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Optimal Executive Incentives in a Principal Agent Framework

The Effects of Risk Aversion Modelling Choices

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Industrial Economics and Technology Management
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Optimal Executive Incentives in a Principal Agent Framework

The Effects of Risk Aversion Modeling Choices

By

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Supervisor Einar Belsom

Abstract

In order to determine the structure of the optimal CEO contract, we create a principal agent model and implement it on a sample of Norwegian firms. The model takes account of executives' loss- and risk-aversion and the fact that undiversified and risk-averse executives do not put the same value on stock options as shareholders do. We employ the certainty equivalent approach in determining the perceived value of the CEO's stock options and conduct a comprehensive numerical computer simulation to determine the optimal CEO contract.

Our analysis delivers four important findings. First, our results show that the option's exercise price of long term option grants does not affect executive performance in the optimal contract. When awarding the executive premium or at-the-money options, we find similar CEO performance and contracts cost for long term options grants. Premium options do however have a lower incentive effect. At-the-money options must therefore be substituted with larger amounts of premium options to induce the same level of effort.

Second, the CEO's ability to affect the firm outcome has a large impact on the optimal contract. As the executive's action has an increasing impact on the firm performance, the marginal incentive effect from equity awards increase. This results in higher levels of effort and cheaper contracts.

Third, our results indicate that Norwegian firms suffer large agency costs as they fail to present executives with optimal contracts. Norwegian executives should receive more stocks and options and a lower base salary. This tradeoff would involve a transfer of risk from the shareholders to the executive, resulting in a higher total compensation due to the CEO's need for a risk premium. The increase in executive compensation is however more than outweighed by the increase in CEO effort and shareholder return. We also find it to be optimal from the shareholders view that executives invest more of their personal wealth in the company.

Finally, we show that our model is a good predictor of CEO performance. When we run our model for the actual CEO contract of the sample firms, we predict a performance close to the observed level. This suggests that executives indeed are risk- and loss-averse. We propose some societal constraints on the magnitude of the executive compensation in Norway in an attempt to explain why firms fail to present executives with optimal performance incentives.

Preface

This paper is the master thesis for the MSc study at the Norwegian Institute of Science and Technology, department of Industrial Economics and Technology Management. The thesis is the conclusion of the specialization in Investment analysis, Finance, and Business management.

We want to address the subject of incentive payment for three reasons. First, agency costs are relevant for all organizations and in any situation where a task is performed on behalf of someone else. Creating incentives to align personal and organizational interests should be the aim for any enterprise wanting to maximize the performance, and is often achieved through incentive contracts. Second, the subject of CEO compensation has received increased focus in the media since the financial crises of 2008. There is large public interest in how CEOs are rewarded and if their high compensation can be justified. The media coverage in Norway increased considerably in the summer of 2010, when a new legislation on national regulation of remuneration in the financial sector was proposed to prevent incentives for long-term risk-taking and short-term profit. Finally, we find the subject of incentive contracts interesting in the way that it will always be of great interest and highly relevant in all organizations. We therefore want to expand our knowledge and understanding of its underlying mechanisms, as we are sure that the expertise on incentive payments will come in great hand in the working life.

In this paper we will focus solely on the chief executive officer and we will refer to him as manager, executive and CEO. Corporate management consists of more than just the CEO, but like a majority of the research on incentive contracts, we narrow our scope to just the chief executive officer.

We would like to thank our supervisor Einar Belsom for moral and professional support, for useful ideas and suggestions in the process of composing our master thesis.

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1. Introduction

The total executive remuneration has increased greatly the last 25 years, and has consequently caused much debate in the media and in the finance sector. The growth in executive payment can be attributed to the increased use of stock- and option-based compensation. As options and restricted stocks have become a major component of executive compensation, investors have become increasingly concerned about the real impact towards firm value. The ongoing discussion concerns whether equity grants actually increases CEO performance and shareholder value, or if they lead to excessive risk-taking and large losses for the shareholders. Critical investors argue that equity grants lead to overpaid executives, extracting large values for poor performance in bull markets and thus reducing the firm value.

Granting executives with contracts that inspire to value creation is important for shareholders, whose interest lies in the return on capital investments. In addition, value creation is also of great importance for social development, since firms represent the main source of tax income, provides employment and necessary societal services. Poor firm performance leads to reduced tax incomes and increases unemployment, thus representing a socio-economical loss. Optimal firm conduct is therefore of societal interest. We suggest how firms can reduce agency costs and in that sense reduce socio-economic losses, by presenting new ideas and evidence to the discussion of executive pay in Norway.

We review the most relevant theoretical and empirical literature pertinent to executive incentive plans, and develop a principal agent model analyzing the effects of risk-aversion, loss-aversion and the subjective valuation of executive option plans. We focus on a compensation contract consisting of base salary, stocks and options and apply numerical methods to solve the incentive optimization problem between the executive and shareholders.

We develop our model based on the study of Dittmann and Maug (2007) to determine the optimal incentive contracts for Norwegian executives in a principal agent framework. However, we improve the methodology of their model by implementing loss-aversion, reference dependency and the certainty equivalent method. We reject the assumption that executives already are utilizing the optimal level of effort in the observed contract, and do not allow for negative option holdings in our model. To avoid the shortcomings of the first order approach, we develop a numerical optimization method.

We conduct a comprehensive computer analysis on a sample of Norwegian firms. We conclude that Norwegian managers indeed exhibit both risk- and loss-aversion, and that shareholders do not succeed in presenting the executives with incentive maximizing contracts. The wedge between the level of effort induced from an optimal contract and the executive's actual performance can be seen as an agency cost. Presenting the executive with a new contract consisting of a lower base salary and more equity grants can contribute to a substantial reduction of this cost. The new contract implies an increased risk premium to the executive that will be more than justified by the improved firm performance and the reduced agency cost. Finally we discuss societal structures that might inhibit shareholders in Norway from awarding executives with optimal contracts.

We contribute to the field of incentive pay by evolving a model that considers the most important theories and findings in the field of optimal executive compensation. As some studies do not allow both stocks and options to be awarded simultaneously, we test multiple compensation combinations of stocks, options and base salary. Where most studies have a shortcoming through only focusing on a few theoretical aspects in their models, we build a complex model that incorporates risk-aversion, loss-aversion, reference dependency, subjective equity valuation, the effects of option strike price and the executive's ability to affect the firm performance. We also develop a new methodology to numerically solve the incentive optimization problem between the shareholders and the executive. As a consequence, this paper is of highly interest for shareholders, executives, economists and researchers in the field of incentive pay.

The paper is structured as follows. Chapter 2 reviews the basic theoretical foundation of human behavior, involving agency theory, prospect theory, preference under risk and motivational theory. In chapter 3 we examine various incentive contracts. Chapter 4 discusses factors that affect optimal incentive contracts and review the most relevant empirical findings. Chapter 5 presents five important principal agent models and their results. In chapter 6 we present our model, the results from our contract optimization and a discussion of our findings. Chapter 7 presents our overall assessment of this paper.

2. From the theory of human behavior to incentive contracts

A firm consists of people with differing needs and values. To facilitate value creation in the firm, it is important to present the employees with incentives that ensure they pursue collective goals. An incentive is a factor that inspires or motivates an individual to actions desired by the delegating party. Incentives can be of financial or non-financial art. In this chapter we present the underlying theories that explain the need for incentive contracts to motivate executives. We present agency theory, prospect theory, theories on risk preference and motivational theory.

2.1 Agency Theory

Agency theory describes the ubiquitous relationship between a delegating party (the principal) engaging another person (the agent) to perform some specified activity or service on their behalf, which involves allocating some decision making authority over to the agent (Eisenhardt, 1989 and Jensen and Meckling, 1976). Pindyck and Rubinfelds (1998, page 627) describe the definition of the relationship between the agent and principal as follows:

"An agency relationship exists whenever there is an arrangement in which one person's welfare depends on what another person does. The agent is the person who acts, and the principal is the party whom the action affects."

The theory focuses on solving the agency problem, the situation where the agent's actions differ from the desire of the principal. The problem occurs in the relationship between the agent and the principal due to *incomplete and asymmetric information*, *moral hazards, rent seeking* and *adverse selection*. Eisenhardt (1989) describe two factors that together cause the principal- agent problem to arise: (1) when the desire or goals of the principal and the agent differ and (2) when it is difficult or expensive for the principal to verify what the agent is actually doing.

The focus of the theory is to determine the most efficient contract governing the principal agent relationship. The agent theory rests on some important assumptions:

- The agent acts out of self-interest
- The agent has bounded rationality
- The agent is risk-averse
- Information is a commodity that can be purchased
- There is a partial goal conflict between the participants in the organization

The theory describes two different contracts, behavior-oriented contracts and outcome-oriented contracts, and how the contracts' influence the agent's actions. The agency theory has developed around two lines, positivist- and principal agent theory. They have a lot of similarities, but differ in the areas their main focus.

2.1.1 Positivist Agency Theory

The positivist agency theory focuses on the relationship between the principal and the agent. The theory identifies situations in which the principal and the agent are likely to have conflicting goals, and describes the governance mechanisms that limit the agent's self-serving behavior. When the contract between the principal and agent is outcome-based, the agent is more likely to behave in the interest of the principal since their preferences depend on the same actions, thus reducing conflicts and self-serving behavior (Eisenhardt, 1989).

If a behavior-based contract is applied, the principal needs information to verify agent behavior. As more of the agent's behavior becomes known, the agent is more likely to behave in the interests of the principal. Implementing information systems reduce the agent's opportunism as the principal is informed about the agent's actions, and the agent realizes that the principal cannot be deceived. In this way information is regarded as a commodity that can be bought through investing in information systems (Eisenhardt, 1989).

2.1.2 Principal agent theory

The focus of the principal agent theory is to determining the optimal contract between the agent and the principal. While the positivist theory identifies various contracts, the principal theory indicates which contract is the most efficient under varying levels of outcome uncertainty, risk aversion, information and other various variables (Eisenhardt, 1989).

When there are conflicting goals between the principal and agent, outcome-based contracts are favorable. If there is no goal conflict the agent will behave as the principal likes, regardless of whether his behavior is monitored or not. The agent is assumed to be risk-averse, while the principal has a risk-neutral behavior due to diversification of his portfolio. The outcome- based contract passes risk to the agent, and aligns his interest with those of the principal (Eisenhardt, 1989).

The firm's outcome uncertainty affects the choice of contract. Contracting based on the outcome of an agent's behavior motivates an alignment of the agent's preferences with those of the principal, but transfers risk to the agent since outcome can be based on more than the agent's behavior. The cost of the risk transfer increase with outcome uncertainty since the agent must receive compensation for his increased risk exposure (Eisenhardt, 1989). This cost is the risk premium the principal must pay to increase the risk-taking for the risk-averse agent.

When the agent is increasingly risk averse, a behavior-based contract will be a more attractive compensation form. The cost needed to compensate the transfer of risk to the agent is gradually reduced with the agent's decreasing risk aversion. Consequently, as the agent becomes decreasingly risk averse, it will be more attractive for the principal to pass risk to the agent with an outcome-based contract (Eisenhardt, 1989).

Task programmability makes behavior-based contracts more attractive, since increasing programmability of the agent's tasks makes observation and evaluation of the agent's behavior easier. When outcomes are either difficult to measure or cannot be measured in a given amount of time, outcome-based contracts are less attractive than behavior-based contracts. Long term relationships also favor a behavior-based contract, since the principal is likely to learn about the agent and be able to assess behavior more readily (Eisenhardt, 1989).

2.1.3 Agency costs

Jensen and Meckling (1976) relate agency cost to the issue of debt and define the costs as the sum of:

- The monitoring expenditures by the principal
- The bonding expenditure by the agent
- The residual loss

The principal can limiting divergences between his own and the agent's interest by investing in monitoring systems, designed to limit aberrant activities from the agent. The term monitoring expenditures includes the effort from the principal in controlling the behavior of the agent, which can be done through observations or introduction of operating rules, compensation policies or budget restrictions. The bonding expenditure is the reduction of bond value due to bondholder's beliefs about the agent's opportunistic behavior. Bonding cost can be linked to the cost of getting an outside auditor to verify the agent's claims about firm performance to the bondholders. The residual loss is the agency cost engendered by the issuance of debt. Jensen and Meckling claim that agency costs increase with firm size, due to the increasing difficulty of monitoring the agent's behavior in larger organizations.

Bebchuk and Fried (2003) show that executives have more power when: (1) the board is relative weak or ineffectual; (2) there are no large outside shareholders; (3) there are few institutional shareholders; or (4) the executives are protected by antitakeover arrangements. The increase in power due to these factors relates to an increase in ability to extract rent. Large outside shareholders and institutional shareholders result in closer monitoring of the CEO and the board, reducing rent extraction and stealth compensation, like retirement perks and executive loans.

Michal C. Jensen (1986) link agency cost to a firm's free cash flow. As firms increase profitability and generate larger portion of free cash flow, they are increasingly exposed to an agency problem. As the free cash flow increases it is more likely that the CEO will engage in empire building, low return investments and executive perks, resulting in a destruction of firm value.

The payout to shareholders through dividend or repurchase of shares reduces the resources controlled by a manager, thus reducing the manager's power. Executives might feel reluctant to pay out dividends, and want to keep excess capital in the firm even without any good investments alternatives. The manager has incentives to cause the firm to grow beyond its optimal size or destroy firm value through empire building and perks. Jensen argues that debt has benefits in reducing agency cost and can substitute dividend through leverage stock buyback. It bounds the CEO substantially more than promises of dividend and reduces the free cash flow available for spending. "By issuing debt in exchange for stock, managers are bonding their promise to pay out future cash flows in a way that cannot be accomplished by simple dividend increase (Jensen, 1986, page 324)". A leverage buyback of stock reduces the free cash flow available for spending by the manager, hence reducing the agency cost. The leverage buyout has tax advantages, but also increases cost associated with a debt increase. "The optimal debt-equity ratio is the point at which firm value is maximized, the point where the marginal cost of debt just offset the marginal benefits" (Jensen, 1986, page 324).

Berk and DeMarzo (2007) also emphasize the agency benefits of debt, and how it can reduce management entrenchment and empire building, thus increasing the firm value. Increased leverage can reduce wasteful investments by management since it will reduce the firm's free cash flow available for the CEO to spend. The possibility of bankruptcy increases with the firm's debt level, and induces increased management effort in pursuing valuable investments opposed to reckless spending on perks and negative NVP projects. Increased leverage is also followed by better monitoring by the firm's creditors, increasing the levels of visibility into the firm's management.

Jensen and Meckling (1976) determine the optimal capital structure with the objective of minimizing agency cost. As a manager sells off debt or equity to outside investors, the value of the claims decreases as the managerial ownership declines, due to the agency problem. The optimal capital structure will thus be the combination of debt and equity that minimizes this agency cost. This study is most applicable for small firms, where the CEO is a large shareholder. However, the general idea is transferable to all firms, and points out that both debt and equity are composites in an optimal capital structure. To find the optimal capital structure, the CEO's claims in the firm must be evaluated.

2.1.4 Contributions of Agency theory

Agency theory emphasizes that much of organizational life is based on self-interest and that agents are risk averse and might therefore make choices in contradiction to the principal's interests. Agency theory contributes to organizational theory in the way it treats information as a commodity that has a cost and can be purchased. Organizations can therefore invest in information systems in order to control agent opportunism. Agency theory contributes to corporate finance in the view agency cost affects the value of debt. The theory brings attention to how outcome uncertainty and an agent's risk aversion should influence the contracts between principal and agent.

2.2 Prospect theory

Prospect theory has been one of the most important theories of decision making under risk in the past decades (Fennema and Wakker, 1997). The theory proposes an alternative to the expected utility theory. As being a descriptive model for CEO utility, it gives a different description of individual decision-making under risk. Prospect theory argues that choice among risky prospects exhibit several pervasive effects that are inconsistent with the expected utility theory. The theory includes distortions of probabilities, diminishing sensitivity, and the status quo as a reference point, and therefore explains major deviations from expected utility theory, such as the framing effect and the certainty effect (Kahneman and Tversky, 1979).

In the classical utility theory, the utility of an uncertain prospect is the probability weighted sum of the utilities of outcomes. In standard applications of expected utility theory, the objects of choice are probability distributions over wealth, the valuation rule is expected utility, and the utility function that maps uncertain events and possible outcomes is a concave function of wealth (Tversky and Kahneman, 1992). The prospect theory of Kahneman and Tversky (1979) suggest two major modifications to the expected utility theory:

- The carriers of value are more appropriate to be seen as gains and losses, and not as final assets.
- The value of each outcome is multiplied by a decision weight, in contrast to the utility theory where outcome is multiplied by an additive probability.

The decision weight measures the impact of events on the desirability of prospects, and not merely the apparent likelihood of these events as the utility theory values the outcome. In prospect theory, the valuation rule is a two-part cumulative function, the value function is S-shaped and the weighting functions are inverse S-shaped.

Decision making under risk can be viewed as a choice between prospects or gambles (Kahneman and Tversky, 1979). The prospect theory distinguishes between the two phases, framing and valuation, in the choice and decision process. The framing process consists of a preliminary analysis of the offered prospects, where the different actions and its outcomes are represented. The framing process is followed up by the valuation process where the different prospects are evaluated, and the decision-maker chooses the prospects of highest value according to his preferences.

Kahneman and Tversky propose two variants of prospect theory. In these two variants, Separable and Cumulative Prospect Theory, risk attitudes depend both on the attitude towards outcomes: through a value function, and on the attitude towards probabilities: through a weighting function. As a result, a risk attitude then becomes a combination of both the attitude towards probability and the attitude towards outcomes. The two variants differ in the manner of the probability weighting function in combination with utilities (Harrison and Rutström, 2007).

2.2.1 Separable Prospect Theory

The original version from 1979, referred to as the Separable Prospect Theory, posits some weighting function which ensures the outcomes are separable. The derived value function, or the utility function, from the separable prospect theory has several clear properties.

The outcomes of risky prospects are evaluated by a value function that has three essential characteristics: reference dependence, diminishing sensitivity and loss aversion. The value function is defined on deviations from the reference point, where the reference point serves as a boundary that distinguishes gains from losses. When people respond to sensory, as well as non-sensory attributes, the past and present context of experience defines a reference point that may be dissimilar for different individuals. This indicates that the value should be treated as a function that takes into consideration the individual reference point and the magnitude of the change, positive or negative, from this point. The hypothetical value function in the prospect theory is generally concave for gains and commonly convex for losses.

Results from a student survey by Kahneman and Tversky (1979) indicate a diminishing sensitivity value function. For gains of equal difference, the perceived value difference seems to decrease as the magnitude of the gains increase, indicating that the value function is concave. Similarly, the difference between two relative small losses appears greater than the difference between two bigger losses with the same magnitude, which is consistent with the hypothesis that the value function is convex for losses. This condition reflects the principle of diminishing sensitivity, where the impact of a change diminishes with the distance from the reference point. Diminishing sensitivity therefore entails that the impact of a given change in probability diminishes with its distance from the boundary.

Additionally, a salient characteristic of attitudes to changes in welfare is that the value function is steeper for losses than for gains, indicating that people are loss-averse. This condition is implied by the principle of loss aversion according to which losses are weighted larger than gains, which results in an asymmetry between gains and losses (Tversky and Kahneman, 1986, Tversky and Kahneman, 1991).

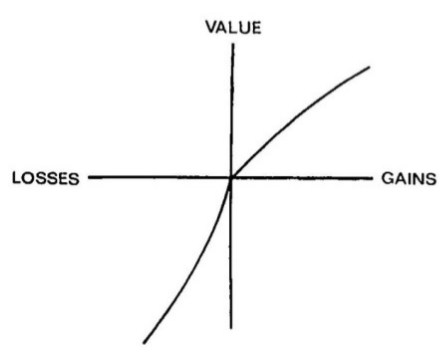

Figure 1 – Value function (Kahneman and Tversky, 1979, p.279)

The characteristic S-shaped function in Figure 1 is the value function assumed by both the separable- and the cumulative prospect theory. It has its steepest range at the reference point, which is the opposite of the value function from the expected utility theory, where the range around the reference area is relative shallow. The value function explains the framing effect which specifies that people appear to evaluate not absolute outcomes but look at outcomes in terms of gains and losses relative to a neutral reference point (Jost and Wolff, 2003). As a consequence, the value of an outcome is treated as a function of two arguments, the reference-point and the magnitude of change from that point. The analysis confines risk-seeking behavior in the domain of gains with small probabilities, and risk aversion in the domain of losses with small probabilities. Additionally, there is a nonlinear transformation of the probability scale, which overemphasizes small probabilities and underemphasizes moderate and high probabilities**.**

Three effects can be drawn out of this. (1) Phenomena effect, where people overemphasizes outcomes that are considered certain, relative to outcomes which are merely probable. This effect contributes to risk aversion in choices involving sure gains and to risk-seeking in choices involving sure losses. (2) Reflection effect, where risk aversion in the positive domain is accompanied by risk seeking in the negative domain. (3) Isolation effect, where people generally discard components that are shared by all prospects under consideration. This leads to inconsistent preferences when the same choice is presented in different forms.

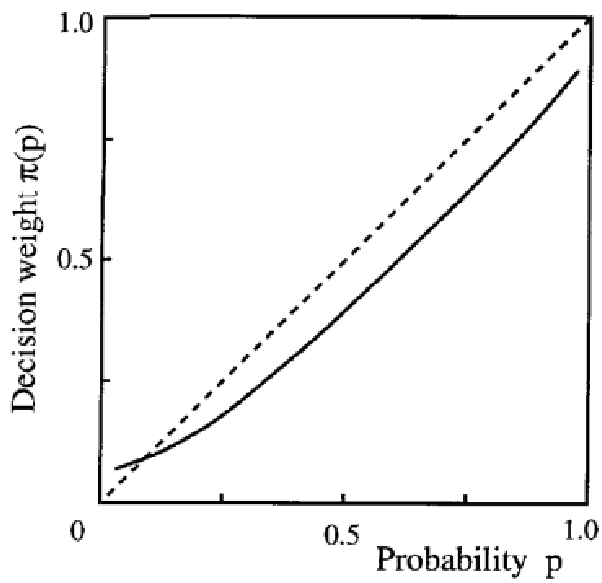

Figure 2 – Weighting function (Kahneman and Tversky, 1979, p.283)

Figure 2 shows a typical weighting function for the original prospect theory. Kahneman and Tversky (1979) find that preferences of subjects can best be modeled by a weighting function that enhances small probabilities and reduces higher probabilities. The weighting function is therefore relatively sensitive to changes in probabilities near the endpoints 0 and 1, and relatively insensitive to changes in probability in the middle region.

2.2.2 Cumulative Prospect Theory

The cumulative prospect theory employs cumulative rather than separable decision weights. The cumulative prospect theory extends the original prospect theory in several aspects. First, it is applicable to any finite prospect and also to continuous distributions. It also applies to both probabilistic and uncertain prospects and can therefore accommodate some form of source dependence. Cumulative prospect theory uses a value function with the same characteristic as in original prospect theory. However, the determination of decision weights deviates. The idea behind the decision weight in the cumulative theory is to apply a rank-dependent function separately to gains and losses, and then take the sum of the two resulting evaluations. Furthermore, the cumulative theory also allows different decision weighting functions for gains and losses. The weighting function w^+ is defined for the probabilities associated with gains, and a separate weighting function w^- is defined for probabilities associated with losses. This allows for different attitudes towards probability for gains than losses.

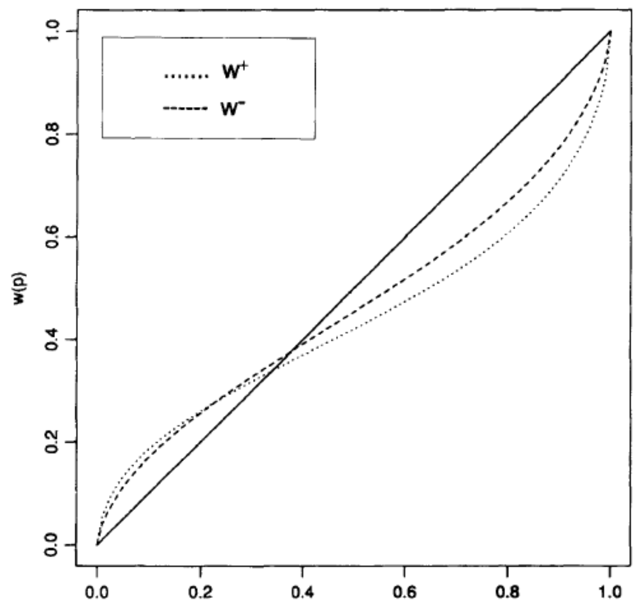

Figure 3 – Decision weighting functions (Kahneman and Tversky, 1992, p.313)

The weighting function indicates diminishing sensitivity with respect to probability changes. The function is relatively sensitive to changes in probability near the end points, but relatively insensitive to changes in probability in the middle region. The loss weighting function w^- has a much similar shape as the w^+ for gains, but it is somewhat higher and less curved. Accordingly, for moderate and high probabilities, risk-aversion for gains is more clearly than risk seeking for losses.

The key feature of cumulative prospect theory is that it permits a satisfactory modeling of diminishing sensitivity, not only with respect to outcomes but also with respect to changes in probabilities. The cumulative prospect theory highlights characteristic risk attitudes. For high probabilities, the CEO attitudes reflect risk aversion for gains and risk seeking for losses. For low probabilities, the attitudes are risk seeking for gains and risk aversion for losses. When the executive experience a gain and the probability of a larger gain is high, the CEO becomes risk averse, as the value of further gains is worth less than the loss of his initial gain. Similar, if the executive already has experienced a loss and the probability of an additional loss is high, the CEO becomes risk seeking, because further losses do not affect his utility as much as the possibility of a gain. The CEO will always aim to improve his prosperity and wealth, and he becomes risk seeking when faced with gains of low probability. This action is referred to as gambling. When he faces losses with low probability he becomes risk-averse, which explains why people buy insurance.

Probability / Outcome	High	Low
Gain	Risk aversion	Risk seeking
Loss	Risk seeking	Risk aversion

Table 1 - Risk matrix

On the subject of decision-making under risk, both prospect and expected utility theory specify the object of choice and give a valuation rule. They also specify characteristics of the functions that map uncertain events and possible outcomes into their subjective counterparts (Tversky and Kahneman, 1992). However, from these criteria we can also see that the two theories have major differences. In standard expected utility theory, risk aversion and risk seeking are determined solely by the utility function. The objectives of choice are probability distributions over wealth, the valuation rule is expected utility, and the characteristic of the function is a concave utility function of wealth. From the empirical evidence framed by Tversky and Kahneman, the prospect theory rises from the results that the objects of choices are prospects formulated in terms of gains and losses. The valuation rule is a two-part cumulative function, where the value function is S-shaped and the weighting function is inversely S-shaped. Risk-aversion and risk seeking are determined jointly by the value function and by the cumulative weighting functions.

Tversky and Kahneman (1992) indicates that, for even chances to win and lose, a prospect will only be acceptable if the gain is at least twice as large as the loss. However, the reference point in the value function that distinguishes gains from losses will be individual. What an executive will weight as loss and gains will be decided through his preferences and utility. As a result, the prospect theory presents a different view of the agent's utility, assuming a more loss-averse behavior. The value function is steeper for losses than for gains, indicating that people are more risk averse than the expected utility theory implies. The prospect theory's view of a concave utility function for gains and convex utility for losses, results in a marginal motivation provided by tangible rewards as a declining function. According to cumulative prospect theory, there is a tendency to gamble when a loss is certain and a tendency to becoming risk averse when facing a certain gain.

2.3 Preference under risk

Individual decision-making under uncertainty involves a subject evaluation of risk. Individual preferences affect the rationality of human decision-making. Initial wealth, assessment of risk and fear of loss affect an individual's risk-taking. When assessing the outcome of a situation, individuals' reference point separate what is perceived as loss and gain. In the following sections we discuss the impact of risk-aversion, loss-aversion and reference dependency on decision making under risk.

2.3.1 Risk aversion

Risk-aversion is a well-known concept used in explaining human behavior while exposed to uncertainty. Risk aversion helps explaining financial investment behavior, like why investors still invest in bonds rather than stocks even when the equity premium for stocks have been considerably higher than for government bonds (Shiller, 1998). Risk-aversion affects the utility from receiving a monetary reward. Figure 4 presents a general interpretation of individual risk preference.

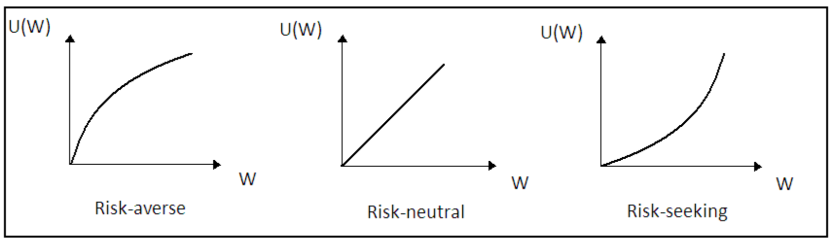

Figure 4 - Utility of wealth

Risk-aversion is the reluctance of a person to accept a bargain with an uncertain payoff rather than another alternative with more certain but possibly lower expected payoff. A person is defined as risk-averse if he, starting from a position of certainty, is unwilling to take a bet which is actuarially fair considering the payoff and underlying risk (Arrow, 1974). Arrow describes the properties of risk-aversion through utility and wealth. If U(W) represents the total utility of holding wealth W, then U'(W) represents the marginal utility of wealth and U''(W) represents the change of marginal utility with respect to wealth. Arrow (1974) defines two measures of risk aversion, absolute risk-aversion and relative risk-aversion:

Absolute risk-aversion	$R_A = -\frac{U''(W)}{U'(W)}$
Relative risk-aversion	$R_R = W\,R_A = -W\frac{U''(W)}{U'(W)}$

Figure 5 – Measurements of risk-aversion

The relative risk-aversion is defined as the elasticity of the marginal utility of wealth. The higher the curvature of U(W), the higher is the risk-aversion. While relative risk-aversion is increasing with executives' wealth, the absolute risk-aversion is a decreasing function of wealth Arrow (1974).

The most straightforward implication of increasing or decreasing absolute or relative risk-aversion and the impact of initial wealth, occur in the context of forming a portfolio of risky and risk-free assets. If a person experiences an increase in wealth, he will choose to increase the hold of risky asset held in the portfolio if absolute risk aversion is decreasing. The assertion of increasing relative risk aversion is that if both wealth and the size of the bet are increased in the same proportion, the willingness to accept the bet as measured by the odds demanded should decrease (Arrow, 1974). In an agency setting, it is broadly permissible to assume that relative risk aversion for an executive decreases with outside wealth and increases with the degree of wealth related to the firm stock price.

Both measures for risk-aversion are useful in different contexts, though the relative risk aversion appears to be the more useful of the two for evaluating agency problems. Most agency models assume the agent has a constant relative risk-aversion (CRRA). Constant risk-aversion implies an isoelastic utility function or a power utility function, where the elasticity of the marginal utility of wealth is constant. The implication of CRRA is the independency of initial wealth. This makes it possible to compare risky bets for individuals with different initial wealth as the demand for risky assets is linear to his wealth. If the CEO experiences CARA, his preference over risky assets is unaffected by changes in wealth (Quiggina and Chambers, 2004).

2.3.2 Loss aversion

Loss aversion is a central assumption saying that losses and disadvantages have greater impact on preferences than gains and advantages. An immediate consequence of loss aversion is that the loss of utility associated with giving up a valued good is greater than the utility gain associated with receiving it. Empirical evidence indicate that there is a large disparity between the minimum amount people are willing to give up of a good, and the maximal amount they are willing to pay to acquire it. Thus, the reluctance to sell is much greater than the reluctance to buy (Tversky and Kahneman, 1991). Loss-aversion is represented as an explanation on this endowment effect, which is a discrepancy between buying and selling prices. The retention of the status quo is an opportunity in many decision problems, and as a result, loss aversion induces a bias that favors the retention of the status quo over other outcomes.

In its simplest form, loss-aversion is applied to all negative departures from the status quo; however, Novemsky and Kahneman (2005) believe that loss-aversion operates on benefits rather than on attributes of goods. Goods with different attributes that provide the same benefits can be exchanged without a feeling of loss-aversion. The coding of outcomes as gains and losses will thus depend on the agent’s intentions and not only on the objective state of affairs at the moment of decision. A key idea is that exchange goods that are given up as intended, like giving up money in purchasing goods, do not exhibit loss aversion.

2.3.3 Reference dependence

Experimental evidence indicates that decision-making depends on individual reference points, may it be the status quo or a dynamic reference level. Changes of reference point often lead to reversal of preferences because a shift of reference can turn gains into losses and vice versa. Reference-dependence means that people do not evaluate final outcomes but instead base decisions on gains and losses relative to a reference point. The standard utility models of decision making often assume that preference do not depend on current reference point. This assumption greatly simplifies the analysis of individual choice. However, there is substantial evidence indicating that initial entitlements do matter and that the rate of exchange between goods can be quite different depending on who is acquiring and who is giving up the goods. Reference levels play a large role in determining preferences (Tversky and Kahneman, 1991). Empirical facts supporting reference-dependence comprise diminishing sensitivity and loss aversion. Empirical results indicate that the overweighting of small and the underweighting of large probabilities in prospect theory changes with increasing status quo (Schmidt, 2001). Unlike original prospect theory, other variants like cumulative prospect theory have been derived from behavioral foundations in terms of preference conditions.

Schmidt and Zank (2010) criticize cumulative prospect theory as allowing the reference-dependence of preferences be imposed beforehand, letting the location of the reference point be exogenously determined. Prospect theory assumes the existence of a preference relation defined on gains and losses relative to an exogenously fixed reference point, and then imposes reference-dependent preference relation. This means that reference-dependence is not derived from preference conditions but assumed beforehand. For prospect theory to become valuable for economic analyses, the model needs a theoretical foundation of how to perceive the reference point from preferences. According to the previous models of prospect theory there are two criteria that can be used to identify the reference point, diminishing sensitivity and loss aversion. Schmidt and Zank (2010) focus on diminishing sensitivity and introduce a framework where the reference point is located at the position at which sensitivity towards changes in outcomes is at its maximal. Thus, reference-dependence is derived from a preference condition and a unique reference point is set endogenously which give flexibility for analyzing behavior.

There are several other ways to define the reference-point, which will affect the subjective value a manager attaches to his compensation portfolio. Köszegi and Rabin (2007) assume that a person's reference point is the rational expectations about the relevant outcome the manager hold between the time he first focused on the outcome and shortly before it occurs. Jost and Wolff (2003) defines the reference-point for valuing options as the Black and Scholes value at the time of grant plus the risk-free interest earned on this amount during the option period. Dittmann and Maug (2010) state the reference income as the expectations the executive forms based on his previous year's compensation package, where the executive regards total compensation below the fixed salary of the previous year as a loss.

De Meza and Webb (2006) define both exogenous and endogenous formulations of reference income. With exogenous reference income, earnings in earlier periods determine whether current income is satisfactory. The reference income reflects an accustomed standard of living and hence the executive's income history matters, but the reference income is exogenous in the current period. The endogenous reference income is forward looking and depends on the distribution of outcomes, with losses achieved if the executive does not perform as well as expected. Executives will thus define gains and losses according to whether the outcome is better or worse than anticipated. Both the actual outcome and the unattained outcome affect the executive's satisfaction of his payoff. As a result, one possibility is to define the reference income as the certainty equivalent of the income distribution. De Meza and Webb interpret the idea that when defining the reference point the focus should be on the probabilities of the different outcomes, and not on whether utility is below the expected level or not. That is, there is no disappointment in not achieving an income that has low probability, whereas losses are experienced when one fails to beat the odds. As a solution to this problem, de Meza and Webb propose an interpretation to determine the reference income by relating it to the median of the income distribution.

Several researchers have noted that the reference point may to some extent be influenced by expectations; however, numerous models either equate the reference point with the status quo, or leave it unspecified. Disappointment-aversion as one of the most central effects from prospect theory, come closest to saying that the reference point is influenced by recent expectations (Köszegi and Rabin, 2007). Dittmann and Maug (2010) show that higher reference income lead to a higher dismissal probability and to lower pay-for-performance sensitivity on the job. The executive's personal reference point is therefore an extremely important factor in determining the optimal incentive contract.

2.4 Motivation theory

As a supplement to the agency theory and prospect theory, motivation theory can bring about new aspects to how a CEO's motivation is affected by rewards presented by the principal, and how his motivation further affects his performance. The nature of motivation concerns all aspects of activation and intention. Thus, motivation is highly valued, and it is therefore of preeminent concern for shareholders, whose interest involves mobilizing executives to act, and trying to motivate to highly performing managers. As a result, motivation has been a central and perennial issue in the field of executive compensation, since it is at the core that motivation produces.

Maslow, Alderfeld and Herzberg are considered classical theories in organizational behavior and motivation theory (Bolman and Deal, 2004). The basic hierarchy of needs by Maslow is one of the most fundamental motivation theories through time. He presents five main types of needs in a strict hierarchy: physiological needs, safety needs, social needs, needs for self-esteem and self-realization. A more modified approach by Alderfer opposes with this strict setup, and argues that individuals have different ranking of needs, and hence some individuals choose to satisfy higher order needs at the expense of the more basic needs. Needs can be ranked at the same level and thus active at the same time, further, it is personal whether an individual move upward as well as down the hierarchy (Bolman and Deal, 2004). Herzberg presents the principle of separation between motivation factors and hygiene factors. The theory is often referred to as the two-factor theory, where Herzberg produces a list of factors that contribute to satisfaction at work (motivation factors), and a different list of factors (hygiene factors) that contributes to dissatisfaction if they are non-existing in the worker's environment (Miner, 2005). The list of motivation factors consist of properties like achievements, acknowledgment, involvement, responsibility and autonomy, promotion and continuously personally growth. This paper focus the attention purely on executives, who can be assumed to have all his basic needs fulfilled. Therefore, further on the main focus will be based on theories concerning higher order needs.

A highly motivated individual will have an inherent tendency to seek out novelty and challenges, to extend his capacity, to explore and to continuously learn, all resulting in a greater enhanced performance and persistence (Ryan and Deci, 2000b). Hence the degree of motivation a manager holds can have a significant effect on the overall firm performance in the underlying company. Seeking to induce higher motivation through incentives can thus be one of the main subjects shareholders face to maximize firm performance. The difficulty in implementing motivating factors is that motivation is not a unitary phenomenon. Understanding motivation is complex because it not only differs in amount or level, but also different kind of motivation between individuals. That is, the orientation of motivation concerning the underlying attitudes and achievements that give rise to the action.

2.4.1 Intrinsic motivation

The literature concerning motivation often distinguishes between intrinsic and extrinsic motivation. However, whether a factor is perceived as intrinsic or extrinsic is highly subjective, depending on the individual attribution process. Intrinsic motivation is defined as the purpose why individuals do activities for its essential satisfaction and act for the fun or challenge entailed, rather than for some separable result like pressure, rewards or external consequences. Internal rewards are intangible and can be feelings like satisfaction and pride of the work, a strong belief in what is being accomplished, or the sense of making a significant difference or feeling helpful towards other individuals or organizations (Thomas, 2000). The importance of intrinsic motivation is reflected through the idea that it is through acting on his own inherent interest that an individual grows in knowledge and skills (Ryan and Deci, 2000). An intrinsic motivated person is an active curious, inquisitive and playful individual, displaying a ubiquitous readiness to learn and explore without requiring extraneous incentives to go through with the action. Overall literature has based the phenomenon of intrinsic motivation on the free choice measure, and the use of self-reports of interest and enjoyment of the underlying activity. Intrinsic motivation in an important construct in understanding the natural human eager for personal development through learning and assimilating new expertise and knowledge.

Normative intrinsic motivation refers to a desire to live up to the organization's norms and values, often as a result of the employee's identification toward the organization (Kuvaas, 2008). It is therefore important to ensure internal motivated job design and enhance the psychological and social bonds between management and owners that gives the management an incentive to make an extra effort, so-called normative intrinsic motivation.

Kenneth W. Thomas (2000) distinguishes between four intrinsic rewards that make work more energizing and fulfilling. These energizing emotions should be achieved and maintained through the working process.

- A sense of competence from performing work activities well:
  The feeling of pride, and a belief that what the person is doing is high-quality work.

- A sense of purpose or meaningfulness:
  The feeling of pursuing a worthy purpose or a valuable mission, which will result in a strong commitment to the task.

- A sense of ownership and responsibility:
  The ability to choose how tasks are performed and the feeling of using own judgment in carrying out the task. Personal views and insights matter, which leads to a feeling of ownership for the task and responsibility for the outcomes.

- A sense of progress:
  The feeling that time and effort are paying off, which results in enthusiasm and eagerness to keep investing energy into the task.

These emotions are psychological vital signs of intrinsic motivation. When achieving these rewards of intrinsic motivation you genuinely care about the work, always look for better ways to do it, and are enthusiastic and energized by doing it well. For intrinsic motivation to be effective, it is important to be able to find the task meaningful, and be able to identify oneself with it. According to Thomas, work autonomy and feedback is also important factors leading to intrinsic motivation.

The result of enhanced intrinsic motivation can be summarized in the following points (Kuvaas, 2008):

- Individuals will work harder as a result of greater involvement, commitment and engagement due to a high degree of job autonomy and self-management.
- Individuals will work more responsibly since the responsibility is delegated over to them.
- Individuals will work smarter as a result of an encouragement to develop their skills and expertise.

Highly intrinsically motivated executives require less compensation for high performance when they are autonomous and find the job meaningful. It is therefore essential to intrinsically motivate executives.

2.4.2 Extrinsic motivation

In contrast to intrinsic motivation, extrinsic motivation requires an instrumentality between the activity and some separable outcome or consequence, such as tangible or verbal rewards. With extrinsic motivation the satisfaction comes not from the activity itself but rather from the extrinsic reward to which the activity brings forth. When externally motivated, individuals act with the intention to obtaining a desired consequence or avoiding an undesired result. They are thus energized into action only because the action is instrumental to a goal or an end.

Ryan and Deci develop an Organismic Integration Theory, OIT, explaining different forms of extrinsic motivation. The main focus is on the relative strength of autonomous versus controlled extrinsic motivation (Ryan and Deci 2000). Whereas autonomous motivation assists effective performance and well-being, controlled motivation on the other hand can undermine these outcomes. One can experience extrinsic motivation but still have a personal endorsement and a feeling of choice, or an individual can experience situations which involve mere compliance with an external control which result in less job autonomy. Higher autonomous extrinsic motivation is associated with greater engagement, higher quality learning, better performance, reduced chance for dropping out and a greater psychological well-being. The theory explains different degree of extrinsic motivation and the context in which the different forms come about, and the way in which extrinsically motivated behavior is been regulated into a person's behavior. It posits autonomy dependency to describe the degree of extrinsic motivation to which an external regulation has been internalized and integrated with the person's own goals and identity.

The theory defines four different types of extrinsic motivation:

- Externally regulated behavior:
  The least autonomous motivation is referred to as the externally regulated motivation. Behavior is performed purely to satisfy an external demand or reward contingency. This action is characterized as having an externally perceived locus of control.
- Introjected regulation of behavior:
  A regulation is introjected if it has been taken in by the individual but has not been fully accepted as his own, and the regulation is thus controlling the person. An example is self-esteem, where an individual feel motivated to demonstrate ability to maintain self-worth. Although this is internally driven, Deci and Ryan argue that introjected behavior is on an externally perceived locus of control because it is not perceived as part of oneself.

- Identified regulation of behavior:
  A more autonomous form of extrinsic motivation is regulation through identification. With identified regulation, the individual has a greater feeling of freedom and desire because the behavior is more in agreement with own personal goals and identity. Thus a person will feel relatively autonomous while performing the task even though the activity is not itself intrinsically interesting. This involves to consciously valuing a goal or regulation in the way that the specific action is accepted as personally important.

- Integrated regulation of behavior:
  The greatest type of autonomy comes from the integration of regulations. This behavior occurs when regulations are fully assimilated with oneself in the way that they are included in a person's self-evaluations and beliefs of own needs. This induces a sense that the behavior is an integrated part of the individual's personality. However, integrated regulations are still considered extrinsic motivation because the motivation is characterized by the activity being instrumentally important for personal goals. This differs from intrinsic motivation where the individual behaves completely out of interest in the underlying activity.

Extrinsically motivated behavior can thus be internalized into self through integration, the process of taking in a value or a regulation. In addition to autonomy, extrinsic motivation concerns the individual's perceived competence. An individual will more likely internalize and integrate an extrinsic goal as his own if he understands it and has the relevant knowledge and skills to succeed at it. A feeling of competence can let an individual adapting an extrinsic goal to his own if he feels efficacious with respect to it. The more the action has been internalized, the more autonomous will the extrinsically motivated behavior be. Thus, individuals will naturally strive to fulfill two basic needs: the need for competence and the need for self-determination. To enhance motivation, people must experience both perceived competence and a feeling that their behavior is self-determined. Increasing internalization and its sense of personal commitment increases persistence, better quality of engagement and a more positive self-perception (Ryan and Deci, 2000).

The different types of external motivations are results from parameters like individually differences and the social environment, like the job and the work climate which can be characterized as autonomy supportive, controlling or demotivating. Research have shown that as extrinsic motivation become autonomous, it can result in the same value creation parameters as intrinsic motivation induce, like high performance, trust, commitment, satisfaction and well-being in the work climate.

Like the theories of needs by Maslow, Alderfer and Herzberg, the motivation theory by Thomas and the self-determination theory use a concept of psychological needs and states that satisfaction of these needs will result in greater and effective performance, as well as a higher well-being. Similar to the theory of Herzberg, Thomas and SDT focus on the importance of autonomous in a person's working climate to induce high motivation toward the task or activity.

Over the long run, people need intrinsic rewards to continue with high quality work and perform their best at all time. Extrinsic rewards are also important, however, they are never enough to keep a worker at his best over a longer time period. People in the academic field should not be surprised by the effect intrinsic motivation has on the job performance. Few academics who engage in research do this activity to capture the incentive payments associated with the publication of a paper. The high productivity and quality of research cannot be explained by the basis of incentive payment alone, rather it is because of their intrinsic motivation that they value research output independent of its extrinsic reward.

With pure extrinsic motivation, the focus is on the reward rather than the work itself and the executive will only work hard enough to get the compensation. For this reason, there is a need for intrinsic reward to recruit and hold on to a great CEO. High intrinsically-motivated executives are energetic and passionate in relation to their job. They look at the job as an opportunity to make a difference and believe in what they are doing. They work for people other than themselves, and realize that what they do has a great significance for others. They find satisfaction through well-conducted activities, and are proud of innovation and creative thinking. High payment is not the reason for doing a good job. As a result, high intrinsically motivated executives often include their job in leisure time, and the challenge will be to set the limit for involvement in the job. The economic conditions are therefore not essential when the job is done, and does not itself explain the quality of the work performed.

In general, intrinsic rewards as a source of good performance seem to be the most effective motivation for tasks where quality, comprehension, learning, creativity and development are more important than quantity (Deci 1999). For top management in knowledge-intensive organizations, the tasks will require independent work, initiative and commitment. This is in turn dependent on more passion and satisfaction than the external rewards can contribute (Thomas 2002). In such situations intrinsic motivation is highly valued, and is an important driving force for great performance. It is therefore vital to understand the underlying concept and the condition that fosters both intrinsic and extrinsic motivation and their value to the executive's actions. An understanding of the interaction from compensation payment on extrinsic and intrinsic motivation will be necessary to bring forth a high performing manager.

2.5 Optimal compensation related to motivation, agency and prospect theory

In the agency theory, a main assumption is that extrinsic incentives are necessary to increase an individual's effort: without extrinsic incentives the effort is at the lowest possible level (Kreps, 1997). However, motivation theories argue against this view when the underlying activity is already intrinsic motivating. If intrinsic motivation lets an employee undertake some level of effort without receiving extrinsic rewards, the effort will reflecting his enjoyment of the task independent of a reward. However, if extrinsic motivation is put in place, the employee will link his effort to those incentives, and will only enjoy his work in the absence of the extrinsic incentives. A well-established norm in the general motivation theory is that use of extrinsic rewards to motivate work behavior can be destructive to intrinsic motivation. Extrinsic rewards can therefore have negative consequences for performance, leading to reduced levels of performance- and quality-weighted effort and lower the net profit (Kreps, 1997). Not only tangible rewards but also pressure through competition, threats, imposed goals, deadlines and directives diminishes intrinsic motivation because individuals experiences them as controllers of their behavior and therefore reduces their job autonomy (Ryan and Deci, 2000).

However, Deci et al (2000) show that tangible rewards will not undermine intrinsic motivation if rewards are given independent of specific task engagement, which is the case when awarding through fixed salary, or when rewards are not anticipated like unexpected bonuses or other tangible gifts. In addition, if rewards are contingent on high-quality performance and the interpersonal environment are supportive rather than pressuring, tangible compensation enhances intrinsic motivation relative to no rewards and no feedback. A tangible reward prove to be beneficial if the reward convey information about a person's ability or competence, leading him to believe that he is personally responsible for his own behavior, or if the reward promote the acquisition of new skills, which are necessary for the apprehension of intrinsic interest in the underlying activity (Kunz and Pfaff,2002). Although extrinsically motivated behavior is instrumentally induced, external regulations may enhance competence and self-determination when integrated. An optimal pay for performance compensation will reflect the value creation an executive brings to the firm and thus convey the executive's competence and effort put in the work. Thus compensating the executive with performance-based reward, extrinsic reward need not be detrimental to intrinsic motivation, rather it can represent opportunities to enhance intrinsic motivation when used correctly.

The analysis of Eisenberger et al (1999) brings forth an assessment that executives might view the pay-for-performance compensation as an opportunity to carry out the job in their own way. This can further be an indication that the firm trust the CEO's judgment, competence and loyalty. A performance-based compensation should therefore increase apprehended autonomy, which in turn will raise the perceived intrinsic motivation. Confronted with performance-based payment, an executive can, if he wishes, decline the reward through not taking the action as requested. Thus, performance-contingent compensation might increase experienced self-determination, thereby further enhancing intrinsic motivation. Eisenberger et al suggest that rewards depending on high performance may increase the executive's belief in own ability and competence and in addition an increased perceived self-determination, all resulting in higher intrinsic motivation.

Executive compensation depending on close supervision and detailed rules are often not possible, and shareholders need an executive who is highly self-managing and hard-working. Self-managing requires more initiative and commitment, which rely on deeper passion and satisfactions than extrinsic rewards can offer alone. Therefore, executives need to be motivated not only by extrinsic rewards, but also by intrinsic rewards to perform well over a longer period of time. Performance pay gives shareholders the possibility to reward quality of performance which will enhance perceived competence, and will in turn result in increased intrinsic motivation. The findings of Eisenberger et al (1999) suggest that reward for high performance has this incremental effect on intrinsic motivation. Expectation of rewards correlated with high performance lead to greater perceived self-determination, attracting the interest of individuals who have a high desire for autonomy and control (Eisenberger et al, 1999).

Another advantage using performance-based reward is the fact that typically tasks for executives are ambiguous, and creativity is often valuable, making it hard for the shareholders to say ex ante what should be done. Hence, pay-for-performance incentives give shareholders the possibility to give opportunistic responses to contingencies that arise, and will therefore be better than rewards specified beforehand. Compensation that is performance-based can improve the agent's self-esteem or intrinsic motivation, because of a different learning effect compared to ex-ante compensation (Bénabou and Tirole, 2003). The executive can feel that a performance-based compensation is used because the task is considered difficult and to manage to complete it, requires him to use his talent, thus increasing his self-confidence and feeling of self-actualization.

According to agency theory, the composition of the equity holders in a firm is vital in controlling the agency costs. As Bebchuk and Fried (2003) finds, firms without large controlling shareholders and efficient boards are likely to endure higher agency cost due to increased managerial power and ability to extract rent by the CEO. This leads the shareholders of large firms to increase the pay for performance compensation, especially in uncertain environments. When shareholders use outcome-based contracts to induce effort incentives and to solve the agency problem, the executive might feel more responsible for the outcome of his work. The delegation of responsibility from shareholders to the executive is in the agency theory viewed as an increased risk for the CEO, something negative he must be compensated for. Motivational theory has a different view and links this to intrinsic motivation. According to this theory, delegation leads to task ownership and feeling of increased sense of purpose and commitment to the outcome. While the compensation for the increased responsibility is linked to extrinsic motivation, the delegation in itself can lead to intrinsic motivation. The agency theory focuses on tangible rewards to compensate the executive, and less on the emotional rewards through intrinsic motivation. However, the work in itself can be a source of intrinsic motivation with the psychological rewards the executive gets from the accomplishments of his job. This however will depend on the executive's initial motivation, and the degree of extrinsic versus intrinsic reward the activity brings. In addition, the delegation of responsibility from shareholders to the CEO can also fulfill the executive's need for power, both personal and institutional, and can therefore be an additional source of motivation.

A performance-based contract seems to be the best alternative for an executive. The required level of self-management and responsibility for a CEO makes this contract preferable. The difficulty of monitoring a CEO and the mistrust it signals, also points towards this contract form. The sum of extrinsic and intrinsic motivational rewards is high for outcome-based contracts, thus making it a natural choice. For the CEO to act in the interest of the owner, it is essential to reduce his risk aversion by giving him incentives to take risk on behalf of the owners. The prospect theory's view of a concave utility function for gains is in line with the extrinsic motivational theory, where the marginal motivation provided by tangible rewards is a declining function. Further, as prospect theory and agency theory state, the cost related to the creation of incentive in the contract will be determined by the level of the CEO's risk aversion. Thus, making the decision of the optimal compensation contract relates both to the degree of risk-aversion and the need to induce high motivation to give optimal effort-incentives for the CEO. The following chapter will present the different pay-for-performance incentive contracts available for a CEO.

3. Incentive contracts

From a traditional agency-theory framework, an efficient contract is defined as one that maximizes the net expected economic value to shareholders, after transaction costs and payments to the employees. An optimal contract is one that minimizes the agency costs. Through compensation plans the executive is given incentives to increase his performance, leading to a reduction of agency costs and higher firm performance. Executives are given variable compensation and incentives through three primary mechanisms (Core et al, 2003):

- Total flow compensation, which is the total of the CEO's annual salary, bonus, new equity grants, and other compensation
- The compensation from changes in the value of the CEO's portfolio of stock and options
- The potential increase/decrease in the value of the CEO's human capital. This value will decrease if the CEO gives a poor performance in his job, and might induce a dismissal effect for which the CEO will fear for losing his job

The total flow compensation consists of a fixed and a variable part. The fixed part of the salary is a guaranteed payment, while the variable part can be a monthly or yearly bonus based on an assessment of his or the firm's performance (Kuvaas, 2008). The fixed payment scheme is usually linked to the CEO's relevant experience, seniority and required competence, the number of employees, job responsibility, firm risk and task complexity (Nordhaug, 2003).

Dissimilarities in the fixed salary depend on at least five factors (Barringer and Milkovich, 1998):

- Work design: Title, assignments and responsibility
- Employer: Special field, education, experience and age
- Market: Payment varies in different markets
- Country: Payment levels varies between countries
- Organization: Industry and business sector have different norms for payment

The variable payment in an executive's compensation has two concrete functions, selection effect and changing the CEO's behavior. The selection effect comes from attracting and holding on to great CEOs and removing CEOs that do not live up to the company standards. The risk involved in the variable payment makes the job more attractive for people with lower risk aversion and that have sufficient qualifications to meet the required expectations (Colbjørnsen, 2000).

The change of the CEOs behavior brought on by the variable pay can be divided into direct and indirect incentive effects. The direct incentive effect is often supposed to be both explicit and objective, while the indirect effect might be implicit and subjective. The purpose of the direct incentive effect is to reward desired behavior and induce increased effort and efficiency. Result-based individual bonuses are assumed to give the greatest direct incentive effect, giving undisputable measurement of performance, compared to subjective measurements. It makes it easier for the CEO to see the link between own effort and reward. The indirect incentive effect is related to the setting of the fixed payment. A high fixed payment results in increased loyalty and psychological ownership towards the organization, increasing CEO effort and efficiency

(Kuvaas, 2008). The prospect of an increase in the fixed payment for the next period leads to an indirect intrinsic effect.

The aim for many organizations is to implement a reward system that induces both direct and indirect incentive effects, attracting and keeping good CEOs and creating psychological ownership towards the firm (Kuvaas, 2008).

The measurability of the variables that estimates the CEO's performance is the most important consideration for a firm when selecting an incentive contract. Based on different performance measures, incentive contracts can be divided in four categories:

- Result-based incentive contracts
- Contacts based on objective assessments
- Contracts based on subjective assessments
- Market based contracts

The contracts have different areas of application and different pros and cons. The choice of contracts is determined by the type of company, industry and organizational objectives.

3.1 Result-based incentive contracts

Result-based contracts reward the CEO based on measures from the firm's financial statements. The company chooses which accounting variables it will use to measure the performance of the CEO and how they will weigh the reward based on these variables. The chosen variables should align the CEO's interest with those of the shareholders. The most used accounting variables are return on investment (ROI), return on equity (ROE), return on asset (ROA), return on sale (ROS), earnings per share (EPS), residual Income (RI) and economic value added (EVA). It is important to choose a variable that the CEO can affect, that provides value to the shareholders and is easy to measure and control. The result-based incentive contract gives clear and objective goals that align the interest of the CEO and the owners. However, the use of result-based incentives may induce the CEO to short-sightedness, improving the short-term results and reducing long-term profitability by avoiding future-oriented investments. It can also lead to manipulation by the CEO, decreasing amortizations and changing the periodization of income and expenses to increase his own payoff (Zhang et al, 2008). For example, CEO's who have little chance of reaching the performance target necessary to earn the bonus this year, push profits into the next period in an attempt to increase the possibility of achieving future bonus (Hall and Knox, 2002).

3.2 Contracts based on objective assessments

This contract rewards the CEO based on objective and quantifiable goals. Examples of this can be market share, customer's satisfaction and product quality. The contract will give the CEO clear indication of action and decision criteria that are easy to understand and relate to. Goal achievement can easily be set when targets can be quantified. A disadvantage is that it typically takes 20-30 key performance indicators to cover all aspects of the CEO's function. In addition, there might be a problem in quantifying all the relevant result dimensions and making sure the CEO focuses on all aspects. The CEO might focus his effort only to the key indicators, and non-quantifiable aspects of running the firm may be left in the background. Not all objective measures, like market share, capture the profitability of the firm and reflect the shareholders' interest. High focus on such areas might even reduce shareholder return.

3.3 Contracts based on subjective assessments

The board decides the reward based on a subjective evaluation of the CEO's performance. The board must assess the CEO's effort and what value he has for the firm. A benefit with a subjective contract is its ability to intercept aspects of the CEO's behavior that affect the organization in ways that an objective contract cannot perceive. When the CEO is rewarded based on the observations of the board, it increases the indirect incentive effect, resulting in improved loyalty, trust, cooperation and innovation (Baker et al, 1994). However, if it is difficult to monitor the CEO's behavior, this type of contract can lead to increased CEO rent extraction.

A benefit of the incentive contracts with a subjective assessment of the CEO's performance is the ability to capture non-quantifiable aspects of the CEO's performance. An important aspect for achieving good results through the use of subjective measures is a high level of trust between the CEO and the board making the subjective evaluation. The disadvantage of basing compensation on subjective variables is the difficulty associated with assessing a fair judgment of the CEO's performance. CEOs may tend to overestimate their own performance (Colbjørnsen, 2000), and may not trust that the observer has the right basis to conduct a fair assessment. If the CEO feels the evaluation differs from his expectation, it can lead to a decline in his motivation and thereby firm performance. Therefore, an important assumption is trust between the executive and the supervisors if subjective performance assessment systems are to be successful (Baker et al, 1993). While an objective contract can be enforced by a court, a subjective contract cannot, and is thus vulnerable to default by the firm. However, the notion of trust in performance evaluation should be enforced by the firm's concern for its reputation in the labor market. Overall, as it is difficult to monitor all aspects of the CEO's performance, unless the firm consists of very active owners, incentive contracts based on subjective assessments is less suitable for chief executives.

3.4 Market-based incentive contracts

Over the last decade, equity-linked compensation plans has increased as a proportion of managers' compensation. Equity-linked compensation might mitigate agency problems between shareholders and self-interested managers by tying pay directly to stock-price appreciation and thereby align managers' incentive with those of shareholders. A widely used argument for equity-linked compensation is that "managers tend to think like owners only by becoming owners"(Meulbroek, 2001, page 7).

A market-based incentive contract is very suitable for companies traded in efficient capital markets, where the market gives a good indication of the real firm value. This is typical for corporations listed on the stock exchange. The relationship between the CEO's compensation and the market value of the firm represents the highest alignment of interest among the CEO and the owners. A way of aligning the interest is to reward through stocks or options, and in that way tying the CEOs reward with the value creation for the shareholders. Owners and investors find it positive that CEOs are willing to accept part of their payment being linked to the stock value. They believe this to be a sign of intrinsic value in the firm, and that the CEO has confidence in the firm and own performance.

For a publicly traded company the stock price is a good measure of the firm performance, which the owners want to maximize. The advantage of a market-based incentive contract is the objectivity of the stock price as a measure of company performance through the effect of the CEO's actions. An important assumption is that the market price of the company gives a rational reflection of the company value. When the market fails in assessing the true market price of the company, or when the market is subjected to an economical up- or downturn, the reward can represent a misleading assessment of the CEO's performance (Colbjørnsen, 2000). Thus, a disadvantage with the market-based contract is the possibility that the development in the firm value can be caused by trends in the economy and not by the CEO's performance. This represents a systematic risk for the CEO, as his reward can be affected by factors outside his control. Because the executive is unable to control all the variables that influence a firm's stock price performance, there will be some form of randomness that will enter his payment. This represents a risk for both the executive and the shareholders, since equity-based compensation rewards or punishes managers for all movements in the stock, regardless of the source of such movement.

3.4.1 Option compensation

The great rise in CEO compensation during the 90's is mainly due to the increased use of options. The main argument in favor of stock option plans is that they give executives incentive to act in the interests of shareholders, by providing a direct link between realized compensation and company stock price performance. Options link the reward to the development in the stock price, aligning the interest of the CEO and the owners. The impact of the CEOs decisions greatly affects the markets assessment of the company, thus options give the CEO incentives to make value maximizing choices for the firm. In addition, using equity-linked compensation cause increased managerial risk-taking and this can moderate problems with executive risk aversion.

Stock option compensation induce a selection effect through attracting highly motivated and entrepreneurial employees who believe they can increase company stock prices and thereby earn a profit from the receiving options. The expectations of potentially large rewards for good performance through options can make firms an attractive employer even though the fixed salary is low. Firms in growing markets, recently established firms and firms where direct monitoring is difficult, award managers more frequently with options (Hall and Murphy, 2003). Offering options in lieu of cash compensation lets companies obtain employment services without directly expending cash. The companies are effectively borrowing from employees, receiving employment services today in return for highly variable, and often nonexistent, payouts in the future.

In addition, options provide retention incentives in the way that they are typically structured so that only employees who remain within the firm over a fixed period can benefit from them. These retention incentives are high in a bull market, where stock prices rise above the exercise price and workers find it advantageous to stay with their current employers. However, in a bear market, stock prices will fall below the exercise price, and if the firm does not offer to lower the exercise price or grant new options, workers might leave their current firm to join a competitor offering a fresh compensation package.

Sanders and Hamrick (2007) examines the effect of option and stock pay with regards to managerial risk-taking. The most important finding in the study is that executive stock option pay is significantly positively related to three investment measures: R&D investments, capital investments and acquisition investments. This implies that high levels of stock options trigger high levels of investment spending in uncertain categories. In other words, option loading of the CEO's induces larger risk taking. The findings by Barron and Waddell (2008) indicate that firm size and R&D expenditure determine the use of stock options. Larger firms where the magnitude of a CEO's decision has a larger impact tend to reward less equity as options. In addition, high R&D expenditures will increase the likelihood of more stock in the CEO's compensation package.

Exercise prices on options can be set at-the-money, in-the-money (discount options), out-of-money (premium options) or indexed to an industry or market index (index options). Discount- and at-the-money options are often criticized as giving huge rewards for mediocre performance, especially in a bull market, whereas premium options often reduces incentives when the exercise price goes far out-of-the-money.

Since executives holding indexed options are only rewarded when their performance exceeds the market, indexed options protect executives from market shocks and protect shareholders from rewarding poorly performing executives in bull markets. The most pronounced benefit by using indexed options is the way it eliminate systematic risk and let the executive's compensation depend only on the idiosyncratic risk of the firm. The market risk is beyond the manager's control, and hence higher market risk leads to decreased effort incentives. For volatile firms the risk is often related to future evolution of technology and other market uncertainty which is out of the manager's control and unrelated to the manager's effort. When compensating executives with option grants and stocks, high market volatility will act on the stock "as a hurricane surrounding the boat: rowing just does not affect the boat's progress very much relative to the effect of the hurricane" (Meulbroek, 2000, page 10).

Introducing indexed-options in an executive's compensation portfolio make the executive compensation depending on the risk he can control through his effort. However, firms face several potentially costly implementation issues with respect to indexed options. An index must be specified so as it removes the systematic market risk beyond the executive's control. It therefore creates greater incentives to increase risk than standard options. Jenter (2002) find that incentive induced with indexed options are more expensive than using stocks, but less expensive compared to standard non-indexed options. Indexed options are more efficient than normal option grants because they deliver pay-for-performance more cheaply and because less pay-for-performance is required to generate the same incentives. Since an efficient index-option only rewards the CEO for the change in firm value because of his effort, index options have a smaller probability to end up with a stock price that exceeds the exercise price than with traditional options. Thus, index options reduces the company's cost of granting an option, but it can reduce the executive's value even more because of the smaller probability of the option ending in-the-money, and executives will thus attach very low values to options likely to expire worthless. As a result, it costs the company more to grant indexed options rather than traditional options (Hall and Murphy, 2003).

Discounted options are also often unpopular, which can be explained by accounting and tax considerations (Hall and Murphy, 2000). However, Hall and Murphy (2002) brings forth the conclusion that incentives per dollar spent on compensation to risk-averse executives are maximized by granting options with exercise price just below the market price at the grant date. This gives the executive a marginal change in wealth for both rises and falls in the stock price.

Studies have shown that stock options in an executive's compensation package give the executive incentives to reduce dividends (Lambert et al, 1989) and favor repurchases (Jolls, 1998). The introduction of a stock option plan will induce the manager to reduce corporate dividends relative to the level of dividends that would have been paid in the absence of the plan. Executive stock options are not generally dividend-protected, and thus the payment of a dividend reduces the expected value of the option, and therefore increases the cost to the manager of paying out dividends. The empirical results from Lambert et al (1989) indicate that, on average, actual dividends for firms using option-based compensation where below forecasted dividends. In addition, stock options may have the effect of encouraging managers to choose repurchasing shares over dividends. Repurchasing shares, unlike dividends, do not dilute the per-share value of the firm since the outflow of earnings corresponds to the proportionate reduction in the number of outstanding shares. As a consequence, stock options are worth more after a repurchase than after a dividend. Christine Jolls (1998) finds evidence that firms managed by executives with large numbers of stock options will be more likely to repurchase their stock than otherwise similarly situated firms. These implications can result in either benefit or disadvantage to the shareholders depending on the tax rules in the country where the firm is operating. Different tax rules on dividend and equity profit can make the shareholders prefer one over the other. However, financial theory states that investors are indifferent between dividend payments or repurchase of stocks when the impact of taxation is neglected (Hillier et at, 2008).

A drawback using options in the CEO's compensation package is that high payoffs for risk-taking can lead to hazardous behavior, and thus reducing shareholder return. Also, managers might manipulate exercise price and timing of stock option grants. Because stock options generally are awarded with a fixed exercise price equal to the stock price on the award date, Aboody and

Kasznik (2000) find that executives manipulate investors' expectations around award dates by delaying the release of good news and accelerating the disclosure of bad news. The evidence indicates that executives of firms with scheduled awards make opportunistic voluntary disclosures that maximize their stock option compensation. Recent studies have documented this positive correlation between CEOs' equity incentives and earnings manipulation, by manipulating the disclosure of information around executives' option grants (Frydman and Jenter, 2010). The abnormal returns around CEO stock option reflect two distinct sources of opportunistic behavior: opportunistic timing of voluntary disclosures around award dates for firms with scheduled awards, and opportunistic timing of awards around news announcements for firms with unscheduled awards. Aboody and Kasznik (2000) suggest that CEOs' incentives to manage investors' expectations around scheduled awards could be mitigated by setting award dates immediately after earnings announcements. CEOs who receive their options before the earnings announcement are significantly more likely to issue bad news forecasts, and less likely to issue good prognoses, than are CEOs who receive their awards after the earnings announcement. A common practice for solving this problem is to grant options with a strike price based on an average stock price in a given time period before the grant.

3.4.2 Stock-based compensation

Stock-based compensation ties the CEO reward linearly to the market value of the firm, and aligns the interest of the CEO and the owners. "It motivates managers to improve stock prices, which is exactly what the shareholders would like managers to do" (Hillier et al, 2008, page 664). When the CEO reward is linked to the stock price, his actions will be rewarded for performing well and punished for bad performance through the markets valuation of his actions (Colbjørnsen, 2000). The difference between stock and options is in their valuation and payoff. A CEO receiving equal value of stocks or options as part of his payment would have a larger gain for a rise in the stock price if the reward was given as options. However the option will have no value if the stock price is below the option strike price, while stocks' values are linearly linked to the company value. The risk for the CEO will then be lower when the reward is through stocks rather than options. Since stocks will still have value even if the share price drops, it will not encourage the same level of risk taking, creativity and innovation as options induce. Stocks give fewer incentives for the CEO to increase his effort and firm value. However, as opposed to options, stocks penalize bad performance in a better way since their value is directly linked to the firm value. Overall, the most important benefit by using stocks in executives' compensation portfolio is the creation of a stronger feeling of ownership towards the firm.

Restricted stocks

Restricted stocks are a common portion in a manager's compensation plan. With restricted stocks, managers receive a specified number of shares in the firm, but cannot sell these shares for a given period of time. Some compensation plans with restricted stocks have a minimal vesting period, where the executive is entitle to sell some of his shares after a minimum waiting period, but the remainder only after an additional period. In addition, the shares are forfeited if the manager leaves the firm before the restriction period is over. As a result, managers face severe restrictions on their ability to sell their shares and diversify the risk of their personal wealth. Because of these restrictions, executives bear the costs of holding an illiquid undiversified portfolio for many years. In recent years, many managers have suffered huge losses during market downturns while liquidity restrictions prohibited them from selling their shares (Kahl et al. 2003). Another implication using restricted stocks in the executive's compensation package is that the high illiquidity costs of concentrated managerial equity holdings give managers a strong incentive to diversify their firms, and thereby diversifying their shares. This might encourage acquisitions, even if it is not in the interest of the shareholders (Kahl et al, 2003).

Disregarding the cost of the illiquidity, restricted stocks have several advantages that make it a good compensation form. Benefits like retaining key employees and executives, reducing agency costs, resolving moral hazard and adverse selection problems are all captured when using restricted stocks. Another advantage with restricted stock is that it also gives executives an incentive to take actions that increase the long-term value of the firm. In addition, restricted stocks make it less likely that the shares are sold to the public shortly before the release of negative information about the firm (Kahl et al, 2003). Most importantly, restricted stocks give the executive a feeling of ownership towards the firm, and a long term perspective of value creation. Although there are several benefits of liquidity restrictions for the shareholders, the cost imposed by the restrictions might be large. Strongly restricted stocks imply a higher risk-premium, and can make this type of compensation to executives a costly corporate governance tool, consequently less effective at reducing agency costs.

3.5 CEO's compensation portfolio

In the early 1980s, there was a substantial increase in the degree of stock options in CEOs compensation portfolio. During the 1980s and especially the 1990s, stock options became the largest component of top executive pay in the US (Frydman and Jenter, 2010, Hall and Murphy, 2002, and Aseff and Santos, 2002). Hall and Liebman (1998) find that both the level of CEO compensation and the sensitivity of executive compensation to performance due to option-based compensation, increased sharply over the years from 1980 to 1994 where the elasticity of executive compensation to firms' market value more than tripled. However, after the stock market decline of 2000-2001 stock options lost some of their strength, and restricted stock grants replaced them as the most popular form of executive equity compensation by 2006 (Frydman and Jenter, 2010).

The popularity of the marked-based compensation is mainly explained by their effect of directly aligning executives' and shareholders' interests. For marked-based compensation to realize their stated purpose, it is essential that they are non-tradable and that executives are restricted from taking actions such as short-selling company securities to hedge their exposure against idiosyncratic risk. If executives' options or stocks were tradable, poorly-skilled and highly risk-averse executives could solely accept and immediately sell off all options and stocks offered. Thus they would eliminate the self-selection effect, retention incentives and reduce effort incentives by annihilate the link between executive wealth and company performance.

The study of Core et al (2003) results in a comprehension that stock price is the primary performance measure in executives' incentives, and that equity portfolio incentives increase with firm size and growth. Frye (2004) show that as firms are becoming more human capital intensive, the compensation portfolio for employees are becoming more important, and firms appear to turn towards greater use of equity-based compensation to attract and retain highly skilled employees. The results indicate that firms which make use of greater amounts of equity-based compensation achieve a greater performance. Also, high-performing firms are more likely to link employee compensation to firm revenue. Kadan and Swinkels (2007) show that young firms, firms that invest heavily in research and development, and human-capital intensive firms, are more likely to use options in the executive's compensation package. In addition, firms with high managerial ownership and low bankruptcy risk tend towards options. Larger firms and companies that are more likely to go bankrupt, tend to use more restricted stocks in the executive's compensation. However, Kadan and Swinkels suggests that only firms with significant non-viability risk, that is, financially distressed firms and start-ups, should use restricted stocks in the executive's compensation portfolio.

Compensating through restricted stocks and options affect value per share in the company, and hence the total firm value. There are three dimensions of costs which restricted stocks issues can affect overall firm value. First, restricted stock issues in the past will create an overhang of restricted stocks that can affect the value per share. Second, restricted stock issues to compensate the executive in the current year will reduce current earnings because of their expenses. And finally, expected restricted stock issues in the future will reduce future earnings and cash flows (Hillier et at, 2008). Using options as executive compensation will influence firm value in a similar way. Options outstanding represent potential cash outflows to existing shareholders, and expected option grants in the future will affect value per share by increasing the number of shares outstanding in future periods, therefore reduce the portion of the terminal value that belongs to existing equity investors. However, the different type of incentives market-based compensation induces can have a significant value creation on the overall firm value, thus making this type of compensation optimal.

A number of studies have documented that executive pay tends to increase approximately by 0.3 % for a 1 % increase in firm size (Frydman and Saks, 2007). The observed relationship between firm size and pay could be driven by competition among firms for scarce managerial talent if the returns to talent are increasing in firm size. As a consequence, larger firms would pay their executives more than smaller firms in any given year. In addition, the magnitude of compensation would rise over time if the total size of the market increases. Therefore the compensation may respond differently to changes in individual firm size versus total market size. Frydman and Saks (2007) find that the cross-sectional relationship between firm size and executive compensation has remained relatively stable over the years from 2000 to 2007, explaining the growth in CEO compensation in recent years.

3.6 Options or restricted stocks? A non-ending battle

There exist a vast amount of studies trying to establish whether stock options or restricted stocks should be the most dominate portion in an executive's optimal compensation portfolio. Most studies assess how executive's risk-aversion affects these various compensation forms and overall firm performance. There is a considerable debate in the prior literature about the optimality of stock option compensation versus restricted stocks, and the following chapter will try to review and discuss some of the most important findings relative to the principal-agency problem.

The practice of granting large amount of options to CEOs had its peak around the year 2000. Lambert et al (1991), Habib and Ljungqvist (2005), Dittmann and Maug (2007), Sanders and Hamrick (2007) and Barron and Waddell (2008) point out that the practice of granting large amount of options to the CEO can serve against its intended purpose of increasing the CEO's risk-taking and improving firm performance. The implications from these studies results in a comprehension that a change in the CEO contract from the current practice to fewer options and more restricted stocks can increase shareholder return, by reducing CEO salary cost and optimizing risk-taking. Habib and Ljungqvist (2005) measure the magnitude of agency costs and find that the greater the CEO stock holdings, the higher is the alignment to the shareholder's interests, and thus the lower is the agency cost.

Dittmann and Maug (2007) indicate that a CEO can perform at his current level with a new contract consisting of no options, less salary and more restricted stocks, and at the same time reduce the cost for the shareholders. They conclude that the optimal predicted contract should almost never contain stock options for chief executive officers, and the CEO should be required to invest in the firm, rather than receiving a salary. However, their analysis assume that the observed compensation contract implement the optimal effort. They investigate whether the shareholders can change to another contract that induces the same actions at a lower cost. If options are granted at-the-money, and one assume that the existing contract already reflects the expected optimal level of effort, then options will have little incentive effect. Consequently, from these assumptions it is not surprising that stock options are not a part of the executive's optimal contract.

Sanders and Hamrick (2007) find that stock option pay is significantly positive predictors of performance extremeness for both total shareholder return (TSR) and return on asset (ROA). When they look at CEO compensation where options represent a maximum of 20 percent of the total pay, they find that for TSR the cases of extreme gains are twice as large as the extreme losses and that ROA is weighted approximately 60 percent towards gains. However, CEOs with more than 50 percent of their total pay given as options take too high risks, resulting in almost twice as many big losses than big gains, measured as extreme TSR outcomes. The study has two important findings: Stock option pay tends to bring about extreme corporate performance, both gains and losses and in addition, option-loaded CEOs delivered more big losses than big gains. Supportive to this, Habib and Ljungqvist (2005) show that increasing the CEO's option holdings by one standard deviation from the mean reduces the firm value by 1,4 percent.

However, increasing the CEO's stock holdings or the options vega by one standard deviation will increase firm value by 2.9 and 1.7 percent.

Jenter (2002) concludes that stock grants are a more optimal compensation form than options since options gives weaker incentives and therefore much higher levels of average pay-for-performance sensitivity is needed to induce the same level of effort incentives. Thus the cost of achieving the same level of incentives is clearly higher with stock options than with restricted stocks. Even compared to indexed options, restricted stocks remains a more cost efficient method of effort incentives. Two effects explaining the inefficiency of stock options are exhibited in the study. The first is the low valuation the executive puts on option grants since granting options induces more risk into the executive's wealth than granting stocks. The second effect is the fact that incentives induced by options are much lower than their pay-for-performance sensitivity would lead to expect. Considering the executive's initial wealth in the analysis, Jenter find that the cost advantage of stock grants is increasing in the degree of private wealth related to the firm. For initial wealth in the range of 0 to 50 percent invested in the firm, Jenter find that the executive's valuation of the option grants compared to stock grants becomes more pronounced as the percentage of wealth tied to the firm increases. The increase in initial wealth has the same effect on the covariance between marginal utility and marginal effect of effort on wealth, which is substantially more negative with option grants than with stock grants, and increases as the initial wealth linked to the firm value increase. As a result, Jenter find that the best way to induce high levels of effort is to optimally combine stock grants with a share purchase program, requiring the executive to put his own wealth on the line.

Hall and Murphy (2002) show that incentives are more efficiently provided through restricted stocks than options if the firm is free to change the existing form of compensation portfolio when compensating the CEO with new equity grants. Granting options on top of existing compensation portfolio results in systematically overpaid executives, providing inefficiently incentives and reduced company profit. Their study shows that restricted stocks are relatively cheap because executives value restricted stocks more highly than options and are therefore willing to take a larger cut in cash salary when existing compensation is adjusted; reducing cash pay and replace it with market-based compensation. Thus, the firm can grant relatively more shares and provide stronger incentives per dollar of company cost. Holding the executives utility constant, their study shows that incentives are maximized by issuing restricted stocks rather than options.

The focus in the paper of Meulbroek (2001) is the wedge between firms' cost for the executive compensation and the manager's subjective value placed on this compensation portfolio. The efficiency of stock option compensation to an executive is the ratio of the option's value to an undiversified executive relative to the cost of that compensation to the firm, and Meulbroek shows that this will always be less than the efficiency of the underlying stock. As the expected rate of return premium increases, option efficiency further decreases, since risk-averse and undiversified executives do not place enough value on the risky payout to justify the cost given up by shareholders. However, a criticism against the study of Meulbroek is that she does not model the incentive effects of the stock options and thus she is unable to assess the net benefit to shareholders from using stock options.

Both the results from Meulbroek (2001) and Hall and Murphy (2002) gives a comprehension that stock options are an inefficient mechanism for compensating executives relative to restricted stocks. Hall and Murphy (2002), Lambert et al (1991) and Jenter (2002) all argue that restricted stocks dominates options. However their results are based on a partial equilibrium analysis and do not formally incorporate the cost of the option, the valuation done by the CEO, or the incentives provided by the options into an optimization program. Also, criticism is directed against the result of Meulbroek (2001), Dittmann and Maug (2007) and Hall and Murphy (2002) as they do not solve the complete bi-level optimization problem between the shareholders and the executive (Armstrong et al, 2007).

In contrast to the above studies, Kadan and Swinkels (2007) develop an agency model where stock options dominate restricted stocks when non-viability or bankruptcy risk is zero. They analyze a fully specified optimization model where the executive's compensation contract consist of a base salary and either stock options or restricted stocks. Their results implicates that stock options dominate restricted stocks when non-viability risk is non-existing, where the measurement for the non-viability risk is the probability of bankruptcy. This measure is shown to be positively related to the use of restricted stocks. However, since the probability of bankruptcy is relatively low in most firms, they conclude that stock options should be part of the optimal executive compensation. An important drawback in their analysis is their restriction of using either options or stocks and not both, which is often the case in optimal contracts.

The study of Aseff and Santos (2005) find that stock options are an important component of the observed executive compensation contract. They show that implementing stock options in the executive's compensation portfolio can reduce moral hazard behavior caused by selecting actions with low effort, and motivate the executive to select higher effort with a very small additional cost. A marginal dollar spend in lowering the strike price has a greater impact in providing incentives, but it yields less utility to the executive than a dollar spent in increasing the fixed component. These findings may help to explain why most stock options are granted at-the-money. They find that at-the-money options receive a better fiscal treatment and the cost of deviating from the optimal strike price seems to be minimal. Also, this small cost can be accommodated by an appropriate reshuffling of the option grant and the fixed component of the contract. However, they do not test for restricted stocks in the contract, and will not be able to determine if stocks have a stronger incentive effect than options. Armstrong et al (2007) on the other hand, includes both stocks and options. They allow for a complete optimization of the agency problem, and find that stock options are almost always an important part of the optimal executive compensation contract over the most probable range of outcomes. They conclude that the optimal compensation contract frequently includes large quantities of stock options granted at-the-money. They show that options are almost always part of the optimal contract and often the primary source of new equity incentives. However, as the executive's risk-aversion increases, the cost of using stock options can outweigh the increase in incentive benefit from using options.

Lambert and Larcker (2004) find that restricted stocks are normally not the optimal contract form and show that option-based contracts generally dominate restricted stock-based compensation. They argue that the exercise price in the optimal contract is frequently far "out-of-the money", particularly in situations where the executive is not very risk averse or where there is little risk in the economic setting. Although an option-based compensation offers lower incentives than restricted stocks when outcome probabilities are poor, it offers more incentives for higher outcome probabilities. By offering a contract of options with a nonzero exercise price, the shareholders are able to shift the slope of the contract to the regions of the outcome where the probabilities are more sensitive to the manager's actions.

The optimal contract will depend on the degree of risk-aversion to the executive. For a risk-neutral manager the cost of the option compensation portfolio is a decreasing function of the exercise price of the options. In contrast to Hall and Murphy (2002) and Meulbroek (2001), Lambert and Larcker (2004) find that among all exercise prices for which it is reasonable to motivate the desired level of effort, options with exercise price equal to zero (restricted stocks) is the most expensive contract for the shareholders. Restricted stocks will thus give up the most value to the agent relative to the effort level it can be used to induce. Since the slope coefficient in a restricted stock contract is constant over all ranges of the outcome, but the impact of the agent's actions on the probability of an outcome is not constant, restricted stock contracts waste value in regions of the outcome where there are low incentives.

When the agent is risk-averse, higher exercise prices impose more risk on the executive to motivate the same level of effort, and one would therefore expect an optimal contract with lower exercise prices as the agent becomes more risk averse. Both the degree of risk aversion and the structure of how the executive's actions affects the shape of the probability distribution of the stock prices, will affect the shape of the optimal contract (Lambert and Larcker, 2004 and Armstrong et al, 2007). An optimal contract for a risk-averse executive will thus vary as a function of exogenous parameters. For low degrees of risk-aversion, Lambert and Larcker (2004) find that the optimal contract will be a convex function of the performance, and therefore, options should be a part of the compensation contract. For higher level of risk-aversion and low levels of volatility, the optimal contract consists solely of options. However, as the volatility of the stock price increase, the number of options and the exercise price of the options decline. As the volatility further increases, the optimal compensation contract eventually reaches the point where no options are used and the contract consists primarily of stocks and salary. Allover, the study of Lambert and Larcker (2004) shows that for most parameter values, the optimal contract contains a mixture of stocks and options, or consists entirely of options. However, if there exist any combination of high degree of risk-aversion and high levels of exogenous variability, a restricted stock contract will be optimal.

An overall weakness in examining the real cost of compensating executives with stocks and options is the difficulty of measuring the incentives provided. Incentives depend on several individual parameters, like the degree of risk-aversion, personal reference-point, and their initial wealth. In addition, the optimal shape of an executive's compensation portfolio will depend upon the effects that executive's actions have on the revenues to the firm and on the extra utility to the executive. Other components to consider is the opportunity cost of the executive relative to the size of the firm, the disutility of effort, and the executive's technology linking productivity to effort. The incentives provided by stock options and restricted stocks is the main reason why firms use market-based contracts in the executive compensation portfolio. It is therefore impossible to make realistic conclusion about the relative optimality of an equity grant unless the incentives are actually modeled fair in the analysis.

3.7 Explaining the high executive compensation over the last decades

Most CEO compensation portfolios contain five main components: a base salary, annual bonus, payouts from long-term incentive plans, restricted option grants, and restricted stock grants. In addition, executives often receive contributions to defined-benefit pension plans, various perquisites, and severance payments in case of departure. The high level of executive pay has given rise to an intense debate about the nature of the pay-setting process. Some authors argue that large executive compensation portfolios are the result of powerful managers setting their own pay and extracting rents from firms (Frydman and Jenter, 2010). The rent extraction view of executive pay posits that weak corporate governance and acquiescent boards allow executives to determine their own pay, resulting in inefficiently high levels of compensation. Much of this rent extraction occurs through forms of pay that are less observable or more difficult to estimate, such as stock options, perquisites, pension plans and severance pay. The three latter components of the executive's compensation have however received little attention in the literature.

The majority of the present literature assumes that firms use equity grants mainly to severe two purposes (Core and Guay, 2003). First, increasing the executive's incentives to act in the interest of the shareholders and minimize the agency cost. Second, equity-compensating can serve as a substitute for cash compensation and eases financing constraints or carries tax and accounting advantages. A majority of the literature assume that executives hold more firm equity than they prefer, and that they have no control over the allocation. Because of this lack of control, when the executive is granted more equity or the value of his equity compensation increases, it further lowers his diversification. As a result, the executive values the change in his compensation at less than its market value. Thus a growing body of literature questions whether the executive's incentive and valuation of equity compensation should be adjusted to reflect parameters like the executive's degree of risk-aversion, initial wealth and lack of diversification.

Several studies have tried to put forward an explanation for the high observed executive compensation. One explanation is that a repercussion of firms with weak governance and high executive pay can induce inefficiently high levels of pay in all firms in the economy. If firms with strong and weak governance coexist in the economy, firms with weak governance and high executive pay impose a negative externality on better governed firms through the competition for managers. In contrast to this view, others argue that the growth in executive pay is the efficient result of increased demand for CEO effort or unusual managerial talent. Further, a different explanation for the rise in executive pay is increasing firm size and scale effects

(Frydman and Jenter, 2010). Higher executive talent might be more valuable in larger firms, which naturally results in higher levels of pay in larger companies to attract more competent CEOs in an efficient labor market. Small increments in the executive's talent can imply large increments in firm value and compensation because of the scale of operations under the CEO's control. In addition, moral hazard problems might be more severe in larger firms, resulting in a stronger need to provide the CEO incentives as firms grow.

Another theory is that changes in firms' characteristics, technologies, and product markets have increased the effect of executive effort and talent on firm value. This leads to higher optimal levels of incentive and compensation pay. Alternatively, the productivity of managerial effort and talent may have increased because of more intense competition due to entry by foreign companies, improvements in the communication technology, or because of higher volatility in the business environment. Lastly, the growth in CEO pay can be the result of stricter governance and improved monitoring of CEOs by boards and large shareholders. If the executive's job stability is negatively affected by an increase in monitoring intensity, firms can respond by increasing the level of compensation pay to retain and attract highly talented CEOs.

Our analysis brings forth another argument in justifying the high executive compensation. To understand the high compensation, one has to look at the valuation the executive places on his compensation portfolio. It is vital to estimate both the costs and benefits imposed by the shareholders and the executive. Designing the optimal contract, one has to take into account the value-maximizing problem for the incentives related to the cost in providing the compensation, and its potential impact in increasing the overall firm value. We will continue our analysis on optimal contracts after presenting the most important factors that determine how executives value their compensation.

4. The real cost of awarding executives with market based compensation

As options and restricted stocks have become a major component of corporate compensation, investors have become increasingly concerned about their real cost to the firm. Standard methodologies such as Black and Scholes or binomial option pricing formulas, provide reasonable estimates of what an outside investor would pay for an option in the underlying firm, and therefore measures the company's cost of granting options as compensation. However, standard models are not appropriate for determining the value of options and restricted stocks to the undiversified, risk-averse executive who can neither freely sell or trade their options, nor hedge their risk through short selling or other equivalent methods. Because executives with a market-based compensation plan are exposed to idiosyncratic risk with no opportunity to hold a fully diversified portfolio, they will value stock- and option-based compensation at less than its market value.

4.1 Dissimilarities in the valuation of equity grants

To find the optimal incentive contract, a question to be answered is the degree of incentives options and restricted stocks provide, compared to the cost towards the firm. In the framework of agency theory, incentives are defined as the change in value as perceived by the executive relative to the change in shareholders wealth (Ingersoll, 2002). Therefore, it is of interest to determine the change in the subjective value of the market-based compensation for a given change in the market value of the underlying stock.

Dissimilarities between the executive's subjective valuation and the real market value of the equity grant depend on at least eight factors:

- Time to maturity and vesting period
- Reference point
- Risk-aversion
- Initial wealth
- The probability that options becomes re-priced
- Volatility
- Loss-aversion
- Diminishing sensitivity

4.1.2 Time to maturity and vesting period

A vesting restriction of an executive option is the time period the executive is constrained from selling the option and realizing its value. To the extent that vesting requirements prohibit risk-averse executives to exercise early, the incentive effect and the cost of rewarding with stock options will increase and the executive's subjective value decrease, as the vesting period increases (Kulatilaka and Marcus, 1994). If options in the compensation package can be exercised early, risk-averse and undiversified executives will rationally exercise early following price run-ups to lock in a gain. As stock price increases and pushes options to become far in-the-money, early exercise becomes profitable and conceivably also optimal (Core and Guay, 2001, Hall and Murphy, 2000, 2002, and Hall and Knox, 2002). Allowing early exercise will give conflicting impact on the cost of compensation towards the firm. The fact that early exercise can be optimal from a subjective viewpoint increases the subjective value of the option to the executive. In addition, since the exercise is premature relative to a market valuation, it reduces the objective cost of the option to below the market value of a comparable freely traded option (Ingersoll, 2002, Hall and Murphy, 2002). However most importantly, early exercise removes the original incentives from the equity grant. Thus there will be a cost towards the firm for granting new equity-based compensation to provide the executive with optimal incentives.

Carpenter et at (2010) specify that wealthier or less risk-averse executives exercise later and thereby creating greater option cost for the firm. However, decreasing risk-aversion reduces their need for incentives to induce efficient risk-seeking behavior and thus decreases the incentive cost. On the other hand, if the executive has a high risk-aversion, or if he holds a great fraction of his wealth in the company stock, the degree of incentive payment needed to induce optimal incentives increases, which increases the compensation cost. However, highly risk-averse executives will be expected to exercise earlier, but the cost of granting them with new incentives will overweigh the potential cost savings from early exercise.

Bettis et al (2005) find that early exercise among employee stock options is a well-known phenomenon, with exercise occurring on average about two years subsequent to vesting and more than four years prior to expiration. They also show that as stock price volatility increase, the tendency of option holders to exercise prior to expiration increases. Evidence from Devers et al (2005) demonstrates that early exercise is positively associated with stock price appreciation. Similarly, Bettis et al (2005) find statistically significant differences in exercise patterns for different trends in the market. An increase in the stock market gives a steady increase in the degree of early exercise. Correspondingly, they observe options being exercised later when there is a decline in the market. These exercise patterns confirm the importance of taking account of the risk-aversion when constructing an optimal compensation portfolio; the higher the degree of risk-aversion the earlier is the executive expected to exercise in a positive market trend.

Overall, option incentives increase slightly as the time until option maturity increases (Meulbroek, 2001). As firm usually grant options with long time to expiry date, they lead the CEO to engage in long-term value creation and increased creativity and innovation. However, as the option’s time to maturity increase the CEO faces more uncertainty, and hence the difference between the market value and executive’s subjective valuation will rise as time period increases. Similar arguments also apply to the subjective valuation of restricted stocks. As the volatility and the length of the liquidity restriction horizon grows, the implied value of the restricted stock decrease significantly (Kahl et al, 2003). Restricted stock compensation will thus be more expensive as the vesting period increases.

The longer a manager is constrained to hold an undiversified portfolio, the less is the equity-based compensation worth to him (Meulbroek, 2001). Because the manager will value equity-linked compensation less than its market value, there will be an extra cost of the compensation to the firm as a result of the different valuation in risk. While allowing for non-restricted stocks and early exercise for options in the executive's compensation portfolio, the executive's subjective value will increase and the firm's cost will indeed be reduced. However, this will also eliminate the incentive-alignment benefit associated with options and restricted stock which probably cost the firm even more than the potential savings. Overall, early exercisable options and non-restricted stocks may reduce the firm's cost below its market value, but not as much as one might initially suspect after taking account of the need to continually maintain incentive alignment through future option and stock grants.

4.1.2 Reference point

Tversky and Kahneman (1991) present the theory of reference-dependent preferences as an extension of the original prospect theory. Experimental evidence indicates that individuals' preferences between given alternatives vary systematically according to what is perceived to be the reference point, that is, the status quo, or the customary or normal state of affairs. Loss-averse models have a central assumption that losses and disadvantages have greater impact on preferences than gains and advantages. The rate of exchange between goods can be quite different depending on who is acquiring and who is giving up, and reference levels play a major role in determining the preferences.

A striking feature from experimental evidence imposed by Munro and Sugden (2001) is the speed for which reference points adjust to changes in wealth. The result brings forth a suggestion that a theory of choice needs to treat reference points as endogenous. Munro and Sugden propose a criticism towards Tversky and Kahneman's reference-dependent theory as saying that it treats reference points as exogenously given, when they should take the reference point as endogenous if they are to explain behavior in markets over a longer run. The assumption about exogenously reference points limits the economic applicability of the theory because empirical evidence suggests that individuals adjust their reference points remarkably quickly in response to changes in their endowments. As a result, acting in accordance with the preferences appropriate to one reference point, an executive makes a trading or transaction decision which then induces a change in the reference point. This change may lead to further trade or to revised transaction decisions, and so on. This will induce a need for a reference-dependent model that explains behavior over a longer run.

Munro and Sugden argue that Tversky and Kahneman's representation of reference-dependence is too restrictive. They bring forth three reasons:

- The model of Tversky and Kahneman (1991) does not allow goods to be complements
- It does not allow the strength of status quo bias to vary with the degree of similarity between goods
- The assumption that preferences depend only on increments and decrements of consumption, independently of absolute levels, has unrealistic implications for behavior in real markets

As a consequence, reference point can vary greatly between executives and over periods of time, thus the reference point should be determined dynamically and individually for each executive.

There are several ways to define the reference-point which will further affect the subjective value a manager attaches to his compensation portfolio. Tversky and Kahneman (1991) explicitly leave open the question of how reference points are determined, and move freely between alternative interpretations. However, several studies define a person's reference point as the rational expectations about the relevant outcome (Köszegi and Rabin, 2007, Dittmann and Maug, 2010 and Meza and Webb, 2006). The executive forms these expectations based on his previous year's compensation package, where the executive regards total compensation below the total reward of the previous year as a loss. Thus, they will define gains and losses according to whether the outcome is better or worse than anticipated.

Implementing loss-aversion in a standard principal agent model makes the determination of the reference point significantly important. With loss-aversion, the psychological pain of falling below the reference income is greater than any pleasure from surpassing it by an equal amount. Granting a premium option will be seen as a loss if the executive has expectations of an option granted at-the-money, and this will reduce his effort incentives. Barron and Waddell (2008) analyses a dataset from 1993 to 2003 and discover that, even though an at-the-money option costs more to grant than an equivalent premium option, over 96 percent of option awards are made at-the-money. They conclude that this result likely come from a constraint on the choice of exercise price due to a social reference point, where relative treatment matters to individuals and similar treatment is valued. Increasing the exercise price decreases the cost to the firm since the option is more likely to expire worthless. However, if the exercise price is set relatively high compared to the executive's expectations, the decrease in the executive's subjective valuation will be significant since he will neglect the probability of a positive payoff. This can in worst case eliminate all incentives tied to the option compensation. As a consequence, the pay-for-performance sensitivity is greatly influenced by the executive's reference point, therefore the reference-point is an extremely important consideration when determining the optimal incentive contract.

4.1.3 Risk-aversion

The Black and Scholes option valuation is substantially affected by small probabilities of large outcomes, while risk-averse individuals naturally discount these small probabilities. As a consequence, there will be a wedge between the Black and Scholes- and the executive's valuation, which will be even larger for well out-of-the-money options (Hall and Murphy, 2001). The wedge arises since the valuation of options from an executive's perspective depends on the usual Black-Scholes parameters in addition to personal risk-aversion, initial wealth and stockholdings in the firm.

There have been doubts on whether options actually have the property of giving incentives to risk-taking, and evidence posits that options might even decrease risk-taking (Lambert et al.

1991). Although the Black and Scholes value of options increases with firm stock price volatility, the executive's subjective value can decrease as volatility increases when they are risk-averse and undiversified. Lambert et al find that a risk-averse manager who is prevented from diversifying the risk associated with the options' payoff may not prefer an increase in the variance of the firm's stock price. An increase in the variance can have a positive effect on the option's value from the convexity of the option's payoff, however it can have a negative outperforming effect from the concavity of the manager's utility function.

Similarly, a problem using stock-based compensation is that its linear payoff might create an incentive for a risk-averse manager to undertake risk reducing activities even at the expense of maximizing firm value (Ingersoll, 2002). The implied value of restricted stocks is a decreasing function of the executive's risk-aversion level, and thus, illiquid shares are worth less to executives who are more risk-averse (Kahl et al, 2003). As a result, options and liquidity restrictions on stocks can have the unintended effect of discourage risk averse but otherwise innovative managers from forming new ventures and increase the firm value. However, the convexity of loss-aversion implies a higher marginal cost for losses under option-based contracts than with stock-based compensation. This will increase the gain from taking risky actions by more under stock-based compensation than under option-based contracts (de Meza and Webb, 2006). As a consequence, option-based compensation can make the executive less inclined to take risky actions than would be the case with stock-based contracts.

Lambert et al (1991) look at the effect of substituting the CEO's stocks with options. As the option's probability of ending in the money increases, the CEO's marginal utility from the option reward decrease. In other words, his incentives for seeking risk are reduced with the increasing probability of a certain option payoff, thus the incentive effect of options diminishes as the option goes deeper in-the-money. When the CEO's compensation portfolio consists of stocks and deep in-the-money options, it can be viewed as portfolio of just stocks. Thus for high stock prices, the compensation loses the strong incentive effects options are meant to give the CEO. Likewise, Lewellen (2003) shows that options can work against their intended purpose and increase the manager's risk-aversion when the probability of finishing in-the-money is adequately high. Supportive to this, Habib and Ljungqvist (2005) find that CEO performance decreases with option vega, suggesting that in-the-money options have less incentive effects and thus induce less risk-taking than optimal by the CEO. Moreover, the degree of risk-aversion will increase if the executive has high holdings in deferred pay and pensions, making him less likely to undertake risky investment choices (Bolton et al, 2010).

Carpenter et al (2010) show that executives with less absolute risk-aversion are likely to exercise their options later. The exercise boundary declines with the level of risk-aversion and will reduce the cost of the CEO compensation from the shareholders view. However, risk-aversion brings forth less incentives from stock-based compensation, thus executives will need a higher risk premium and a larger degree of equity-based compensation in their portfolio to induce optimal incentives. Executives' degree of risk-aversion is highly important when estimating the compensation cost towards the firm. Increased risk-aversion decreases incentives and the subjective valuation of the equity-based compensation which greatly increases the cost to the firm.

4.1.4 Initial wealth

There is a central difference between the former and latter literature on the findings of an optimal incentive contract to reduce the principal agent problem. Latter work explicitly recognizes that the structure of the executive's outside wealth is a key determinant of the efficiency of any incentive contract (Core and Guay, 2003, and Armstrong et al, 2007). The incentive needed to reduce risk-aversion behavior depends on the manager's initial wealth. High outside wealth implies low absolute risk-aversion, leading to stronger risk incentives for an executive with higher wealth. Reducing wealth, or increasing the wealth related to the firm's equity, increases his risk-aversion and his incentives to decrease the variance of stock returns. Bo Becker (2006) supports these findings and shows that wealth has a positive relation with the strength of incentives computed from stock and option holdings: high non-firm wealth gives strong incentives. Similarly, Core et al (2003) and Armstrong et al (2007) find that the incentive effects of fixed salary, at-the-money options and restricted stocks are dominated by the level and composition of the executive's pre-existing wealth. Devers et al (2005) extend the concept of endowment effect to subjective stock option valuation, and argues that upon award, executives immediately endow value from un-exercisable stock options into their perceptions of personal wealth. Once awarded, managers count on receiving profit from stock options and perceive this value as real wealth. As a consequence, efficient contracts should vary the amount of incentives given to a CEO as a dynamic function of the CEO's wealth. To write such contracts, the firm requires continuously information about the composition of the executive's total wealth (Core et al, 2003). When firms write efficient contracts over executive's wealth, the contracts are consistent with relative performance evaluation: requiring executives to increase their exposure to firm-specific risk by reducing the amount of wealth they hold in diversified portfolios, or increasing the wealth related to firm equity (Core and Guay, 2003).

Decreasing absolute risk-aversion implies that a wealthy CEO is less risk-averse than a similar, but less wealthy CEO, and wealth should therefore proxy for risk-aversion. Suppose that there are two CEOs with the same wealth and same efficient compensation contract. Each CEO also has the same absolute risk-aversion and utility function. These assumptions results in equal marginal product of effort. Then one of the executives is given a lot of money, but the other loses all outside wealth. Unless their compensation is reconstructed or rebalanced, both executives have incentives to take actions that do not maximize shareholders value, the first by working less and the second by taking fewer risks. Only if executives have constant absolute risk-aversion would there be no benefit to wealth-based contracting. Given that the CEO has constant relative risk-aversion, conditional on firm characteristics and CEO effort-aversion, the optimal linear contract would expose some fixed proportion of the CEO's wealth to firm risk. This risk exposure would be equivalent to requiring the CEO to own stock with value equal to a fixed proportion of his wealth.

Firm size can be used as an indirect proxy for CEO wealth as larger firms require more talented CEOs who demand greater compensation, which again can explain why CEO incentives increases with firm size (Core and Guay, 1999). Under the assumption that individuals' utility functions exhibit declining absolute risk-aversion, CEOs of larger firms are expected to have higher dollar incentives from equity (Core et al, 2003). The evidence in Core and Guay (1999) that CEO incentives increase with CEO tenure may also indicate a relationship between CEO wealth and CEO incentives under the assumption that more senior CEOs have greater experience and thereby greater wealth. The strong positive effect that executives' non-firm wealth has on incentive strength, is consistent with traditional principal agent theory of risk-aversion, but also with the alternative explanation that interpret wealth as a proxy for either personal power or skills (Becker, 2006).

Executives' initial wealth has a strong implication on the subjective valuation of their equity-based compensation. A higher degree of wealth related to the firm's stock price increases the executive's relative risk-aversion which again reduces his incentives for risk-seeking. Hence, the cost of inducing optimal incentives will increase. A large degree of outside wealth makes the CEO less risk-averse, which increases the efficiency of the risk-seeking incentives. However, the cost of inducing effort incentives for wealthier CEOs increases with executives' wealth, and thus increases the total cost of inducing incentives through equity-based compensation. Lambert et al (1991) illustrate the importance of considering the executive's total portfolio of wealth when evaluating the executive's subjective value of the stock option portfolio. They show that the manager's valuation of an option can be less than 50 percent of the Black and Scholes value when he is constrained to hold half of his wealth in the firm's stock. The valuation is even lower for managers who are more risk-averse and less diversified. Thus, it can be of great cost for the shareholders to ignore the structure of the manager's initial wealth when constructing an optimal incentive contract.

4.1.5 The probability that options becomes re-priced

To continuously provide effective incentives when the stock price falls and options become far out-of-the money, firms tend to re-price options to re-align the incentives. Re-pricing strategies are either done by resetting the exercise price or by replacing old options with new options with a lower exercise price (Hall and Murphy, 2003). Heavy criticism have been proposed against option re-pricing from investors thinking that resetting exercise prices is synonymous to rewarding management for poor performance, and in addition destroying original incentives presented in the initial contract (Core et al, 2003). If options are re-priced after a stock price decrease, the re-pricing effectively removes the risk originally imposed on the executive for incentive purpose and might be seen as a reward for poor performance.

The analysis of Hall and Knox (2002) show that large future option grants follows large changes in the stock price. This result in a V-shape in the relationship between future grant size and stock price performance: Both large increase and decrease in the stock price leads to larger option grants. As a consequence, the way for executives to get the most options is to do very well and receive a reward, or very poorly and receive an incentive restoration grant.

Consequently, re-pricing has been seen as a windfall for poor performance periods. As well as being viewed as unfair, the windfall protects against the previous stock price drop and thereby reduces the CEO's ex-ante incentives to the extent such re-pricing might have been anticipated.

Managers recognizing that their options can be re-priced after a fall in the stock price will understate the consequences of large falls in the share price. To circumvent this problem, some re-pricings strategies are constructed as an exchange where the old out-of-the-money options are swapped for fewer new at-the-money options (Ingersoll, 2002). The Black and Scholes re-pricing strategy, where there is an exchange in options with a high exercise price for a smaller number of options with a lower exercise price, has become more commonly over the years (Hall and Murphy, 2002). The re-pricing is structured such as the total Black and Scholes value of the options is the same immediately before and after the exchange. This result is beneficial to the executive since both option packages have the same expected value but the new options are less risky. In addition, from the shareholders' perspective, the expected cost will be the same with or without the re-pricing.

To summarize, an important advantage using re-pricing strategies is that it can serve as an instrument to eliminate the consequences of systematic risk to the executive's compensation and thus reinstate the initial incentives. If the firm wishes to keep the CEO following a bad outcome, it will want to re-contract or re-price the options to provide the CEO with optimal retention incentives. Re-pricing options can then have an selection effect, since the board of directors might give only the well-performing managers re-priced options and thus the poor managers will move on to another firm that offers a fresh compensation package. However, if there exists expectations of re-pricing following poor performance, original incentives that equity-based compensation was granted to induce will be spoiled. Re-pricing is though costly for the shareholders, but this cost may be substantially smaller than the cost of executive turnover, and thus re-pricing can be a value-increasing action.

4.1.6 Volatility

Option holders recognizing the positive linear relationship between stock price volatility and option value, will seek to increase stock price volatility to enhance the value of their options (Devers et al, 2005, Hillier et al, 2008). However, evidence reveals that executive's behavior fails to consistently conform to this financial option theory. Devers et al (2005) propose that managers' risk preferences vary in response to stock price volatility and market trends, as the direction of previous stock price movement, in valuing stock options. In the valuation of options, executives attach a premium to stock price volatility in negative stock price trends, and discounts for stock price volatility in positive stock price trends. Thus, the volatility of the underlying stock will negatively influence managers' subjective stock option valuations in positive trends in the market. The study of Core and Guay (2002) concludes that options deep in-the-money are very sensitive to changes in the underlying stock price, but rather insensitive to changes in the stock-return volatility. In contrast, as the options move far out-of-the-money the sensitivity to the underlying stock price drops steadily while the sensitivity to the stock-return volatility rises. This is in accordance with the prospect theory, and an indication that executives exhibits loss-aversion.

Bettis et al (2005) state that increased volatility decreases the expected time to exercise. Their study examines options with ten years to maturity and with a vesting period of two years. They estimate an average expected time to exercise of 5.7 years, and find that for a 50 percent increase in stock price volatility, the expected time to exercise decreases by almost 1 ½ year. In addition, an increase in volatility also increases the expected stock price at exercise, the expected cancellation or forfeiture rate and the amount of the remaining option value sacrificed by early exercise. Carpenter et al (2010) use numerical examples with CRRA utility to show how the exercise boundary and option cost vary with volatility. In contrast to standard option theory, executive stock option cost can decline with increases in volatility, since increased volatility causes the optimal exercise boundary to drop. Similarly, Kahl et al (2003) shows that the implied value of restricted stocks is decreasing with the volatility of the firm's return, because an increase in volatility implies that the undiversified illiquid position held by the executive is riskier without any compensating increase in its expected return.

Jost and Wolff (2003) investigate the impact of volatility on the subjective value of stock options for executives. They suggest that the executive would have no incentive to increase the volatility giving the assumption that executives possesses both risk-aversion and loss-aversion and applies objective probabilities in the evaluation of the stock option grants. The absence of incentives to increase volatility is due to the declining marginal utility towards wealth, combined with a strong aversion to potential losses. Executives would therefore try to reduce rather than increase volatility. Contrary to common notion that stock options necessarily cause executives to become more risk-seeking, Jost and Wolf find that it might actually create an incentive to lower the volatility, depending on how much the options are in-the-money. This is due to the fact that the manager will try to secure the existing value rather than risking losing it. Stock options can only create incentives to raise volatility if the manager is either optimistic or overly sensitive to small probabilities. Jost and Wolff (2003) suggest that if shareholders want to increase volatility by managerial incentives, they should set a high exercise price for the executive's options. Consequently there is a trade-off between the increase in the subjective pay-volatility intensity, the increase in the value of the stock option grant for an increase in the future volatility of the stock price, against the potential of causing a deadweight loss and a reduction in the pay-performance intensity.

In line with the loss-aversion and diminishing sensitivity theory, executives find stock price volatility an advantage in negative stock price trends, but deducts for stock price volatility in positive trends. Thus, executives holding options in-the-money will try to reduce rather than increase the volatility. For positive stock price trends, higher volatility decreases executives' subjective valuation, and also decreases their incentive for risk-seeking. Thus, increasing volatility can escalate the cost for the firm by more than the potential savings from early exercise.

4.1.7 Loss-aversion

The loss-aversion index is of psychological nature (Köbberling and Wakker, 2005). It is affected by the psychological perceptions of the reference point, and thus explains the underlying known discrepancies between willingness to pay and willingness to accept. Loss-averse executives will demand a high risk premium for being exposed to losses. As a consequence, shareholders will offer a contract that pays at least the reference wage most of the time in order to avoid paying risk premium (Dittmann et al, 2006). A standard principal agent model with loss-averse agents suggests contracts that offer a high base salary together with options. This compensation package is more attractive compared to contracts that expose a larger fraction of the CEO's wealth to risk, like restricted stocks together with lower base salaries as suggested by the standard expected-utility model (Dittmann et al, 2006).

Pursuant to Devers et al (2005), the tendency in the market of investors and traders selling appreciating stocks too early and hold on to depreciating stocks too long, is consistent with loss-aversion. In accordance with prospect theory and loss-aversion, research indicates that managers owning stocks outperforming the market will exhibit preferences for risk-aversion and sell off appreciating stocks to secure the value of current gains at the expense of further profit. Similarly, owners of poor stock performance exhibit preferences for risk seeking and will thus continue to hold depreciating stocks to avoid incurring immediate losses and holding on to the opportunity that offers the potential to mitigate the prospect of loss. This is in line with the findings of Devers et al (2005) suggesting that loss-averse executives exhibit preferences for risk-aversion in positive trend in the stock market, and preferences for risk seeking in negative trend. Implementing the assumption of loss-aversion raise question about the effectiveness of stock option compensation to uniformly encourage managerial risk seeking, and thus achieve incentive alignment.

Assuming loss-averse executives, the value of an outcome is treated as a function of two arguments, the reference-point and the magnitude of change from that point. The assumption of loss-aversion will make the executive's valuation of options less than its market value. Small probabilities of gains will be discounted, and thus the Black and Scholes valuation will be too high to represent the executive's subjective value. The characteristic S-shaped value function from prospect-theory has its steepest range at the reference point, indicating that the incentive effects are more effective near the executive's reference point. Thus, the incentive effects will have its steepest range for stock prices near the exercise-price. However, the reference point that distinguishes gains from losses will be individual, and what executives will weight as loss and gains will be decided through their own preferences and utility, often through their expectations on the outcome. As a result of the phenomena effect, stated in prospect theory as the contribution of risk-aversion in choices involving sure gains and to risk-seeking in choices involving sure losses, higher in-the-money options will lose its incentive effects, making the executive become risk-averse since even higher gains will have less effect than the risk of losing some of the gain. In addition, the incentive effect for risk-seeking will increase for highly out-of-money options.

4.1.8 Diminishing sensitivity

Diminishing sensitivity implies that the impact of a difference is diminished when two alternatives are remote from the reference point for the relevant dimension. According to the diminishing-sensitivity assumption in prospect theory, the subjective impact of a change in the absolute payoff decreases with the distance from zero, that is, the marginal value of both gains and losses decreases with their size (Tversky and Kahneman, 1991). Results from Köszegi and Rabin's (2007) study shows that diminishing sensitivity is a significant feature of gain-loss utility.

Erev et al (2008) brings forth a conclusion that loss-aversion and diminishing sensitivity determine the effect of experience on choice behavior. However, their experiment shows that behavioral tendencies in decisions based on experience are often better described as the impact of diminishing sensitivity to absolute payoffs rather than loss-aversion effect. Evidence for loss-aversion in decisions based on experience can often better be explained by the assertion of a strong diminishing sensitivity effect. The fact that many individuals are under-invested in the stock market can be explained through the diminishing sensitivity hypothesis rather than loss-aversion. Diminishing sensitivity will reduce the executive's estimation of subjective value with the same arguments as those used for loss-aversion. Erev et al (2008) show that the tendency to prefer safe outcomes that ensure a positive return over risky outcomes with a much higher average return is explained with the contention of low sensitivity to the difference between the different gains.

In particular, making the executive's compensation more sensitive to changes for performance indicators at low levels of the stock price makes it more difficult to provide strong incentives at higher levels (Kadan and Swinkels, 2007). This will lower the executive's responsiveness to stock price changes at higher levels, which potentially can result in a decrease in his optimal choice of effort. The impact of diminishing sensitivity will decrease the growth in subjective valuation the executive places on the compensation as the options move further in-the-money. Thus the cost of rewarding executive's with options ending highly in-the-money will not be justified by the induced incentive effects which will decrease in growth as the stock price increase.

4.2 The certainty equivalence approach

To estimate the value of a non-tradable option to an undiversified risk-averse executive, several studies (Lambert et al. 1991, Hall and Murphy, 2000, 2001) use the certainty equivalence approach. The certainty equivalent value is defined as the amount of riskless cash the executive would exchange for his risky option compensation. This is also referred to as the subjective option value, where the value is the amount of freely investable money that would give the executive the same utility as the options (Carpenter et al, 2010).

Finding the subjective value from the certainty equivalent approach, is achieved through calculations of the expected future distribution of stock prices and option payouts in a binomial model, anticipating a CRRA utility function. Making use of the assumption of constant relative risk-aversion, results indicates that the value of a stock option is significantly lower to the executive than what it cost the firm. Hall and Murphy (2003) find that employee value newly granted at-the-money options with a value equal to about half of the real cost to the firm. In addition, the value-to-cost ratio is considerably smaller if the executive is granted premium options, if the exercise prices increases over time or if the options have a long vesting period. Hall and Murphy (2000) also show that the certainty equivalent value decreases with risk-aversion and increases with non-firm-related wealth. Executives with large holdings of company stock relative to their wealth will therefore place lower values on options, resulting in a decrease in the certainty equivalent value.

The difference between the cost of the option to the firm and its certainty equivalent value is part of the cost of extracting better performance. This can be seen as the agency cost of the inefficient risk allocation necessary to provoke unobservable or non-contractible effort. The result is that the total cost of eliciting better performance may be quite high. However, there is empirical evidence of positive stock price reactions to announcements of the adaption of an option plan, and the benefit from market's anticipation can thus outweigh these costs (Carpenter et al, 2010). Hall and Murphy (2000) suggest that it is best to grant options with a low exercise price to minimize the value gap. They argue that restricted stocks, which is options with an exercise price of zero, dominates options with non-zero exercise prices.

4.3 Executives' subjective valuation of equity grants

To determine the real cost of awarding executives with equity grants, a central aspect is to find their subjective valuation of the compensation, which highly depends on their exposure towards risk. There are several reasons why executives have risky, undiversified portfolios with large holdings of the firm's stock. The holding might contain restricted stocks or incentive options which cannot be traded freely, executives' contract can require large holdings of the company's stock, or restrictions might be due to a large capital gain that executives are unwilling to realize. In addition, the holding can contain pension or profit sharing plan over which the executive has no control, or the CEO feels morally constrained not to sell his shares (Ingersoll, 2002). In addition to holding options and restricted stocks in their compensation plan, managers typically have considerable investments of human capital in their firm which represent another non-diversifiable component of the manager's total portfolio. This firm-specific human capital may be highly correlated with the firm's stock price

As a consequence, executives are exposed to large holdings of risk. The magnitude of the risk premium given the executive depends on both the total riskiness of his compensation through the firm specific risk, and his individual degree of risk-aversion. Thus, the subjective value the executive places on his compensation portfolio can vary greatly, and this significantly determines the compensation cost towards the firm (Jost and Wolff, 2003). The adequate governance of options and restricted stocks in the provision of compensation and incentives therefore requires measuring both the executive's subjective value, the real cost to the firm and the incentives provided by the executive's compensation plan.

Lambert and Larcker (2004) propose a critic against the study of Hall and Murphy (2000), saying that their analysis is a partial equilibrium that does not formally incorporate the cost of the option, the value to the employee, or the incentives provided by the options into an optimization program. Also, Jost and Wolff (2003) argue against the model of Hall and Murphy and conclude that their results are skewed due to the specification of their model. They believe that executives do not value stock option plans according to expected utility theory but are limited rational. If an executive is rational, his valuation of a compensation plan is based on his expected personal gain in wealth according to the realized stock price at the time of exercise, and not the subjective probabilities he attaches to different realizations of stock prices. Jost and Wolff use the prospect theory to estimate the subjective value of a stock option plan to an executive with limited rationality. They generalize the model of Hall and Murphy by taking framing, diminishing sensitivity and loss-aversion into consideration in the value function of the certainty equivalent model. Consequently, they find that options can be an efficient method to induce incentives, and even be a cheap method of compensation if the executive is optimistic in the sense that he overstates the likelihood of positive outcomes.

Lambert et al (1991) brings forth results that adding restricted stocks to an option based compensation plan can give conflicting effects. The first effect is a wealth effect that could increase option cost, and the second effect is the consequence of increasing the executive's exposure to firm risk which can reduce option cost. Carpenter et al (2010) find that adding restricted stocks to the original compensation reduces option cost and average option life, thus the second effect dominates. In addition, their results indicate that the subjective value of options decreases with the size of the restricted stock holding.

Several studies find that the implied costs associated with executive stock options and restricted stocks are significantly less than its market value. Meulbroek (2001) find that executive stock options with a ten year to maturity and a vesting period of three years, are worth only 53-70 percent of their Black and Scholes value. However, this is likely an underestimate of the true loss the executive experiences since the model excludes the effect of personal preferences about risk exposure. In addition, this cost is greater for high-volatility firms or when managers have a great part of their personal wealth related to the firm's stock price (Meulbroek, 2001). Similarly, results from Hall and Murphy (2002) indicate that executive stock options are worth only 40-60 percent of their Black and Scholes value if the options have ten year to maturity. Bettis et al (2005) find that the subjective value of an option with seven year to maturity and an excepted time to exercise of 5,75 years, is approximately 20 percent lower than the objective value of the option. However, with a vesting period of one year, Core and Guay (2003b) find that the executive will value the option at 94 percent of its market value. These results indicate the importance of taking into account the vesting period when considering the subjective value of the compensation.

The impact of illiquidity on restricted stock values can be just as severe as on executive stock option values, and significant larger the more overall welfare is affected. If stocks are restricted for five years and represents 50 percent of the executive's wealth, Kahl et al (2003) find that the executive would be better off if he could sell his restricted stocks for 30-80 percent of its market value. As the length of the liquidity restriction horizon grows from one to five years, their findings show that the subjective value of the restricted stock can decrease more than proportionately. Kahl et al find evidence that these costs are even higher when nearly all of the executive's wealth is tied up in restricted shares or if the executive is prohibited from diversifying his restricted shares with offsetting stock market strategies. These costs further increase with managers' risk-aversion, and the magnitude of the implied cost on restricted stocks is thus in the same order as the implied cost with executive stock options (Kahl et al, 2003). These findings are important since there is a widely belief among practitioners that restricted stocks have only a minor cost to the shareholders, and are a much more efficient form of compensation than executive stock options.

Clearly, there are costs to the firm providing too many or too few equity incentives, resulting in inefficient compensation contracts. The executive may not take actions that maximize shareholders wealth, or they require a large risk premium when too many incentives are provided. Granting a risk-averse executive too many options can make him quite affluent at moderate stock prices. Since higher wealth translates into a lower marginal utility of income, the executive will be less motivated by compensation changes at higher levels of stock prices. This lower his responsiveness to stock price changes at high levels, potentially by enough to actually decrease his optimal choice of effort. As a consequence of diminishing sensitivity, there will be a tradeoff between providing incentives at one stock price level, and the ability to do so at higher stock prices.

If a risk-averse manager has a significant portion of his wealth tied to the stock price, the value of his compensation contract can be substantially different from the cost as perceived by shareholders. If the probability that the option will finish in the money is sufficiently high, executive stock options can reduce the initial incentive effect. Hall and Murphy (2000) conclude that equity grants are an expensive form of compensation since the value perceived by the executive can be substantially smaller than the cost to the firm. They conclude that option grants impose more risk on executives per dollar of compensation compared with the risk per dollar imposed. Bettis et al (2005) support these findings by showing that the subjective values of the options are uniformly lower than the corresponding objective values, and the difference is increasing relative to stock-price volatility.

The cost difference between the market value of equity grants, and the subjective valuation by the executive, is often referred to as the deadweight cost to the firm. The introduction of the reference-point, loss-aversion and risk-aversion reduces the value of the stock option to the executive, and hence increases the deadweight cost towards the firm. However, the decision weighting process represented in prospect theory can yield opposite results (Jost and Wolff, 2003). If the executive has a tendency to be overly optimistic it would increase the subjective value of the stock options. If executives' expectations regarding the firm's future returns are highly optimistic, the firm can more effectively induce incentives by offering options rather than restricted stocks (Oyer and Schaefer, 2003). Supportive to these findings, Devers et al (2005) presents evidence that executives' subjective valuation of options in their compensation portfolio can exceed the Black and Scholes valuation. They argue that the endowment effect is likely the reason that executives' valuation can be higher. They find that executives place a higher value on awarded stock options than on identical, un-awarded options. Thus, the willingness to accept value consistently exceeds the willingness to pay value. This difference demonstrates that once awarded, executives attach a positive value to options in their equity portfolio, even though these options are restricted from exercising. Optimism might be correlated with productivity, especially in firms which invest greatly in human specific skills and thus, the selection effect from options might result in highly motivated executives. Given the asymmetric payouts from a stock option, an optimistic effect can be compounded by an emotional overemphasis of unlikely extreme outcomes. Thus, decision weighting could lead the executive to place a higher perceived value of the stock option grants which can lower the deadweight cost or even lead to a value surplus.

Overall, unless the executive has a very high tendency to overweight small chances of high outcomes, the value gap is always minimized by setting a medium to low exercise price on the options (Jost and Wolff, 2003). Jost and Wolff suggest that given sufficient optimism, options might be a cheap method of compensation since the optimism can more than compensate for risk-aversion. As a consequence, it is always necessary to take the subjective preferences of the executive into account when constructing an incentive contract. Depending on their risk-aversion and their level of optimism, the executive's evaluation of restricted stocks and options is likely to vary significantly.

4.4 Sticks or Carrots?

Firms with cash constraints are expected to use stock options and restricted stock as a substitute for cash payment, since these forms of compensation require no concurrent cash payout (Core and Guay, 1999). In the United States, stock- and option grants can also be driven by tax motivations, since the use of stock-based compensation is expected to be less costly for firms with low marginal tax rates (Core et al, 2003), or firms can favor stock option compensation because of the financial accounting treatment (Core and Guay, 1999).

Hall and Knox (2002) use the certainty-equivalent approach and finds that option incentives are much more fragile than stock incentives. In response to stock price changes, the incentives provided by stocks changes less than those provided by options. The incentive changes provided by options are proportionately smaller when return volatility is higher since high volatility gives a reasonable chance of moving options back into-the-money before expiration. The study also acknowledges loss-aversion by showing that the incentives provided by the changes in the executive's wealth in response to changes in firm value, are much more responsive on the downside of the compensation than on the upside.

The value of a given compensation component depends on the structure of the remainder of the compensation portfolio. To ensure that overall incentives are the same, lowering option holdings are always matched by an increased holding of the firm's stock. When the firm replaces some options with stocks, the contract becomes more valuable to the CEO since options are worth less than the corresponding number of shares. Hence, replacing options with stocks implies that the base salary decreases (Dittmann et al, 2006). If a manager's compensation is converted, where an option package is substituted for a portion of the manager's fixed payment, the manager's wealth related to the stock price will increase, thus risk-aversion will rise and expand his incentive to decrease the variance of stock returns. However, this will not be the case if options are purely added to the existing compensation contract (Lambert et al. 1991). In this case, Hall and Murphy (2002) find that incentives are maximized at exercise prices at or near the grant-date market price. However, if the company can adjust the existing compensation portfolio, managerial incentives are more efficiently provided through restricted stocks than options.

Ingersoll (2007) composes a model to estimate executive's subjective value of options and restricted stocks, and the incentive provided by these form of equity-compensation. The results show that the objective value of a company's stock with a ten-year restriction is substantially higher compared to an otherwise identical option with ten-year vesting period. This is in accordance with the usual comprehension that options are a cheap method of aligning executives and shareholders' interests. However, this might no longer be the case when measuring the subjective value. For very risk-averse managers who have a substantial stock holding, the objective cost compared to the subjective benefit favors restricted stocks. In extreme cases, using restricted stocks can be almost five times as cost effective as options in the executive's compensation.

Restricted stocks have several advantages over stock options in providing incentives to chief executives. Restricted stocks provide relatively stable incentives regardless of the stock price, whereas with stock options the incentive value depends on the market price relative to the exercise price. Options in market where the price is well above the exercise price provide incentives that are similar to those provided by restricted stocks. However, the incentive value changes once the stock price falls sufficiently below the exercise price so that the executive perceives little chance that the options will ever provide a payoff. This argument is widely used for companies lowering the executive's option prices or even replaces the out-of-the-money options with new option grants when the market falls.

Compensating the executive with options rather than restricted stocks affects managerial incentives to engage in risky investments. In line with prospect theory, where risk aversion in the positive domain is accompanied by risk seeking in the negative domain, executives holding far out-of-the-money options will have incentives to undertake riskier investments compared to executives holding in-the-money options. For executives holding stocks instead of options, the investment incentives are roughly independent of stock prices, unless the price is sufficiently low so that the risk from bad performance is transferred to the debt holders. Also, executives holding restricted stocks rather than options have better incentives to pursue an appropriate dividend policy. Restricted stock compensation also provides incentives to avoid accounting manipulation, by preventing the executives to boost up the stock price before the expiration date of options and thus risk ending up with accounting scandals like the Enron case.

The use of carrots over sticks is frequently optimal, especially when risk-aversion is low and reference income is endogenous (Meza and Webb, 2006). As long as the reference income is neither significantly high nor very low relative to the optimal level in the absence of loss-aversion, de Meza and Webb find that there will be an interval over which compensation does not depend on performance. Dittmann et al (2010) extend their analysis and show that parts of the optimal wage function are flat where the median of the income distribution is close to the reference income. The principal agent model with loss-aversion will generate convex contracts because the executive's aversion to risk is concentrated near the reference-point, where risk tolerance is almost zero. As the payout increases, the executive becomes more risk tolerant. Risk-aversion is thus concentrated around the reference-point and because of diminishing sensitivity it becomes negligible far away from this point. Optimal risk sharing implies that the fast increase in risk tolerance leads to optimal compensation contracts that are convex. Adding loss-aversion, the executive is risk-loving in the loss space, so any incentive payment within this space is inefficient. The analysis of Dittmann et al (2010) suggests that the optimal loss-averse contract can be implemented best with a combination of stock and options. The risk-tolerance effect increases with the extent of loss-aversion. Thus, the more risk-averse the executive is towards losses, the more options are used in the optimal compensation contract.

The findings of Jost and Wolff (2003) suggest that a way to minimize the deadweight cost and maximize the incentives is to choose either restricted stocks or options with an exercise price set at the market value of the stock at the time of grant. Barron and Waddell (2008) suggest that if the shareholders are constrained to set the exercise price at-the-money, their response should be to substitute options with restricted stocks.

There is a trade-off faced by the firm when setting exercise prices for executive options: increasing the exercise price reduces the incentives of each option granted, but also reduces the company's cost of granting the option. The incentive-maximizing exercise price will depend on the usual parameters in the Black and Scholes function, but also on other factors such as the degree of risk-aversion, loss-aversion, the time to maturity and vesting period, wealth, the probability of re-pricing, initially stock holding, and number of options to be granted. Inducing optimal incentives from restricted stocks will also depend on these factors, making it a complex problem for solving the optimal compensation contract for executives.

4.5 Justification of the high CEO compensation

Adding loss-aversion to the standard principal agent-model can explain why bonuses are paid for good performance rather than penalizing poor performance. Subjecting an executive to the discomfort of loss relative to his reference income can be too costly to efficiently induce good performance. This is especially the case when the comprehension of losses can be reduced by lowering the median income. The use of option-based compensation in the executive's compensation portfolio can therefore be an efficient compensation form.

The deadweight cost brings forth the question whether compensation in specific firms are weighed to heavily toward incentive-alignment to be cost efficient. Hall and Murphy (2002) show that as the level of total compensation for S&P 500 executives has expand dramatically over the last decade, the growth in risk-adjusted pay has been relatively modest, indicating that the executive's subjective value has increased far less than the company cost during the period. To determine whether options and restricted stocks are an efficient method of providing compensation, the question is whether the attraction, retention and motivation incentives are sufficient to justify the large compensating differential implied by the wedge between the cost to the firm and the executive's subjective value.

Our analysis brings forth a conclusion that might help explaining the high CEO compensation. We suggest that the main reason why their total compensation is remarkably high is the fact that the vast majority of it is in the form of restricted stocks and options. The alignment of interest between shareholders and executives through risky equity grants, requires high risk-premium which significantly increases the executive's compensation. In addition, the high degree of risk-exposure for the executive results in a subjective value which is much less than the market value.

In section 6, we compose an optimal contract for a risk-averse executive and implement it on real firm data. The optimal contract will take into account factors presented here, which all have a great impact of the executive's subjective valuation of the compensation, and therefore its cost toward the firm. In addition, the optimal contract will greatly depend on the form of the executive's utility functions, whether the minimum compensation constraint is ever binding, and the function that determines how the executive's actions affects the probability distribution of the stock price outcomes (Lambert and Larcker, 2004).

5. Determining the optimal CEO contract

This section presents the results from some of the most popular and relevant agency models in the executive compensation literature, the work of Hall and Murphy (2002), Dittmann and Maug (2007, 2010), Armstrong et al (2007) and Kadan and Swinkels (2008). These models are implemented on observed data, and they all try to determine the optimal contract for a CRRA agent. The models seeks to induce the optimal level of effort by the agent, which experiences an increasing discomfort of effort, described as a convex and increasing function. All models limit the simulated contracting period to one year, and seek to find the contract that maximizes the principal's profit.

Hall and Murphy (2002) investigate the cost and value of option grants for CRRA CEOs. They explain how the lack of CEO diversification and risk-aversion affect the CEO's valuation of equity-linked compensation, and why executives exercise options grants early. They employ the certainty equivalent method to find the CEO valuation of his option, and assume a lognormal stock price distribution. They define the incentive strength from holding an amount of options as the change in CEO value with respect to the stock price, and set out to maximize the incentives, while holding the cost to the company constant. They consider two cases, one where equity compensation is added to the existing contract and one where equity is substituted for a part of the CEO's cash compensation while holding his utility constant. They assume the executive has a 5 M$ wealth, and hold either half or 2/3 of his wealth in the company stock.

The study shows that risk-aversion and the amount of wealth tied to the company stock price greatly affects the optimal exercise price for the CEO's options. For lower risk-aversion and greater diversification, a higher exercise price is optimal. As the CEO's risk-aversion increases and more wealth that is tied to the company stock, the lower is the optimal exercise price of his option award. The range of optimal exercise prices varies from premium to discount options depending on the degree of risk-aversion. The optimal exercise prices will be 25 percent above the initial stock price for the least risk-averse and most diversified executives. For the highly risk-averse CEO with a low degree of diversification, the optimal exercise price is 60 percent below the initial stock price. In addition the study shows that the value to cost ratio of CEO options drop more dramatically for high risk averse and less diversified CEO's as the option vesting period increase. In general Hall and Murphy find that the value of options is lower than the cost, and that the use of restricted stocks gives better incentive effects per dollar spent.

A critique to the study is that it is not a fully developed principal agent model, as it only tests certain part of the optimal contract by the tradeoff between equity and cash compensation. The process of granting equity awards to the CEO by having him forsake a part of his cash compensation is not realistic. However, they show that CEO option valuation differ from that of Black and Scholes.

The 2007 study by Dittmann and Maug calibrates a normal principal agent model for a CRRA executive on a sample of 598 US firms. They assume that CEO's have been given contracts stimulating optimal performance. The objective of the model is to recalibrate the contracts, giving the CEO's the same level of utility for different degrees of risk aversion, but at a lower cost for the principal. The model sets out to maximize the principal's profit, subjected to the constraints that the expected utility and utility-adjusted pay-for-performance sensitivity should equal those of the observed contract. The model uses lognormal stock prices, and uses a first-order approach in order to evaluate the CEO's effort (Dittmann and Maug, 2007, page 311-313).

The main implications from this study are that CEOs should receive lower base salary, more restricted stocks and almost never options. They find that 96 percent of the sample firms differ from the optimal contract suggested by the model. Almost half of the CEOs should receive no salary at all, but rather purchase company stock from their private savings (Dittmann and Maug, 2007, page 305). As the CEO risk aversion increase, the amount of executives that receive options and are required to invest in the company stock decreases. The average firm saving from the new CEO contract is 19,6 percent for the base case in the model.

A critique towards the study is that it allows negative option holdings in some of their calculations. It also assumes that the given contract inspires the CEO to utilize the optimal level of effort. The methodology of using the first-order approach to measure the agent's incentives is criticized by Armstrong et al (2007). The argument is that the use of this method becomes invalid for power utility and lognormal stock prices, rendering the use of an utility-adjusted pay-for-performance constraint problematic.

Armstrong, Larcker and Su (2007) create an agency model mimicking the contracting problem between the shareholders and the CEO for a sample of 46 firms from the fortune 500. They assume that the risk-averse agent has a power utility and incorporate the agent's wealth in the model. They estimate the executive's wealth as five times his cash compensation plus the estimated value of his pension plan. To solve the optimization problem they apply numerical methods in optimizing the agent's contract, consisting of fixed pay, stocks and options granted at-the-money. The objective function of the model is to maximize the payoff to the principal less the cost of the contract for a single period. Armstrong et al find the optimal contract to consist of less salary, less stocks and more options. The average optimal (actual) contract consists of a base salary of 2 070 044 (3 911 474) $, 22 607 (1 503 151) stocks and 1 122 174 (581 423) options.

Armstrong et al (2007) argue that Hall and Murphy (2002) and Dittmann and Maug (2007) do not completely solve the optimization problem between the agent and the shareholders, and that the use of the first order approach is problematic for lognormal stock prices and power utility. In contrast to these studies, Armstrong et al find that options are almost always part of the optimal CEO contract. They also discover that the incentive effects from the CEO contract in some cases can be outperformed by the incentive effect from preexisting wealth.

A weakness with this model is that they only test for option grants set at-the-money. Lambert and Larcker (2004) previously found support for options and restricted stocks being a part of the optimal contract, but with an exercise price set out-of-money.

Kadan and Swinkels (2008) test a principal agent model on 2418 firms in the period 1992-2004. They use a quadratic cost function of effort and apply the first-order approach on the manager's incentive constraint. They test how managers should be compensated through fixed salary, stocks and options for different degrees of firm viability, and find increasing bankruptcy risk to be associated with granting of stocks instead of options. However, if the risk of bankruptcy can be neglected, pure stock compensation is never optimal. The study finds support for the use of restricted stock awards for new start-up firms with high non-viability risk and the use of options for firms with lower bankruptcy risk.

Kadan and Swinkels also show that awarding a risk-averse manager with too many options can reduce the incentive effect from the options. As moderate increases in the stock price can increase the manager's wealth substantially, it lowers the responsiveness towards further stock price increases, potentially decreasing the optimal level of effort.

A weakness with the study is how they define the CEO's equity compensation. They do not allow for both stocks and options to be awarded simultaneously, and only look at either case. This limits the possible scenarios of compensation composition that are tested, and gives the results less validity.

The 2010 study by Dittmann and Maug analyze executive compensation when the CEO is loss averse and compare the results from the agency model with observed contracts for 595 US firms. They assume the CEO exhibits properties as described by the prospect theory. The CEO is depending on a reference point when valuing his wealth, exhibits loss aversion and has a diminishing sensitivity. They develop a methodology for the agency model corresponding to their 2007 study and incorporate the features from the prospect theory. The parameters for risk- and loss aversion calculated by Tversky and Kahneman are applied in the model. As in the first study, they assume the CEO displays the optimal effort level under the observed contract, and use the first-order approach in order to determine the CEO's effort and recalibrate the contracts.

Dittmann and Maug find this model to give a better explanation of the observed practice of granting executives options and a high fixed salary than a normal risk-averse agent model. When comparing the results from the loss-averse model with a pure risk-averse model they find options to be a part of the optimal contract in 83,3 percent of the cases, compared to 30,8 percent with a risk-averse model. They also find base salary to be positive for 59,66 percent of the executives in the sample, compared to 1,7 percent with the risk-averse model (Dittmann and Maug, 2010, page 2031).

An unrealistic assumption for both the risk-averse and loss-averse model in the study is that they both allow negative option holdings when calculating the optimal contact. Short positions in call options, or awarding put options is not an applied practice for CEO compensation. In principle, this works against the purpose of incentive contracts that is to inducing CEO risk taking and creating shareholder value. For Norwegian executives it is illegal to hold short positions in the company stock or option, in order to avoid insider trading.

We propose a critique to the studies above for have a somewhat limited scope. Besides the study of Armstrong et al (2007), the models do not mimic a realistic compensation allotment. By allowing short option holdings or not assessing both stocks and options in the compensation simultaneously, they cannot claim to find an optimal contract. The studies that explore the impact of option exercise price fail in doing so on an optimized contract. On the other hand, in the studies where the contract is truly optimized, the effect of different exercise prices is not examined. Neither is the certainty equivalent method applied on an optimized contract. As we see the need for a more extensive model, we set out to exceed these shortcomings and develop a more realistic model that takes account of loss-aversion, subjective valuation and test for more than one exercise price.

6. Principal agent model

To determine the optimal executive contract, we develop a principal agent model in the lines of Dittmann and Maug (2007, 2010). We take into account loss aversion and the CEO's subjective valuation of his options trough the certainty equivalent method. Following we present our theoretical model and the results from the model implementation on a set of Norwegian firms.

6.1 Theoretical Principal Agent model

We model the stock price, S_t, to have a lognormal development. The lognormal stock price depends on the risk free rate, r_f, the firms volatility, σ, a random normal variable, u, the dividend payment rate δ and the initial stock price, $S_0(e)$, which is defined as strictly increasing function depending on the CEO's effort, e.

$$(1)\ S_t(u,e) = S_0(e) * exp\left[\left(r_f - \frac{\sigma^2}{2} - \delta\right)T + u\sqrt{T}\sigma\right] \text{ u~N(0,1)}$$

The executive's wealth at time t is represented by W_t. The fixed pay is symbolized by F, W_0 is his initial wealth, n_s the number of stocks, n_o the number of options, K the option strike price and D is the certainty equivalent discount factor of the CEO options. We differ from the models of Dittmann and Maug (2007, 2010) in the way we allow the CEO to invest in the firm. Where Dittmann and Maug permit negative base salary, meaning he is obligated to invest in the company stock, we allow the executive to receive a positive base salary and at the same time allowing him to invest his initial wealth. The CEO can invest a percentage m of his initial wealth into the company stock and place *(1-m)* in the bank at the risk free rate at the beginning of the period. The CEO's wealth at time t, then becomes:

$$(2)\ W_t = (F + (1 - m) * W_0)\exp(r_f T) + S_t(u,e) * \left(n_s + \left(W_0 * \frac{m}{S_0}\right)\right) + n_o * \max(S_t(u,e) - K, 0) * D$$

The certainty equivalent is defined as the risk free amount, v, that the executive indifferently will trade an uncertain part of his compensation against. The left hand side of (*) represents the executive's expected utility from a reward consisting of a non-stochastic constant C, stocks with price S_t, and options with the Black and Scholes value BS (Lambert and Larcker, 1991).

$$(*)\ \int_0^{\infty} U(C + S_t + BS) = \int_0^{\infty} U(C + S_t + v)$$

We do not elaborate the assumptions for (*), as we make some simplifications to the certainty equivalent approach. Using data from Lambert and Larcker (1991) we run a regression to simplify our model, and obtain an approximation of the certainty equivalent for a CRRA executive. We obtain exponential functions describing the executive's devaluation of his options depending on his level of risk aversion (0.5, 2, and 3) and the proportion of his wealth tied to the company stock. In addition, we simulate the certainty equivalent value for a risk aversion of 1, as it is not included in the study.

We define the executive's devaluation of his options, due to his risk aversion, as the ratio of the certainty equivalent against the Black and Scholes value of the option:

(3) $D = v/BS$

Figure 6 presents a graphical illustration of the CEO's valuation of his options under different levels of risk-aversion and wealth related to the company stock.

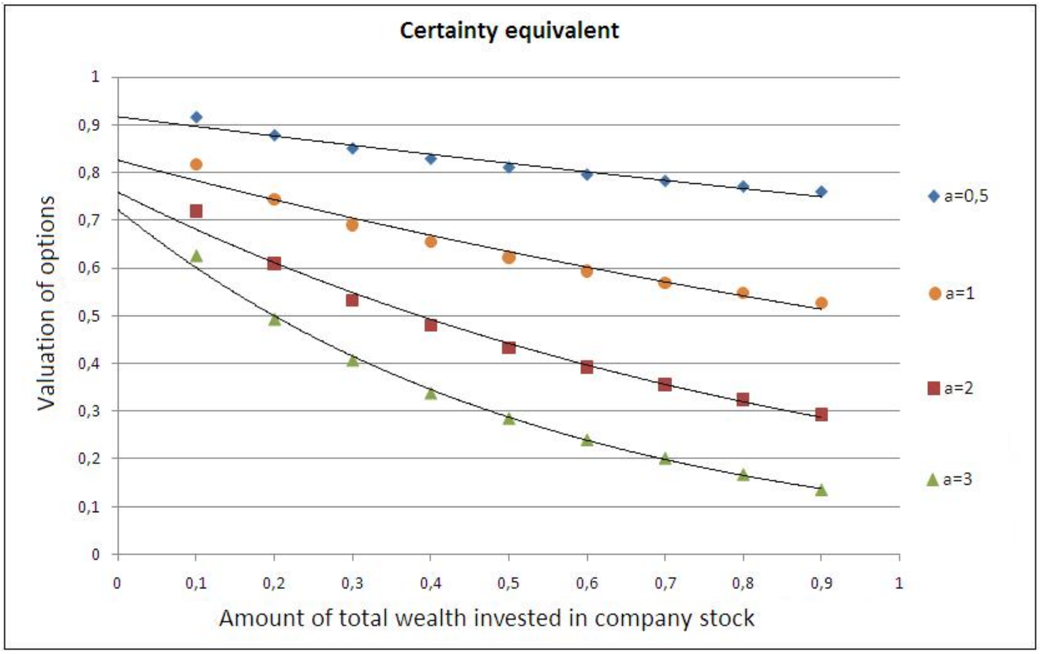

Figure 6 - The certainty equivalent value of the executive options

Equations (a) – (d) represent the executive's subjective valuation of his options, where *a* represents the CRRA parameter and *x* represents the proportion of the CEO wealth invested in risky assets.

(a) D(a=0,5) = 0,9166*exp(-0,244x)
(b) D(a=1) = 0,8256*exp(-0,528x)
(c) D(a=2) = 0,7588*exp(-1,081x)
(d) D(a=3) = 0,7227*exp(-1,845x)

The executive's valuation of his compensation is represented by *V*, where θ is the CEO's reference point, *α* and β represents his risk aversion above and below the reference point and λ is the loss aversion parameter. The perceived reward in the period is the difference between the increase in wealth ΔW_t and his reference point. Following Tversky and Kahneman (1992) and Dittmann and Maug (2010), the executive's assessment of the changes in his wealth can be expressed on the form

(4) $V(Wt) = \begin{cases} (\Delta W_t - \theta)^{\alpha}, for\ W_t \geq \theta \\ -\lambda(\theta - \Delta W_t)^{\beta}, for\ W_t < \theta \end{cases}$

The reference point, θ_t, for the executive's income is affected by expectations based on previous experiences, and represents a psychological reference point for assumed increase in wealth at the end of the period. The reference point is defined as the previous year fixed salary adjusted by the risk free rate, in addition to the increase in value of his stock- and option holdings in the last period.

$$(5)\ \theta_t = F_{t-1} * \exp(r_f * T) + n_s * (S_{t-1} - S_{t-2}) + n_o * (BS_{t-1} - BS_{t-2})$$

The cost of the CEO's effort, C(e), is measured as a quadratic function. Like Schaefer (1998), Köszegi and Lie (2008) and Kadan and Swinkels (2008), we define the cost of effort as:

$$(6)\ C(e) = \frac{e^2}{2}$$

The CEO's utility is given by the change in his wealth at time t, the cost of his effort, *e*, the risk aversion parameters α and β and the loss aversion parameter λ. The CEO utility is kinked around the reference point θ. If the changes in wealth are below this point, it will have a greater impact on his utility due to his loss aversion. The CEO's utility function is defined as the value of his compensation less the cost of his effort.

$$(7)\ U((W_t), e) = V(W_t) - C(e) = \begin{cases} (\Delta W_t - \theta)^\alpha - \frac{e^2}{2}, for\ W_t \geq \theta \\ -\lambda(\theta - \Delta W_t)^\beta - \frac{e^2}{2}, for\ W_t < \theta \end{cases}$$

The principal's profit, π, is represented by the increase in the stock price in addition to any dividend payments δ, multiplied by the total number of outstanding shares, n_{tot}.

$$(8)\ \pi = (\Delta S_t(e, u) + \delta) * n_{tot}$$

The shareholder's optimization problem is to grant the CEO a contract that aspire high levels of effort e~, and maximizes their payoff.

$$(9)\ \max \pi = \max\ (\Delta S_t + \delta) * n_{tot}$$

Subjected to

(10) e~ = arg max $E[U(W_t, e)]$, for $0<e<\infty$

(11) $0 \leq n_s < 1$

(12) $0 \leq n_o < 1$

(13) $n_o + n_s \leq 1$

(14) $0 \leq m \leq 1$

(15) $F \geq 0$

The constraint (10) is the optimal level of effort that solves the optimization (9) to (14). The executive will chose a level of effort that maximizes his expected utility for the given contract. The contract is not optimal if a different contract configuration leads to a higher level of effort and larger payoff to the principal. Constraint (11), (12) and (13) represents the limits on the stock and option award. We do not allow negative stock or option holdings, and limit the maximum award to the number of outstanding shares. Constraint (14) represents the executive's ability to invest his initial wealth in the company stock, and (15) states that the fixed salary must be non-negative.

In line with Benartzi and Thaler (1995), Barberis et al (2001), Langer and Web (2001) and Dittmann and Maug (2010), we apply the risk- and loss-aversion parameters of Tversky and Kahneman (1992) which seems to have become a somewhat standard in loss-aversion studies. The scale of this risk-aversion parameter differs from that of CRRA, where a risk-neutral agent is represented by a CRRA of 0, and the agent becomes increasingly more risk-averse for higher values of CRRA. The definition of the CRRA utility is given by:

$$(16)\ CRRA = \frac{W^{1-a}}{1-a}$$

The experimental risk-aversion parameters calculated by the trial of Tversky and Kahneman are defined in the range between 0 and 1. They exhibits risk-neutrality for α=β=1, and increasing risk-aversion for decreasing parameter values. Benartzi and Thaler (1993) find that λ=2,25 and α=0,88 equals a CRRA parameter of approximately 0,7.The mathematical properties of the prospect theory utility function and the CRRA differ. To employ the certainty equivalent approach which is based on CRRA utility, we define the risk aversion parameters of Tversky and Kahneman to equal a CRRA of 1. As we later will examine how a lower and a higher risk-aversion parameter affects the CEO contract, we find that α=0,95 fits a CRRA of 0,5 and the value α=0,81 approximates to a CRRA of 2. This allows us to utilize the certainty equivalent equation trough equation (a), (b) and (c).

6.2 Implementation of the model

The theoretical model is tested on a sample of Norwegian firms listed on the Oslo stock exchange. A sample of 20 firms of different size and sectors are selected, and the essential data for our model is obtained from the company's annual reports in the period 2005 to 2009. We note the number of the CEO's options and stocks, the average exercise price and average time to expiration, the CEO's fixed and variable pay, amount of exercised options and other remuneration like company car privileges or compensation from board meetings. From the internet stock exchange Nordnet, we obtain the company stock prices in the period, and calculate the annual volatility for each of the firms. The volatility is used to calculate the value of the executive's option holding for all years in our sample.

The model sets out to calculate the optimal contract for a period of one year, 2009. We compare our results with the actual data, to determine whether the executives in fact are given optimal contracts. The CEO's wealth is incorporated when solving for the optimal contract. Obtaining accurate data for the executive's actual wealth is difficult from the available public data. We therefore assume his wealth at the beginning of 2009 equals his cumulative earnings from both equity and non-equity pay the four previous years in addition to the value of his stocks and options held at the end of 2008. In the cases where the CEO had an outside job or another position in the firm in the time period, we took into account any earnings he had accumulated from those positions. We disregard the CEO's acquired pension plan in our model. Due to lack of data on the CEO's earnings, stock- and option awards and option strike prices in the period, we are forced to reduce our sample to 12 firms.

Similar to the study of Kadan and Swinkels (2007), the option strike price is set 10 percent above the initial stock price in our base model. This assumption can be justified by the observed practice in many Norwegian companies. To explore the effects of a lower strike price, we also test how an exercise price set at-the-money affects the optimal contract. We use firm specific data when calculating the optimal contract for each CEO. We set the total CEO compensation in 2008 as his reference point for what he perceives to earn in 2009. In addition to the CEO's wealth and reference pay, we use the firm's previous year volatility and dividend payments as parameters. We assumed a risk free rate of 5 percent for all the firms in our sample.

Our model implements the parameters calculated by the study of Tversky and Kahneman (1992), with a loss aversion parameter of λ=2,25 and a risk aversion of α_1= β_1=0,88. To see how the risk aversion affects the choice of contract we also run the model for a higher and a lower risk aversion, α_2=β_2=0,81 and α_3= β_3=0,95, and the consequently corresponding certainty equivalent functions. Besides the risk aversion parameter we test how the option's time to expiration affects the contract composition, and test for options with one, three and seven years to expiration. When the option has one year to expiration, it is exercised by the CEO at the end of the period. When the option has a longer time period, the value of the option is calculated by the Black and Scholes formula.

Unlike the approach of Dittmann and Maug (2007, 2010) we employ numerical methods in solving the optimal contract. Their studies assume that the agents have been given optimal contracts, and try to minimize the cost of the contracts, while obtaining the same level of effort. In contrast, we do not assume that the given contracts are optimal, nor do we assume that agents are utilizing the maximum firm performance. We set out to determine the composition of the optimal contract that maximizes firm performance when the CEO maximizes his own utility.

The factors determining the firm performance in our model is the firm's volatility, dividend payments, the risk free rate, the CEO's effort and a normal distributed random variable representing different growth prospects in the economy. The two latter will be dynamic while the three former is fixed in our model. We test for multiple random variables to determine the optimal contract for different forms of "bear" and "bull" markets.

The CEO's ability to affect the stock price is modeled as a linear function of his effort. His actual ability to affect firm performance varies with parameters like his personal skills, firm size and business sector. We do not set out to determine the degree the executive's choices actually affect firm performance. However, we test for three different sets of linear effort dependency, where the CEO at his best can influence the stock price by 16.67, 25 and 50 percent by applying the maximum level of effort. The CEO's effort is defined as an integer in the range of 0 to 5000. This restriction is due to two reasons; first as we do not scale the executive's utility this is a suitable interval and it is unlikely that executives exceed this range due to the high cost of effort. Second, to limit the calculation time of our model, it is necessary to restrict the range to a feasible region. We assume the course of action taken by the agent is the optimal choice. We make no discrimination of the quality from the agent's action; rather focus on the quantity of the effort the agent puts into the "right" action. In other words, the agent cannot make a "wrong" choice, only choose to decrease the effort put into the desired task.

We implement our algorithm in Matlab, a mathematical computation software. For every random normal variable, we apply our numerical method, testing all possible contract compositions against multiple decision criteria. We create a three dimensional compensation matrix consisting of base salary, options and stocks. Every contract in the matrix is run against each set of effort dependency. We test possible investment combination the CEO can undertake, when choosing between investing his wealth in the company stock and in the bank at the risk free rate. For each investment alternative, the CEO will choose a level of effort that maximizes his utility under the given contract. Since we incorporate the certainty equivalent method, the CEO will increasingly devaluate the value of any option award as more of his wealth is tied to the company stock. The optimal contract is the one that maximizes shareholders' profit, the increase in firm value less the cost of the CEO's contract.

We run the simulation for multiple random variables, and obtain a set of three optimal contracts for each random variable, one for each degree of CEO effort dependency. We define the optimal contract to be the one with the highest expected payoff to the shareholders, taking into account the probability for the occurrence of each of the normally distributed random variables.

6.3 Descriptive data

Descriptive data, fiscal year 2009				
	Average	Median	Max	Min
CEO Wealth	31 707 468	28 228 026	64 084 708	18 592 167
Total CEO compensation	11 212 034	9 710 416	28 435 838	4 576 912
Fixed Pay	4 791 514	4 717 000	6 495 000	3 260 000
Cash bonus	1 240 399	676 000	4 235 450	-
Amount of CEOs with option holdings	27,27 %			
Amount of CEOs with Stock holdings	90,91 %			
Option holdings for the entire sample	0,0516 %	0 %	0,323 %	0,018 %
Option holding in companies with option plans	0,155 %	0,132 %	0,323 %	0,018 %
Value of CEO options in the companies with option plans	13 071 816	8 228 524	22 758 400	3 252 640
Stock holdings for the entire sample	0,0262 %	0,0035 %	0,1768 %	0,0000 %
Value of CEOs Stocks	4 651 738	2 377 256	19 452 535	-

Average stock increase in 2009	52,37 %

Average stock volatlity 2008	67,37 %
Average stock volatlity 2009	54,24 %

Table 1 - Descriptive data of the sample firms for the year 2009

Table 1 present the descriptive data of our sample. We had to exclude Norwegian Air Shuttle (NAS) from our sample, as the substantial wealth and stockholdings of the company's CEO gives an imbalance to our analysis. Bjørn Kjos, the CEO of NAS owns 25 percent of the company, and has a wealth close to 1000 MNOK. After excluding NAS, there are 11 firms in our sample, with an average CEO compensation of 11,2 MNOK. Only 27,3 percent of the firms use options as part of the CEO compensation. Most firms award the executive with a non-equity performance bonus, averaging about 25 percent of the CEO's base salary. The average increase in stock value in 2009 was 52,73 percent for our sample firms. We will later compare the results from our simulation against the firm performance of the sample firms, and the cost and composition of the executive contracts.

6.4 Results

The following section contains the results from our 1500 hours of computer optimization. Table 2 presents the results for the optimal CEO contract when he has a medium ability to affect the firm performance. Table 3 displays the contract where the CEO has either a low or high ability to affect the development of the firms' value. The stock and option holdings are standardized as a percentage of the total number of outstanding shares.

The results are presented in three ways. The first section presents a discussion on the effect of option exercise prices on the optimal executive contract. Further we show how risk-aversion affects the chosen level of effort and the cost of the optimal CEO contract. Finally, we discuss how the executive's ability to affect the firm performance influences the optimal contract.

NORMAL RISK AVERSION			
Ability to affect stock price	Medium		
Option time to maturity	T=1	T=3	T=7
Presantage increase in stock	80,13 %	69,44 %	71,46 %
Amount wealth invested	99,00 %	100,00 %	100,00 %
effort	4622	4506	4621
Fixed pay	1 500 000	1 150 000	950 000
Amout options	0,14 %	0,10 %	0,10 %
Amount Stock	0,12 %	0,14 %	0,12 %
CEO investment in firm	0,17 %	0,17 %	0,17 %
Total CEO ownership	0,28 %	0,30 %	0,29 %
Contract cost	31 337 452	34 198 383	40 077 964
Contract value, end of period	43 900 610	47 322 002	57 412 061
Value above cost	40 %	38 %	43 %

HIGH RISK AVERSION			
Ability to affect stock price	Medium		
Option time to maturity	T=1	T=3	T=7
Presantage increase in stock	79,72 %	71,07 %	71,00 %
Amount wealth invested	100,00 %	100,00 %	99,00 %
effort	4578	4591	4581
Fixed pay	1 500 000	1 450 000	650 000
Amout options	0,042 %	0,032 %	0,027 %
Amount Stock	0,17 %	0,16 %	0,17 %
CEO investment in firm	0,17 %	0,17 %	0,17 %
Total CEO ownership	0,34 %	0,33 %	0,33 %
Contract cost	34 094 435	38 315 918	38 490 255
Contract value, end of period	49 472 503	55 430 513	58 236 144
Value above cost	45 %	45 %	51 %

LOW RISK AVERSION			
Ability to affect stock price	Medium		
Option time to maturity	T=1	T=3	T=7
Presantage increase in stock	80,55 %	72,18 %	72,06 %
Amount wealth invested	99,00 %	100,00 %	100,00 %
effort	4666	4671	4671
Fixed pay	1 450 000	-	1 150 000
Amout options	0,20 %	0,086 %	0,080 %
Amount Stock	0,046 %	0,10 %	0,11 %
CEO investment in firm	0,17 %	0,17 %	0,17 %
Total CEO ownership	0,21 %	0,27 %	0,28 %
Contract cost	27 733 089	29 173 207	35 848 958
Contract value, end of period	32 470 873	46 263 453	53 680 206
Value above cost	17 %	59 %	50 %

NORMAL RISK AVERSION, EXERCISE PRICE ATM			
Ability to affect stock price	Medium		
Option time to maturity	T=1	T=3	T=7
Presantage increase in stock	84,50 %	71,16 %	71,46 %
Amount wealth invested	99,00 %	99,00 %	100,00 %
effort	4606	4561	4621
Fixed pay	3 700 000	2 850 000	950 000
Amout options	0,028 %	0,10 %	0,047 %
Amount Stock	0,30 %	0,11 %	0,15 %
CEO investment in firm	0,17 %	0,17 %	0,17 %
Total CEO ownership	0,47 %	0,28 %	0,32 %
Contract cost	66 737 102	34 827 121	36 628 505
Contract value, end of period	97 327 348	51 729 911	56 921 000
Value above cost	46 %	49 %	55 %

Table 2 – Optimal contracts, medium effort dependency

NORMAL RISK AVERSION						
Ability to affect stock price	High			Low		
Option time to maturity	T=1	T=3	T=7	T=1	T=3	T=7
Presantage increase in stock	104,75 %	105,94 %	108,12 %	76,85 %	56,36 %	58,68 %
Amount wealth invested	90,00 %	94,00 %	90,00 %	100,00 %	90,00 %	100,00 %
effort	4890	4881	4891	4253	3926	4251
Fixed pay	1 450 000	140 000	250 000	5 800 000	2 000 000	1 700 000
Amout options	0,017 %	0,014 %	0,014 %	0,233 %	0,203 %	0,224 %
Amount Stock	0,049 %	0,096 %	0,049 %	0,233 %	0,148 %	0,162 %
CEO investment in firm	0,16 %	0,16 %	0,16 %	0,17 %	0,14 %	0,17 %
Total CEO ownership	0,21 %	0,26 %	0,20 %	0,40 %	0,29 %	0,33 %
Contract cost	8 518 824	12 532 321	7 803 940	58 380 503	53 333 977	73 167 194
Contract value, end of period	16 131 377	24 432 564	15 405 457	72 986 723	65 917 249	95 330 667
Value above cost	89 %	95 %	97 %	25 %	24 %	30 %
HIGH RISK AVERSION						
Ability to affect stock price	High			Low		
Option time to maturity	T=1	T=3	T=7	T=1	T=3	T=7
Presantage increase in stock	104,59 %	107,98 %	107,98 %	62,91 %	58,02 %	57,94 %
Amount wealth invested	89,00 %	89,00 %	89,00 %	100,00 %	100,00 %	100,00 %
effort	4878	4881	4881	3974	4121	4111
Fixed pay	1 450 000	720 000	850 000	8 437 000	1 680 000	3 900 000
Amout options	0,010 %	0,010 %	0,010 %	0,154 %	0,261 %	0,149 %
Amount Stock	0,056 %	0,053 %	0,053 %	0,235 %	0,183 %	0,235 %
CEO investment in firm	0,159 %	0,152 %	0,152 %	0,170 %	0,170 %	0,170 %
Total CEO ownership	0,215 %	0,206 %	0,206 %	0,404 %	0,353 %	0,404 %
Contract cost	8 757 010	8 478 500	8 744 995	67 655 355	68 925 050	75 533 331
Contract value, end of period	16 994 659	15 921 703	16 188 199	84 920 727	89 096 777	99 945 206
Value above cost	94 %	88 %	85 %	26 %	29 %	32 %
LOW RISK AVERSION						
Ability to affect stock price	High			Low		
Option time to maturity	T=1	T=3	T=7	T=1	T=3	T=7
Presantage increase in stock	104,91 %	108,25 %	108,25 %	77,40 %	59,52 %	59,39 %
Amount wealth invested	90,00 %	90,00 %	90,00 %	99,00 %	100,00 %	99,00 %
effort	4902	4901	4901	4391	4401	4391
Fixed pay	1 250 000	-	-	4 500 000	570 000	1 450 000
Amout options	0,024 %	0,022 %	0,022 %	0,273 %	0,216 %	0,234 %
Amount Stock	0,042 %	0,040 %	0,040 %	0,106 %	0,098 %	0,111 %
CEO investment in firm	0,162 %	0,155 %	0,155 %	0,167 %	0,170 %	0,167 %
Total CEO ownership	0,203 %	0,195 %	0,195 %	0,273 %	0,268 %	0,279 %
Contract cost	8 080 291	6 982 876	7 718 640	49 008 966	52 906 789	70 040 811
Contract value, end of period	15 085 646	13 978 396	14 647 272	56 467 391	65 736 006	86 723 927
Value above cost	87 %	100 %	90 %	15 %	24 %	24 %
NORMAL RISK AVERSION, EXERCISE PRICE ATM						
Ability to affect stock price	High			Low		
Option time to maturity	T=1	T=3	T=7	T=1	T=3	T=7
Presantage increase in stock	115,17 %	106,86 %	108,12 %	76,70 %	58,61 %	58,68 %
Amount wealth invested	100,00 %	89,00 %	90,00 %	100,00 %	100,00 %	100,00 %
effort	4869	4801	4891	4241	4221	4251
Fixed pay	1 550 000	100 000	250 000	8 500 000	1 050 000	1 450 000
Amout options	0,010 %	0,014 %	0,014 %	0,12 %	0,25 %	0,23 %
Amount Stock	0,24 %	0,05 %	0,05 %	0,30 %	0,12 %	0,16 %
CEO investment in firm	0,17 %	0,15 %	0,16 %	0,17 %	0,17 %	0,17 %
Total CEO ownership	0,41 %	0,20 %	0,20 %	0,47 %	0,29 %	0,33 %
Contract cost	47 634 074	7 013 232	7 824 524	83 256 186	61 649 404	76 300 223
Contract value, end of period	84 739 745	14 137 357	15 424 169	116 673 980	80 023 849	96 355 949
Value above cost	78 %	102 %	97 %	40 %	30 %	26 %

Table 3 – Optimal contracts, High and low effort dependency

6.4.1 Normal risk-aversion and the effect of option exercise price

The process of setting the option exercise price has been subjected to vast discussions in the executive compensation literature. In this section we explore the effect of option exercise prices on the optimal contract for a loss-averse executive with normal risk-aversion and medium ability to affect the firm performance. Figure 7 (a) displays the firm performance and contract cost for premium options with different time to maturity. Figure 7 (b) shows the impact of setting the exercise price at-the-money.

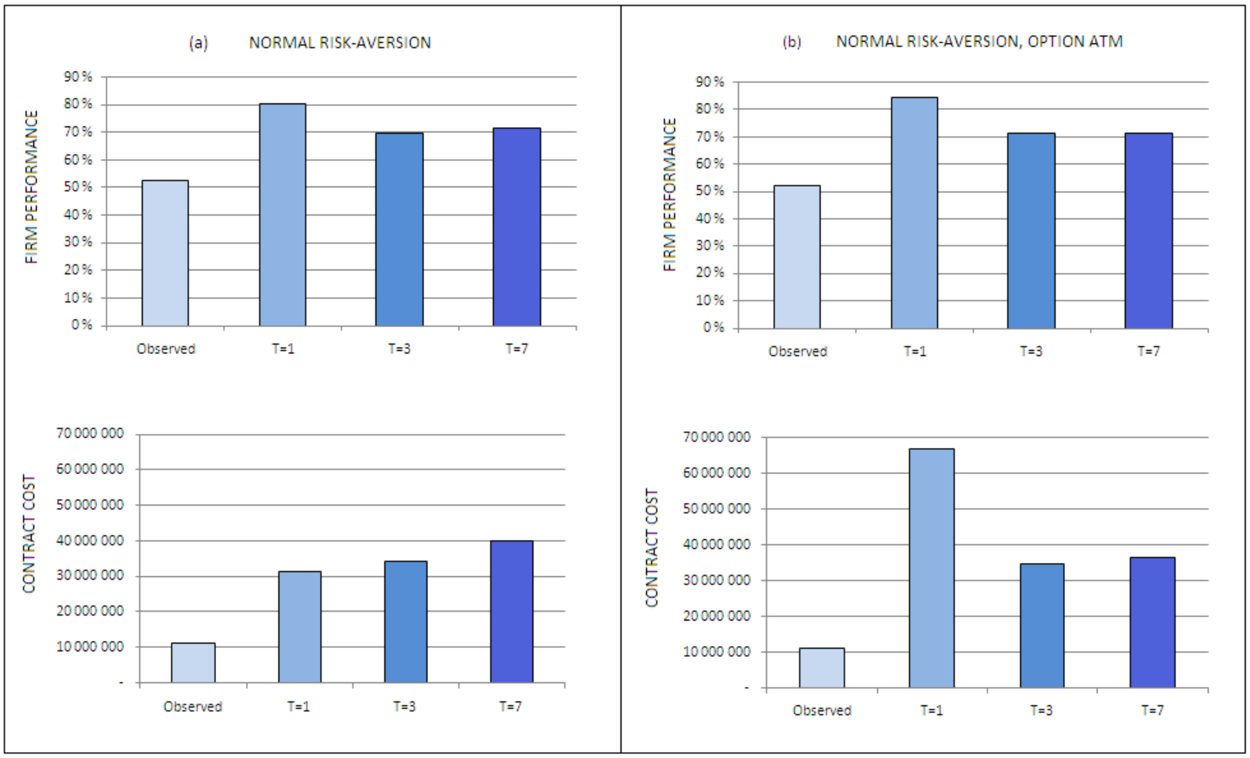

Figure 7 - Optimal contracts, Normal risk-aversion and medium ability to affect the firm performance

Results presented in Table 2 and Figure 7 illustrates that all the simulated contracts outperform the observed contract. The costs of implementing the new contracts are however 3-4 times higher than the observed compensation. Nevertheless, the increased firm performance largely outweighs the increased cost of the CEO compensation.

The one year at-the-money option grant triggers the highest firm performance. At the same time it is also the most expensive contract, twice the cost of awarding premium options. As this contract triggers the largest increase in the stock price, the CEO will receive a large option payoff compared to the other contracts. In general, for all cases of effort dependency, the contracts with short term options (T=1) triggers the highest performance level by the CEO. Since the CEO will receive a reward from his options at the end of the year, directly related to his effort in the given period, short term options trigger a higher level of effort than long term options which is related to higher uncertainty.

Comparing the composition of all the simulated contracts with the observed contract reveals that it is optimal to grant more equity in the compensation. When premium options with one year to maturity are awarded, the optimal (actual) contract consist of a base salary of 1,5 (4,8) MNOK, 0,12 (0,026) percent stocks and 0,14 (0,05) percent options. When the options have three (seven) years to maturity, the contracts should consist of a base salary of 1,15 (0,95) MNOK, 0,14 (0,12) percent stocks and 0,10 (0,10) percent options. This indicates that tying more of the executive's reward to firm value yields higher firm performance. At the end of the period the contract has a value of 38-43 percent above its cost, due to the increased value of the executive's stock grants. This shows that stock grants are a cost effective way to induce CEO effort. Our analysis also suggests that it is optimal for the firm to require the CEO to invest almost all his outside wealth into the firm. This however is an unreasonable requirement, as most executives would be reluctant to expose themselves to more firm specific risk than necessary without receiving an increased risk-premium. Nevertheless, our results indicate that CEOs should increase their investments in company stock from the observed level to induce higher effort incentives.

If the principal is constrained to award the CEO with at-the-money options, the composition of the contract changes. The optimal (actual) contract with short term options then consists of a base salary of 3,7 (4,8) MNOK, 0,30 (0,026) percent stocks and 0,03 (0,05) percent options. When the options have three (seven) years to maturity, the contracts should consist of a base salary of 2,9 (0,83) MNOK, 0,11 (0,15) percent stocks and 0,10 (0,05) percent options. The cost of awarding at-the-money options is higher than awarding the executive with premium options, resulting in a contract with fewer options and more stocks. As both the total cost and performance of contracts with premium and at-the-money options are roughly equal, we cannot distinguish between the two, merely state that the exercise price affects the amount of options in the optimal contract.

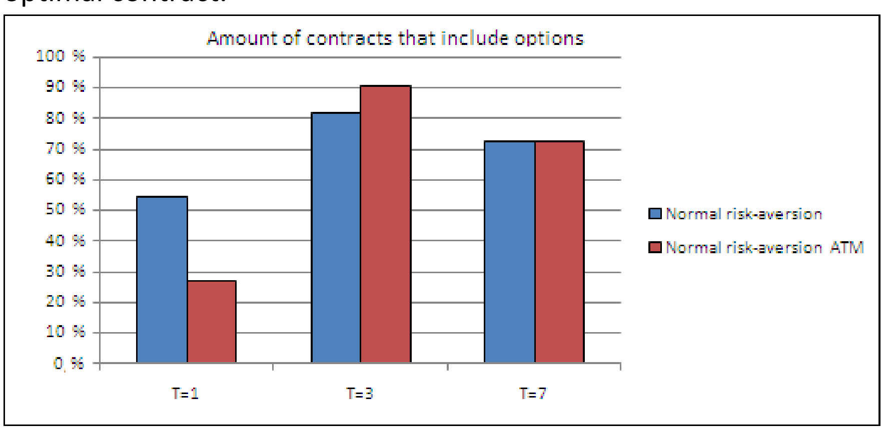

Figure 8 - Amount of firms that include options in the contract

Figure 8 displays the amount of contracts that include options when comparing premium and at-the-money options. We find stocks to allways be a part of the optimal contract. As the time to maturity increases, at-the-money options represents a larger part of the optimal contracts. The cost difference between premium options and options granted at-the-money declines with option lifetime. This is intuitively given by the fact that the intrinsic and time-value of the options increase with time to maturity, undermining the impact of differing exercise prices.

6.4.2 The effect of risk-aversion

Risk-aversion is a characteristic of human behavior when faced with a decision under uncertainty. The parameters obtained by Tversky and Kahneman represent the results from individual choices in a risk-experiment. To better understand the effect of risk-aversion on the optimal CEO contract, we explore the impact of changes in risk-aversion. We show how deviations in risk-aversion from our normal case affect the optimal contract. Figure 9 (a) and (b) displays the performance and cost of awarding an executive that exhibits high and low risk-aversion with an optimal contract.

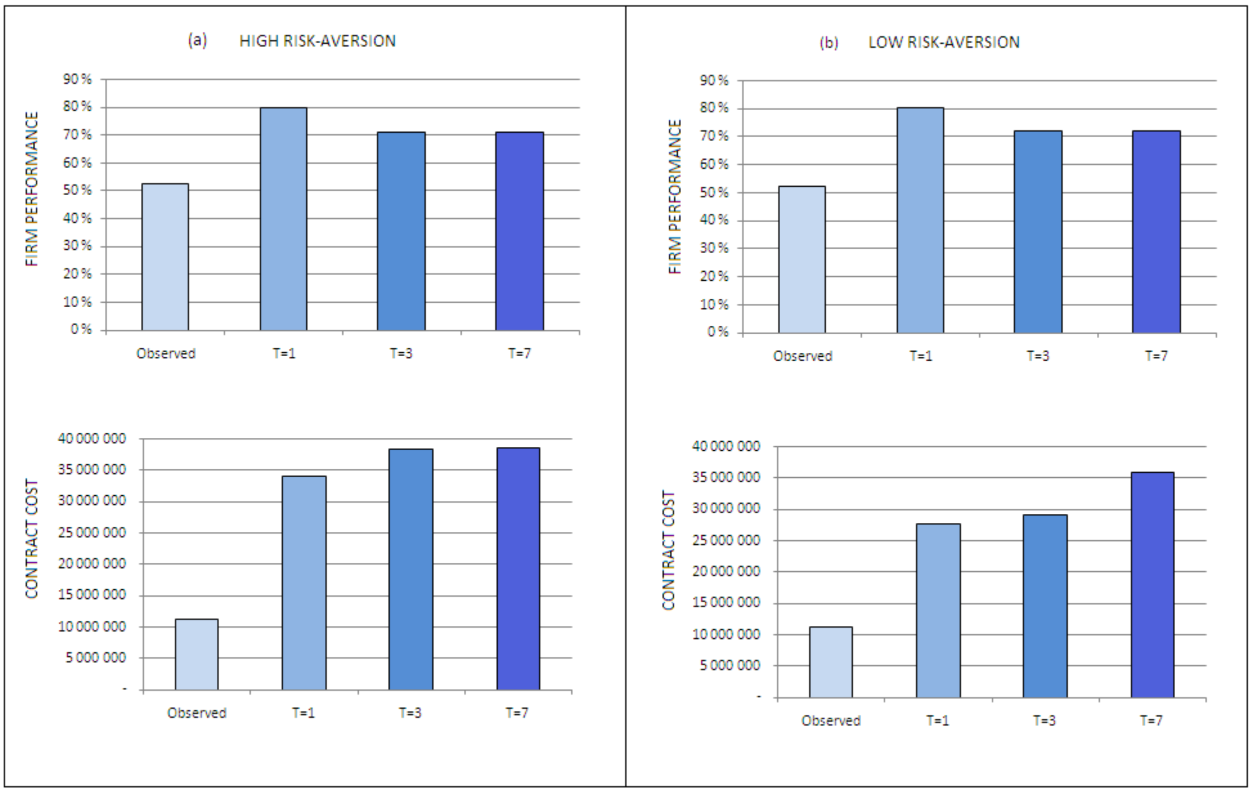

Figure 9 – Optimal contracts, High and Low risk-aversion and medium ability to affect the firm performance

Risk-aversion affects performance and the cost of inducing CEO effort. We find that an executive with low risk-aversion performs marginally better, but at a substantially lower cost than a highly risk-averse executive when both are given optimal contracts. In addition, we find the cost of the executive contract to increase with the option's time to maturity.

Comparing the composition of the contract, we see that granting options with one year to maturity for executive with high (low) risk-aversion, the optimal contract consist of a base salary of 1,5 (1,45) MNOK. In addition the CEO should be awarded with 0,17 (0,046) percent stocks and 0,042 (0,20) percent options. For option grants with a three year maturity length, executives with high (low) risk-aversion should receive a base salary of 1,45 (0) MNOK, 0,16 (0,10) percent stocks and 0,033 (0,086) percent options.

When the option’s time to maturity increase to seven years, executives with high (low) risk-aversion have an optimal base salary of 0,65 (1,15) MNOK, in addition to 0,17 (0,11) percent stocks and 0,027 (0,08) percent options.

The executive’s performance is related to his level of risk-aversion. More risk-averse executives are reluctant to undertake the same level of risky behavior. However, a higher compensation can induce the same level of effort for a more risk-averse executive compared to an executive with a lower risk-aversion. Since the marginal incentive effect from the option grant decreases with risk-aversion, it is less optimal to use options to induce incentives when the executive has a high risk-aversion. Increased risk-aversion leads to a larger gap between the executive’s valuation of his options and the cost associated with the option grant. To induce the same incentive effect, more risk-averse executives must therefore be awarded with larger equity grants. We find a lower amount of options in the contract for highly risk-averse executives, suggesting it is more cost efficient to award them with stocks rather than options. In addition, as the options time to maturity increases, the number of options in the optimal contracts decrease, suggesting it is less optimal to award long term options than restricted stocks.

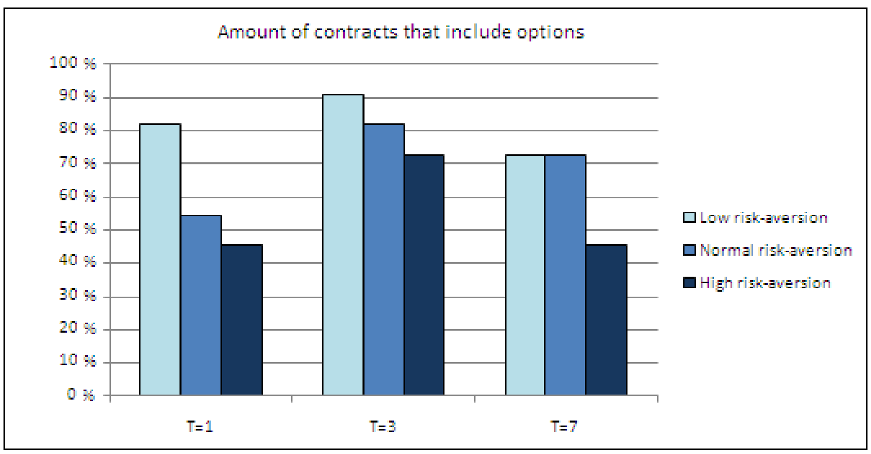

Figure 10 - Amount of firms that include options in the contract

Figure 10 illustrates that fewer firms find it optimal to award executives through options when risk-aversion increases, as the risk premium associated with the award increases substantially.

Our analysis does not find support for the observed structure of the CEO contracts. Our results suggest that executives should be awarded with a lower base salary and more equity. The tradeoff between a certain base salary and an uncertain equity-based award comes with change in risk premium, resulting in a large increase in the total executive compensation. Nevertheless, we find that the new contract stimulates levels of firm performance that more than outweighs the increased cost.

6.4.3 How much can the CEO's effort really affect the firm performance?

The previous section presented the optimal contract for executives with a medium ability to affect the firm performance. In this section we bring our attention to situations where the CEO has either a low or high ability to affect the firm's result. We focus on executives with normal risk-aversion, and explore how their ability to affect the firm's performance affects the optimal contract. The effect of different option exercise prices will also be considered in this section.

When the CEO's ability to influence the stock price is reduced, the chosen level of effort decreases (table 4). This is due to a lower marginal utility with respect to effort. As the marginal effect of his effort has a lower impact on the value of his compensation, he needs to be awarded with more equity to induce higher levels of effort. Consequently a CEO with a low ability to affect the firm performance requires a higher base salary, more stocks and more options in his compensation. On the other hand, when the executive has a high ability to influence the firm performance, a marginal change in his level of effort has a greater impact on the value of his equity-compensation, thus less equity is needed to induce an increase in effort. The cost of contracts for CEOs with a low ability to affect the firm performance is approximately 5 - 8 times higher compared to CEOs with a high ability to influence the firm performance.

When the CEO has a high ability to affect the stock price outcome, the firm performance increase with the option's time to maturity. When the ability to affect the result is low, the opposite effect emerges, where firm performance decreases with the option's time to maturity. The CEOs with low abilities to influence the stock price have a lower chance of ending up with options in-the-money for an increase in effort, and will thus exhibit a lower level of effort as the time period to the option's payoff increases.

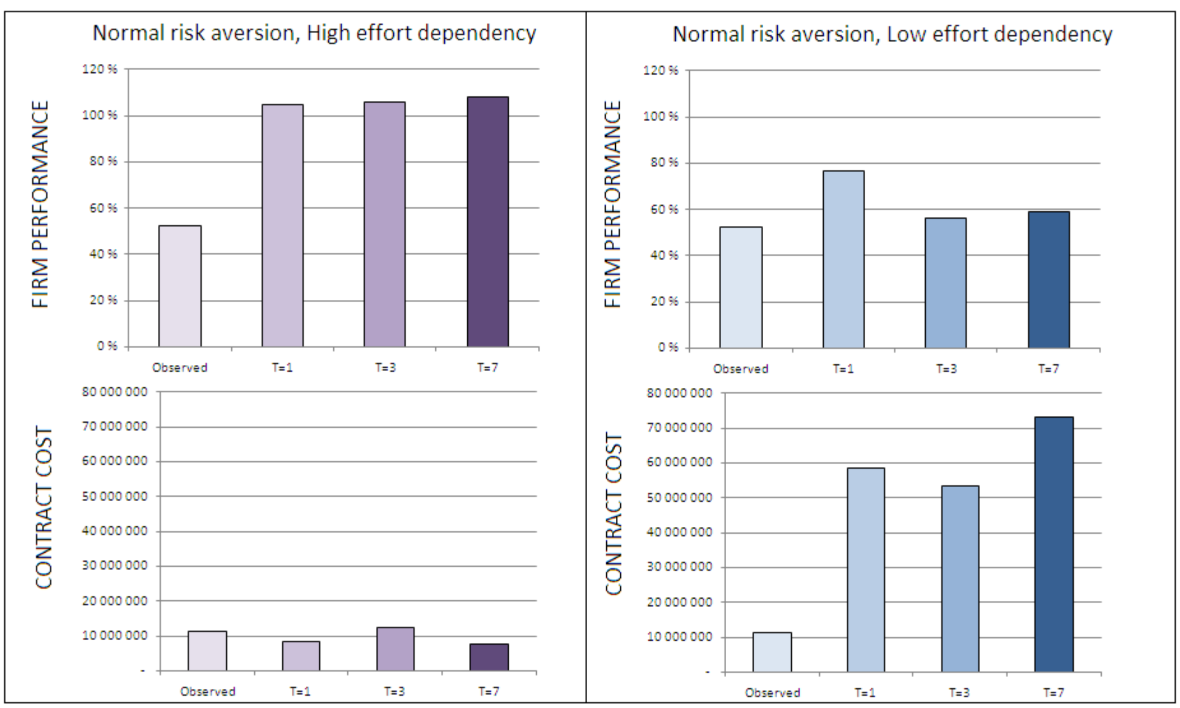

Figure 11 - Normal risk-aversion, High-low ability to affect the firm performance

For both the cases where the CEO either has high or low ability to affect the firm's performance, the simulated contracts outperform the observed contract; however the cost of the contracts differs greatly. When the CEO has a high ability to affect the firm's outcome, the costs of the contracts are close to the observed contract. In the case where the CEO has less control over the outcome, he is exposed to a higher risk, and the cost of the contract will be 5 - 7 times above the observed contract cost. Though this seems extreme, the simulated contract increases shareholders' wealth beyond the actual contract cost.

Our analysis shows that a contract consisting of short term at-the-money options triggers the highest performance. However, as time to maturity increases, premium and at-the-money options triggers roughly equal performance by the CEO, for all levels of effort dependency. Options that expire in one year must be replaced for the contract to maintain its incentive effect. We do not consider the long-term profitability of short term options versus options with longer time to maturity. It is however important to note that the higher firm performance triggered by the short term options comes with increasing long-term costs.

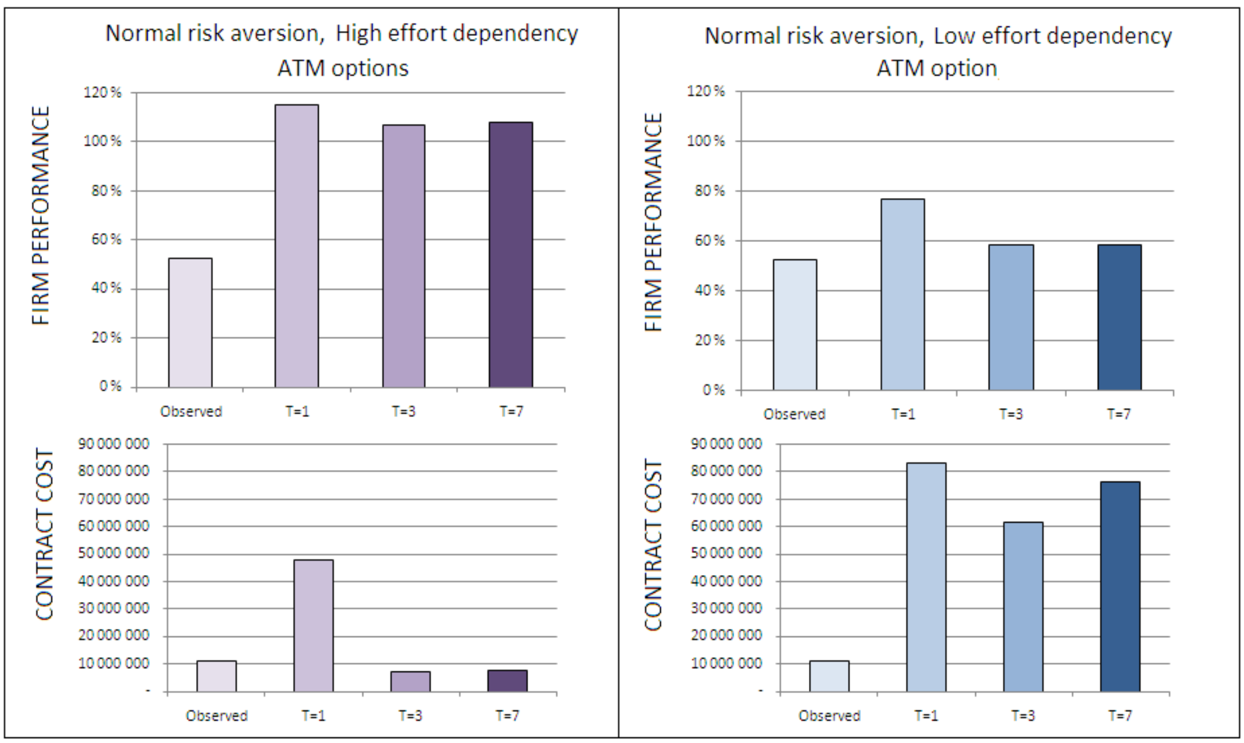

Figure 12 - Normal risk-aversion, ATM options, High-low ability to affect the firm performance

When the executive has a low ability to affect the performance, it is more costly to award him with at-the-money options compared to premium options when the options expire in one year. For the executives that have a high ability to affect the firms outcome, short term at-the-money options triggers a substantially higher firm performance. However, most firms choose to award executives with long-term options to induce long-term thinking and avoid risky short-term profiteering. Awarding executives with options with one year to maturity is therefore not a realistic alternative for most firms.

It is hard to determine the accuracy of our assumption about the relationship between the executive's effort and the firm's performance. The cost of the contracts where the CEO has a high ability to affect the outcome is close to the observed level of pay, but with the optimized contract the executive triggers a considerably better firm performance than with the observed contract. When the executive has a low level of influence over the firm's outcome, the firm performs close to the observed performance, but at a substantially higher compensation cost. It is impossible to determine the CEO's unobservable level of effort in the observed contracts or to what degree he actually is able to affect the firm performance.

Nevertheless, we test the executives' actual contracts in our model, in an attempt to estimate his effort and the incentive effect from the observed contract. Comparing the simulated performance with the actual performance will give a reasonable indicator on how much a CEO actual can affect the firm performance. One inaccuracy in this approach is that many firms award the executive with a non-equity bonus system based on various measurements. We do not know the mechanisms in these systems, and will not be able to simulate the incentive effect from the executive bonus system. We simplify this matter, and incorporate the cash bonus into the executive's fixed pay when running our simulation. We assume that the CEO does not invest any part of his initial wealth in the firm, and run the model for the case of normal risk aversion. The CEO performance in our model with his real contract is presented in Table 4.

Actual contracts, simulated performance in our model			
Ability to affect stock price	High	Medium	Low
Presantage increase in stock	52,92 %	43,55 %	40,25 %
Effort	923	714	502

Observed stock price increase in period	52,37 %

Table 4 – Predicted performance for the actual CEO contracts

The firms in our sample have an average firm performance of 52,37 percent in the period. This is close to the results from our model where the CEO has a high ability to affect the firm performance. This indicates that executives actually have large impact on firm performance. Consequently, shareholders can induce higher levels of executive effort, reduce agency cost and increase firm value by awarding CEOs with a new contract, consisting of more equity and a lower base salary. This new contract will have approximately the same cost as the observed contract. However, if one were to incorporate the incentive effect from the non-equity bonus scheme that most of the executives actually are awarded, it is reasonable to assume all performance levels in Table 4 would increase to some degree. This would results in the CEO's actual ability to affect the firm's outcome to lie closer to the medium level. Nonetheless, it seems reasonable to assume that the CEO's real ability to affect the firm performance lies somewhere in our defined range. Most of the CEO's non-equity bonus schemes are constraint to a certain proportion of his base salary, therefore limiting the incentive effect they can induce.

Our analysis shows that Norwegian companies fail in presenting CEOs with an optimal contract. The contracts presented in Table 2 and Table 3 induces greater CEO effort, higher corporate performance and larger shareholder return than the observed practice. The fact that our model predicts a result close to the actual corporate performance when considering the executives real contracts, gives support for the idea that executives are indeed loss-averse. It also shows that the parameters and the utility function from the experiment of Kahneman and Tversky (1979) are a reasonable interpretation of executive behavior.

6.5 Discussion of results in light of theory, relevant studies and societal conditions

This section focus on comparing our results to the closest related studies, the 2007 study by Dittmann and Maug with a principal agent model for a risk-averse CEO, and their 2010 study that in addition takes account of CEO loss-aversion. Finally, we discuss the impact of societal and cultural structures on the interpretation of our results.

The study from 2007 suggests more stocks, less options and close to no fixed pay. For a range of risk aversion, from high to low, they find that the optimal contract should consist of 2,56 to 3,19 percent stocks and 0 to 0,065 percent options. In addition the CEO must invest 2,92 to 38,5 percent of this wealth in the company stock. The observed contracts in their data has a mean base salary of 2037 thousand dollars, stock holdings of 2,29 percent and option holdings of 1,29 percent (Dittmann and Maug, 2007, page 315-317). Since the compensation level of the US executives is much higher than the Norwegian average, it is difficult to transfer the results of their study to Norwegian firms.

We find optimal stock holdings in the range of 0,05 - 0,30 percent, option holdings of 0,01 - 0,27 percent and a base salary between 0 and 8,5 MNOK. The results suggests that the optimal contracts for Norwegian executives consists of less stock, more options and a higher fixed salary than the 2007 study of Dittmann and Maug. The optimal level of investments by executives is much higher for our model, as we show that the CEO is required to invest 89 to 100 percent of his wealth in the company stock. This gives the executives in our sample a total firm ownership of 0,20 to 0,45 percent. The differences in the design of the contracts and implied ownership between the US and the Norwegian executives can to some degree be explained by dissimilarities in initial wealth. The US executives have substantially larger fortunes and are awarded with more stocks, and thus need to invest less of their initial wealth to obtain the same level of ownership.

The 2010 study by Dittmann and Maug incorporate loss-aversion and makes a comparison on how loss aversion affects the optimal executive contract. They find that CEO loss aversion triggers higher levels of options and fixed salary than the risk aversion model. Where the risk aversion model predicts 30,8 percent of the executives to have positive option holdings, the loss aversion model predicts 83,3 percent of the executives to receive options in the contracts. The amount of executives with a positive fixed salary is 1,7 percent in the risk aversion model and 59,6 percent in the loss aversion model (Dittmann and Maug 2010, page 2031).

Our model finds the use of options in the CEO contract to lie between the results from the two studies of Dittmann and Maug. For executives with low ability to affect the stock price, we find options to be used in 82 to 91 percent of the contracts. For a medium ability the range is from 27 to 82 percent, and for executives with high ability to affect the stock price we find options to be a part of 9-36 percent of the contracts (Table 5, appendix 9.2).I

In line with Dittmann and Maug (2010) we find support for the use of options in the CEO contract. However, if the CEO is in position to greatly affect the firm performance, options are a less frequent part of the optimal contract.

Our results do not support Lambert et al (1991) claim that incentives for risk seeking are reduces with increased probability of options ending in-the-money. Our results suggest that setting the exercise price at-the-money induces the same amount of effort as granting the CEO premium options. However, we do observe that the amount of options in the optimal contract is reduced when at-the-money options are used, suggesting these options have a stronger incentive effect than premium options. Neither do we find support for Barron and Waddell (2008) claim that increasing the exercise price increases the CEO's effort.

Comparing the compensation level of the Norwegian executives with those presented in Armstrong et al (2007) for US firms, it is obvious that Norwegian executives receive a substantially lower payment. The proportion of equity in the optimal contracts found by Armstrong et al (2007) and Dittmann and Maug (2007) is substantially larger than our findings. An interpretation of this observation can be the fact that CEO wealth is an important factor in designing the contract. As US executives are generally wealthier than the average Norwegian CEO, a higher level of compensation is needed, as the marginal increase in effort with respect to the CEO's wealth is lower for wealthier executives. Though this problem can be solved by requiring the CEO to invest heavily in the company stock, this approach is unconventional, as most risk-averse executives would be reluctant in increasing their exposure to firm specific risk.

A report by Hay Group, a global consulting firm specializing in executive compensation, compares the salaries of executives in the largest companies in Europe. The report indicate that Norwegian executives receive 47 percent lower compensation that the average European executive. Among the Nordic countries, Norwegian executives have the lowest level of compensation (Kigen, 2005). As most shareholders can be assumed to be rational and profit maximizing, it is unlikely that they fail to award Norwegian CEOs with an optimal contract due to irrationality. However, there seems to be some constraint in setting the CEO compensation in Norway.

Hofstede et al (2010) have conducted several comprehensive studies on how social values at the workplace are influenced by cultural differences. When comparing Norway with UK and US, there are four differing cultural aspects. The largest cultural difference is the type of values that are emphasized in the work place. UK and US organizations exhibits masculine values, where competition, power and wealth are central. In contrast, Norwegian organizational values are defined as feminine, where interpersonal relationships and quality of life is emphasized. Secondly, individualism has a stronger impact in UK and US firms, where individuals are less integrated as a group. Thirdly, Norway has a higher level of organizational democracy, including more people in the decision process. Finally, Norwegian firms have a higher long term orientation, where reputation and thriftiness are central. These cultural dissimilarities can help explaining the variations in the observed level of pay. Equality, thriftiness and quality of life are more important cultural factors than materialism in Norway, resulting in less focus on individual compensation.

Different economical systems can also help explaining part of the differences in the observed CEO compensation. Where the economy in the US is close to a free market, Norway has a mixed economic system, where the government has substantial ownership in several of Norway's largest firms. This allows the government to influence the size of the executive compensation, setting a benchmark for the rest of the country. In 2011 the Norwegian government stated that one of its main goals for its economical politics was to secure a fair distribution of wealth, where all should be guaranteed a fair share of wealth in the society (Finansdepartementet, 2011a). This can indicate that there is some equality constrain on the level of pay in the Norwegian society, if profit is to be shared among all. In 2007, Hydro's CEO Eivind Reiten received 20 MNOK from exercising his options, resulting in massive negative press coverage, both towards him and the firm (Hydro, 2008). This can in some ways be seen as an example of the Scandinavian phenomena, "Jante-loven", a sociological term used to describe a negative attitude towards successful individuals, where one refuses to acknowledge their achievements. The idea of a social norm, where an income deviating too far from the average is frowned upon, and a government striving to achieve higher levels of equality can indeed be seen as a limiting effect on the total CEO compensation in Norway.

In 2000 the average US CEO was paid 300 times the salary of an average employee (Lawrence, 2006). In Norway this ration is significantly lower, in the range of 5-10 times. The low difference between executives and workers in Norway is mostly due to a high average worker income. However, keeping the difference in pay low, increases societal equality and can have a socio-economic value. Wilkinson and Pickett (2009) find a relationship between equality of wealth and socio-economic loss, suggesting it is economical beneficial for a country to have a low gap between rich and poor. If the Norwegian government is striving to keep chief executive salaries at a low level, it can be seen as a way to minimize the socio-economic loss.

Our model only takes into account the extrinsic motivational factors from a monetary reward, and does not capture other decisive factors in setting the CEO pay. An executive's performance can be driven by the fear of dismissal and the desire to increase his reputation. Success can in itself be a source of intrinsic motivation and leverage in future negotiations for improved salary. Great performance can also improve social status. An executive can be willing to accept a lower than optimal salary if the job can enchant his career, increasing the value of future income and improving social status.

Like the majority of studies on incentive contracts, we focused purely on the chief executive officer. However, the corporate management consists of more than just the firm's CEO. The entire executive team is involved in the daily operations and decision making. Assuming the firm's leadership is solely exercised by the CEO gives an unrealistic representation of reality. In light of this, an interpretation of our results is that they are applicable for the entire corporate management. Our model assumes a linear link between effort and firm performance, but the cost of effort is quadratic. This makes it reasonable to think it would be cheaper to divide effort over several people. A continuation of our work could be to apply our model to the entire management team. However, in order to determine the optimal contract one would need to consider the individual wealth and reference point of each member of the executive team.

For every loss-averse model, the setting of the reference point is an important factor. The kinked utility function leads the executive to choose a level of effort insuring he does not end up in the loss region. If the reference point is based on the previous year's income, the CEO will demand a continually increasing compensation. To avoid an aggregation after a highly profitable year or a bull market, it would be reasonable to set the reference point based on longer historic average for multi period models. In the following part we present the most important insights gained from our analysis.

6.6 Insights gained from our model

The results from our study indicate that Norwegian shareholders fail to provide executives with optimal contracts. The chief executives should receive a lower base salary, more stocks and more options. This involves increasing the total value of their compensation from today's level. In addition, we find it optimal that the CEO invests more of his own wealth in the company, tying his own prosperity to the firm in a larger degree than the given practice.

We find that the optimal contract always involves granting executives with stocks. The amount of contracts than include options decreases with executive risk-aversion. The size of the base salary increase with the CEO's risk-aversion and decrease as the CEO is granted options with longer time to maturity. Executives with low risk-aversion have the greatest performance at the lowest cost, as it is more costly to induce the same level of effort when CEO risk-aversion increases.

Setting the exercise price at-the-money reduces the optimal amount of options to be granted as both the incentive strength and cost of the award increases compared to premium options. We find it to be optimal for fewer firms to award options if they are constrained to grant options at-the-money. Awarding the CEO with at-the-money options induces a higher level of effort when the option grant has a short time to maturity, but as the option lifetime increases this effect disappears. Our results suggest that awarding at-the-money options in long term contracts is not cost efficient, as it increase the contract cost but not the CEO's effort.

It is worth mentioning that as we look at a time period of one year, we do not consider the fact that options with longer time to maturity will have an incentive effect beyond the period we consider. Options that are exercised after one year will have to be replaced to renew the CEO's incentives for the next period. Granting the CEO with short term options triggering the highest levels of performance, but since the options need to be replaced more often it will bring about a higher cost. We do not consider the long term profitability of short term options against options with a longer time to maturity.

To our knowledge there are no studies that have conducted an equally thorough exploration of the optimal contract for Norwegian CEO's. Most studies on executive contracts use US or UK firms in their sample. As the executive's initial wealth is an important factor in determining the optimal contract, the results from these studies are not transferable to Norwegian firms due to considerably differences in executive wealth. Most studies on CEO compensation apply a risk-averse model, and some take into account the fact that CEOs do not value their options in the same way as a diversified risk-neutral investor. In contrast, we have built a complex model, considering CEO risk-aversion, loss-aversion, reference dependency and use the certainty equivalent method to determine the executive's valuation of his options. We show that Norwegian firms do not grant CEOs with optimal contracts, and speculate that there can be some societal constraints on the size of the CEO compensation in Norway.

6.7 Weakness of the model

The greatest weakness with our model is the interpretation of how much the CEO's effort can affects the development of the stock price. We allow the CEO to be able to affect the firm performance with a maximum of 16.67, 25 and 50 percent for different scenarios of effort dependency. These estimates might be too high, affecting our results. However, despite this bias, we have shown that the degree of influence the executive has in the firm performance is a major factor in determining the optimal contract. When we run our model on data from the real CEO contracts, we find the highest level of effort dependency to match the actual firm performance.

Another weakness is the model dependency on previous year's volatility and dividends when simulating the lognormal stock price development for the next period. It might be more accurate to use the volatility from a longer time period to incorporate a more average variation in the stock price. We also use the previous year's volatility when calculating the Black and Scholes value of the executive's option holdings at the end of the simulated period. Using the average volatility of a longer time period or calculating the volatility in the simulated period would most likely be a better approach. The latter would however involve a more complex model, and greatly increase the computation time.

Increasing the amount of random variables will also increase the accuracy of our model. This would allow an evaluation with a wider range of possible outcomes. However, due to the complexity of our model this would involve a too extensive computation time for the computers at our disposal. Nevertheless, we believe our results reflect a reasonable approximation of the structure of the optimal contract.

Utilizing the data for the Norwegian firms, we have used a weighted average strike price and average time to expiration to simplify the calculations. The CEO usually has multiple option grants, awarded at different times, with different strike prices and time to expiration. In our model we only look at one time period, and only allow for one option award with a given exercise price and time to expiration. Increasing the model's time period and allowing for multiple option awards with different exercise prices can improve the accuracy of the model.

There is also a bias in the selection of the sample firms. We have a relative small sample of firms, and it is possible that these firms are not suited to represent the Norwegian market. Firm size, performance and the practice of granting executive compensation might differ from the actual average. Increasing the sample size can give a more correct description of the optimal contract. However, as our model optimizes a firm specific contract the results are valid for our sample and provide insight in the difference between the actual and optimal contract.

The random variable we use to simulate the asset prices is normally distributed. However, as one of the major stylizes facts for asset returns state "…the distribution of returns are not normal" (Taylor, 2007, page 4). The observed properties of asset return suggest that it is approximately symmetric, has fat tails and a high peak, i.e. a higher kurtosis than normal distribution (Taylor, 2007).

7. Overall assessment

We propose that Norwegian firms can improve corporate performance by awarding CEOs with a new contract consisting of more stocks, more options and a lower base salary. Our model incorporates both loss- and risk-aversion and the results indicate that executives should be required to invest a larger part of their wealth into the company than today's practice. The suggestion of increased firm ownership and a higher level of performance pay through equity awards are in line with the principal agent theory. Higher levels of equity awards reduce moral hazard and rent extraction and induce a selection effect by attracting highly motivated executives. Increased ownership reduces the monitoring cost for both shareholders and debt holders. However, it is worth noting that the required level of investments proposed by our model seems unrealistically high, as it ties up almost all of the executive's wealth.

The developed loss-averse model gives a reasonable reproduction of the actual CEO performance when implemented with the real data of the observed executive contracts. This gives support to the idea that executives indeed are loss-averse, and validates our claims that firms do not present executives with optimal contracts. Loss aversion can help explaining the need for options in the optimal contracts, as the convexity of the utility function below the reference point can be offset by the use of options. In the view of prospect theory, the marginal motivation provided by tangible rewards is a declining function from the reference point. Thus granting executives with an option portfolio of different exercise-prices, where premium options are allocated on top of an existing compensation portfolio, will be a good method to give loss-averse executives optimal incentives for a wider range of stock prices. The difference between the companies' observed performance and the predicted performance under the optimal contract can be seen as the firms' agency cost, due to inefficient CEO contracts. Our results imply that Norwegian firms suffer large agency costs.

The aim of this paper is to build a principal agent model wider scope than the studies of Hall and Murphy (2002), Dittmann and Maug (2007, 2010) and Kadan and Swinkels (2008). We differ from the studies above in three areas. First, we do not allow negative option holdings and allow for both stocks and options to be awarded simultaneously. This represents a more realistic awarding process for executives, who frequently are awarded with a portfolio consisting of both stocks and options. Second, we test the effect of both at-the-money options and premium options, in distinction from other studies that focus solely on one of them. Finally, as the use of the first-order approach for solving the optimal contract is criticized by Armstrong et al (2007), we do not assume that CEOs are utilizing the optimal level of effort nor maximizing firm profit through the observed contract. Consequently we use a numerical method to solve the optimal contract, which renders us unaffected by the shortcomings of the first-order approach. However, the effect of the CEO's effort on the stock price development is a critical assumption in our model. The utilization of effort has a linear relation to the firm development while the cost of effort is assumed to be quadratic. We test for three scenarios, where the utilization of effort has different impacts on firm performance. The shortcoming of our model is related to the realism of these assumptions; the relationship between the CEO effort and firm performance, and the cost of effort.

It is impossible to capture all aspects of human behavior in a mathematical model as incentives are affected by motivation, which is individual and highly variable between executives. Our model can predict the extrinsic motivational driving forces of executive behavior, but it cannot account for the intrinsic factors motivating a CEO. Another shortcoming is the fact that we cannot give the chief executive the entire credit for a firm's performance as all CEOs are part of an executive team that also have a high impact on value creation in the firm. One way of interpreting our results is to assume that the optimal contract applies to the entire management team. Nevertheless, our study gives an indication of how an executive perceives his compensation, how the compensation affects his performance and how it should be structured, given the existing theoretical framework.

The new national regulation of remuneration in the financial sector, Prop 117 L, will be effective from the end of 2012. This legislation is a response to the crisis in the international financial market after the fall of Lehmans Brothers in 2008. The purpose of the new law is to ensure long term value creation and lower risk-taking in the finance sector. The legislation limits the total bonus an executive can receive to 50 percent of his base salary. The law also greatly restricts the use of equity grants (Finansdepartementet, 2011b). The implication of the new rules is that banks, investment firms and insurance companies most likely will increase the base salary of executives and turn to other types of bonus incentives based on accounting measures, subjective or objective evaluations (PricewaterhouseCoopers, 2010). As the new legislation was generated to counteract high risk-taking and short term profit incentives, new bonus plans in the financial sector should be based on measurements providing long term value creation and in addition take into account individuals' risk exposure.

The results from our analysis are not consistent with the new legislation. However, the purpose of the legislation is to reduce risk seeking in the finance sector, while our model attempts to maximize shareholder return by inducing an optimal level of risk seeking towards the executive. If the new legislation leads to higher base salary and less equity grants, it can increase the intrinsic motivation and reduce the cost of compensating the executive as it requires a lower risk premium. It is not possible to determine the effect of the new regulations, but it will present interesting new research possibilities after it takes effect.

There are number of interesting ways to extend our model. Rather than restrict the principal to a single option grant, either at-the-money or as 10 percent premium options, we could allow multiple layers of options with different exercise prices. This approach is in line with the diminishing sensitivity theory, and allows the principal to construct a more convex compensation scheme, giving strong incentives to the executive over a larger range of stock prices. Another direction to extend our analysis would be to consider index options in the executive compensation. As executives holding indexed options are only rewarded when the company performance exceeds the market, index options protect executives from market shocks and also protect shareholders from rewarding poorly performing executives in bull markets. Since efficient indexed options let the executive's compensation depend only on the idiosyncratic risk, the executive will be rewarded for the change in firm value because of his effort. This increase in the relation between the executive's effort and firm performance will increase the incentives provided by the options.

Other aspects of the executive's compensation, like pension plans and severance pay, could be included in the model. These components of the executive's compensation have received little attention in the literature, and introducing them into the principal agent model will give a more realistic analysis as it includes new features of the risk in CEO compensation. Finally, improvements to our model can be done by applying the probability density function of real asset return as an alternative to normal distribution. In addition, incorporating a multistage stock price development that allows for calculating the implied volatility from the simulated stock prices will improve the accuracy of the option valuation in the model and improve the realism of the model.

Further research on CEO incentive contracts should focus on how executive's behavior affects preferences of risky choices in a loss- and risk-averse perspective. The study of Tversky and Kahneman (1979) is evolved on a sample of Israeli subjects. To calibrate the parameters of the prospect theory to better fit a CEO, it would be useful to replicate the study on a sample of executives. After the new regulations in the finance sector have taken effect, research on the impact of the legislation would prove beneficial to the field of incentive studies. In addition, more research on determining the actual impact of the CEO's effort on firm performance can contribute to better optimization of executive incentive schemes, and in the end improve corporate performance.

8. References

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9. Appendix

In the appendix we present the list of firms in our sample, results not included in the main text and matlab code for our model with one and three/seven year option holdings.

9.1 List of sample firms

The following firms were included in our computer simulation:

- Aker Solutions
- DNO International
- DNB NOR
- Fred. Olsen Energy
- Kongsberg Group
- Norwegian Air shuttle*
- Norsk Hydro
- Orkla
- Prosafe
- Statoil
- Telenor
- Yara

*Norwegian Air Shuttle was excluded from the data set after the model simulations. This is due to the large stockholdings and wealth of the CEO, Bjørn Kjos, with a ownership of 25 percent of the NAS stock, and about 1000 MNOK wealth.

Firms that have been excluded prior to running our model, due to lack of data:

- Marin Harvest
- Petrolium Geo-Service
- Renewable Energy Corporation
- Royal Caribbean Cruises
- SAS AB
- Schibsted
- Seadrill
- Subsea 7

9.2 Composition of the executive contract

Table 5 presents the amount of contracts where options and stock are awarded. Stocks are always part of the optimal contract, but the use of options varies with executive's ability to affect the firm performance and his risk-aversion.

Amount of equity awards								
	Normal risk-aversion				High risk-aversion			
Ability to affect firm development	Overall	High	Medium	Low	Overall	High	Medium	Low
Options	60,61 %	36,36 %	54,55 %	90,91 %	45,45 %	9,09 %	45,45 %	81,82 %
Stock	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %
Only Option	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
Only Stock	39,39 %	63,64 %	45,45 %	9,09 %	54,55 %	90,91 %	54,55 %	18,18 %
Both stock and option	60,61 %	36,36 %	54,55 %	90,91 %	45,45 %	9,09 %	45,45 %	81,82 %
	Low risk-aversion				Normal risk-aversion, atm options			
Ability to affect firm development	Overall	High	Medium	Low	Overall	High	Medium	Low
Options	69,70 %	36,36 %	81,82 %	90,91 %	39,39 %	9,09 %	27,27 %	81,82 %
Stock	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %
Only Option	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
Only Stock	30,30 %	63,64 %	18,18 %	9,09 %	60,61 %	90,91 %	72,73 %	18,18 %
Both stock and option	69,70 %	36,36 %	81,82 %	90,91 %	39,39 %	9,09 %	27,27 %	81,82 %

Table 5- Amount of equity in the optimal contracts

9.3 Matlab code for model with one year option holdings

This and the following section contain the algorithm we have used in our calculations. The programming language is for Matlab. The black text is the actual algorithm and the green text is explanations for the code. The program takes approximately 10 hours to run for one sample firm. To speed up the calculations, the amount of random variables, Lu, can be reduced. Also the interval of the executive effort loop, i, can be increased. Increased speed can also be achieved by reducing the size of the compensation matrix (LF, Lk, Ll).

```
%%%%%%%%%%%%%% Constants %%%%%%%%%%%

L=2.25;   %loss aversion
a=0.88;   %risk aversion
b=0.88;   %risk aversion
rf=0.05;  %risk free
T=1;           %looking at a period of 1 year


%%%%%%%%%%%%%% Random Variable %%%%%%%%%%%

Lu=15; % Amounts of normal random variables
u=randn(1,Lu) % creates a vector of normal random variable with
length Lu
RandVar=u; %Stores vector u

%%%%%%%%%%%%%% Firm specific Variables %%%%%%%%%%%%%%%%
sigma=0.9521;       %Firm Volatility
delta=2/45;         %Firm dividend payment

ref=5128144;        %Reference point, CEOs earnings last year
IntWealth= 26388039;%Cumulative earnings last 4 years, can be
invested in the                 bank or in the firm

nsTot= 274000000;   %Total outstanding stocks in the firm
S=45;               %stock price at beginning of period

K=S*1.1;            %Strike price of awarded options

LF=30;              %Length of Loop for fixed pay
Lk=30;              %Length of Loop for awarded options
Ll=30;              %Length of Loop for awarded stocks
LLL=LF*Lk*Ll;       %Size of the compensation matrix

Profitstore=zeros(7, LLL); %Matrix for storing intermediate
results
MaxP=zeros(1, LLL);        %Matrix for storing intermediate
results
```

```
%%%%%%%%%%%%%%   B&S option pricing   %%%%%%%%

    d1 = (log(S/K) + (rf + 0.5*sigma^2)*T)/(sigma*sqrt(T));
    d2 = d1 - sigma*sqrt(T);
    N1 = 0.5*(1+erf(d1/sqrt(2)));
    N2 = 0.5*(1+erf(d2/sqrt(2)));

    Call = S*N1-K*exp(-rf*T)*N2;


%%%%%%%%%%%%%%%%% MODEL %%%%%%%%%%%%%%%%%%%%%%

for xx=1:1:3;

for zz=1:1:Lu;

for j=1:1:LF;
    F=(j-1)*500000;

    for k=1:1:Lk;
        no=(k-1)*30000;

        for l=1:1:Ll;
            ns=(l-1)*30000;


 Lh=11;                             %Length of investments counter
   for h=1:1:Lh;                    %Counter for investment in firm
       m=0.1*(h-1);                 %Percentage of Wealth to be
invested
   bank=IntWealth*(1-m);            %How much wealth in the bank
   InvestStock=IntWealth*m;         %How much wealth in the company
stock

   CountInvest=h+Lh*(l-1)+(k-1)*Lh*Ll+(j-1)*Lh*Ll*Lk; %Position
in the matrix


for i=1:1:5000;                   %Loop for CEO effort
    e=i;

P0=S+(S/100)*e/(100*xx); %Initial stock price - Step on 100*xx e
increases                            lognormal development by
1%, xx in range 1-3
PT=P0*exp((rf-(sigma^2)/2-delta)*T+u(zz)*sqrt(T)*sigma);
%lognormal stock
price development
```

```
Stock(i)=PT; %Temporally storage of PT

Anndel=(ns*S+no*Call+InvestStock)/(ns*S+no*Call+F+bank+InvestSto
ck);   %Proportion of wealth tied to risky assets

D=0.8256*exp(-0.528*Anndel);                %Certainty
Equivalent

W=F*exp(rf*T)+ns*PT+no*(max(PT-K,0))*D + bank*(exp(rf*T)-1) +
(InvestStock*(PT-S))/S; % CEO Wealth

if W>ref                %Reference dependency demand
    V=(W-ref)^a;         %Utility if W is above reference point

else V=-L*(ref-W)^b;     %Loss Aversion if W is below reference
point
end

Wealth(i)=W;  %Temp Store values of CEO wealth

C=e^2/2;      % Cost of effort
U=W-C;        % CEO Utility
Utility(i)=U; % Temp store all values of U

end

[Umax,maxeffort] = max(Utility); %gir max Utility og effort av
temp
EndOfPeriodStockPrice = Stock(maxeffort);%gir aksjekurs om et år
TotComp = Wealth(maxeffort); %CEO wealth with max effort

Profit = (EndOfPeriodStockPrice-S)*nsTot -(F+ns*S+no*(max(PT-
K,0))) + delta*nsTot; %eierens profit av CEOs innsats

%countmatrix=h+Lh*(l-1)+(k-1)*Lh*Ll+(j-1)*Lh*Ll*Lk; %TELLER
%TELLER FOR STØRRELSEN PÅ MATRISEN

%Profiten(CountInvest)=Profit;

Profitstore(:,CountInvest)=[EndOfPeriodStockPrice; m; maxeffort;
F; no; ns; Profit]; %LAGRER PARAMETERE
   end
        end
    end
end

%%%%%%%%%%%%%%%%%%%%%%% SOLUTION %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
 MaxPP=max(Profitstore(7,:)) ;                 %Finds the owners
maximum profit
 maxindex=find(Profitstore==max(Profitstore(7,:))) ; %Finds
where in the
     matrix this is stored

 SizeMI=length(maxindex);
 if SizeMI>1;      %If more than one equal maximum points,
choose the first
 maxindex=maxindex(1);
 end

 Goal=Profitstore(:,maxindex/7);    %Stores the parameters for
when profit is              maximized (Must div on amount of
parameters in Profitstore!)
 StockPrice=Goal(1,:)           ;    %Stock price at maximum
profit
 Mm=Goal(2,:)                   ;    %Amount of initial wealth
to be invested
 AppliedEffort=Goal(3,:)        ;    %Effort at maximum profit
 FixedPayment=Goal(4,:)         ;           %Fixed pay at
maximum profit
 AmountOptions=Goal(5,:)        ;          %# Options at maximum
profit
 AmountStocks=Goal(6,:)         ;           %# Stocks at maximum
profit
 CompanyValue=Goal(7,:)         ;            %Comp value at
maximum profit

 Incenitiveffect=StockPrice/(S*exp((rf-(sigma^2)/2-
delta)*T+u(zz)*sqrt(T)*sigma)); %increased comp value due to CEO



%%%% FINAL RESULTS %%%

%%% Stores 3 different matrix with different effort dependency
%%%
if xx==1
Index1(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end

if xx==2
```

```
    Index2(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end

if xx==3
    Index3(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end
end
end

Index1 %Display Index1
Index2 %Display Index2
Index3 %Display Index3
```

9.4 Matlab code for model with three/seven year option holdings

```
%%%%   PRINCIPAL AGENT MODEL  w/ 3 years option holdings %%%%
%(TO simulate 7 year option holdings replace TTT=3 with 7)

%%%%%%%%%%%%%% Constants %%%%%%%%%%%

L=2.25;   %loss aversion
a=0.88;   %risk aversion
b=0.88;   %risk aversion
rf=0.05;  %risk free
T=1;           %looking at a period of 1 year

Lu=15; % Amounts of normal random variables
u=randn(1,Lu) % creates a vector of normal random variable with
length Lu
RandVar=u; %Stores vector u

%%%%%%%%%%%%%% Firm specific Variables %%%%%%%%%%%%%%%%


sigma=0.9521;       %Firm Volatility
delta=2/45;         %Firm dividend payment

ref=5128144;        %Reference point, CEOs earnings last year
IntWealth= 26388039;%Cumulative earnings last 4 years, can be
invested in the                bank or in the firm

nsTot= 274000000;   %Total outstanding stocks in the firm
S=45;               %stock price at beginning of period

K=S*1.1;            %Strike price of awarded options

LF=30;              %Length of Loop for fixed pay
Lk=30;              %Length of Loop for awarded options
Ll=30;              %Length of Loop for awarded stocks
LLL=LF*Lk*Ll;       %Size of the compensation matrix

Profitstore=zeros(7, LLL); %Matrix for storing intermediate
results
MaxP=zeros(1, LLL);        %Matrix for storing intermediate
results


%%%%%%%%%%%%%%   B&S option pricing 1 - Initial value  %%%%%%%%

TTT=3;          %Length of option time frame
```

```
    d1 = (log(S/K) + (rf + 0.5*sigma^2)*TTT)/(sigma*sqrt(TTT));
    d2 = d1 - sigma*sqrt(TTT);
    N1 = 0.5*(1+erf(d1/sqrt(2)));
    N2 = 0.5*(1+erf(d2/sqrt(2)));

    Call = S*N1-K*exp(-rf*TTT)*N2; %Value 1 of options



%%%%%%%%%%%%%%%% MODEL %%%%%%%%%%%%%%%%%%%%%

for xx=1:1:3;                       %Counter for variations of
effort dependency

for zz=1:1:Lu;                      %Counter for normal dist rand
variables

for j=1:1:LF;                       %Counter for fixed pay
    F=(j-1)*500000;

    for k=1:1:Lk;                   %Counter for options
        no=(k-1)*30000;

        for l=1:1:Ll;               %Counter for stocks
            ns=(l-1)*30000;

 Lh=11;                             %Length of investments counter
   for h=1:1:Lh;                    %Counter for investment in firm
       m=0.1*(h-1);                 %Percentage of Wealth to be
invested
   bank=IntWealth*(1-m);            %How much wealth in the bank
   InvestStock=IntWealth*m;         %How much wealth in the company
stock

   CountInvest=h+Lh*(l-1)+(k-1)*Lh*Ll+(j-1)*Lh*Ll*Lk; %Position
in the matrix


for i=1:1:5000 ;                    %counter for level of effort
    e=i;

P0=S+(S/100)*e/(100*xx); %Initial stock price - Step on 100xx e
increases                                    lognormal development by 1%
PT=P0*exp((rf-(sigma^2)/2-delta)*T+u(zz)*sqrt(T)*sigma);
%lognormal stock
price development
```

```
Stock(i)=PT; %Temporally storage of PT

%%%%%%%%%%%%%%   B&S option pricing   2 %%%%%%%%

TT=TTT-1;    %Length of option vesting period after the first
year is passed
    dd1 = (log(PT/K) + (rf + 0.5*sigma^2)*TT)/(sigma*sqrt(TT));
    dd2 = d1 - sigma*sqrt(TT);
    NN1 = 0.5*(1+erf(dd1/sqrt(2)));
    NN2 = 0.5*(1+erf(dd2/sqrt(2)));

    Call2 = PT*NN1-K*exp(-rf*TT)*NN2; %Value of options at the
end of year 1

Anndel=(ns*S+no*Call+InvestStock)/(ns*S+no*Call+F+bank+InvestSto
ck);   %Proportion of wealth tied to risky assets

D=0.8256*exp(-0.528*Anndel);       %Certainty Equivalent
regression formula             (must manually change for
different levels of risk aversion!)

W=F*exp(rf*T)+ns*PT+no*Call2*D + bank*(exp(rf*T)-1) +
(InvestStock*(PT-S))/S; % CEO Wealth

if W>ref    ;           %Reference dependency demand
    V=(W-ref)^a;        %Utility if W is above reference point

else V=-L*(ref-W)^b;    %Loss Aversion if W is below reference
point
end

Wealth(i)=W;  %Temp Store values of CEO wealth

C=e^2/2;       % Cost of effort
U=W-C;         % CEO Utility
Utility(i)=U; % Temp Store all values of U

end
[Umax,maxeffort] = max(Utility); %Gives the level of effort that
maximize Utility
EndOfPeriodStockPrice = Stock(maxeffort);% Stock price with
given effort
TotComp = Wealth(maxeffort); %CEO wealth with max effort

Profit = (EndOfPeriodStockPrice-S)*nsTot -(F+ns*S+no*(max(PT-
K,0))) + delta*nsTot; %Owners profit
```

```
Profitstore(:,CountInvest)=[EndOfPeriodStockPrice; m; maxeffort;
F; no; ns; Profit]; %Saves the temporary values
   end
        end
    end
end

%%%%%%%%%%%%%%%%%%%%%%% SOLUTION %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


 MaxPP=max(Profitstore(7,:)) ;             %Finds the owners
maximum profit
 maxindex=find(Profitstore==max(Profitstore(7,:))) ; %Finds
where in the
     matrix this is stored

 SizeMI=length(maxindex);
 if SizeMI>1;      %If more than one equal maximum points,
choose the first
 maxindex=maxindex(1);
 end

 Goal=Profitstore(:,maxindex/7);    %Stores the parameters for
when profit is               maximized (Must div on amount of
parameters in Profitstore!)
 StockPrice=Goal(1,:)          ;    %Stock price at maximum
profit
 Mm=Goal(2,:)                  ;    %Amount of initial wealth
to be invested
 AppliedEffort=Goal(3,:)       ;    %Effort at maximum profit
 FixedPayment=Goal(4,:)        ;           %Fixed pay at
maximum profit
 AmountOptions=Goal(5,:)       ;          %# Options at maximum
profit
 AmountStocks=Goal(6,:)        ;           %# Stocks at maximum
profit
 CompanyValue=Goal(7,:)        ;            %Comp value at
maximum profit

 Incenitiveffect=StockPrice/(S*exp((rf-(sigma^2)/2-
delta)*T+u(zz)*sqrt(T)*sigma)); %increased comp value due to CEO


RandVar;                                                %Display
rand var
```

```
%%%% FINAL RESULTS %%%

%%% Stores 3 different matrix with different effort dependency
%%%
if xx==1
Index1(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end

if xx==2
    Index2(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end

if xx==3
    Index3(:,zz)=[StockPrice; Mm; AppliedEffort; FixedPayment;
AmountOptions; AmountStocks; CompanyValue; u(zz);xx];
end
end
end

Index1 %Display Index1
Index2 %Display Index2
Index3 %Display Index3
```