in a sample of 200 large U.S. firms. Henceforth, they arrive at the conclusion that outsider director compensation is an attractor for outside directors that closely monitor the CEO and utilize the firm's growth opportunities. A sufficient compensation for the outside directors diminishes agency costs and agency problems.

The levels of CEO and director compensation may connect for a fair amount of reasons. A negative relation could arise when the effort of directors replaces the work of the CEO (Berry et al., 2006). Nevertheless, a positive relation between CEO and director compensations could arise when the size and complexity of a firm asks for high skills and more effort of both the director and CEO. Cronyism could also cause a positive relation, because both managers and directors put their interests above the interests of shareholders. In order to distinguish between these alternative explanations, Brick et al. (2006) contribute to this literature stem by studying the levels of director and CEO cash compensation, in order to see if these compensations relate to each other and to firm performance. In their regressions, they include a variable for excess director compensation that indicates the presence of a statistically significant relationship between the compensation of CEOs and directors. One of their main findings is a significant positive relation between CEO compensation and director compensation, after controlling for firm-specific and board-specific variables.

Hereafter, they performed a regression to estimate the effect of CEO and director excess compensation on the future firm performance. Henceforth, cronyism turns out to be one of the main reasons for the positive relationship between CEO and director compensation since it causes a negative relationship between future firm performance and the high compensation of both CEO and Directors. The negative association between excess compensation and future firm performance reflects the suboptimal performance of a management, driven by self-interest instead of shareholder interests.

A large part of the literature overlooks the effect of the compensation level of the director on the compensation level of the CEO (Carpenter, 2002). Both inside- and outside director compensation affect the structure and level of the CEO compensation and the pay-performance elasticity. The inside director- and outside director-compensation variables might be correlated with the CEO compensation, however they might be correlated with other explanatory variables (Brick et al., 2006).

2.2.4 Board & CEO share-ownership

Besides the board size, board composition and the compensation of the directors, ownership variables relate to the CEO compensation as well. Ownership variables stand for the percentage of shares an executive or director owns out of the total shares outstanding for the firm. Shareholders of large firms own the majority of the equity whereas managers and directors control the firm, this creates a separation between ownership the control (Fama, 1980a). In order to diminish possible agency problems, due to the separation of ownership and control, managers and directors receive equity-based compensation (Mangel & Singh, 1993). The involvement with shareholder value of the CEO will increase when they receive firm equity, therefore a higher percentage of ownership might increase the level of CEO involvement and the sensitivity to firm performance (Mehran, 1995). This theory is also applicable to the outside directors in the board, since their involvement eventually increases when their ownership percentages increase (Brick et al., 2006).

A higher percentage of share ownership by outside directors has a negative effect on the total compensation level and the cash compensation level of the CEO (Ozkan, 2011; Lin et al, 2013). Ozkan (2011) interprets this finding as a confirmation that outside directors closely monitor the CEO when they receive equity incentives. Therefore, they are also stricter in their compensation policies. In addition, yearly CEO compensation decreases if the CEO has a higher ownership stake since the level of equity grants to the CEO will decrease. Nevertheless, there is a weaker connection between the ownership percentage of an inside director and CEO compensation, because of the marginal influence of inside directors on the compensation of the CEO (Lin et al., 2013).

2.3 CEO compensation & investment strategies

The structure of the CEO compensation package influences the investment strategy of the firm. Especially the equity-based compensation components of the total package affect the amount of risk a manager might take in his/her investment strategy (Core & Guay, 2002). Therefore, this section firstly discusses the two most widely used investment variables capital expenditures and R&D expenditures. Thereafter, this section describes the relation between the equity compensation a CEO receives and the amount of risk he/she takes with his/her investment strategy, due to this compensation.

2.3.1 Investment strategies

The asymmetrical information distribution amongst the CEO and the shareholders, which arises because of the agency problems, decreases when the CEO has a compensation contract that focuses on both long and short-term stock prices (Bizjak et al., 1993). Hence, the CEO has incentives to make optimal investment decisions for the current and future value of the firm. Cash compensation incentivizes the CEO to make investments focused on the short-term stock price, whereas stocks and stock options incentivize the CEO to invest in projects to enhance future stock performance (Frydman & Jenter,2010). The earlier literature has spent less time on this phenomenon compared to the direct pay-performance link. However, most studies that focus on the link between the CEO's equity portfolio and investments use research and development (R&D) expenditures and capital expenditures as independent variables (Core & Guay, 1999; Core & Guay, 2000; Coles et al. 2006; Hayes et al., 2012). When analyzing this relationship, it is essential to distinguish between different industries, since pharmaceutical and technological industries, for instance, require a higher intensity of R&D. Therefore, industry controls have to be included in the analysis (Coles et al., 2013). Furthermore, Smith & Watts (1992) argue that the investment opportunity set varies across firms and industries. Cash compensation, equity bonus plans, market-to-book ratios, leverage ratios, surplus cash vary across firms and influence the investment opportunity set of the CEO. Therefore, these firm-specific variables have to be included in investment regressions.

R&D expenditures relate to a risky investment. The uncertainty of the return on the investment, which can be as low as zero, plus the longer time-horizon of an R&D expenditure cause the risky character of R&D expenditures. However, if a R&D expenditure is successful it will significantly increase the growth opportunities of the firm (Kim & Lu, 2011). Growth strategies can be beneficial to the firm, although managers can be discouraged to take on long-term value creating projects because of the involved uncertainty of the actual return on the investment. Furthermore, investments in R&D have a significant positive effect on the productivity of the firm (Lichtenberg & Siegel, 1991). Capital expenditures (CAPEX) imply a safe investment, because these are investments in necessary products/systems to improve and maintain production and productivity (Coles et al., 2006). The capital expenditures have a lower risk profile because the outcome is often directly visible and easily measurable. Another characteristic of CAPEX, which makes the investment safer, is the easiness to lower the expenditures without generating significant losses.

2.3.2 CEO equity compensation & risk-taking

Coles et al. (2006) have studied the effect of equity-based CEO incentives on the policies/strategies executed by the firm. One of the implications of their research is that firm policies become riskier when both the pay-performance of equity-based CEO compensation and the pay-risk relation of CEO stock option compensation are stronger. Hence, when the CEOs possess a large amount of equity, especially stock options, they tend to increase R&D expenditures and to decrease their capital expenditures when the stock return volatility increases. Furthermore, the empirical evidence indicates a strong relation between the compensation structure and managerial decisions, considering the riskiness of investments. The investment policies of a firm depend on the sensitivity of the CEO's wealth to stock return volatility, also called *vega* (Coles et al., 2006; Hayes et al., 2012). Vega is actually a proxy for the CEO equity value sensitivity to risk, which accounts for 99% of the variation in this sensitivity (Core & Guay, 2002). When the board provides CEOs with more incentives to increase risks (a higher vega), they will eventually tend to increase the risks. Coles et al. (2006) find that this effect of vega remains observable after controlling for the pay performance sensitivity of the CEO wealth, also called *delta*. Bizjak et al. (1993) find that higher R&D expenditures are associated with a lower delta

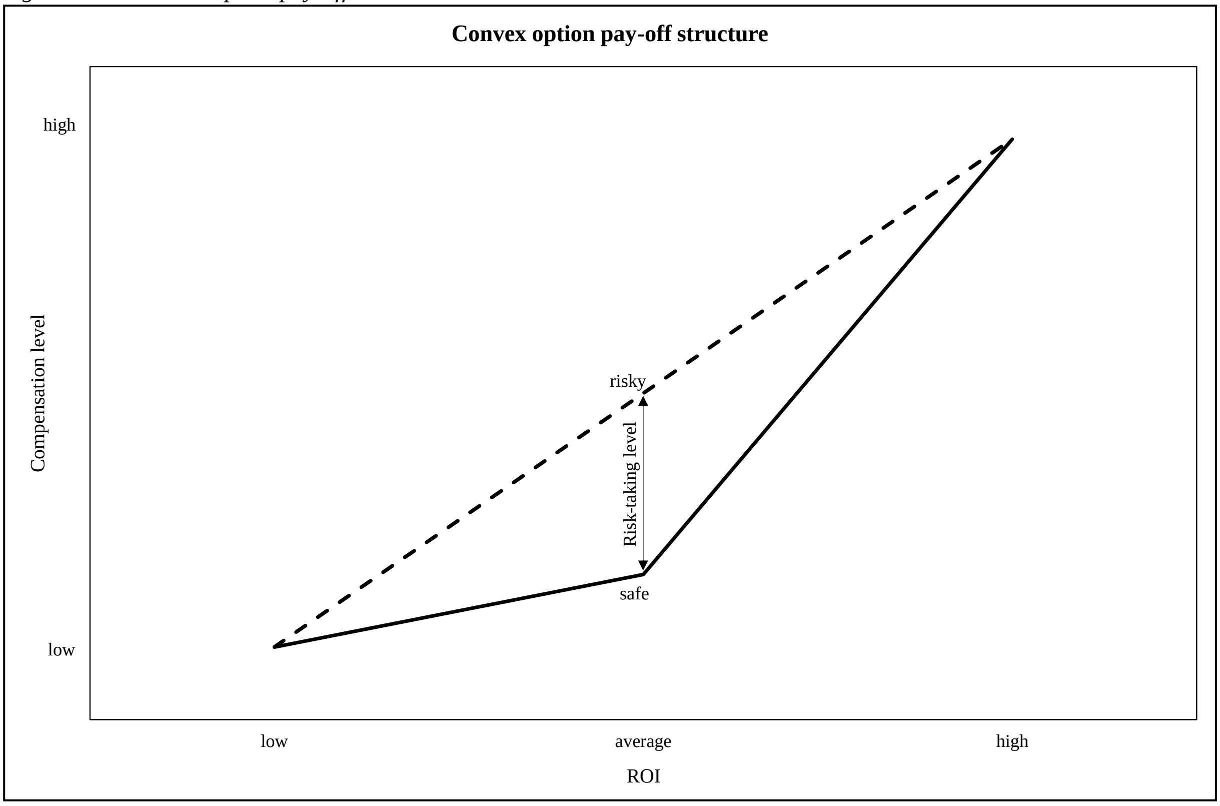
In general, stock option incentives will diminish the effect of CEO risk aversion, and therefore provide the CEO with higher incentives to take on risky projects. The convex pay-off structure of stock option incentives, see *figure 2*, characterizes the higher risk-taking behavior of the CEO. The two-sided arrow in the figure show the amount of risk a CEO can take in his/her strategy and the option pay-off at an average return on investment. The figure shows that the risky strategy leads to a substantially higher pay-off from the stock options than a safe strategy. The convex/nonlinear pay-off of option causes that managers who take excessive risk receive huge bonuses, whereas managers who invest safely receive marginal bonuses (LeRoy, 2010).

Nevertheless, several studies are not able to find evidence for the claim that stock-option compensation cause managers to make riskier investments, when they possess more options of the firm (Guay, 1999). Guay (1999) argues that the concavity of the utility function, of the risk-averse manager, diminishes the convex payoff structure of the stock option incentives. In line with these findings, there is no clear incentive that cancels out risk aversion (Ross, 2004). More specifically, a call option contract forces managers either to take too much or too little risk, depending on the level of managerial risk aversion and the underlying investment (Ju et al., 2002). When stock call-options are in the money, they can also discourage managers to take riskier investments (Lewellen, 2006).

Various empirical studies explore the relationship between managerial stock/options holdings and the different elements of a firm's strategy. An analysis, of the connection between the managers' equity holdings and the investment scope of the firm, shows that the value of the options granted to managers has an explanatory power towards simultaneous R&D investments (Ryan & Wiggins, 2002). CEOs with more stocks and stock options are more likely to take a risky investment, for example stock price variance increasing acquisitions (Agrawal & Mandelker, 1987).

Guay studied a sample of 278 CEOs and shows that the standard deviation of returns (firm risk) and the vega of CEOs positively relate to each other (Guay, 1999). Furthermore, Guay (1999) argues that CEOs, who receive higher cash compensation, diversify more of their outside company equity, which affects the amount of risk they will take. Finally, Cohen et al. (2000) argue that book leverage has a positive correlation to the sensitivity of CEO wealth to stock return volatility (vega), since risk-taking of the CEO is also translated in a higher leverage ratio.

Figure 2: The convex option pay-off structure



This figure contains the relationship between return on investment (ROI) and the compensation/pay-off from stock options. The double-sided arrow displays the risk-taking level of a CEO’s investments and the average compensation he or she receives for taking risk. Inspired by " Convex Payoffs: Implications for Risk-Taking and Financial Reform " by S. LeRoy, 2010, FRBSF Economic Letters, 30. Retrieved July 28, 2016, from http://www.frbsf.org/economic-research/publications/economic-letter/2010/october/convex-payoffs-risk-taking-financial-reform

2.4 Literature overview

The literature consists of mixed views on the CEO compensation incentives and especially their relations to firm-performance and risk-taking. Therefore, it is beneficial to include a table that summarizes the different findings, samples and methodologies of the previous literature. *Table 2* provides this overview.

Table 2: Empirical literature overview

CEO Compensation and firm Performance						
Author(s)	**Year**	**Time-frame**	**Sample Size**	**Industry**	**Method**	**Empirical Result**
Gerard and Milkovich	1990	1981-1985	200 US firms	All	OLS	Incentive pay is positively associated with financial performance, base pay is not.
Jensen & Murphy	1990	1974-1986	1049 US firms	All	OLS	CEO compensation changes with $3.25 for each $1,000 change in stock returns.
Kostiuk	1990	1969-1981	83 US firms	Manufacturing	OLS	Firm size has significant positive effect on CEO pay.
Mehran	1995	1979-1980	153 US firms	Manufacturing	OLS	Firm performance is positively related to the CEO equity ownership and CEO equity compensation.
Yermack	1995	1984-1991	792 US firms	All	OLS/Tobit	Few agency or financial contracting theories have explanatory power toward patterns in CEO pay.
Core & Guay	1999	1992-1997	±1100 US firms	All*	OLS	Firms tend to set optimal share-based incentive levels and grant new share-based incentives according to economic theories.
Core, Holthausen & Larcker	1999	1982-1984	205 US firms	All	OLS	Weak governance leads to higher compensation and worse performance
Conyon & Murphy	2000	1997	510 UK, 1666 US firms	All	OLS	The mean level of CEO ownership (%), in US implies that the median CEO receives 1.48% of an increase in stock returns.
Perry & Zenner	2001	1992-1996	100 US firms	All	OLS	Compensation committees have taken the monitoring seriously after the SEC regulations of 1992, which has had systemic impact and on the overall pay for performance relation.
Conyon	2006	1993-2003	±1200 US firms	All	OLS	The boards and compensation committees became more independent and started providing CEO's with appropriate compensation.
Brick, Palmon & Wald	2006	1992-2001	±1300 US firms	All*	OLS	Excess compensation (Director & CEO) is strongly related to firm underperformance.
Ozkan	2011	1999-2005	390 UK firms	Non-financial	OLS	The pay-performance sensitivity is lower in the UK compared to US. However, firm performance is tied to compensation.

Equity-based compensation and investment strategies						
Author	**Year**	**Time-frame**	**Sample Size**	**Industry**	**Method**	**Empirical Result**
Bizjak, Brickley & Coles	1993	1975-1989	430 US firms	All	OLS	Equity compensation has to be focused on both current and future stock performance, in order to resolve informational asymmetries and to stimulate optimal investments.
Guay	1999	1993	228 US firms	All	OLS	Stock options significantly increase the sensitivity of CEOs' wealth to equity risk (vega).
Core & Guay	2002	1993	10000 US employees	All	OLS	Vega explains 99% of the variation in stock option value due to stock return volatility.
Ryan & Wiggins	2002	1997	1088 US firms	All*	OLS	Stock option compensation positively affects R&D investments.
Coles, Daniel & Naveen	2006	1992-2002	±1100 US firms	All*	OLS	CEOs with a higher vega implement riskier policies, i.e. more investments in R&D and less investments in capital.
Hayes, Lemmon & Oui	2012	2002-2008	1156 US firms	All*	OLS	Firms have reduced stock option compensation after the FAS 123R rules, nevertheless it does not affect the risk-related agency costs so CEOs with large option packages still make riskier investments.

'All*' stands for all industries excluding financial firms and utilities.

2.5 Conceptual framework

The literature review provides an overview of the different variables and determinants, which play an important role in the relation between on the one hand CEO compensation and on the other hand firm performance and investment policies. This section contains visual representations of the potential relationships between these important variables. The research consists of three parts. The first part describes the main determinants of CEO compensation variables and the performance elasticity of CEO compensation. The second part focuses on the effect of equity-based incentives on the investment policies of the firm.

Figure 3 displays the part of the research that discusses the relationship between the levels of CEO compensation and the performance of the firm, this relationship is referred to as pay-performance sensitivity or the pay-performance elasticity (Murphy, 1999; Conyon, 2006). Our analysis contains the pay-performance elasticity, since percentage returns explain a larger part of the variance in the CEO compensation variables than changes in shareholder value expressed in dollars (Murphy, 1999). The literature indicates that the main determinants of the CEO compensation levels consist of firm size and firm performance. Firm performance concerned two measures in this study. We chose stock returns and the return on assets (ROA) as firm performance measures. Stock return reflects long-term market performance since the stock prices are forward looking (Dikolli, 2001). ROA is one of the leading performance measures in cash-based compensation contracts, because the return on assets shows the result of the CEO's management of the firm's assets in place (Bushman et al., 1995). Henceforth, both performance metrics might relate to the level of CEO compensation, thus we had to implement both metrics into our models. As an additional firm performance measure, we add Tobin's Q, which is a combination of accounting and market values. Tobin's Q and stock returns are less sensitive to accounting manipulation by the CEO, which makes them reliable performance measures compared to the ROA.

This study aims to distinguish the effects of firm performance on the determination of the different CEO pay components. Therefore, the independent variables in our first part will be three different CEO compensation variables. These are the total compensation, the cash compensation and the equity-based compensation. The firm size largely contributes to the level of CEO compensation, as stated in paragraph 2.2.1., and therefore it is necessary to take account of this variable in the analysis. The characteristics of the CEO in *figure 1* are derived from the literature; there are different findings on the effects of these characteristics. Furthermore, chapter 2.2 of the literature describes the relation of several board characteristics with the compensation level of the CEO. These board characteristics might be vital since the board of directors determines the payment the CEO receives. Therefore, they are also included in our research framework.

The second framework in *figure 4* is inspired by Core & Guay (1999) and Coles et al. (2006 & 2013). The main goal in this part of the study is to establish a relationship between the sensitivity to risk of the equity portfolio (CEO wealth) and the investment variables of the firm, i.e. vega. CEO delta is included as a control variable, since the performance sensitivity often influences the risk-sensitivity. There are two different investment variables in our study: Capital expenditures, which stand for safer investments and R&D expenditures, which stand for a riskier investment. Furthermore, firm and CEO control variables are included because there are many possible drivers for investment policies. For example, the cash compensation, CEO tenure, CEO turnover, market-to-book ratio, the sales growth, firm size, book leverage and surplus cash (Coles et al., 2006).

Figure 3: Determinants of CEO compensation levels

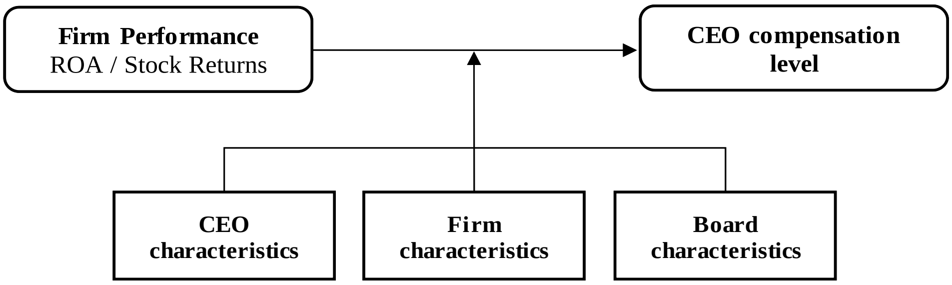
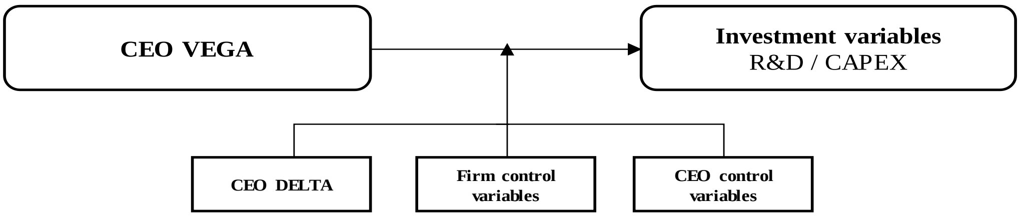


Figure 4: CEO equity-based incentives & investment strategies



2.6 Hypotheses

Table 3 gives an overview of all the hypotheses derived from the literature. Hypotheses 1-3 relate to the first part of the conceptual framework, which examines the relationship between firm performance and CEO compensation. In these hypotheses, firm performance stands for either stock return (market-based) or return on assets (accounting-based). Hypotheses 4-7 relate to the board characteristics, discussed in section 2.2, and have a controlling character since these expectations might affect the relationship between firm performance and CEO compensation. Firm size is an important factor to take into account during the tests of hypotheses 1-7, since it usually determines a large part of the variance in the CEO compensation level (Kostiuk, 1990). Hypothesis 8 and 9 focus on the second part of the conceptual framework, which studies the effect of equity-based incentives, especially stock options, on the investment strategy of the firm. All the hypotheses serve to identify the possible relationships from earlier theories, in order to test them in our empirical section.

Table 3: Hypotheses

H1: Firm performance has a positive relationship with the total CEO compensation level.
H2: Firm performance has a positive relationship with the CEO cash compensation level.
H3: Firm performance has a positive relationship with the CEO equity-based compensation level.
H4: A higher number of directors in the board has a positive effect on the CEO compensation level.
H5: The level of outside director compensation has a positive effect on the CEO compensation level.
H6: CEO and executive director ownership have a negative effect on the CEO compensation.
H7: Higher percentages of outside director ownership have a negative effect on the CEO compensation level.
H8: Capital expenditures negatively relate to the sensitivity of CEO wealth to stock return volatility.
H9: R&D expenditures positively relate to the sensitivity of CEO wealth to stock return volatility.

3. DATA AND VARIABLE CONSTRUCTION

3.1 Sample collection

The first step in the analysis was the determination of the sample. The sample of this study consisted of the CEOs at U.S. publicly listed firms. More specifically, firms listed in the S&P 1500, i.e. S&P 500, S&P Midcap and S&P Smallcap. The use of the different S&P indexes accounts for biases that might occur due to firm size. The time frame we considered, was 2006-2014. The data of the executives was obtained from the Execucomp database, which also provided us with board data. In addition, the ISS director database provided the more detailed board information. The firm-specific data came from the Compustat database. Lastly, we used the CRSP database in order to obtain stock-specific data.

We chose the time frame 2006-2014, because the accounting and reporting rules changed in 2006. These changes have consequences for the output of the compensation variables in Execucomp, our main data source. The major change in the output format of Execucomp concerns option valuation and share valuation, which is crucial for a research including equity-based compensation incentives.

Financial firms and utilities were excluded from the sample, which is a standard procedure in the corporate finance literature because these firms have significantly different structures and goals (Core & Guay, 1999; Coles et al. 2006; Brick et al., 2006; Ozkan, 2011). This exclusion was based on the standard industrial classification codes (SIC). Firms with the following codes, 6000-7000 (financial firms) or 4900-5000 (utilities), were excluded.

After the data collection from the different sources, we matched the databases by using unique IDs, a combination of firm ID numbers and the fiscal year. Thereafter, the merged data from the Execucomp, ISS, Compustat, CRSP and Datastream was prepared for the variable construction. After the merging process, our dataset consisted of *9868* firm-year observations for *1176* S&P firms in *58* different industries (based on two-digit SIC codes). Nevertheless, it is important to recognize that some variables missed data on several observations. Hence, the sample size differed per analysis in the empirical results section, especially when it included variables with missing data-points.

3.2 Variable construction

We started the variable construction for the regressions with a subdivision of the dependent and independent variables into four groups:

1. *CEO characteristics (section 3.2.1.)*
2. *Firm characteristics (section 3.2.2.)*
3. *Board characteristics (section 3.2.3.)*
4. *Investment characteristics (section 3.2.4.)*

In these sections, we elaborate on the variable construction for each group of characteristics.

3.2.1 CEO characteristics

The *CEO characteristics* that we constructed for the analysis were:

- Total compensation: cash compensation + equity-based compensation
- Share ownership
- Age, tenure & CEO turnover
- Delta & vega

The three compensation variables were readily available in the Execucomp database. However, the construction of the variables might need some extra explanation. Total compensation was constructed as follows:

$$TC_{i,t} = CC_{i,t} + EBC_{i,t} + OC_{i,t} \quad \textbf{(1)}$$

Where *TC* is the executive's i total compensation in year t. The amount is comprised of the following components:

- *CC* is the cash compensation:
  $CC_{i,t} = Salary_{i,t} + Bonus_{i,t}$
- *EBC* is the equity-based compensation:
  $EBC_{i,t} = Restricted\ stock\ awards\ _{i,t} + Stock\ option\ awards_{i,t}$
- *OC* is all other compensation: e.g. pensions, travel allowances and cars.

The compensation data of CEOs is only available on a yearly basis in the Execucomp database. Therefore, we constructed all variable on a yearly basis. These years were the fiscal years, which differed per firm due to the different reporting dates.

The CEO share ownership variables were computed with the Execucomp variables SHROWN and CSHO[2]. We divide the number of shares owned by CEOs (SHROWN) by the firms' common shares outstanding (CSHO):

$$CEO\_OWN_{i,t} = SHROWN_{i,t}/CSHO_{i,t} \quad \textbf{(2)}$$

Where *CEO_OWN* is the percentage of the total shares outstanding owned by CEO i in year t. The ages of the CEOs were readily available. Nevertheless, we had to compute the tenure with the following equation:

$$CEO\_TEN_{i,t} = Fiscal\ year_{i,t} - Became\ CEO_i \quad \textbf{(3)}$$

Where *CEO_TEN* is the tenure of CEO i in fiscal year t. *Fiscal year* is the fiscal year t for firm i. *Became CEO* is the fiscal year t, in which the CEO i started as a CEO. Subsequently, we constructed the CEO turnover dummy variable as follows:

$$CEO\_TURN_{i,t} = 1\ if\ CEO\ leaves\ during\ fiscal\ year\ t\ ,\ CEO\_TURN_{i,t} = 0\ otherwise \quad \textbf{(4)}$$

The data collection and the calculation of the CEOs' stock-option deltas and vegas required an extensive process, which will be described into further detail in the methodology section. The option valuation model, by Black & Scholes, adjusted by Merton to account for dividends was utilized to derive the formulas for the *delta* and *vega* (Merton, 1973; Core & Guay, 1999).

[2] Appendix A. contains an overview of the Execucomp, Compustat and ISS variable names.

3.2.2 Firm characteristics

The *firm characteristics* that we constructed were:

- ROA
- Tobin's Q
- Stock returns
- Firm risk
- Firm size

Firstly, the ROA was calculated with the standard formula as proposed by Coles et al. (2006), amongst others:

$$ROA_{i,t} = EBITDA_{i,t}/TA_{i,t} \tag{4}$$

Where ROA is the return on assets for firm i at time t, EBITDA are the earnings before interest, tax, amortization and depreciation, and TA are the total assets. Secondly, we estimated the future growth opportunities of the firm (Tobin's Q) with the following formula:

$$TQ_{i,t} = \left(MVE_{i,t} + PS_{i,t} + DEBT_{i,t}\right)/TA_{i,t} \tag{5}$$

Where TQ is the approximate Tobin's Q for firm i in the fiscal year t. MVE is the market value of the firm's equity, we calculate this by multiplying the firm's share value by the number of outstanding shares. *PS* is the liquidation value of the outstanding preferred stock of the firm. Debt is the value of the net short-term liabilities of the firm's short-term assets plus the book value of the long-term debt. Finally, the TA is the book value of the total assets of the firm. In 1994, Chung & Pruitt introduced this equation in order to calculate the 'approximate q'. The main advantage of this proxy for Tobin's Q is that all the input values are readily available in the Compustat database. Therefore, the 'approximate q' is classified as a short-cut measure, which reflects nearly 97% of the variance in the actual Tobin's Q (Chung & Pruitt, 1994).

Thereafter, the yearly stock returns were calculated with the end-of-the-fiscal-year stock prices, which were provided by the CRSP database. We used the following formula to estimate the continuously compounded returns with these stock prices (Fama, 1980b):

$$RET_{i,t} = \ln\left(S_{i,t}/S_{i,t-1}\right) \tag{6}$$

Where *RET* is the continuously compounded return of firm i at time t and *S* is the stock price for firm i at time t. Continuously compounded returns are referred to as log returns (Fama, 1980b). Hereafter, we estimated the stock return volatility, which was used as a proxy for firm risk. Hence, the standard deviation of the daily log returns was calculated and annualized:

$$SIGMA_{i,t} = \sqrt{\frac{1}{N-1} * \sum_{i=1}^{N}(RET_{i,t} - \overline{RET})} \quad \textbf{(7)}$$

Where *SIGMA* is the annualized stock return volatility (firm risk) of firm i in fiscal year t, N is the number of days in the year, *RET* is the daily log return and $\overline{RET}$ is the mean of the daily log returns in the year. Finally, the firm size was calculated as follows:

$$FS_{i,t} = \ln(Sales_{i,t}) \quad \textbf{(8)}$$

We took the natural logarithm of sales as proposed by different papers, Conyon (2006) and Coles et al. (2006) amongst others. These studies use the logarithm of sales, in order to establish the elasticity between compensation and firm size.

3.2.3 Board characteristics

The relevant *board characteristics* were:

- Board size: the total number of directors
- Board composition: the percentages of inside and outside directors
- Board share ownership: inside director ownership + outside director ownership
- Board compensation: inside and outside director compensation

These variables were constructed with data from the Execucomp and the ISS director databases. Firstly, board size was calculated as follows:

$$BOARDSIZE_{i,t} = \#\text{Inside directors}_{i,t} + \#\text{Outside directors}_{i,t} \quad \textbf{(9)}$$

The percentages of inside and outside were calculated as follows:

$$IN\_P_{i,t} = \#\text{Inside directors}_{i,t} / BOARDSIZE_{i,t} \quad \textbf{(10)}$$

$$OUT\_P_{i,t} = \#\text{Outside directors}_{i,t} / BOARDSIZE_{i,t} \quad \textbf{(11)}$$

Secondly, the board share ownership was calculated with the similar technique as the CEO share ownership variables:

$$IN\_OWN_{i,t} = Shares\ held_{i,t} / CSHO_{i,t} \quad \textbf{(12)}$$

$$OUT\_OWN_{i,t} = Shares\ held_{i,t} / CSHO_{i,t} \quad \textbf{(13)}$$

Where *IN_OWN*/*OUT_OWN*, is the percentage of the total shares outstanding owned by inside/outside directors i in year t. Shares held is the ISS database equivalent of SHROWN.
Finally, board compensation is an aggregation of the total compensation per inside or outside director in the corresponding fiscal year. This resulted in the following equations:

$$IN\_C_{i,t} = \sum TC\ inside\ director_{i,t} \quad \textbf{(14)}$$

$$OUT\_C_{i,t} = \sum TC\ outside\ director_{i,t} \quad \textbf{(15)}$$

Where the *IN_C*/*OUT_C* is the aggregated compensation of the inside/outside directors of firm i in fiscal year t. The compensation of the CEO was excluded from the *IN_C*.

3.2.4 Investment characteristics

The investment variables and additional control variables for the investment analysis were:

- CAPEX
- R&D expenditures
- Market-to-book ratio
- Book leverage
- Sales growth
- Surplus Cash

Firstly, *CAPEX* was calculated as follows:

$$CAPEX_{i,t} = (CAPX - SOP)_{i,t}/TA_{i,t} \quad \textbf{(16)}$$

Where *CAPEX* stands for the capital expenditures-to-assets ratio for firm i in fiscal year, t. Capital expenditures (*CAPX*), sale of property (*SOP*) and total assets (*TA*) were obtained from the Compustat database. Secondly, the R&D expenditures were calculated as follows:

$$R\&D_{i,t} = (XRD)_{i,t}/TA_{i,t} \quad \textbf{(17)}$$

Where *R&D* stands for the R&D expenditures-to-assets ratio for firm i in fiscal year t.
Thirdly, the market-to-book ratio was calculated (Coles et al., 2006):

$$MTB_{i,t} = (TA - COE + PRCC_F * CSHO)_{i,t}/TA_{i,t} \quad \textbf{(18)}$$

Where *MTB* is the market-to-book ratio for firm i in fiscal year t. TA stands for total assets. COE is the book value of common ordinary equity. PRCC_F is the closing stock price at the end of fiscal year. CSHO are the common shares outstanding. Market-to-book ratios measure a size-investment relationship, and proxy for the growth opportunities of the firm. *MTB* is a similar measure as the Tobin's Q see section 3.2.2.

Fourthly, the book leverage was calculated with the following formula (Coles et al., 2006):

$$BLEV_{i,t} = (LTDT + LTDCL)_{i,t}/TA_{i,t} \quad \textbf{(19)}$$

Where *BOOKLEV* is the book leverage ratio of firm i at fiscal year t. *LTDT* stands for the book value of the long-term debt and *LTDCL* is the long-term debt in current liabilities. Book leverage is control variable for the financing policy of the firm, considering investments. CEOs often tend to finance investments with debt when they assume the firm is undervalued by the market, whereas they prefer equity when the market overvalues the firm's stock (Narayanan, 1988). Higher leverage ratios relate to more risk, however the optimal financing structure, which implies less risk, is a mix of debt, equity and cash (Jensen & Meckling, 1976).

After the book leverage, sales growth was calculated:

$$SGR_{i,t} = ln\left(Sales_{i,t}/Sales_{i,t-1}\right)/TA_{i,t} \quad \textbf{(20)}$$

Finally, surplus cash was calculated as follows:

$$SC_{i,t} = (OANCF - DPC + XRD)/TA_{i,t} \quad \textbf{(21)}$$

Where *SC* is the ratio of cash-surplus-to-total assets. The formula divides the cash flow from operations (*OANCF),* minus depreciation (*DPC*) plus the R&D expenditure (*XRD*), by total assets (*TA*) (Core & Guay, 2002). Surplus cash is a control variable for the cash a firm has available to invest (Coles et al., 2006).

After all the different variable constructions, this section ends with an overview of all variables that were constructed. Table 4 gives us a structured summary of all the variables of interest. This table provides clarity since we have a wide variety of variables.

Table 4: Summary table of all variables

Characteristics	**Source**	**Variable name**
CEO characteristics		
Total compensation	*Execucomp*	TC
Cash compensation	*Execucomp*	CC
Equity-based compensation	*Execucomp*	EBC
Share ownership	*Execucomp*	CEO_OWN
Age	*Execucomp*	AGE
Tenure	*Execucomp*	CEO_TEN
Turnover	*Execucomp*	CEO_TURN
Delta	*Execucomp*	DELTA
Vega	*Execucomp*	VEGA
Firm characteristics		
Return on assets	*Compustat*	ROA
Tobin's Q	*Compustat*	TQ
Stock Returns	*CRSP*	RET
Firm risk	*CRSP*	SIGMA
Firm size	*Compustat*	FS
Board characteristics		
Board size	*ISS & Execucomp*	BS
Inside directors (%)	*ISS & Execucomp*	IN_P
Outside directors (%)	*ISS & Execucomp*	OUT_P
Inside director ownership	*ISS & Execucomp*	IN_OWN
Outside director ownership	*ISS & Execucomp*	OUT_OWN
Inside director compensation	*ISS & Execucomp*	IN_TC
Outside director compensation	*ISS & Execucomp*	OUT_TC
Investment characteristics		
R&D expenditures	*Compustat*	RD
Capital expenditures	*Compustat*	CAPEX
Market-to-book ratio	*Compustat*	MTB
Book leverage	*Compustat*	BLEV
Sales growth	*Compustat*	SGR
Surplus Cash	*Compustat*	SC

3.3 Descriptive statistics

After the collection and construction of the variables, a first glance on the data provided us with viable insights for the further analysis. First, we looked at the descriptive statistics of all constructed variables in order to see if we needed to adjust them. Second, we looked at the evolution of compensation and firm size over time. Finally, we analyzed the correlations between the variables in order to specify our regressions.

3.3.1 Descriptive statistics

Table 5 contains the descriptive statistics of all the different characteristics to determine the CEO pay package. The average total compensation is $5.904.000, whereas the average cash compensation is $996.000 and the average equity-based compensation is $3.337.000. These statistics reveal the preference for equity-based compensation over cash compensation. The delta and vega of the CEOs' equity portfolios are respectively $1.156.000 and $254.000. This implies that the average CEO wealth changes with $1.156.000 for each 1% change in stock price. Furthermore, a 1% change in stock return volatility causes a $254.000 change in CEO wealth, on average.

In terms of sales, the average size of the firms in our sample is $7.6 billion, which is a high average and this seems reasonable since we solely included S&P firms. The average yearly stock return for a stock of these firms is 5%, and the average firm risk or daily variance of these returns is 15%. Firm size often increases over time, which directly affects the CEO compensation levels (see section 3.3.2). The yearly ROA has a higher average value, i.e. 15%, than the stock return. Therefore, the average accounting-based performance is considered higher than the average market-based performance.

The average board in our sample consists of 9 directors. The average board consists of 82% outside directors and 18% inside directors. The high percentage of outside directors is in line with the importance of outside directors in the SEC regulations. Outside directors are often less involved than inside directors, thus outside directors must be incentivized to monitor the firm (Fich & Shivdasani, 2005). Therefore, they receive compensation that has an average value of $210.000. The largest part of the $210.000 compensation will consist of attendance fees. However, share ownership is another tool to improve the involvement of directors (Fama & Jensen, 1983). The total share ownership of the inside directors and outside directors are on average 4% and 2%.

The average investment characteristics show that CAPEX (5%) is more popular than R&D expenditures (3%). Market-to-book ratios are comparable to Tobin's Q, which is visible in the similar statistics for both variables. Finally, firms report an average 6% yearly growth in sales over the sample period.

Table 5: Descriptive statistics of all characteristics

Characteristics	Variable name	mean	sd	min	max	Units
CEO characteristics						
Total compensation	TC	5904	5736	246	31582	$1000s
Cash compensation	CC	996	7596	0	5503	$1000s
Equity-based compensation	EBC	3377	4007	0	22153	$1000s
Share ownership	CEO_OWN	0.02	0.05	0.00	0.29	%
Age	AGE	56	7	27	96	year
Tenure	CEO_TEN	7	7	0	35	year
Turnover	CEO_TURN	0	0	0	1	dummy (0,1)
Delta	DELTA	1156	2149	21	15442	$1000s
Vega	VEGA	254	398	0	2304	$1000s
Firm characteristics						
Return on assets	ROA	0.15	0.08	-0.09	0.43	%
Tobin's Q	TQ	1.65	1.11	0.15	6.42	ratio
Stock Returns	RET	0.05	0.39	-1.23	1.05	%
Firm risk	SIGMA	0.15	0.03	0.10	0.25	%
Firm size (natural logarithm)	FS	7.69	1.56	4.25	11.68	$millions
Sales	SALES	7631	17224	69	117993	$millions
Board characteristics						
Board size	BS	9	2	1	23	#
Inside directors (%)	IN_P	0.18	0.14	0.00	1.00	%
Outside directors (%)	OUT_P	0.82	0.14	0.00	1.00	%
Inside director ownership	IN_OWN	0.04	0.08	0.00	0.45	%
Outside director ownership	OUT_OWN	0.02	0.05	0.00	0.34	%
Outside director compensation	OUT_TC	211	107	36	627	$1000s
Investment characteristics						
R&D expenditures	R&D	0.03	0.05	0.00	0.22	%
Capital expenditures	CAPEX	0.05	0.05	0.00	0.26	%
Market-to-book ratio	MTB	1.96	1.13	0.80	7.07	ratio
Book leverage	BLEV	0.21	0.17	0.00	0.73	%
Sales growth	SGR	0.06	0.17	-0.51	0.67	%
Surplus cash	SC	0.09	0.08	-0.10	0.37	%

All variables except AGE, CEO_TURN, IN_P and OUT_P are winsorized at the 1st and 99th percentile. The sample period is 2006-2014 and the number of unique firms is 1176, which gives us 9868 firm-year observations in total.

3.3.2 Evolution of the compensation components

Table 6 shows the evolution the different components in the CEO pay package and the firm size. The amounts of the different components have changed over time as expected. The table also includes information about the size of the firms in the sample, by providing the sales in millions US$. This table provides us with some time-series patterns, which are viable to identify before the regression analysis.

The level of base-salary has been similar during the first years of the 8-year time period, a small average annual growth of 1.5% is reported over the whole period. However, if we look at 2006 the average salary was around $790.000 and at the end, in 2014, *table 6* reports an average of $889.000. This indicates that salary increased during the period 2011-2014. The average firm size is also higher in this period, this might provide evidence that firm size affects the level of base-salary. Since managing larger firms is more complex and requires an extraordinary skill-set, managers are paid better (Gabaix & Landier, 2014).

According to *table 6* cash bonuses have become less and less popular, the table documents a huge average annual decrease in the level of cash bonuses, i.e. -11.7%, over the sample period. During 8 years, the level of average cash bonuses dropped from $367.000 to $114.000, which is around 31% less. This statistic adapted according the earlier dissatisfaction of people with the exorbitant cash bonuses of managers, governmental legislation on cash bonuses after the crisis probably plays an essential role here. *Table 4* also shows that cash bonuses had a very high standard deviation in 2008, at the start of financial crisis. For now we keep the variables like they are, but we have to take in mind that the crisis probably affected different compensation and firm variables. Although the slight increase in base salaries, the large decrease in the cash bonuses has caused a drop in the average level of total cash compensation.

In *table 6* we can see a shift in popularity from cash compensation to equity-based compensation. The total amount of equity-based compensation has an annual average growth of 3.5%, which is about 5% higher than the average growth of total cash compensation. Equity-based compensation became increasingly popular since 1992, back then especially the stock-options were used to align the interest of managers and shareholders (Jensen & Murphy, 1990). However, since 2001 restricted stocks are more often awarded than stock options because their alignment with shareholder value is assumed to be closer (Conyon, 2006). This trend is visible in *table 6*, we document a 7.6% average annual growth for the value of restricted stock awards and a 3.4% average annual decline in the value of stock-option awards. The average value of the option awards dropped with $393.000 over the sample period. Whereas, the average value of the restricted stock award rose with $1.288.000 over the same period.

The consequences of the abovementioned for total compensation are a 2.5% average annual growth and a $1.146.000 total increase in the total level of compensation. The major part of the increase in total compensation is in the period from 2010, where the economy has recovered from the largest shocks of the financial crisis (Gabaix & Landier, 2014). In the same period, the firm sizes in terms of sales also increased significantly. Therefore, the strong relationship between firm size and compensation has to be taken into account when analyzing the effects of performance on the compensation of the CEO.

Table 6: CEO compensation components over time

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Avg. Growth
CC	1168	946	957	946	983	995	1000	995	1015	-1.5%
		-(0.19)	(0.01)	-(0.01)	(0.04)	(0.01)	(0.00)	(0.00)	(0.02)	
Salary	790	750	782	784	806	826	840	866	889	1.5%
		-(0.05)	(0.04)	(0.00)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	
Bonus	367	190	165	154	172	162	153	120	114	-11.7%
		-(0.48)	-(0.13)	-(0.07)	(0.12)	-(0.06)	-(0.06)	-(0.21)	-(0.05)	
EBC	3355	2951	2995	2729	3138	3433	3542	3881	4267	3.5%
		-(0.12)	(0.01)	-(0.09)	(0.15)	(0.09)	(0.03)	(0.10)	(0.10)	
Restr. stock	1774	1691	1690	1535	1932	2184	2405	2659	3062	7.6%
		-(0.05)	(0.00)	-(0.09)	(0.26)	(0.13)	(0.10)	(0.11)	(0.15)	
Stock options	1497	1226	1243	1124	1167	1210	1081	1115	1104	-3.4%
		-(0.18)	(0.01)	-(0.10)	(0.04)	(0.04)	-(0.11)	(0.03)	-(0.01)	
TC	5900	5313	5176	4965	5778	6089	6174	6568	7046	2.5%
		-(0.10)	-(0.03)	-(0.04)	(0.16)	(0.05)	(0.01)	(0.06)	(0.07)	
DELTA	1531	1393	819	966	1126	991	1065	1308	1346	0.7%
		-(0.09)	-(0.41)	(0.18)	(0.17)	-(0.12)	(0.08)	(0.23)	(0.03)	
VEGA	230	215	264	293	258	285	277	222	229	0.8%
		-(0.06)	(0.23)	(0.11)	-(0.12)	(0.11)	-(0.03)	-(0.20)	(0.03)	
SALES	7805	6909	7262	6576	7232	7862	8140	8294	8519	1.4%
		-(0.11)	(0.05)	-(0.09)	(0.10)	(0.09)	(0.04)	(0.02)	(0.03)	
N	856	1087	1097	1107	1115	1132	1140	1160	1174	

CC, Salary, Bonus, EBC, Stocks, Options, and TC are in $1000s. SALES is in $mil. The intra-year growth rates are between parentheses. CC=cash comp, EBC=Equity-based comp, TC=Total comp, N=# of firms per year. Stocks and options are the yearly fair value measures of granted restricted stock and stock options. The last column ‘Growth’ contains average annual growth percentages. All variables are winsorized at the 1^{st} and 99^{th} percentile.

3.3.3 Correlations

Table 7 shows the cross correlation matrix for the dependent and independent variables that we might include in the first regressions. The firm performance metrics, i.e. RET and ROA, show different correlations with the total-, cash- and equity-based compensation level. Stock returns shows small positive correlations with total and equity-based compensation levels. However, stock returns show no correlation with cash compensation. Whereas, ROA shows positive small positive correlations with all the compensation variables. Firm size (FS) has the strongest correlations with the compensation variables. This correlation is in line with the theory that firm size is the largest determinant of CEO compensation levels (Kostiuk, 1990; Tosi et al., 2000; Gabaix & Landier, 2006; Gabaix et al., 2014).

For the board characteristics, we find that the size of the board (BS) and the average level of total compensation for outside directors have relatively large correlations with the CEO compensation levels. These variables strongly correlate to the firm size. Strong correlations have to be mentioned, since they might cause biases. Multicollinearity occurs when two explanatory variables are highly correlated, i.e. the correlation between these variables is a lot higher than the overall correlation between the dependent and other independent variables (Farrar & Glauber, 1967). A more general measure/thumb rule for multicollinearity is a correlation between two explanatory variables of 0.7 or higher (Farrar & Glauber, 1967). When there is multicollinearity, it is necessary to drop one of the correlated explanatory variables from the regression. Firm size and board size have a 0.59 correlation, since this correlation is lower than 0.7 it is safe to analyze both variables within the same regression model. However, it is important to notice that the effect of both variables might overlap with higher correlation, which can lead to biased coefficients. The other variables show no signs of multicollinearity, which is a positive finding since it allows us to measure the effects of the variables together in one regression model.

Table 7: Cross correlation matrix for the pay-performance analysis

	TC	CC	EBC	ROA	RET	FS	TQ	AGE	CEO_TEN	CEO_TURN	CEO_OWN	BS_w	IN_P	OUT_P	IN_OWN	OUT_OWN	OUT_TC	CAPEX	RD
TC	1.00																		
CC	0.56	1.00																	
EBC	0.92	0.44	1.00																
ROA	0.07	0.02	0.06	1.00															
RET	0.05	0.00	0.02	0.05	1.00														
FS	0.62	0.47	0.55	0.04	-0.01	1.00													
TQ	0.03	-0.09	0.06	0.61	0.24	-0.19	1.00												
AGE	0.07	0.13	0.01	-0.05	0.00	0.08	-0.09	1.00											
CEO_TEN	-0.04	0.00	-0.06	-0.02	0.02	-0.14	0.08	0.42	1.00										
CEO_TURN	-0.03	-0.02	-0.04	-0.03	-0.03	0.00	-0.04	0.12	0.04	1.00									
CEO_OWN	-0.14	-0.10	-0.14	0.04	0.01	-0.18	0.09	0.18	0.44	0.01	1.00								
BS	0.41	0.33	0.35	-0.04	-0.02	0.60	-0.17	0.07	-0.15	-0.01	-0.18	1.00							
IN_P	-0.15	-0.06	-0.14	0.07	0.00	-0.21	0.12	0.06	0.23	0.01	0.29	-0.28	1.00						
OUT_P	0.15	0.06	0.14	-0.07	0.00	0.21	-0.12	-0.06	-0.23	-0.01	-0.29	0.28	-1.00	1.00					
IN_OWN	-0.12	-0.03	-0.13	0.04	0.01	-0.17	0.08	0.13	0.33	-0.01	0.64	-0.12	0.57	-0.57	1.00				
OUT_OWN	-0.09	-0.05	-0.09	0.01	0.00	-0.13	0.02	-0.05	-0.05	0.01	0.05	0.01	-0.05	0.05	0.06	1.00			
OUT_TC	0.48	0.28	0.47	0.01	0.01	0.42	0.08	-0.02	-0.08	0.01	-0.16	0.16	-0.07	0.07	-0.15	-0.10	1.00		
CAPEX	-0.02	0.03	0.00	0.21	-0.12	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	-0.01	0.02	-0.01	0.04	1.00	
RD	-0.01	-0.11	0.04	-0.05	0.01	-0.24	0.26	-0.08	0.05	0.01	0.02	-0.18	0.02	-0.02	-0.02	-0.01	0.16	-0.19	1.00

Where TC=total compensation, CC=cash compensation, EBC=Equity-based compensation, CEO_OWN=CEO share ownership, AGE=CEO's age, CEO_TEN=CEO's tenure, CEO_TURN=Turnover dummy, ROA=return on assets, TQ=Tobin's Q, RET=Stock return, FS=natural logarithm of sales, BS=Board size, IN_P= percentage of inside directors, OUT_P= percentage of outside directors, IN_OWN= inside director share ownership, OUT_OWN= outside director share ownership, OUT_TC= Average outside director compensation, CAPEX= capital expenditures and RD= R&D expenditures. The number of firms is 1176 and the sample period is 2006-2014.

Table 8 contains the correlations between the dependent and independent variables for the investment regressions. *Table 7* already shows the dependent investment variables to see their relation with the compensation components. CAPEX and RD both have a small correlation with total compensation. However, the correlations of RD with CC (-0.11) and EBC (0.04) indicate that higher R&D expenditures might lead to less cash compensation and more equity compensation. *Table 8* shows a positive correlation (0.03) between VEGA and RD, which might imply that a higher risk sensitivity of the equity portfolio leads to higher R&D expenditures. Whereas, VEGA and CAPEX have a negative correlation (-0.04) hence higher vega might indicate less investment in capital and more in R&D. However, we have to note that the causation can go in both directions when there is correlation.

Furthermore, the correlations between the independent variables show no signs of multicollinearity. The highest correlation between independent variables is 0.55 for the relationship between CS and MTB. This correlation implies that the firm's cash surplus is higher when the market-to-book ratio of a firm is higher, and vice versa. As mentioned in the first part of this section, high correlations between independent variables have to be noticed however if the correlation is lower than 0.7 it does not hurt the analysis badly. Therefore, it is safe to implement all the independent variables from *table 8* into our regression models.

Table 8: Cross correlation matrix for the investment analysis

	CAPEX	RD	DELTA	VEGA	CEO_TEN	CC	FS	MTB	CS	RET	SGR	BLEV
CAPEX	1.00											
RD	-0.18	1.00										
DELTA	0.05	0.01	1.00									
VEGA	-0.04	0.03	0.40	1.00								
CEO_TEN	0.02	0.03	0.25	-0.02	1.00							
CC	0.03	-0.13	0.25	0.42	0.00	1.00						
FS	0.00	-0.29	0.32	0.50	-0.13	0.49	1.00					
MTB	0.03	0.25	0.24	0.04	0.05	-0.08	-0.14	1.00				
CS	-0.01	0.58	0.12	0.08	0.03	-0.08	-0.15	0.55	1.00			
RET	-0.11	0.00	0.09	-0.02	0.01	0.00	-0.01	0.25	0.08	1.00		
SGR	0.10	0.05	0.06	-0.04	0.04	-0.03	-0.06	0.23	0.11	0.04	1.00	
BLEV	0.03	-0.26	0.01	0.10	-0.04	0.18	0.27	-0.19	-0.33	-0.04	-0.05	1.00

Where CAPEX = capital expenditures, RD = research & development expenditures, DELTA = pay-performance sensitivity of CEO equity, VEGA = pay-risk sensitivity of CEO equity, CEO_TEN = CEO tenure, CC = cash compensation, FS = firm size, MTB = market-to-book ratio, CS = Cash surplus, RET = yearly stock return, SGR = yearly sales growth and BLEV = book leverage. All variables are winsorized at the 1^{st} and 99^{th} percentile. The firm's total assets scale CAPEX, RD and CS.

4 METHODOLOGY

The dataset in this study consisted of time-series data with a panel-structure. Panel-data is a multidimensional form of data, since it contains different observations of different variables over time (Brooks, 2008). There is a distinction between a balanced panel and an unbalanced panel, where a balanced panel contains observations of the same firms over the same years and an unbalanced panel contains observations of different firms over different years. In this research, we have different observations of different firms in different years, for each variable, thus an *unbalanced panel*.

The analysis of time-series panel data is usually carried out with a *fixed effects model* or a *random effects model.* These models are suitable for balanced and unbalanced panels. In this section, we will discuss the properties of both models and decide which model suits our dataset. Although the majority in earlier literature on CEO compensation uses FE models (Jensen & Murphy, 1990; Core & Guay, 1999; Coles et al., 2006; Brick et al., 2006; Ozkan, 2011), some of them use the FE model because it is done earlier without justifying the model choice.

After the model justification, we discuss the different steps of the Black-Scholes Merton model in order to value the equity portfolio of each CEO and to calculate the delta and vega of these equity portfolios.

4.1 Fixed effects model

The choice between a fixed and a random effects model depends on several factors. The main factor is the expected presence of omitted variables in the model **(**Mundlak, 1978**)**. If one expects no omitted variables or omitted variables not related to the independent variables in the model, a random effects model is suitable. Since, it will provide unbiased estimators and includes all the available data. Although, if one expects the presence of an omitted variable, the *omitted variable bias* usually hurts the estimates. Henceforth, FE model controls for omitted variables by including control group dummies for these variables. In our model, we expected that the industries in which firms operate would influence the dependent variables.

The other factors are the time-variability within the entities of the model and the time-variability of the variables (Mundlak, 1978). A fixed effects model is more applicable when the entities within the model change across time. However, the properties of a FE model allow the researcher to control for time-invariant cross-sectional variables. A random effects model is more applicable when the entities in the model are the same or hardly change over time. In a random effects model, we assume that the unobserved variables have no correlation with the observed variables (Allison, 2005). Conclusively, the FE model seemed a sophisticated model choice for our dataset, because we were interested in the effects of time and time-invariant effects of the independent variables on the dependent variables.

We started with the basic econometrical setup for a panel-data time series model, in order to describe the rationale behind a FE model:

$$Y_{i,t} = \alpha + \beta x_{i,t} + \upsilon_{i,t} \quad \textbf{(1)}$$

Here Y is the dependent variable of firm i at time t, α is the constant or intercept, β is a vector of the parameters that have to be estimated for the independent variables and x is a vector for each observation of the independent variables (Brooks, 2008). The character of the error term in the equation, i.e. u, determines which model suits the panel-data. In the fixed effect model, we decompose this error term into an individual-specific or entity-specific effect (μ) and a cross-sectional and time varying effect (u) that causes the rest of the error variance. Henceforth, the FE model looks as follows:

$$Y_{i,t} = \alpha + \beta x_{i,t} + \mu_i + \upsilon_{i,t} \quad \textbf{(2)}$$

In our dataset, the individual-specific effect was expected to be an industry-specific effect, and the different fiscal years might cause a large part of the u. Therefore, year fixed effects have to be included in the model as well. Hence, the FE model takes the following structure:

$$Y_{i,t} = \alpha + \beta x_{i,t} + \mu_i + \lambda_t + \upsilon_{i,t} \quad \textbf{(3)}$$

Where λ stands for the collection of year dummies and μ stands for all the different firm or industry dummies. Therefore, a FE model incorporates dummies to account for unobserved heterogeneity caused by firm specific or industry specific variables.

The result section describes full model specifications for each part of the analysis. Although, the two general models for performance sensitivity and performance elasticity in our research will have the following form, consistent with Jensen & Murphy (1990a), Conyon & Murphy (2000) and Ozkan (2011):

$$\ln(\text{CEO compensation}) = \beta_1 * \ln(PERF_{t-1}) + \beta \sum Board\ Charact. + \beta \sum Firm\ Charact. +$$
$$\beta \sum CEO\ Charact. + \beta \sum Investment\ Charact. \quad \textbf{(4)}$$

Equation 4 shows the model to measure the pay-performance elasticity of the different compensation component. *PERF* stands for the firm performance measures, which are ROA and stock returns. The board, firm, CEO and investment characteristics function as control variables to see if the pay-performance elasticities hold under different circumstances.

There are three general problems with pay-performance analyses. First, all compensation variables have a *skewed distribution. Figure 5* contains histograms of the winsorized CEO compensation variables that show the skewness in the compensation variable distributions in our sample. The compensation variables are positively skewed, i.e. right-skewed, which violates the normality assumption of the ordinary least squares model for the fixed effect regressions (Brooks, 2008). We used the natural logarithm of these variables in our analysis to account for this problem (Murphy, 1999; Conyon, 2006)

Second, the main relations between the independent variables and dependent variable, in a compensation regression, are often *endogenous* in period t since the relations might have a bidirectional causation (Hartzell & Stark, 2003). For example, firms that perform better might be able to pay a higher level of compensation, whereas higher levels of compensation might lead to better performance. Therefore, we decouple these relationships by including lagged independent variables in our regression specifications (Ozkan, 2011). There are no theories to support that there is a causal effect of the current compensation on the firm performance in the previous period. Henceforth, we minimize *endogeneity* problems by removing the bidirectional causation, with a specification including lagged independent variables (Hartzell & Stark, 2003). Due to the addition of the lagged variables, we create a dynamic panel. Hence, *autocorrelation* might occur which biases the standard errors and the significance of the coefficients within the FE panel-data model, thus it is essential to test for the presence of autocorrelation in error term *u* (Drukker, 2003). In 2002, Wooldridge introduced a new autocorrelation test for panel-data models. The hypotheses of the Wooldridge test are as follows (Wooldridge, 2002):

H0: No first-order autocorrelation in panel data.
H1: First-order autocorrelation in panel data.

In the empirical results chapter (5), we will introduce the full model specification and immediately test them for autocorrelation. If there is any autocorrelation, we have to cluster the regression models at the panel level, in order to correct the standard deviations (Drukker, 2003).

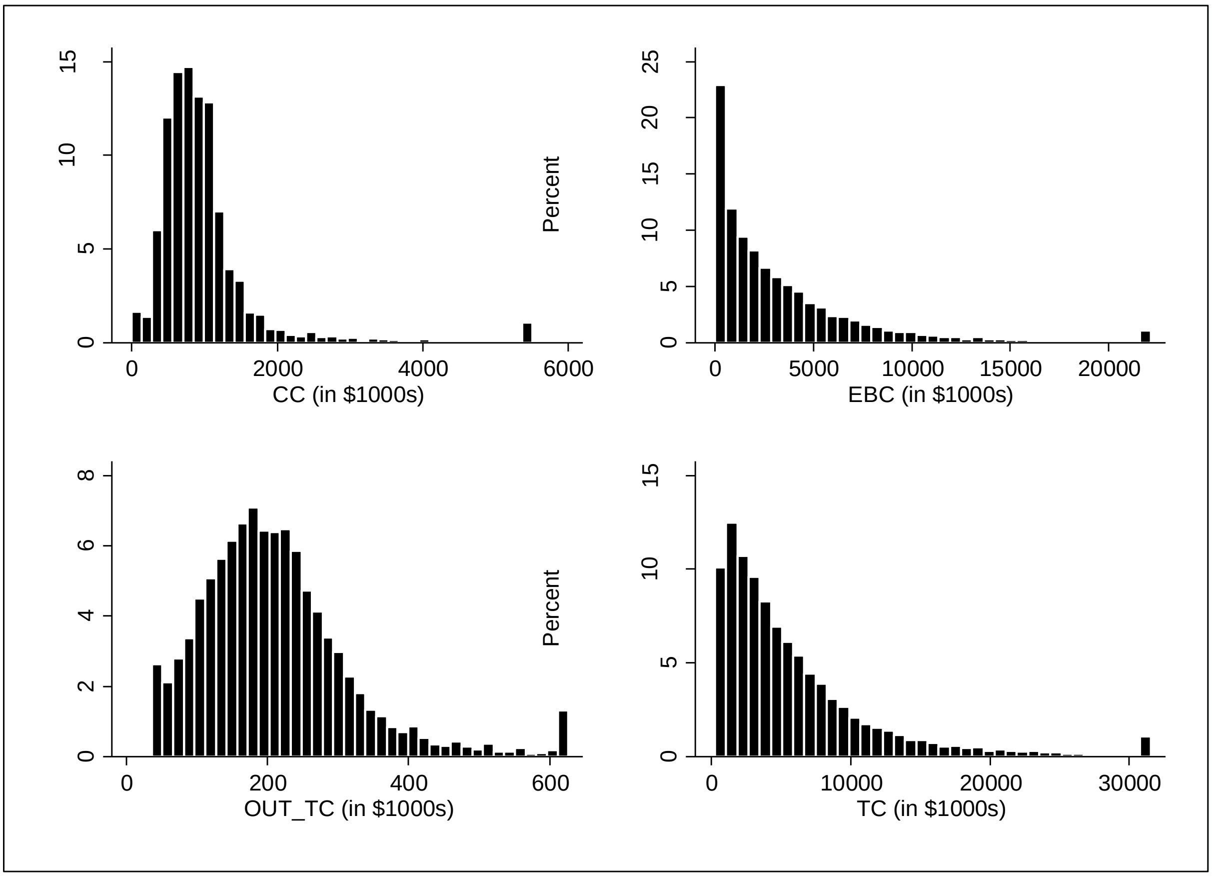
Thirdly, a pay-performance analysis contains many different variables that might correlate, which potentially causes *multicollinearity*. However, we already analyzed the correlations in section 3.3.3 and we found no extreme correlations. Henceforth, there is no sign of multicollinearity problems in our study.

The last regression models are built on the variables delta and vega, which are the CEO incentive variables, the investment variables will function as dependent variables in these regressions. The delta and vega values of the stock and option portfolios of the CEOs are calculated with the Black and Scholes Merton model, which will be described in the next paragraph. Nevertheless, the general model will look as follows:

$$Investm.var = \beta_1 * VEGA_{t-1} + \beta_2 * DELTA_{t-1} + \beta \sum Firm\ Charact. + \beta \sum CEO\ Charact. \quad \textbf{(5)}$$

Here we also take the lagged values of both VEGA and DELTA. In this regression, we do not analyze the board characteristics since there are no theoretical foundations that the board characteristics influence the main relationship, in this study, between VEGA and the investment variables.

Figure 5: The skewed distribution of compensation variables



Where CC=CEO cash comp., EBC= CEO equity comp., OUT_TC=Outside director total comp. and TC=CEO total comp. The graphs contain all data points from the 1176 S&P firms within our sample for the period from 2006-2014.

4.2 Black & Scholes-Merton model

Since we were interested in the effect of the incentive mechanism behind equity-based compensation on investment policies, delta and vega of the CEO equity portfolio had to be calculated. Delta compromises the change in the value (US$) of the CEO wealth for a one percentage-point change in stock price. Whereas, vega is the change in the value (US$) of the CEO wealth due to a 0.01 change in the annualized standard deviation of daily stock returns. In order to calculate these variables we applied the same methodology as Core and Guay (2002), namely the modified version of the Black & Scholes-Merton option valuation model, i.e. BSM model, which includes dividends (Merton, 1973).

$$\boldsymbol{Option\ value} = [Se^{-dt} * N(d1) - Xe^{-rt} * N(d2)] \quad \textbf{(6)}$$
$$\boldsymbol{d1} = [(LN(S/X) + T(r - d + \sigma\hat{}2/2))/\sigma\, T\hat{}0{,}5]$$
$$\boldsymbol{d2} = d1 - \sigma\, T\hat{}0{,}5$$

With the following input variables (Merton, 1973)**:**

N = the cumulative probability function for the standard normal distribution
S = the underlying stock price.
X = the exercise price of the call option.
σ = the anticipated stock return volatility during the maturity period of the option.
r = the natural logarithm of the risk-free interest rate
T = the number of years to maturity of the option
e = Euler’s exponential base number
d = the natural logarithm of anticipated dividend yield during the maturity period of the option

Henceforth, the derived formulas for the option delta and vega are (Core & Guay, 2002):

$$\boldsymbol{DELTA} = \Delta(option\ value)/\Delta(stock\ price) * (S/100) = e^{-dt} * N(d1) * (S/100) \quad \textbf{(7)}$$
$$\boldsymbol{VEGA} = \Delta(option\ value)/\Delta(stock\ price\ volatility) * 0{,}01 = e\hat{}(-dT) * N'(d1) * S * T\hat{}0{,}5 * 0{,}01 \quad \textbf{(8)}$$

Here *N’* is the (standard) normal density function, the other variables are already explained in the previous paragraph. The data to construct the input values for the BSM model mainly comes from different databases. The collection of the data is a quite intensive process[3].

The equity portfolio of a CEO consists of three parts, specifically unvested options, vested options and shares. Unvested options are stock options that currently cannot be exercised. Vested options are options that currently can be exercised. Shares are all the restricted stocks in possession of the CEO. First, we had to order the data to calculate the vega

[3] See Appendix B. for steps in the collection process of the BSM-model inputs

and delta for these three parts. As of 2006, the Execucomp database provides data on option awards in tranches (including both vested and unvested options). Hence, the delta and vega of each tranche have to be calculated separately and to be aggregated per CEO per year afterwards. After finishing the calculation of the deltas and vegas for each option tranche and all stocks, we arrived at the last step in the calculation process. This step was to aggregate the deltas and vegas from the option tranches and shares to a yearly delta and vega per CEO:

$$DELTA = \Delta(CEO\ equity\ portfolio)_{i,t} = \sum Delta(Option\ tranches)_{i,t} + Delta(Restricted\ Stocks)_{i,t} \quad \textbf{(9)}$$

$$VEGA = \nu\big(CEO\ equity\ portfolio\big)_{i,t} = vega\big(\sum Options\ tranches\big)_{i,t} \quad \textbf{(10)}$$

The abovementioned formulas calculated the total equity portfolio delta and vega for firm i at time t. These estimates were used in the regressions to test the effect of equity-based CEO incentives on the investment decisions of the firm. An important note here is that the vega only consisted of the option vega, since the stock vega is assumed to be negligible compared to the option vega (Core & Guay, 2002).

5 EMPIRICAL RESULTS

The empirical result section consists of three parts. These parts are similar to the three different parts of the conceptual framework. First, the effects of firm performance on the level of the different CEO compensation components will be discussed. Second, the results for effects of changes in performance on changes in the level of CEO compensation components are described, i.e. sensitivity to performance. Finally, we discuss the effect of equity-based incentives, measured by the equity portfolio of the CEO, on the implemented investment strategies of the firm.

5.1 CEO pay-performance elasticity

In the methodology section, there is a description of the general form for the first group of fixed effect regressions. The exact model for the three pay-performance elasticity regressions is:

$$\ln(CEO\ COMP)_{i,t} = \alpha + \beta_1 * RET_{t-1} + \beta_2 * ROA_{t-1} + \beta_3 * TQ_{t-1} + \beta_4 * FS_{t-1} + \beta_5 * CEO_{OWN_{t-1}} + \beta_6 * CEO_{TEN_{t-1}} + \beta_7 * Age + \beta_8 * CEO_{TURN} + \beta_9\ OUT_{P_{t-1}} + \beta_{10} * IN_{OWN_{t-1}} + \beta_{11} * OUT_{OWN_{t-1}} + + \beta_{12} * \ln(\mathrm{OUT_{TC}})_{t-1} + \beta_{13} * CAPEX + \beta_{14} * RD + \mu_i + \lambda_t + u_{it} \qquad \textbf{(1)}$$

With the following variable definitions:

CEO COMP = *total compensation (TC), cash compensation (CC)* or *equity-based compensation (EBC)*

RET = the yearly log stock returns
ROA= the yearly log return on assets
TQ = Tobin's Q
FS = the natural logarithm of the firm's sales, i.e. firm size
CEO_OWN = the share ownership percentage of the CEO
CEO_TEN = the CEO's tenure
Age = the CEO's age
CEO_TURN = a dummy indicating if there is a new CEO
IN_OWN = the share ownership percentage of the inside directors, excluding the CEO
OUT_OWN = the share ownership percentage of the outside directors
BS = is the number of directors in the board
OUT_P = the percentage of outside directors in the board
OUT_TC = the total compensation of the outside directors
CAPEX = Capital expenditures divided by total assets
RD = R&D expenditures divided by total assets
μ= firm-specific or industry-specific fixed effects dummies
λ= year-fixed effect dummies
u= the error term, i.e. the variance in CEO COMP that remains unexplained

As proposed in the methodology section, we test the three different specifications for the presence of autocorrelation before conducting the analyses. *Table 9* shows the results of the Wooldridge test for autocorrelation. These results show significant presence of autocorrelation in the three different regression models. Therefore, we corrected the standard errors for clusters at the firm and industry levels in our firm and industry FE regression.

Table 9: Wooldridge test for autocorrelation, CEO pay-performance elasticity models

General regression pay-performance elasticity

$$\ln(CEO\ COMP)_{i,t} = \alpha + \beta_1 * RET_{t-1} + \beta_2 * ROA_{t-1} + \beta_3 * TQ_{t-1} + \beta_4 * FS_{t-1} + \beta_5 * CEO_{OWN_{t-1}} + \beta_6 * CEO_{TEN_{t-1}} + \beta_7 * Age + \beta_8 * CEO_{TURN} + \beta_9\ OUT_{P_{t-1}} + \beta_{10} * IN_{OWN_{t-1}} + \beta_{11} * OUT_{OWN_{t-1}} + + \beta_{12} * \ln(\mathrm{OUT_{TC}})_{t-1} + \beta_{13} * CAPEX + \beta_{14} * RD + \mu_i + \lambda_t + u_{it}$$

Dependent	*F-statistic*	*p-value*	*H0*	*H1*
ln(TC)	63.49	0.00	Accept	Reject
ln(CC)	4.30	0.04	Accept	Reject
ln(EBC)	43.14	0.00	Accept	Reject

The first column shows the three different dependent variables for the model and the independent variables are the same in each specification as one can see in the general regression. The F-statistics are the test statistics for the Wooldridge test. The p-values indicate the significance of the test-statistics. H0: autocorrelation in panel data, H1: no autocorrelation in panel data. We accept H0 in all cases since the p-values are lower than 0.05, which implies that we have to correct the standard errors for autocorrelation. See APPENDIX C for the Stata output of the Wooldridge test.

Table 10 shows the regression with the total compensation level as dependent variables and all independent variables, plus the different fixed effects and the correction for autocorrelation. The coefficients of both fixed effect (FE) regressions are similar in sign and magnitude for most of the independent variables. The predicted signs in the table are representative for the hypotheses that we derived from earlier research. *Table 10* includes four different regressions, namely two industry-year FE regressions and two firm-year FE regressions. The first regression of both types is the full model and the second is the model with all significant variables at a 5% level or higher. We use the full model of both types to compare the results.

We can see that the most important relationship for our study, which is the one between total compensation and stock-returns, has a significant coefficient in both cases. The industry FE regression shows that for a 10% increase in stock returns causes a significant increase of 2.14% in the total CEO compensation level. The firm FE regression reports a 1.74% increase in total CEO compensation when the yearly stock returns increase with 10%. These results prove the existence of the relationship between market-based firm performance and total compensation, which is in line with findings of Jensen and Murphy (1990) and Conyon (2006). Nevertheless, the accounting-based firm performance has a significant negative impact on the total in compensation level in the industry FE regression, i.e. a 6.79% decrease for each 10% increase in ROA. Furthermore, we do not find evidence for the existence of the relationship between ROA and total compensation in the firm FE regression. Lagged ROA has been a significant determinant of total compensation according to Brick et al. (2006). Nonetheless, the results of this study contradict this finding. It remains difficult to explain this contradiction, which possibly occurs because of the different time frames and the lower growth of CEO compensation after 2006.

All regressions show a significant association of firm size with the total compensation level. The effects of a 10 percent increase in firm size are respectively 3.18% and 1.48%. It is remarkable that the magnitude and size of the effects of firm size are quite different in the industry and firm FE regressions. The omission of firm specific variables, which influence the firm size in the industry fixed effects regression, might cause the higher coefficient. Nevertheless, both firm performance and firm size variables play a vital role in the current U.S. compensation culture. These findings slightly contradict earlier research by Tosi et al. (2000), which suggested that firm size is a considerably larger determinant of CEO compensation than firm performance. This difference most likely occurs due to the inclusion of more size-related explanatory variables, which affects the coefficient of firm size.

We also find significant relations for some of the other firm characteristics, which function as control variables. The Tobin's Q controls for the growth opportunities and when it increases by 10% it leads to a significant increase of 0.77% in the compensation level, in the industry FE regression. However, the effect of 10% increase in Tobin's Q on compensation is slightly lower (0.60%) in the firm FE regression.

We find a significant relationship between board size and total compensation and the sign is the opposite of what we expected, this implicates that the disadvantages of a bigger board are not directly influencing the compensation level within the sample of this study. The percentage of outside directors or non-executive directors has a significant positive effect on the total compensation level of 0.38% and 0.48% per 1% increase. According to the earlier theory the presence of outside directors should lead to a closer monitoring and thus lower compensation, our results contradict this theory. The same theory is also contradicted by other empirical studies, Mehran (1995) & Ozkan (2011) amongst others. It is noteworthy that the percentage of outside directors has rose over time. This might indicate that an excessive amount of outside directors leads to a higher total compensation level for CEOs.

Nevertheless, the outside ownership percentage has a negative effect on the total compensation level. A 1% increase in the ownership percentage leads to a 0.58/0.53% decrease in the total compensation level. Although the coefficients are insignificant, we expected this effect since it appears that share ownership by outside directors leads to more involvement of these directors (Yermack, 1995). Furthermore, insider ownership has no significant effect on the total compensation level, which raises questions about the effectiveness of equity compensation as a monitoring incentive. Whereas, total outside director compensation shows a significant positive effect of 3.79% on total CEO compensation for each 10% increase, however the relationship with total compensation is not significant in the firm FE regression. Our findings are in line with findings by Brick et al. (2006), since they also find that board compensation positively relates to total compensation in an industry- and a year fixed effects regression.

The other CEO characteristics also deliver some significant patterns. CEO tenure has a small but significant positive effect on the total compensation level, in the firm FE regression. This finding confirms the empirical results of different earlier studies, namely that when the serving period of the CEO becomes longer they will often see an increase in their compensation level (Ozkan, 2011). CEO ownership also negatively affects the total compensation level, almost certainly for the same reason as the outside director ownership. This finding is in line with most studies (Jensen & Murphy, 1990; Mehran, 1995; Conyon & Murphy, 2000; Conyon, 2006). CEO age has no significant relationship with the total compensation level, whereas we might have expected a small but positive effect. Finally, CEO turnover has a significant negative effect on the total compensation level. This is in line with the finding for tenure and seems naturally since a new CEO often starts with a lower compensation level than his/her predecessor.

For all the models, the adjusted R-squared indicates the explanatory power. The firm FE regressions have a higher R-squared. Therefore, we have to keep in mind that the firm-specific effects generally have more explanatory power towards the compensation levels, compared to the industry specific effects.

Table 10: The pay-performance elasticity of CEO total compensation

Dependent variable: ln(total compensation)					
	Predicted Sign	(1)	(2)	(3)	(4)
RET $_{t-1}$	+	0.214***	0.204***	0.174***	0.172***
		(9.34)	(8.00)	(8.10)	(8.87)
ROA $_{t-1}$	+	-0.679**	-0.809***	-0.014	
		(-2.29)	(-2.82)	(-0.08)	
TQ $_{t-1}$	+	0.077***	0.086***	0.060***	0.066***
		(4.09)	(4.84)	(3.40)	(4.47)
FS $_{t-1}$	+	0.318***	0.308***	0.148***	0.173***
		(14.10)	(11.69)	(3.37)	(4.71)
CEO_OWN $_{t-1}$	-	-3.456***	-2.754***	-1.220	
		(-6.76)	(-7.30)	(-1.58)	
CEO_TEN $_{t-1}$	+	0.005		0.006**	0.005**
		(1.63)		(2.20)	(2.18)
AGE	+	0.002		0.004	
		(1.13)		(1.33)	
CEO_TURN	-	-0.184***	-0.213***	-0.118***	-0.114***
		(-3.27)	(-3.32)	(-2.91)	(-3.06)
BS $_{t-1}$	-	0.033**	0.033**	-0.006	
		(2.36)	(2.65)	(-0.81)	
OUT_P $_{t-1}$	+	0.532**	0.560***	0.536***	0.384***
		(2.34)	(3.95)	(2.82)	(2.74)
IN_OWN $_{t-1}$	-	0.173		-0.289	
		(0.58)		(-0.91)	
OUT_OWN $_{t-1}$	-	-0.575		-0.533	
		(-1.56)		(-1.62)	
OUT_TC $_{t-1}$	+	0.379***	0.385***	-0.017	
		(8.14)	(7.75)	(-0.50)	
CAPEX $_{t-1}$	+	0.015		0.069	
		(0.03)		(0.22)	
RD $_{t-1}$	+	0.667		-0.698	
		(1.11)		(-1.00)	
Industry fixed effects		Yes	Yes	No	No
Firm fixed effects		No	No	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes
R^2		0.58	0.57	0.83	0.83
Adjusted R^2		0.57	0.57	0.80	0.80
N		6076	7244	6030	7279

Intercepts are not included in the table since they are not valuable for our analysis and they differ per firm and industry. All values except the age, outside director percentage and turnover are winsorized at the 1st and 99th percentiles (using winsor2**)**. All t-stats can be found between the parentheses below each coefficient, these are based on clustered standard errors, which are corrected for heteroskedascity and autocorrelation. The asterisks indicate the significance levels of the coefficients: *** significant at 1% level, ** significant at the 5% level, * significant at the 10% level. Where TC= total compensation, CEO_OWN= CEO share ownership, AGE= CEO's age, CEO_TEN= CEO's tenure, CEO_TURN= Turnover dummy, ROA= log return on assets, TQ= Tobin's Q, RET= Log stock return, FS=natural logarithm of sales, BS=Board size, OUT_P= percentage of outside directors, IN_OWN= inside director share ownership, OUT_OWN= outside director share ownership, OUT_TC= natural log of average outside director compensation, CAPEX= capital expenditures and RD= R&D expenditures.

Table 11 shows the regressions for the level of cash compensation. The most important implication of these results is the small magnitude for the effect of market-based firm performance on the cash compensation level. Furthermore, ROA has no significant effect on the cash compensation of the CEO. Gerhart & Milkovich (1990) also find a weaker link between salary and firm performance, although they argue that performance most definitely influences the bonuses. Our results implicate the same as their findings, especially since cash bonuses are significantly reduced during our time frame compared to salary.

Firm size is an important determinant again and it has a positive significant effect on the level of cash compensation. The coefficients are smaller than in the total compensation regression, which might be caused by the shift in popularity from cash compensation to equity-based compensation. Larger firms offer market conform cash compensation and offer larger equity-based compensation packages (Hall & Murphy, 2003).

We find that Tobin's Q has a negative significant effect, since a 10% increase causes a significant 0.84% decrease of the cash compensation level in the industry FE regression. Cash compensation is not a long-term performance incentive, which is a possible explanation for this negative relationship (Frydman & Jenter, 2010). However, the effect of Tobin's Q on cash compensation is not significant in the firm FE regression.

For the board characteristics, we also find some different relationships compared to the total compensation regression. Board size has positive effect on the cash compensation level in the industry FE regression. This finding confirms the theory of disadvantages in communications and decision-making for a bigger board (Core et al. 1999; Ozkan, 2011). Although, we have to keep in mind that this relationship only holds in the industry FE regression again and that the coefficient is not significant. It is remarkable that the outside ownership variables are negatively and positively related to the cash compensation level, whereas the inside ownership variables are positively and negatively related. The firm and industry FE regressions give different results and the only significant explanatory is inside ownership (firm FE), i.e. a 1% increase of inside ownership leads to a 1.78% decrease of the CEO compensation level. Furthermore, the relation between CEO cash compensation and outside director total compensation is not significant.

CEO age has a small positive effect on the cash compensation level in both FE models. This is probably because older CEOs usually receive higher salaries compared to younger people in similar positions (Jensen & Murphy, 1990). It is important to note that the only significant CEO characteristics are CEO ownership and CEO tenure, which are both significant in the industry FE regression.

Table 11: The pay-performance elasticity of CEO cash compensation

		Dependent variable: ln(cash-based compensation)			
	Predicted Sign	(1)	(2)	(3)	(4)
RET $_{t-1}$	+	0.084*	0.095***	0.095**	0.094**
		(1.95)	(2.97)	(2.54)	(2.57)
ROA $_{t-1}$	+	0.435		0.339	
		(1.10)		(1.26)	
TQ $_{t-1}$	+	-0.084**	-0.086***	-0.015	
		(-2.13)	(-3.19)	(-0.52)	
FS $_{t-1}$	+	0.108***	0.127***	0.103	
		(3.57)	(3.04)	(0.92)	
CEO_OWN $_{t-1}$	-	-6.784***	-5.378***	0.287	
		(-3.71)	(-3.87)	(0.14)	
CEO_TEN $_{t-1}$	+	0.012**	0.011***	0.010	
		(2.09)	(2.69)	(1.59)	
AGE	+	0.004		0.002	
		(0.95)		(0.36)	
CEO_TURN	-	-0.148		-0.082	
		(-1.47)		(-1.02)	
BS $_{t-1}$	-	0.020		-0.015	
		(1.12)		(-0.77)	
OUT_P $_{t-1}$	+	0.523		-0.156	
		(1.12)		(-0.43)	
IN_OWN $_{t-1}$	-	0.315		-1.780**	-1.533*
		(0.64)		(-1.99)	(-1.86)
OUT_OWN $_{t-1}$	-	-0.081		0.521	
		(-0.16)		(1.06)	
OUT_TC $_{t-1}$	+	-0.008		-0.097	
		(-0.08)		(-1.28)	
CAPEX $_{t-1}$	+	-0.351		-0.604	
		(-0.78)		(-1.35)	
RD $_{t-1}$	+	0.091		-1.990**	-2.169**
		(0.07)		(-2.25)	(-2.38)
Industry fixed effects		Yes	Yes	No	No
Firm fixed effects		No	No	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes
R^2		0.14	0.13	0.68	0.68
Adjusted R^2		0.13	0.12	0.62	0.62
N		6076	7274	6030	6170

Intercepts are not included in the table since they are not valuable for our analysis and they differ per firm and industry. All values except the age, outside director percentage and turnover are winsorized at the 1st and 99th percentiles (using winsor2**)**. All t-stats can be found between the parentheses below each coefficient, these are based on clustered standard errors, which are corrected for heteroskedascity and autocorrelation. The asterisks indicate the significance levels of the coefficients: *** significant at 1% level, ** significant at the 5% level, * significant at the 10% level. Where CC= cash compensation, CEO_OWN= CEO share ownership, AGE= CEO's age, CEO_TEN= CEO's tenure, CEO_TURN= Turnover dummy, ROA= log return on assets, TQ= Tobin's Q, RET= Log stock return, FS= natural logarithm of sales, BS= Board size, OUT_P= percentage of outside directors, IN_OWN= inside director share ownership, OUT_OWN= outside director share ownership, OUT_TC= natural log of average outside director compensation, CAPEX= capital expenditures and RD= R&D expenditures.

Finally, *Table 12* contains the results for the regressions on equity-based compensation. All the estimated coefficients for the industry FE regression show significant effects on the level of equity-based compensation. If we compare the coefficients with cash compensation, we can conclude that companies provide their CEOs with equity-based incentives strongly based on market performance. The effect of a 10% increase in stock returns on the equity-based compensation level is 1.72%/1.40%, which is higher than the effect on cash compensation, i.e. 0.84/0.95% (see *table 11*). This finding meets our expectations, that equity-based incentives are strongly driven by firm performance compared to cash compensations (Frydman & Jenter, 2010). Again, firm size is an important determinant of the level of compensation and it has a significant positive effect on the compensation level.

The other firm characteristic, Tobin's Q, is also significant in both regression. An increase of 1% in the Tobin's Q leads to a significant increase of 0.21%/0.13% in the equity-based compensation level. This finding implicates that the board is compensating the CEO based on forward-looking metrics, since Tobin's Q is a proxy for future growth (Mehran, 1995).

We also find significant effects of 1% increases of the outside director percentages, the outside directors' ownership percentage and the inside director ownership percentage. The percentage of outside directors has a significant positive effect on the equity-based compensation level of 1.20%/1.14%. The positive relationship between outside director compensation could imply that outside directors prefer to compensate the CEO via equity-based incentives instead of cash compensation. Nevertheless, the outside ownership percentage has a significant negative effect on the equity-based compensation level. The inside ownership variables again show different effects in both regressions, i.e. positive and negative effects of 0.80%/-0.81% for a 1% increase in ownership. The fixed and industry effects regressions give different signs, which might be caused by omitted variables in the industry FE regression.

The CEO characteristic, CEO turnover shows the same signs and relationships to equity-based compensation as to cash compensation and total compensation. It has a negative effect for all compensation levels, which seems naturally, since a new CEO often starts with a lower compensation level. Furthermore, there are often less performance incentives to be received, when a new CEO starts during the fiscal year.

The investment characteristic R&D shows a significant positive relationship with the equity compensation of the CEO. A 1% increase in R&D expenditures leads to a 1.77% increase in equity-based compensation for the CEO. This finding might indicate that a firm compensates the CEO with equity to incentivize R&D investments, which we also discuss in the next section.

Table 12: The pay-performance elasticity of CEO equity-based compensation

Dependent variable: ln(equity-based compensation)					
	Predicted Sign	(1)	(2)	(3)	(4)
RET $_{t-1}$	+	0.172***	0.175***	0.140***	0.137***
		(4.96)	(5.77)	(5.19)	(5.17)
ROA $_{t-1}$	+	-1.233***	-1.141***	0.274	
		(-4.14)	(-3.68)	(1.14)	
TQ $_{t-1}$	+	0.208***	0.200***	0.131***	0.142***
		(8.54)	(6.93)	(6.17)	(7.28)
FS $_{t-1}$	+	0.392***	0.405***	0.164***	0.184***
		(13.52)	(17.53)	(3.20)	(3.91)
CEO_OWN $_{t-1}$	-	-1.979***	-1.826***	0.439	
		(-3.08)	(-3.44)	(0.80)	
CEO_TEN $_{t-1}$	+	0.006		0.005	
		(1.64)		(1.58)	
AGE	+	-0.003		0.001	
		(-0.84)		(0.22)	
CEO_TURN	-	-0.117**	-0.122***	-0.126***	-0.110**
		(-2.44)	(-2.72)	(-2.85)	(-2.48)
BS $_{t-1}$	-	0.025*		0.010	
		(1.76)		(0.97)	
OUT_P $_{t-1}$	+	1.198***	1.397***	1.143***	1.222***
		(3.18)	(4.42)	(4.00)	(4.31)
IN_OWN $_{t-1}$	-	0.804**	0.971***	-0.809**	-0.632
		(2.53)	(3.38)	(-2.09)	(-1.63)
OUT_OWN $_{t-1}$	-	-0.848*	-0.791*	-1.095***	-1.144***
		(-1.95)	(-1.86)	(-2.68)	(-2.70)
OUT_TC $_{t-1}$	+	0.507***	0.527***	0.147***	0.143***
		(7.73)	(7.24)	(3.76)	(3.66)
CAPEX $_{t-1}$	+	0.654		0.213	
		(0.76)		(0.55)	
RD $_{t-1}$	+	1.766***	1.883***	1.021	
		(4.70)	(5.40)	(0.96)	
Industry fixed effects		Yes	Yes	No	No
Firm fixed effects		No	No	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes
R^2		0.55	0.55	0.82	0.82
Adjusted R^2		0.55	0.54	0.78	0.78
N		5487	5509	5428	5463

Intercepts are not included in the table since they are not valuable for our analysis and they differ per firm and industry. All values except the age, outside director percentage and turnover are winsorized at the 1st and 99th percentiles (using winsor2**)**. All t-stats can be found between the parentheses below each coefficient, these are based on clustered standard errors, which are corrected for heteroskedascity and autocorrelation. The asterisks indicate the significance levels of the coefficients: *** significant at 1% level, ** significant at the 5% level, * significant at the 10% level. Where EBC= equity-based compensation, CEO_OWN= CEO share ownership, AGE= CEO's age, CEO_TEN= CEO's tenure, CEO_TURN= Turnover dummy, ROA= log return on assets, TQ= Tobin's Q, RET= Log stock return, FS= natural logarithm of sales, BS= Board size, OUT_P= percentage of outside directors, IN_OWN= inside director share ownership, OUT_OWN= outside director share ownership, OUT_TC= natural log of average outside director compensation, CAPEX= capital expenditures and RD= R&D expenditures.

5.2 Pay-risk sensitivity of the equity portfolio & investment strategies

The last regression model of our analysis follows the structure of Coles et al. (2006). The delta and vega calculation is extensively described in the methodology section. Before introducing the model, we show the yearly statistics for delta and vega of the CEO equity portfolio in *table 13*. Vega has increased compared to the study of Coles et al. (2006), they calculated the values for S&P firms from 1992-2002 and find an average vega of $80.000 over the total period, our mean is $254.000. This increase might be contributed to the significant increase in stock-option payments with long maturities during the 1990s, which results in bigger option portfolios in the 2000s. In addition, the average delta increased compared to Coles et al. (2006) mainly because of the popularity of CEO payment in restricted stocks (sometimes also awarded to outside directors), $600.000 vs $1.056.000. The investment variables R&D are constant during the sample period, whereas capital expenditures are more volatile.

Table 13: Evolution of delta & vega

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Avg. Growth
DELTA	1531	1393	819	966	1126	991	1065	1308	1346	0.7%
		-(0.09)	-(0.41)	(0.18)	(0.17)	-(0.12)	(0.08)	(0.23)	(0.03)	
VEGA	230	215	264	293	258	285	277	222	229	0.8%
		-(0.06)	(0.23)	(0.11)	-(0.12)	(0.11)	-(0.03)	-(0.20)	(0.03)	
CAPEX	0.05	0.05	0.06	0.04	0.04	0.05	0.05	0.05	0.05	-0.4%
		(0.01)	(0.01)	-(0.27)	(0.03)	(0.16)	(0.03)	-(0.04)	(0.03)	
RD	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.1%
		(0.07)	(0.01)	-(0.01)	-(0.02)	(0.02)	-(0.01)	-(0.01)	-(0.01)	
N	856	1087	1097	1107	1115	1132	1140	1160	1174	

DELTA and VEGA are in $1000s. CAPEX and RD are in 100%. The intra-year growth rates are between parentheses. DELTA= sensitivity of CEO equity to stock returns, VEGA= sensitivity of CEO equity to stock return volatility, CAPEX= capital expenditures, RD= R&D expenditures, and N=# of firms per year. The last column 'Growth' contains average annual growth percentages. All variables are winsorized at the 1^{st} and 99^{th} percentile.

We used the following model to test if the sensitivity of the equity portfolio affects the actual levels of investments made by the CEO:

$$Investment\ var. = \alpha + \beta_1 * VEGA_{t-1} + \beta_2 * DELTA_{t-1} + \beta_3 * CC. + \beta_4 * CEO\_TEN + \beta_5 * FS + \beta_6 * MTB + \beta_7 * SC + \beta_8 * RET + \beta_9 * SGR + \beta_{10} * BLEV + \mu_i + u_{it} \quad \textbf{(2)}$$

With the following variable definitions:

Investment var. = R&D expenditures or Capital expenditures, divided by total assets

VEGA = the change in the CEO equity portfolio value ($) when stock-return volatility change with 0.01
DELTA = the change in the CEO equity portfolio value ($) when stock price change with 1%
CC = CEO cash compensation
CEO_TEN = the CEO's tenure
FS = the natural logarithm of sales, i.e. firm size
MTB = the market-to-book ratio
SC = the firm's surplus cash divided by total assets
RET = the yearly log stock returns
SGR = the yearly log sales growth
BLEV = the firm's book leverage, i.e. book value of debt/ book value of equity
μ= firm-specific or industry-specific fixed effects dummies
u= the error term, i.e. the variance in Investment var. that remains unexplained

As proposed in the methodology section, we also test the two different investment specifications for the presence of autocorrelation before conducting the analyses. *Table 14* shows the results of the Wooldridge test for autocorrelation. These results also show significant presence of autocorrelation in the three different regression models. Therefore, we corrected the standard errors for clusters at the firm and industry levels in our firm and industry FE regression.

Table 14: Wooldridge test for autocorrelation, CAPEX/R&D & vega models

General regression investment variables & vega

$$Investment\ var. = \alpha + \beta_1 * VEGA_{t-1} + \beta_2 * DELTA_{t-1} + \beta_3 * CC. + \beta_4 * CEO\_TEN + \beta_5 * FS + \beta_6 * MTB + \beta_7 * SC + \beta_8 * RET + \beta_9 * SGR + \beta_{10} * BLEV + \mu_i + u_{it}$$

Dependent	*F-statistic*	*p-value*	*H0*	*H1*
CAPEX	109.95	0.00	Accept	Reject
RD	74.00	0.00	Accept	Reject

The first column shows the three different dependent variables for the model and the independent variables are the same in each specification as one can see in the general regression. The F-statistics are the test statistics for the Wooldridge test. The p-values indicate the significance of the test-statistics. H0: autocorrelation in panel data, H1: no autocorrelation in panel data. We accept H0 in all cases since the p-values are lower than 0.05, which implies that we have to correct the standard errors for autocorrelation. See APPENDIX C for the Stata output of the Wooldridge test.

Table 15 includes all the regressions for the different investment variables. The results show us that vega and delta are significant determinants for R&D and CAPEX in the industry FE specification, whereas they are not significant in the firm FE specification. The difference might occur because the relationship between vega and investment strategy has a stronger presence in the cross-section, compared to the time series. Especially when the CEO turnover variable is more volatile over the years and the delta and vega remain more stable (Coles, et al., 2006).

We expected that a higher vega leads to more investments in R&D and less investments in capital. The industry FE regressions support the theory with significant effects and the expected signs, see the R&D panel in *table 15*. This tells us that vega has a small but significant predicting power for the level of R&D expenditures, i.e. the vega of the previous year explains a part of the current R&D expenditures. We find several significant control variables as well, this gives us a further insight in the explanation of the R&D expenditures. However we do not discuss these variables into depth. The significant negative effect of vega on CAPEX can be described as evidence for the prediction that an increase in the CEO vega, causes a CEO to shift investments towards riskier assets (Ross, 2004). As we stated in the theoretical part of the paper, capital expenditures are classified as less risky investments, therefore a negative value of vega seems natural. The magnitude of our coefficients is smaller in all cases than the coefficients of Coles et al. (2006). However, our results show similar magnitudes compared to a more recent study after the FAS 123R by Hayes et al. (2012).

The delta positively relates to R&D expenditures and negatively relates to capital expenditures, in both industry FE regressions. These findings show that if the pay-performance sensitivity increases the CEO might invest an equal extra amount in both R&D and capital. The main conclusions for the results in the tables follow our expectations, apart from the firm FE models. Vega is significant and positive in the R&D industry FE model, which indicates a shift in investment policy towards riskier assets. In Panel B, the industry FE provides a significant negative vega. This implies that an increasing vega causes CAPEX to decline, i.e. less 'safe' investments and more risk-taking. Considering the industry FE, we might say that CEOs are still shifting their investments when vega changes in the current time frame.

It is important to note here, that several variables experience sign changes across the industry and firm FE regressions, i.e. DELTA VEGA CC FS and SGR. These sign switches remain difficult to explain, however they might be caused by the characteristics within the industry and firm-specific term of the FE models. The R-squared of the firm FE model are higher, which might imply that we omit several variables in the industry FE model.

Table 15: CAPEX/R&D & vega

	CAPEX		R&D	
Independent variables	(1)	(2)	(3)	(4)
$DELTA_{t-1}$	0.000001	0.000001	0.000000	-0.000000
	(1.44)	(1.42)	(1.53)	(-0.99)
	0	0		
$VEGA_{t-1}$	-0.000005***	0.000000	0.000009***	-0.000000
	(-3.10)	(0.43)	(2.93)	(-0.07)
	0	0		
CEO_TEN	0.000158	0.000048	-0.000058	-0.000032
	(1.38)	(0.45)	(-0.29)	(-0.69)
	0	0		
CC	-0.000003***	-0.000001	-0.000001	-0.000000
	(-2.77)	(-0.60)	(-0.27)	(-1.00)
FS	-0.000803	0.000610	-0.006094***	-0.005598***
	(-0.62)	(0.28)	(-2.87)	(-3.16)
MTB	0.003556***	0.005190***	-0.001870	-0.000094
	(2.81)	(6.88)	(-0.93)	(-0.14)
CS	0.024999	0.032015**	0.250900***	0.041791***
	(1.52)	(2.37)	(4.77)	(4.71)
RET	-0.013574***	-0.015785***	-0.004090**	-0.002778***
	(-8.95)	(-14.97)	(-2.44)	(-5.49)
SGR	0.014791**	0.007733***	0.000030	-0.002190*
	(2.33)	(3.45)	(0.01)	(-1.73)
BLEV	-0.000786	-0.007560	-0.004347	-0.007309
	(-0.10)	(-1.25)	(-0.61)	(-1.58)
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
N	6906	6884	6911	6889
R-squared	0.48	0.80	0.54	0.95
adj. R-squared	0.48	0.77	0.54	0.94

Intercepts are not included in the table. VEGA, DELTA and CC are winsorized at the 1st and 99th percentiles (using winsor2**)**. All t-stats can be found between the parentheses below each coefficient, these are based on robust standard errors, which are corrected for heteroskedascity. The original sample size of 9868 for the period 2006-2014 decreased to 6906, 6884, 6911 and 6889 observations due to missing observations. The asterisks indicate the significance levels of the coefficients: *** significant at 1% level, ** significant at the 5% level, * significant at the 10% level. Where CAPEX = capital expenditures, RD = research & development expenditures, DELTA = pay-performance sensitivity of CEO equity, VEGA = pay-risk sensitivity of CEO equity, CEO_TEN = CEO tenure, CC = cash compensation, FS = firm size, MTB = market-to-book ratio, CS = Cash surplus, RET = yearly log stock return, SGR = yearly sales growth and BLEV = book leverage.

6 CONCLUSION

6.1 Conclusion

The extensive literature on CEO compensation recognizes different patterns when analyzing the link between compensation and firm performance. This study provides an empirical framework to test if the different measures of firm performance affect the level of CEO compensation components. Furthermore, we tested if the sensitivity of the CEO wealth, equity portfolio, to stock returns and volatility affects investment decision by the CEO.

Firstly, we document that boards nowadays tend to incentivize their CEOs to increase firm performance, by offering higher levels of compensation when the stock returns increase. This holds for cash compensation, equity-based compensation and total compensation. The link between stock returns and equity-based compensation is clearly stronger than between stock returns and cash compensation. An interesting implication is that the cash compensation levels have decreased significantly after the crisis, whereas equity-based compensation increased. However, we find that ROA has less significant relationships, in some cases negative relationships, with the different compensation levels. This contradicts the theory of Murphy, who argues that bonus contracts are usually not designed based on market-value performance metrics but mainly on accounting-based measures. Nevertheless, the positive relation between stock returns and compensation levels is line with the majority of studies about this topic (Jensen & Murphy, 1990; Conyon & Murphy, 2000; Conyon, 2006; Ozkan, 2011).

In addition, we find that CEO ownership and outside director ownership have a negative effect on the CEO compensation levels, which indicates stronger monitoring/involvement of the board. However, the total compensation levels of the outside directors and managers are positively related to the CEO compensation level. This is not necessarily a disadvantageous finding, since providing the right incentives to both directors and managers improves monitoring (Fich & Shivdasani, 2005). Nevertheless, when the compensation of directors is excessive a red flag rises, because this usually leads to overcompensation of the CEO and less efficient feedback (Jensen, 1993; Brick et al., 2006).

Furthermore, this study provides evidence for a significant performance elasticity of total, equity-based compensation and cash compensation. Each 10% increase in stock returns implies a 1.40% increase in the inter-year change of equity-based compensation and a 1.74% increase in the inter-year change in total compensation. The performance elasticity is lower for cash compensation, i.e. 10% increase in stock returns implies a 0.96% in cash compensation.

These findings, together with the compensation level regressions, prove that there is a strong alignment between stock performance and CEO compensation. Therefore, we might conclude that boards strongly align the interests of the shareholders with the interests of the CEOs, in the current time frame. However, we have to put this into perspective since firm size, which is an important determinant of CEO compensation, has also grown over the years. Another implication is the effect of investments on the firm size, i.e. a successful investment leads to a higher market value of the firm (Kim & Lu, 2011). Therefore, growing firms can pay higher levels of compensation to their CEOs and the pay-performance relation maintains.

Finally, we can conclude that risk-taking is associated with the equity portfolio of the CEO even after the adoption of FAS 123R in 2006. Capital expenditures will decrease when the equity portfolio of the CEO is more sensitive to risk, i.e. stock return volatility. Whereas, R&D expenditures increase if the CEO equity portfolio is more sensitive to risk. Furthermore, a higher performance sensitivity of the CEO equity portfolio will lead to a slight increase in both capital expenditures and R&D. This finding might indicate that awarding a larger percentage of restricted stocks in equity-based compensation leads to a more balanced investment strategy.

6.2 Limitations and further research

This study includes a relatively large number of determinants for the CEO compensation level and the changes in these levels, although there are even more variables e.g. blockholder ownership and managerial characteristics. Therefore, we needed to merge a large number of databases and different files. Theses merges cause a *serious loss of data-points* and therefore the analysis could have been stronger if all the databases were perfectly complementary.

The R&D and CAPEX variables included many observations with zero as value, although the significant findings (and the proper model fit, i.e. a high adjusted R-squared) we might have included a *Tobit regression* which is more suitable when a dependent variable often takes on zero as value (Coles et al., 2006). In addition, our fixed effects models, industry FE and firm FE, show some different results in the analyses. It remains extremely difficult to explain where these exact differences come from.

Although we took precautions (lagged independent variables) against *endogeneity* this phenomena might still affect the ordinary least squares fixed effect regressions. Therefore, it is important to note that the significant relationship between market-based firm performance and CEO compensation levels might have a dual causation. This implies that, besides the relationship we found, firms who give their CEOs higher compensation might also perform better. The fixed effects models that we used are suitable for these kind of time-series analyses. Nevertheless, we might have included *managerial fixed effects* to extend the analysis. This is an interesting route of research, since managerial fixed effects such as risk-aversion can possibly explain the unexplained variance in the compensation level and the investment choices. Furthermore, the personal characteristics and psychology of managers/CEOs in large corporations have an influence on corporate investment decisions. CEO narcism and CEO optimism/overconfidence are possible routes of additional research.

Although our findings for *CEO age* are not significant, several studies also build models incorporating *career concerns* which predict that older CEOs are less risk averse than the younger ones because of their age (Holmstrom,1999). Older CEOs have already proven their capability and skills of managing, therefore a negative outcome of an investment has less impact on their future career compared to a young CEO (Holmstrom, 1999). Hence, the younger CEOs' career depends heavily on investment performance and result. A bad investment jeopardizes their future career potentials, which drives them to implement conservative investment policies (Holmstrom, 1999).

In conclusion, the existing CEO compensation literature is significant in size. Nevertheless, there are still many possible routes to research. The main advantage of CEO compensation, as a topic, is the continuous relevance and the change in structure/level across firms, industries, countries and time.

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APPENDIX A. EXECUCOMP & COMPUSTAT DATA ITEMS

EXECUCOMP data items	Definition	Units
SHROWN	Number of shares owned by CEO	1000s
SHROWN_OPTS_EXCL	Number of shares owned by CEO, options excluded	1000s
EXPRIC	Exercise price of the stock option tranche	US$
OPTS_UNEX_EXER	Number of unvested stock options that are exercisable.	1000s
OPTS_EX_EXER	Number of vested stock options that are exercisable.	1000s
EXDATE	Maturity date of the stock option tranche	date
PRCCF	Closing stock price at the end of the fiscal year	US$
DIVYIELD	The stock dividend yield over the fiscal year	%
COMPYEAR (own variable)	Unique ID based on firm code and fiscal year	

COMPUSTAT data items	Definition	Units
CSHO	Common shares outstanding	millions
COE	Common ordinary equity	US$ millions
LTDT	Long-term debt total	US$ millions
LTDCL	Long-term debt in current liabilities	US$ millions
TA	Total assets	US$ millions
OANCF	Operating activities net cash flow	US$ millions
DPC	Depreciation	US$ millions
XRD	R&D expenditures	US$ millions

APPENDIX B. VEGA & DELTA CALCULATION

The calculation process of delta and vega was quite intensive, especially ordering the data of the different options and shares. Therefore, we present some extra explanation for the ordering of the data to create the input for the Black & Scholes-Merton model.

The equity portfolio of a CEO consists of three parts, specifically unvested options, vested options and shares. First, we had to order the data to calculate the vega and delta for these three parts. Therefore, we obtained the following data from Execucomp: OPTS_UNEX_EXER, OPTS_EX_EXER, EXPRIC, EXDATE, PRCCF, SHROWN_OPTS_EXCL (Coles et al., 2013)[4]. As of 2006, the Execucomp database provides data on option awards in tranches (including both vested and unvested options). Hence, the delta and vega of each tranche have to be calculated separately and aggregated per CEO and year afterwards. We also obtain the risk-free rates corresponding with the options, for the different maturities[5], from the Federal Reserve historical annual Treasury Database. These rates were interpolated to get the 4, 6, 8 and 9-year maturity rates. Furthermore, we need the stock-return volatility[6], i.e. σ, and the dividend yield (DIVYIELD), the dividend yield per year was calculated by taking the average of DIVYIELD over the current year and the past 2 years and was divided by 100 to enter the B-S model[7]. After collecting and calculating the data, we order the data in 2 steps, i.e. the vested & unvested options ***(1)*** and shares ***(2)***.

1. The ***delta*** and ***vega*** of the vested and unvested option portfolio are estimated with the following variables. Firstly, we estimate the time to maturity (*T*) of each option tranche by subtracting the date of the fiscal year start of the expiration date (*EXDATE*). Secondly, we obtain the risk-free interest rate (*r)*, by matching the fiscal year and these times maturity (together named *YRT*) with the corresponding risk-free rates obtained earlier. Thirdly, XPRIC and PRCCF, i.e. the exercise price *(X)* and the stock price *(S)*,

[4] See APPENDIX A. for the definitions of all used Execucomp data items and created variables.

[5] The Federal Reserve Treasury database solely provides the risk-free rates for 1, 2, 3, 5, 7 and 10-year maturities.

[6] The stock return volatility over the maturity period of the option is calculated based on the annualized daily stock return volatility based on the daily returns in the fiscal year. Finally, the estimates are winsorized at the 1th and 99th percentile.

[7] The estimates of DIVYIELD are winsorized at the 1th and 99th percentile

are readily available per option tranche. Fourthly, we match the estimates of stock-return volatility (*σ*) calculations with the right option tranches using unique COMPYEAR codes. Thereafter, ***d1*** value is calculated with the stock price (*S*), the stated exercise price (*X),* stock-return volatility (*σ*), the risk-free interest rate (*r*), the dividend yield (*d*) and the time to maturity of the options (*T)*. The ***delta*** for the current year's option grants is calculated using the *S*, *DIVYIELD* (*d*), *T,* and the ***d1*** value of this portfolio. The ***vega*** is determined with the same variables, but now with a normal density function instead of the cumulative function. By multiplying the total number of options per tranche with the delta and the vega, and aggregating these per CEO per year, we get respectively the ***total delta value*** and ***total vega value*** of the CEO option portfolio.

2. The delta and vega of the shares portfolio are not as complicated to estimate as the options portfolio. The two input values are PRCCF, the stock price at the end of the fiscal year, and SHROWN_OPTS_EXCL, the number of shares owned by the CEO at the end of the year. The delta of the share portfolio estimate is calculated by multiplying the PRCCF with SHROWN_OPTS_EXCL and 0.01.

APPENDIX C. REGRESSION OUTPUT

Wooldridge tests – pay-performance elasticity of CEO compensation

```
. xtserial leadlncc RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN leadage leadturno  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_
> w CAPEX_w RD_w

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     940) =      4.303
           Prob > F =      0.0383

. xtserial leadlncc RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN leadage leadturno  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_
> w CAPEX_w RD_w

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     940) =      4.303
           Prob > F =      0.0383

. xtserial leadlnebc RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN leadage leadturno  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC
> _w CAPEX_w RD_w

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     848) =     43.143
           Prob > F =      0.0000
```

Fixed effects regressions: pay-performance elasticity of CEO total compensation

```
. eststo: reghdfe  f.LNTC RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year twodigit) cluster(twodigit)
. eststo: reghdfe  f.LNTC RET_w ROA_w TQ_w FS_w Ceo_OWN_w f.CEO_TURN  BS_w  OUT_P LNOUT_TC_w, absorb(year twodigit) cluster(twodigit)
. eststo: reghdfe  f.LNTC RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year firm) cluster(firm)
. eststo: reghdfe  f.LNTC RET TQ FS CEO_TEN f.CEO_TURN OUT_P, absorb(year firm) cluster(firm)
. esttab, ar2 r2 star(* 0.10 ** 0.05 *** 0.01) b(3)
```

	(1)	(2)	(3)	(4)
	F.LNTC	F.LNTC	F.LNTC	F.LNTC
RET_w	0.214***	0.204***	0.174***	0.172***
	(9.34)	(8.00)	(8.10)	(8.87)
ROA_w	-0.679**	-0.809***	-0.014	
	(-2.29)	(-2.82)	(-0.08)	
TQ_w	0.077***	0.086***	0.060***	0.066***
	(4.09)	(4.84)	(3.40)	(4.47)
FS_w	0.318***	0.308***	0.148***	0.173***
	(14.10)	(11.69)	(3.37)	(4.71)
Ceo_OWN_w	-3.456***	-2.754***	-1.220	
	(-6.76)	(-7.30)	(-1.58)	
CEO_TEN	0.005		0.006**	0.005**
	(1.63)		(2.20)	(2.18)
F.AGE	0.002		0.004	
	(1.13)		(1.33)	
F.CEO_TURN	-0.184***	-0.213***	-0.118***	-0.114***
	(-3.27)	(-3.32)	(-2.91)	(-3.06)
BS_w	0.033**	0.033**	-0.006	
	(2.36)	(2.65)	(-0.81)	
OUT_P	0.532**	0.560***	0.536***	0.384***
	(2.34)	(3.95)	(2.82)	(2.74)
IN_OWN_w	0.173		-0.289	
	(0.58)		(-0.91)	
OUT_OWN_w	-0.575		-0.533	
	(-1.56)		(-1.62)	
LNOUT_TC_w	0.379***	0.385***	-0.017	
	(8.14)	(7.75)	(-0.50)	
CAPEX_w	0.015		0.069	
	(0.03)		(0.22)	
RD_w	0.667		-0.698	
	(1.11)		(-1.00)	
N	6076	7244	6030	7279
R-sq	0.577	0.573	0.834	0.829
adj. R-sq	0.572	0.569	0.800	0.798

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Fixed effects regressions: pay-performance elasticity of CEO cash compensation

```
. eststo: reghdfe  f.LNCC RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year
        twodigit) cluster(twodigit)
. eststo: reghdfe  f.LNCC RET_w TQ_w FS_w Ceo_OWN_w CEO_TEN, absorb(year twodigit) cluster(twodigit)
. eststo: reghdfe  f.LNCC RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN  BS_w  OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year
        firm) cluster(firm)
. eststo: reghdfe  f.LNCC RET_w IN_OWN_w RD_w, absorb(year firm) cluster(firm)
. esttab, ar2 r2 star(* 0.10 ** 0.05 *** 0.01) b(3)
```

	(1)	(2)	(3)	(4)
	F.LNCC	F.LNCC	F.LNCC	F.LNCC
RET_w	0.084*	0.095***	0.095**	0.094**
	(1.95)	(2.97)	(2.54)	(2.57)
ROA_w	0.435		0.339	
	(1.10)		(1.26)	
TQ_w	-0.084**	-0.086***	-0.015	
	(-2.13)	(-3.19)	(-0.52)	
FS_w	0.108***	0.127***	0.103	
	(3.57)	(3.04)	(0.92)	
Ceo_OWN_w	-6.784***	-5.378***	0.287	
	(-3.71)	(-3.87)	(0.14)	
CEO_TEN	0.012**	0.011***	0.010	
	(2.09)	(2.69)	(1.59)	
F.AGE	0.004		0.002	
	(0.95)		(0.36)	
F.CEO_TURN	-0.148		-0.082	
	(-1.47)		(-1.02)	
BS_w	0.020		-0.015	
	(1.12)		(-0.77)	
OUT_P	0.523		-0.156	
	(1.12)		(-0.43)	
IN_OWN_w	0.315		-1.780**	-1.533*
	(0.64)		(-1.99)	(-1.86)
OUT_OWN_w	-0.081		0.521	
	(-0.16)		(1.06)	
LNOUT_TC_w	-0.008		-0.097	
	(-0.08)		(-1.28)	
CAPEX_w	-0.351		-0.604	
	(-0.78)		(-1.35)	
RD_w	0.091		-1.990**	-2.169**
	(0.07)		(-2.25)	(-2.38)
N	6076	7274	6030	6170
R-sq	0.139	0.130	0.684	0.684
adj. R-sq	0.128	0.122	0.620	0.623

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Fixed effects regressions: pay-performance elasticity of CEO equity-based compensation

```
. eststo: reghdfe f.LNEBC RET_w ROA_w TQ_w FS_w Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN BS_w OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year twodigit) cluster(twodigit)
. eststo: reghdfe f.LNEBC RET_w ROA_w TQ_w FS_w Ceo_OWN_w f.CEO_TURN OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w CAPEX_w RD_w, absorb(year twodigit) cluster(twodigit)
. eststo: reghdfe f.LNEBC RET_w ROA_w TQ_w FS Ceo_OWN_w CEO_TEN f.AGE f.CEO_TURN BS_w OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w RD_w, absorb(year firm) cluster(firm)
. eststo: reghdfe f.LNEBC RET_w TQ_w FS_w CEO_TEN f.CEO_TURN OUT_P IN_OWN_w OUT_OWN_w LNOUT_TC_w, absorb(year firm) cluster(firm)
. esttab, ar2 r2 star(* 0.10 ** 0.05 *** 0.01) b(3)
```

	(1)	(2)	(3)	(4)
	F.LNEBC	F.LNEBC	F.LNEBC	F.LNEBC
RET_w	0.172***	0.175***	0.140***	0.137***
	(4.96)	(5.77)	(5.19)	(5.17)
ROA_w	-1.233***	-1.141***	0.274	
	(-4.14)	(-3.68)	(1.14)	
TQ_w	0.208***	0.200***	0.131***	0.142***
	(8.54)	(6.93)	(6.17)	(7.28)
FS_w	0.392***	0.405***	0.164***	0.184***
	(13.52)	(17.53)	(3.20)	(3.91)
Ceo_OWN_w	-1.979***	-1.826***	0.439	
	(-3.08)	(-3.44)	(0.80)	
CEO_TEN	0.006		0.005	
	(1.64)		(1.58)	
F.AGE	-0.003		0.001	
	(-0.84)		(0.22)	
F.CEO_TURN	-0.117**	-0.122***	-0.126***	-0.110**
	(-2.44)	(-2.72)	(-2.85)	(-2.48)
BS_w	0.025*		0.010	
	(1.76)		(0.97)	
OUT_P	1.198***	1.397***	1.143***	1.222***
	(3.18)	(4.42)	(4.00)	(4.31)
IN_OWN_w	0.804**	0.971***	-0.809**	-0.632
	(2.53)	(3.38)	(-2.09)	(-1.63)
OUT_OWN_w	-0.848*	-0.791*	-1.095***	-1.144***
	(-1.95)	(-1.86)	(-2.68)	(-2.70)
LNOUT_TC_w	0.507***	0.527***	0.147***	0.143***
	(7.73)	(7.24)	(3.76)	(3.66)
CAPEX_w	0.654		0.213	
	(0.76)		(0.55)	
RD_w	1.766***	1.883***	1.021	
	(4.70)	(5.40)	(0.96)	
N	5487	5509	5428	5463
R-sq	0.552	0.550	0.818	0.819
adj. R-sq	0.545	0.544	0.779	0.781

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Wooldridge tests – pay-performance sensitivity & investments

```
. xtserial CAPEX_w  lagvega lagdelta CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     963) =    109.595
           Prob > F =      0.0000

. xtserial RD_w  lagvega lagdelta CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     963) =     73.991
           Prob > F =      0.0000
```

Fixed effects regressions: pay-performance sensitivity & investments

```
. eststo: reghdfe CAPEX_w  l.DELTA_w l.VEGA_w CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w, absorb(twodigit) cluster(twodigit)
. eststo: reghdfe CAPEX_w  l.DELTA_w l.VEGA_w CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w, absorb(firm) cluster(firm)
. eststo: reghdfe RD_w  l.DELTA_w l.VEGA_w CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w, absorb(twodigit) cluster(twodigit)
. eststo: reghdfe RD_w  l.DELTA_w l.VEGA_w CEO_TEN CC FS MTB_w CS_w RET SGR_w BLEV_w, absorb(firm) cluster(firm)
. esttab, ar2 r2 star(* 0.10 ** 0.05 *** 0.01) b(6)
```

	(1) CAPEX_w	(2) CAPEX_w	(3) RD_w	(4) RD_w
L.DELTA_w	0.000001	0.000001	0.000000	-0.000000
	(1.44)	(1.42)	(1.53)	(-0.99)
L.VEGA_w	-0.000005***	0.000000	0.000009***	-0.000000
	(-3.10)	(0.43)	(2.93)	(-0.07)
CEO_TEN	0.000158	0.000048	-0.000058	-0.000032
	(1.38)	(0.45)	(-0.29)	(-0.69)
CC	-0.000003***	-0.000001	-0.000001	-0.000000
	(-2.77)	(-0.60)	(-0.27)	(-1.00)
FS_w	-0.000803	0.000610	-0.006094***	-0.005598***
	(-0.62)	(0.28)	(-2.87)	(-3.16)
MTB_w	0.003556***	0.005190***	-0.001870	-0.000094
	(2.81)	(6.88)	(-0.93)	(-0.14)
CS_w	0.024999	0.032015**	0.250900***	0.041791***
	(1.52)	(2.37)	(4.77)	(4.71)
RET	-0.013574***	-0.015785***	-0.004090**	-0.002778***
	(-8.95)	(-14.97)	(-2.44)	(-5.49)
SGR_w	0.014791**	0.007733***	0.000030	-0.002190*
	(2.33)	(3.45)	(0.01)	(-1.73)
BLEV_w	-0.000786	-0.007560	-0.004347	-0.007309
	(-0.10)	(-1.25)	(-0.61)	(-1.58)
N	6906	6884	6911	6889
R-sq	0.480	0.801	0.543	0.951
adj. R-sq	0.475	0.767	0.539	0.943

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Stata module references

Reghdfe:

Sergio Correia, (2014). "reghdfe: Stata module to perform linear or instrumental-variable regression absorbing any number of high-dimensional fixed effects," Statistical Software Components s457874, Boston College Department of Economics, revised 25 Jul 2015.

Winsor2:

Lian Yu-jun, (2014). "winsor2: Stata module to winsorize data", revised 22 Dec 2014.