An empirical investigation of implicit contracts

An Empirical Investigation of Implicit Contracts

An Empirical Investigation of Implicit Contracts

ISBN: 978 90 5278 733 6

Printed by: Datawyse / Universitaire Pers Maastricht

An Empirical Investigation of Implicit Contracts

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Universiteit Maastricht,
op gezag van de Rector Magnificus, Prof. mr. G.P.M.F. Mols
volgens het besluit van het College van Decanen in het openbaar te verdedigen
op donderdag 26 juni 2008 om 16.00 uur

door

Felix Höppe

UNIVERSITAIRE PERS MAASTRICHT

Promotor

Prof. Dr. Frank Moers

Beoordelingscommissie

Prof. Dr. A. Vanstraelen (Voorzitter)
Prof. Dr. J. Hagedoorn
Prof. Dr. C.D. Ittner (University of Pennsylvania)

Contents

Acknowledgements

During the process of writing this dissertation, the number of grey hair increased significantly, and without the help of many people it would be even higher.

First and foremost, I would like to thank my promoter Frank Moers for his support, suggestions, ideas and critical views, which all aided me to improve the last four year's work. I would also like to thank Frank for the always-open door and the ability to spread his enthusiasm on empirical accounting research, which positively influenced my decision to become a doctoral student at Maastricht University; a decision I do not regret. I also thank Ann Vanstraelen, John Hagedoorn, and Chris Ittner for their prompt evaluation and approval of the final version of the manuscript as well as for their constructive comments.

I also want to thank each of my former and current colleagues of the Department of Accounting and Information Management for creating a pleasant and constructive environment to work in. I especially thank Robbert-Paul for sharing the task of collecting and structuring the data with me, Erik and Rick who helped me out whenever I navigated into computer-related trouble, and my former roommates Ling and Alexander for the discussions that were also work related from time to time.

I finally thank my parents and my brother Tobias for their unconditional support – and, of course, Andrea for her true encouragement, reflection and involvement. With her, an important phase of my life has become a very enjoyable one.

Felix Höppe

Chapter 1

Introduction

1.1 Introduction

Boards of directors represent the interests of a dispersed community of firm shareholders who delegate the task of firm governance to this supervisory body. As firm ownership and control are inevitably separated in publicly listed firms, important decisions delegated to boards concern the CEO who manages the organization on behalf of shareholders. Shareholders expect management to act in their own interests and boards of directors are in charge of installing and motivating capable CEOs in order to encourage entrepreneurial decision making. Important tasks delegated to boards regarding the CEO include her selection and appointment, measuring, evaluating and rewarding her performance, and employment continuation as well as termination decisions. Among these tasks, especially CEO compensation is an issue of public opinion. Over the last two decades, the major fraction of CEO wealth has been influenced by movements in the value of firm equity, due to significant CEO holdings of firm shares and stock options. Establishing exposure of CEO compensation to the firm's success on stock markets presumably results in incentive alignment between managers and owners. However, in view of CEO compensation packages that by far exceed annual payments received by the average employee issues with regard to the fairness, social responsibility and economic justification of such arrangements are debated by business press and academic research alike.

An important question raised is whether boards of directors effectively exert their imposed duties. Especially the dominance of simply providing CEO's with firm equity to achieve incentive alignment casts doubt on whether this is the case and creates research opportunities with regard to the role of boards as the CEO's main supervisory instance. For example, using the firm's share price as the ultimate surrogate of CEO performance indicates that capital markets rather than boards of directors take on the primary role of evaluating CEO performance. This practice implies that boards determine levels of equity held by the CEO but assign performance evaluation and compensation decisions to investors who are likely to be less informed. Overall, this contradicts the underlying idea of delegating performance measurement and evaluation to boards of directors who are more informed than capital markets about important, yet

sensitive issues such as strategic positioning, new product development, and innovation.

In theory, other important decisions affecting the CEO rest upon boards, and these decisions are inevitably based on evaluations of the CEO. For example, boards dismiss the CEO and are unlikely to base this decision entirely on stock performance including investors' expectations of the firm's prospects. On the contrary, they hold more CEO related knowledge and can also ex-ante communicate what CEO performance evaluations are based on. Moreover, board evaluations of the CEO can convey new information to outsiders (Hermalin and Weisbach 1998; Hayes and Schaefer 2005).

This dissertation empirically explores the use and effects of CEO incentives created by boards beyond those resulting from her equity ownership. Using economic theory as the benchmark for evaluation, the following work compiles three empirical studies in an attempt to identify whether boards of directors use their information advantage over capital markets to influence CEO decisions by effectively and efficiently measuring and evaluating her performance. More specifically, the first study examines determinants of board discretion in assessing CEO performance, emphasizing the contracting value of information gained from monitoring the CEO and the ability of boards to exploit such information. The second study deals with the impact of board evaluations on incentives by examining its influence in the CEO's firing decision. The third study investigates whether the board's opportunity to include privately held information in CEO evaluation influences CEO decisions on dimensions that are difficult to measure but affect long-term firm value, using the example of firm innovation.

1.2 Inferring board evaluations

This dissertation aims at the determinants and effects of boards' CEO performance evaluation decisions. For evaluations to influence behavior, CEOs need to have notion of what boards will emphasize in assessing performance before the action choice is taken. To empirically examine this matter, public data on what boards deem important in the CEO evaluation process is necessary. However, firms are not obliged to provide details of CEO performance evaluation to outsiders. To circumvent the problem, ex-ante specifications of CEO performance evaluations are deducted from U.S. CEO annual bonus contracts described in the compensation section of SEC Proxy Statements (DEF 14a).

Numerous studies investigating the design of annual bonus contracts report that executive short-term bonuses are determined almost exclusively based on accounting

performance measures and privately observed measures, which indicates the relevance of boards monitoring the CEO (e.g. Bushman, Indjejikian and Smith 1996; Ittner, Larcker and Rajan 1997). Yet, the dominant role of equity compensation in CEO compensation has led researchers to question the incentive relevance of cash compensation in general, and bonus contracts in particular (e.g. Core, Guay and Verrecchia 2003). If short-term compensation contracts are used to provide incentives, the decisions made in this context must have other effects in how boards influence CEO actions beyond the role direct cash transfers play in achieving this. An appealing alternative is that boards of directors can use bonus contracts and their formal administration as a means to signal what elements the annual review of performance is comprised of. Actual cash payments made by the board consequently contain information about outcomes of the CEO's performance review conducted by the board. This, in turn, is likely to affect other high-powered incentive components such as new grants of firm equity or the likelihood of CEO turnover. The compensation section of Proxy Statements includes detailed information about the ex-ante definition of performance measures and the extent to which board's private information becomes relevant in evaluating the CEO.

Assuming that CEO bonus contracts represent CEO performance evaluation practices, I first focus on determinants of different approaches to CEO evaluation in chapter 2. In chapter 3, I test this assumption by investigating whether bonus contract specifications are systematically related to the relationship between firm performance and the CEO firing decision. I thereby also study if CEO performance evaluations and thus, bonus contracts provide incentives. In chapter 4, I examine whether boards' performance evaluations influence CEO behaviour by studying their effect on firm innovation.

1.3 Outline

In chapter two, the first study entitled ***Discretion and the Complexity of Simple Bonus Contracts*** is presented. I examine whether board discretion in the decision how observed CEO performance translates into rewards ex-post follows optimal contracting considerations or merely represents a means for the CEO to extract rents from the firm. Specifically, consistent with the first view, discretion gives boards the opportunity to adjust performance evaluations for unforeseen factors, and this informational advantage can be used to improve incentives. Consistent with the second view, discretion allows boards to evaluate the CEO in a way that is not transparent to outsiders and to raise performance evaluations beyond economic justifications. Previous studies provide little evidence on the extent to which discretion is driven by

either of these underlying views. In this study, I attempt to investigate whether this lack of evidence is, at least partly, driven by not differentiating between different types of discretion and associated benefits. I focus on two types of discretion: (1) the use of discretionary bonus adjustments in contracts solely based on earnings (implicit earnings-based contracts) and (2) the use of subjective weights in contracts based on multiple measures (implicit multi-measure contracts). In the context of these implicit contracts, I address the following two questions. First, what motives do boards have to write implicit contracts, and thereby condition bonus payments on their subjective evaluation of the extent to which ex-ante specified measures reflect an accurate picture of CEO performance? Second, do these motives for writing implicit contracts, as also the type of discretion used, change with specific contract configurations and associated contracting problems? I develop and test hypotheses corresponding to these questions. I argue that the benefit of filtering out external noise and the achievement of congruity between CEO actions and firm value are the primary drivers of discretion conditional on the main contracting problem at hand. Further, applying discretion is per-se difficult and requires relatively intense monitoring of the board. In line with this reasoning, I test the prediction that the potential benefits and thus the incidence of board discretion hinge on the board's monitoring intensity.

An assumption underlying the first study is that CEO performance evaluation is relevant from an incentive perspective and that bonus contracts are informative of this evaluation. In Chapter 3, I test this assumption by focusing on how, if not via direct cash payments, the evaluation of the CEO spills over to other important governance decisions and thereby affects incentives. In the study ***Bonus Contracts, Private Information, and CEO Turnover***, I address the question whether compensation related details given in annual bonus contracts represent performance dimensions used by boards of directors in administering CEO employment. Specifically, I investigate CEO continuation versus termination as an example of a governance decision which affects CEO incentives as well as shareholder interests. Equity compensation dominates CEO wealth, but nevertheless virtually all firms take care in administering bonus contracts whose designs even exhibit substantial differences across firms and industries. I argue that this observation occurs because more incentive relevant decisions are linked to bonus contracts apart from seemingly trivial bonus payments.

An important duty that shareholders delegate to corporate boards is to attract and fire the CEO. The aim of retaining her position provides significant incentives for the CEO, for instance due to foregone future salary payments and reputation losses. Directors frequently interact with the firm's management, which makes them more informed about her actions and planned initiatives than investors can possibly be. Stock prices therefore contain no new information about CEO quality or effort, and prior empirical research supports this view (e.g. Engel, Hayes, and Wang 2003). The

decision to fire the CEO consequently rests upon board evaluations of CEO performance, and this linkage provides significant incentives. Identifying the importance of board evaluations in CEO firing therefore shows the importance of boards and their monitoring of executives in governing the firm.

I also examine whether investors respond to the informational differences associated with CEO firing. Specifically, the board's dismissal of the CEO can vary with respect to the amount of private information leading to the decision. This results in different implications for investors when a CEO has to leave the company. A firing that is predominantly based on observable (e.g. accounting) performance shows investors that the board is still functioning, resulting in a positive signal. Conversely, if the firing is also based on private information, the capital market receives unexpected negative information about the CEO. Based on this, I predict stock price reactions around the announcement of a CEO to be positive if the board's evaluation of her performance is predominantly conditioned on public information, and negative if it is (partly) conditioned on private information.

After focusing on whether the private information held by boards included in the CEO's performance evaluation is related to high powered incentives in the form of employment continuation decisions, chapter 4 turns to the effects of these incentives. In the third empirical study, ***The Incentive and Signaling Effects of Annual Bonus Schemes: Evidence from Firm Innovation***, I study the effects of boards' private information in performance measurement and evaluation on firm innovation, using a sample of R&D intensive firms. Innovation is crucial for many firms who seek to gain competitive advantage by exploring new products, materials, or methods of production. Innovation does not instantly translate into measurable firm success and the firm's accounting performance is unlikely to capture the value of promising projects. Providing equity incentives can thus be problematic, especially when firms are reluctant to disseminate sensitive information, for example in early stages of identifying innovative processes or products. This highlights the importance of boards' annual performance evaluations undergone by CEOs who gain more information related to the value of innovation than capital markets (Lipton and Lorsch 1992; Bushman and Smith 2001). Innovation is representative of a situation where the assessment of desirable CEO initiatives is per-se difficult and this task is delegated to boards. I develop and test the hypothesis that CEO performance evaluations that take private information about value creation into account are positively related to firm innovation.

I further draw upon the notion that details of performance evaluations systematically translate into components of cash compensation (Chapter 2 and 3 of this dissertation). Investors can then deduct the value of innovation from observing actual cash payments received by the CEO and include this in forming expectations about

firm value (Hayes and Schaefer 2005). As a consequence, the firm's stock price becomes more sensitive to the CEO's innovative behavior, resulting in the increased intensity of given equity incentives and thus, greater CEO motivation to secure innovation. I test the hypothesis that CEO equity is associated with more innovation, in the presence of private measures included in CEO performance evaluation. Identifying whether this interplay is positively related to innovation shows when board evaluations and equity can be complements in providing incentives.

1.4 Sample

The samples of data used in this dissertation consist of U.S. publicly listed firms in the 1998-2002 period included in the EXECUCOMP database and indicating to have the same CEO in this time span. Firm accounting, financial, and innovation information is gathered using COMPUSTAT, CRSP, and USPTO data, respectively. I read, together with two researchers, the Proxy Statements of all firms in the period of interest and coded the following details given: (1) The performance measures used in determining annual CEO bonuses; (2) whether realizations of CEO performance are measured by public sources (e.g. Residual Income, Net Earnings) or alternatively, result from the board's monitoring of the CEO; (4) whether the relative weight of performance measures is set forth in an ex-ante defined formulaic approach or if boards choose to determine weightings ex-post, and (5) if a formula is used, the explicit weights attached to performance measures.

Chapter 2 employs 1,753 observations of 425 firms in the 1998-2002 period. Chapter 3 concentrates on 303 sample firms in 2001 replenished by 45 firms with the incidence of CEO dismissal after fiscal year 2001. Chapter 4 is based on 520 observations from 197 R&D intensive firms in the 1998-2000 period.

1.5 Contribution

This dissertation contributes to the literature in a number of ways. It documents that multiple types of discretion exercised by boards exist. Distinguishing between these types is important, as different types of discretion can be a remedy for different contracting problems, which earlier related work has ignored so far. Moreover, this dissertation indicates that the choice of discretion follows optimal contracting rather than rent extraction considerations, and shows that boards invest special diligence in their task of reviewing and evaluating CEO performance.

This dissertation further examines the incentive effects of board evaluations. Board evaluations are systematically related to the CEO firing decision. In that way the presented findings add to the discussion concerning why firms administer annual incentive programs. Outlining the procedure used in evaluating the CEO by means of annual bonus programs offers various advantages and provides incentives due to spillover effects on employment decisions. Results further indicate that stock market reactions to CEO turnover differ depending on the type of information used in governance decisions. This provides a plausible explanation for the mixed evidence in previous event studies in this area.

The following work also focuses on effects of incentives provided by board evaluations by analyzing their impact on firm innovation. Until so far, accounting studies have predominantly investigated the impact of CEO incentives on R&D spending, ignoring that these investments do not per-se yield innovation. The analysis presented here is novel as it shows that boards monitoring and evaluation of the CEO's innovation oriented behavior is important to secure innovation. Furthermore, this dissertation includes one of the first studies to empirically examine whether cash compensation signals private information to the capital market. It adopts the Hayes and Schaefer (2005) argument stating that stock prices are far from being perfect surrogates of firm value if disseminating all sensitive information to investors in too great detail is infeasible from the firm's perspective. Empirically testing this argument yields important implications both from a theoretical as well as managerial point of view.

1.6 Structure of the dissertation

The remainder of this dissertation is organized as follows. Chapter 2 describes the study on the determinants of board discretion in annual CEO performance evaluation. Chapter 3 presents the study on the role of performance evaluation performed by boards in the CEO firing decision. Chapter 4 treats the incentive effects of board evaluations on firm innovation. Chapter 5 concludes and summarizes this dissertation.

Chapter 2

Discretion and the Complexity of Simple Bonus Contracts[1]

Abstract

In CEO incentive contracts, discretion (or subjectivity) by the board of directors is often present in one form or another. What is unclear, however, is whether this behavior reflects rent extraction or optimal contacting. I argue that discretion can improve incentive contracting by addressing two important considerations: (1) risk reduction and (2) congruity improvement. I distinguish between discretion being applied in bonus contracts solely based on earnings (implicit earnings-based contracts) and discretion being applied in bonus contracts based on multiple measures (implicit multi-measure contracts). I argue that, in an earnings-based contract, the benefit of discretion is its ability to reduce risk by subjectively adjusting for uncontrollable factors and this benefit is more likely to be exploited the greater the noise in accounting earnings. In a multi-measure contract, the benefit of discretion is its ability to reduce noncongruity by subjectively weighting these measures ex-post and this benefit is more likely to be exploited the greater the difficulty of predicting the optimal course of action ex-ante. I therefore expect that, conditional on the use of only accounting information (accounting and nonaccounting information), the use of implicit contracts is positively associated with accounting noise (environmental unpredictability). Finally, I expect that the ability to exploit the benefits of discretion depends on the monitoring intensity of the board. The empirical results based on incentive contract data for 424 CEOs of U.S. public firms are consistent with my expectations and show that the use of discretion is driven by optimal contracting considerations.

[1] This chapter is based on a working paper co-authored with Frank Moers.

2.1 Introduction

In this study, I examine the determinants of discretion in CEO annual bonus contracts.[2] From an economic perspective, firms use CEO incentive contracts to align the executive's interests with those of their owners. In these contracts, discretion (or subjectivity) by the board of directors is often present in one form or another.[3] In observed business practice, there are multiple examples of important subjective components, such as CEOs being evaluated on non-quantifiable aspects of the job or boards deciding on how performance will be translated into rewards ex-post. Proponents of the managerial power theory claim that these forms of discretion are examples of rent extraction (e.g. Bebchuk et al. 2002) and this view has also been expressed in the press (e.g. Morgenson 2006). An alternative view is that boards' choice of discretion reflects optimal contracting. Given that boards of directors play a crucial role in governing the firm, it is important to better understand the reasons for using discretion. Consistent with the optimal contracting perspective, I show that boards use discretion in an attempt to resolve contracting problems.

Previous studies provide little evidence on the extent to which discretion is driven by economic determinants. I argue that this lack of evidence is, at least partly, driven by not differentiating between different types of discretion and associated benefits. In this chapter, I focus on two types of discretion: (1) the use of discretionary bonus adjustments in contracts solely based on earnings (implicit earnings-based contracts) and (2) the use of subjective weights in contracts based on multiple measures (implicit multi-measure contracts). In the context of these implicit contracts, I address the following two questions. First, what motives do boards have to write implicit contracts, and thereby condition bonus payments on their subjective evaluation of the extent to which ex-ante specified measures reflect an accurate picture of CEO performance? Second, do these motives for writing implicit contracts, as also the type of discretion used, change with specific contract configurations and associated contracting problems?

There are two important considerations in designing incentive contracts: the risk premium to be paid to a risk averse agent and the extent to which the contract achieves goal congruence between the principal and agent. I argue that discretion can play an important role in incentive contracting by addressing the problems of risk and

[2] Although the annual bonus represents a small fraction of a CEO's total compensation, it reflects the performance assessment by the board of directors of the CEO. Understanding the way in which boards assess the performance of the CEO is important because it is very likely that this assessment affects other, high-powered incentive components, such as equity grants and the likelihood of CEO turnover.

[3] I use the terms "discretion" and "subjectivity" interchangeably throughout this dissertation.

noncongruity. If a single performance measure is used because it is a sufficiently perfect representation of the economic consequences of the agent's actions, then the remaining contracting problem is one of risk caused by performance measure noise (Feltham and Xie 1994). In this case, the principal can apply discretion to adjust for the effect of uncontrollable factors and make the contract implicit, the benefits of which are increasing in the level of noise. I therefore expect that, conditional on the use of a single performance measure, the choice of implicit contracts (discretionary bonus adjustments) is positively associated with the noise in the single performance measure.

If multiple performance measures are used, then an important contracting problem is how to weight these measures to assure congruity with the principal's gross payoff. One of the choices that needs to be made in this respect is whether to fix the weights ex-ante or allow for discretion ex-post. The benefit of keeping the weights ex-ante implicit is that relevant pre-decision information that will only be observed after the contract has been signed can be incorporated in rewarding the CEO using ex-post subjective weights. This informational advantage is more prevalent the less predictable the environment, because increased unpredictability makes it more difficult to establish the optimal course of action ex-ante. I thus expect that, conditional on the use of multiple performance measures, the choice of implicit contracts (subjective weights) is positively associated with environmental unpredictability.

Despite the above-mentioned benefits, there are also costs associated with the use of implicit contracts, which explains why we do not observe implicit contracts all the time for all firms. Most of the costs relate to the mere use of implicit contracts, such as problems of reneging, favoritism, and bias (e.g. Baker et al. 1994; Prendergast and Topel 1996; Moers 2005). In addition, there are problems that relate to the extent to which the benefits of discretion can be exploited. In this chapter, I focus on this lack of benefits. In order for the implicit contract to be valuable, the use of discretion should either lead to a reduction in risk or a reduction in noncongruity. I argue that the ability to achieve these reductions, and thus exploit the benefits of discretion, depends on the intensity with which the boards of directors monitor. The lower the monitoring intensity the less able the board is in interpreting what they observe and thus the less likely discretion will improve incentive contracting. As a result, I expect that the effect of noise and environmental unpredictability on the use of implicit contracts is moderated by the monitoring intensity of the board of directors.

To test my predictions, I use an extensive dataset based on compensation contract information retrieved from 1998-2002 SEC proxy statements. The data provide me with information on the performance measures specified for deriving annual bonuses and whether their application in the compensation decision is regulated formulaically (explicit contract) or allows for discretion (implicit contract). In line with expectations,

I find that the incidence of implicit contracts is positively related to (1) the noise in accounting earnings, once accounting measures are the sole performance measures specified and (2) the extent of environmental unpredictability, once the firm combines accounting and nonaccounting measures. I further find strong evidence that monitoring intensity of the board of directors increases the effect of noise on implicit contracts, but only moderate evidence that it increases the impact of environmental unpredictability. Finally, additional analyses and numerous robustness checks corroborate the above findings.

I contribute to the literature in several related ways. Despite the prevalence of discretion, there is only limited empirical evidence of the determinants of its use. Most of the previous empirical studies in this area examine the existence or extent to which discretion is applied without distinguishing between different types of discretion (Murphy and Oyer 2003; Gibbs et al. 2004; Ederhof 2007).[4] In a similar vein, even though previous research states that there are different types of benefits to using discretion (Murphy and Oyer 2003), no attempt has been made to disentangle these benefits. I contribute to the literature by conceptually and empirically showing that different types of discretion create different types of benefits and that making this link is important to be able to explain board discretion. I further contribute to the literature by providing evidence that economic arguments underlie the use of discretion in incentive contracts. I show different types of discretion are used to address different contracting problems and these contracting problems depend on the choice of performance measures. Finally, I show that, in addition to distinguishing different types of discretion, it is important to separate uncontrollability (noise) from unpredictability in incentive contract design.

The remainder of the second chapter is structured as follows. In section 2.2, I discuss the theory and develop the hypotheses. In section 2.3, I describe the sample selection, method, and variable measurement and in section 2.4 I discuss the empirical results. Finally, in section 2.5, I provide a conclusion.

2.2 Theory and hypotheses

2.2.1 Benefits and types of discretion

Casual observation of actual practice and prior studies on incentive contracting indicate that accounting performance measures play an important, and often exclusive,

[4] See Moers (2005) for an exception.

role in CEO compensation decisions (Bushman et al. 1996; Ittner et al. 1997).[5] Given the importance of accounting information, I focus on motives of boards of directors to deviate from explicit bonus contracts that are exclusively written on accounting numbers and to introduce discretion in the performance appraisal process. In general, there are three benefits associated with discretion by boards of directors (Murphy and Oyer 2003): (1) reduce CEO's exposure to risk, (2) reduce distortions caused by quantitative performance measures, and (3) promote adaptive behavior. Discretion can thus improve incentive contracting by addressing the dominant contracting problems of risk reduction and congruity improvement (Feltham and Xie 1994).

Although discretion can improve contracting, it can be applied in different ways. In particular, the literature identifies three important types of discretion by boards of directors (Baker et al. 1994; Ittner et al. 2003; Gibbs et al. 2004): (1) discretionary bonus adjustments, (2) explicit bonus pay on subjective performance measures, and (3) subjective weights on multiple performance measures. In terms of contract design, these types of discretion can be formulated as follows.

$$s_1(\cdot) = w + \beta A + D(\cdot) \qquad \text{(Contract } s_1\text{)}$$

$$s_2(\cdot) = w + \beta_1 A + \beta_2 SPM \qquad \text{(Contract } s_2\text{)}$$

$$s_3(\cdot) = w + \beta_1(\cdot) A + \beta_2(\cdot) y \qquad \text{(Contract } s_3\text{)}$$

where w is a fixed wage, β_i is the explicit incentive weight on performance measure i, A is accounting performance measure, $D(\cdot)$ is the discretionary bonus adjustment, SPM is subjective performance measure, $\beta_i(\cdot)$ is the subjective (implicit) incentive weight on performance measure i, and y is non-accounting performance measure. The question that has not been addressed so far in the literature is why boards use one type of discretion instead of another, or whether it matters at all?[6] I argue that each type of discretion is linked to especially one of the benefits. In the following, I specifically argue that Contract s_1 is used for risk reduction, Contract s_2 for reducing distortions caused by quantitative measures, and Contract s_3 for promoting adaptive behavior.

[5] There are several reasons why accounting information is important in incentive contracting. First, accounting data are readily available for purposes other than incentives and are therefore relatively costless for incentive purposes. Further, accounting earnings are quantitative, verifiable by third parties, and conservative in nature, all of which improve their usefulness for contracting (see e.g. Watts and Zimmerman 1986). In addition, Sloan (1993) argues that earnings can shield executives against market risk inherent in firms' stock prices. Finally, accounting earnings are highly aggregated, ultimately capturing the effects of all managerial actions, and are therefore valuable in addressing the incentive problem caused by delegation (Moers 2006).

[6] I acknowledge that combinations of the three contracts are possible. However, the three contracts described, are consistent with the contracts generally observed in practice, there is a theoretical reason for why this is so (as I argue next), and I provide empirical evidence consistent with these arguments. I return to this issue later in the chapter.

2.2.2 Discretion and risk reduction

If there is a contractible performance measure that is sufficiently congruent, i.e., a sufficiently perfect representation of the economic consequences of the agent's actions, then the sole use of this performance measure can direct the attention of the agent in the right direction. In settings where the CEO's actions have predominately contemporaneous performance effects rather than future performance effects, accounting earnings can be thought of as sufficiently congruent. Explicit incentive contracts solely based on accounting information can then be effective, though not necessarily efficient. For discretion to improve incentive contracting, it needs to address the remaining contracting problem of risk reduction and thereby increase efficiency.

The potential inefficiency of earnings-based contracts centers on the noise in accounting earnings. The analytical literature indicates that supervisor discretion can be a solution to the noise inherent in objective performance measures. For example, Baker et al. (1994) show that contracts written on a noisy objective measure can be improved if the principal has (unverifiable) information about actual noise realizations and subjectively determines compensation based on that signal. Boards gain knowledge about uncontrollable and ex-ante non-contractible events that occur during the measurement period and that impact accounting earnings. If the board conditions rewards on this knowledge, through the use of discretionary bonus adjustments (Contract s_1), they can reduce the CEO's compensation risk.

An alternative to the use of discretionary bonus adjustments to reduce risk could be to use explicit pay based on the board's subjective assessment of the noise realizations (Contract s_2). The only difference between these two contracts would be that explicit pay fixes the bonus adjustment, while discretionary bonus adjustment provides the option to adjust. The option to adjust, however, is valuable to meet the CEO's reservation wage when his outside employment opportunities are associated with uncontrollable changes in the market (Oyer 2004; Rajgopal et al. 2006). Given the non-negative value of this option, discretionary bonus adjustments are preferred over explicit pay based on subjective judgments for the purpose of risk reduction.

Although discretion can reduce risk caused by performance measure noise, this risk reduction benefit might be offset by an increase in risk caused by problems that can occur once discretion is allowed, such as reneging, favoritism, and bias (Baker et al. 1994; Prendergast and Topel 1996; Moers 2005). As a result, the use of discretionary bonus adjustments is more likely to improve incentive contacting the greater the benefits of reducing performance measure noise, and these benefits are greater the noisier the measure. Based on the above discussion, I state the following hypothesis.

H1: In earnings-based contracts, the use of discretionary bonus adjustments is positively related to the noise in earnings.

2.2.3 Discretion and congruity improvement

In case earnings are far from being sufficiently congruent, the addition of a more diverse set of performance measures can be optimal (e.g. Holmstrom 1979; Feltham and Xie 1994). Empirical evidence shows that the use of nonfinancial measures and subjective judgments are valuable when accounting numbers fail to immediately capture the effects of all important managerial actions (e.g. Bushman et al. 1996; Ittner et al. 1997; Banker et al. 2000; Gibbs et al. 2004). If boards decide to supplement earnings with alternative measures, a critical issue in contract design is the weighting of these measures (Banker and Datar 1989; Ittner et al. 2003). Ceteris paribus, the principal prefers a weighting scheme that minimizes distortions and makes the overall performance evaluation of the agent congruent with the principal's objective.

Most of the previous studies in the incentive area focus on the determinants of the explicit (relative) weights on different performance measure, including subjective judgments, i.e., Contract s_2 (e.g. Bushman et al. 1996; Ittner et al. 1997; Murphy and Oyer 2003). Instead, I focus on the problem that the principal has to decide to either use an objective, formulaic approach or leave the incentive weights on performance measures open to ex-post adjustment. While an objective formulaic approach avoids problems that can result from ex-post subjective evaluations, the rigidity of this approach can be problematic in unpredictable environments. Fixing the weights ex-ante provides incentives for behavior that is not adaptive to changes in the environment. This is effective if the optimal course of action is known ex-ante, but can cause problems in fast-changing environments where responsive actions are required (Demsetz and Lehn 1985). As a result, in an unpredictable environment, the agent needs to take actions that are value enhancing but unknown ex-ante, which creates a demand for an incentive system that induces situation-specific adaptive behavior.

The use of discretion in weighting different performance measures ex-post allows for this adaptive behavior. The board can, in its weighting decision, incorporate relevant pre-decision information that it observes after the contract has been signed. Given this incorporation, the agent has incentives to similarly incorporate this pre-decision information in his action choice in a congruent way. In sum, the benefits of flexibility in using diverse measures to derive compensation are high when boards know important performance dimensions but are unable to predict as to what constitutes good performance and which, and to what extent, CEO actions will affect firm value during the fiscal year. Accordingly, I state the following hypothesis.

H2: In multi-measure contracts, the use of implicit incentive weights is positively related to environmental unpredictability.

2.2.4 Discretion and monitoring intensity

As noted before, the use of discretion in incentives provides the principal with the opportunity to let her personal preferences play a role in the compensation decision. As such, the mere use of discretion is costly. Even if the principal is 'honest', discretion can be problematic, however. These problems relate to factors that limit or destroy the potential benefits of discretion. The benefits of discretion hinge on the accuracy of the observed unverifiable signal; the lower the accuracy of this signal the lower the benefits of using it to resolve contracting problems (Baker et al. 1994). Discretion can therefore be (too) costly if an honest and unbiased principal misinterprets performance data.

The probability that performance data are incorrectly interpreted is higher the less intense the board monitors. That is, a board that is characterized by a low monitoring intensity is less likely to interpret unverifiable signals correctly. In an earnings-based contract, this implies that the board can misinterpret the noise realizations and make discretionary adjustments that do not adjust for uncontrollable effects. In a similar vein, the board might misinterpret observed pre-decision information and choose incentive weights in a multi-measure contract that are inconsistent with the optimal action choice. Under rational expectations, these problems are taken into account in the ex-ante contracting choice, which implies that an increase in noise (environmental unpredictability) is less likely to lead to an implicit earnings-based contract (multi-measure contract) the lower the monitoring intensity of the board. As a result, I state the following two hypotheses.

$H3_a$: In an earnings-based contract, the relationship between the use of discretionary bonus adjustments and noise in earnings is less positive the lower the monitoring intensity of the board.

$H3_b$: In a multi-measure contract, the relationship between the use of implicit incentive weights and environmental unpredictability is less positive the lower the monitoring intensity of the board.

2.3 Sample, method and variable measurement

2.3.1 Sample selection

My analysis is based on CEO incentive contracts described in the compensation section of SEC Proxy Statements (DEF 14a). Proxy statements do not only provide information about specified performance measures but also whether boards of directors apply them in a formula or with subjective flexibility to derive compensation at the end of a fiscal year. My sample consists of publicly-listed firms included in EXECUCOMP without a change in the CEO position in the period from 1998 to 2002. I obtain an initial sample of 2,895 observations for 579 firms across the five years.

The full sample initially reduces to 2,575 observations due to three sources of missing compensation-related information: lacking proxy information (63 obs.), companies not administering annual incentive programs (127 obs.), and missing indication of performance measures (130 obs.). I merge the remaining observations with stock market and financial statement data obtained from COMPUSTAT and CRSP, by firm and fiscal year, which reduces the sample to 2,073 observations due to missing information. Finally, missing board of directors' information leads to the loss of additional 320 observations, resulting in a final sample size of 1,753, for 424 firms across five years in 11 different industries, as classified by two-digit SIC code.

My main research interest lies in board motives for choosing inside two different performance measure constellations: implicit contracts with respect to (1) earnings or (2) multiple diverse measures. Therefore, I divide the initial sample into the two subsamples EARNINGS and DIVERSE. To determine these subsamples and to create the dependent variables of interest, all individual proxy statements were separately read by me and two researchers. There were only a small number of differences in the classifications (approximately 5% of the sample), all of which were subsequently resolved.

The EARNINGS sample contains observations when the board bases (the explicit part of) the bonus entirely on earnings or an earnings-related measure. This sample (n=812) is derived by focusing on named performance measures such as "Earnings per Share", "ROA", "ROE", or "Residual Income", as well as the indicators for earnings being the only measure specified ("exclusively", "only", no appearance of other measures). The DIVERSE sample encompasses contracts in which boards employ a combination of earnings and alternative non-accounting measures (n=941). In addition to the mentioned earnings indicators, I search for words such as "Quality", "Efficiency", "Customer Satisfaction", "New Product Development", "Leadership", and "Strategic Positioning".

2.3.2 Dependent variables

To test the research hypotheses stated, two dependent variables capture board discretion in performance measure application. I define a binary variable for discretion in each of the subsamples EARNINGS and DIVERSE. In Table 2.1, I provide a detailed overview of excerpts from proxy statements corresponding to compensation contracts in EARNINGS and DIVERSE and whether I code these contracts as implicit (IMPL_EARN=1; IMPL_DIVERSE=1) or explicit (IMPL_EARN=0; IMPL_DIVERSE=0).

In the subsample EARNINGS, I measure IMPL_EARN as an indicator variable that takes on the value 1 if I identify a semantic structure that indicates that boards apply discretion in linking earnings performance to pay, and 0 otherwise. Examples of discretion include "[…], the bonus is not subject to a mathematical formula" and "[…] in awarding bonuses the board may, upon its sole discretion, increase or decrease bonus payments."[7] The mean of the dependent variable IMPL_EARN is 26.11 per cent (212 obs.). Of those contracts that disclose the option to use discretion, at least 33.33% actually exercise this option. This percentage is an underestimate if firms explicitly disclose when they exercise discretion to increase bonus payments but refrain from doing so when they make downward discretionary adjustments.[8] The use of discretionary bonus adjustments is obviously not restricted to earnings-based contracts. I do observe the use of these adjustments in the DIVERSE subsample. The incidence of discretionary bonuses in the DIVERSE subsample, however, is only 12.98% and is significantly lower than the incidence in the EARNINGS subsample ($p<0.01$ two-tailed).

This finding is consistent with the argument that adding performance measures that are informative can also have risk reduction effects (e.g. Feltham and Xie 1994), which reduces the need for discretion for the purpose of risk reduction.

In the subsample DIVERSE, I measure IMPL_DIVERSE as an indicator variable that takes on the value 1 if boards leave relative weights on diverse measures implicit, and 0 otherwise. I search for semantic structures that indicate that the board does not formulaically use diverse performance measures for bonus determination. Examples include "these factors are considered subjectively without specific weight to any item" and "in awarding bonuses, the board may choose among performance measures it considers important for assessing CEO performance". I identify 753 observations (80.02%) where flexibility is applied in the use of diverse performance measures.

[7] A common practice of boards is the specification of earnings targets and resulting pay out schemes, which are characteristics of a formula bonus. Still, some boards explicitly indicate that they can overrule the formula outcome. In this case, the bonus is not court-enforceable and consequently implicit.

[8] This observation signals that using ex-post measures of discretion can be problematic (see e.g. Ederhof 2007).

Table 2.1

Excerpts from compensation committees' reports included in proxy statements

Panel A: Observations included in EARNINGS	
	Topps Co Inc *(proxy dated 05/26/2000)*
1. Explicit use of earnings (IMPL_EARN=0)	For fiscal 2000, bonuses were intended to reward achievements by the executive officers and were contingent upon the Company's financial performance during the year. The Company's Bonus Plan for fiscal 2000 was structured to reward executive officers for increases in the Company's operating profits.[…] Mr. Shorin's bonus for fiscal 2000 was determined entirely by reference to uniform, pre-established earnings targets that were developed for all senior executives at the beginning of the fiscal year.
	Sonic Corp. *(proxy dated 12/17/2001)*
2. Implicit use of earnings (IMPL_EARN=1)	The Company has adopted an incentive bonus plan, which covers all of the Company's executive officers, as well as other mid-level management personnel. Under the plan, the Compensation Committee measures the performance of the Company against an annual business plan prepared by management and reviewed and approved by the Board of Directors. Achievement of the earnings per share target set forth in the annual business plan may result in the payment of incentive payments equal to a percentage of the base salary of the covered officer. Under the plan, the committee may award up to 50% of the incentive payments if the Company achieves 85% of the annual business plan and may award up to 100% of the incentive payments as the percentage of earnings per share achieved increases from 85% to 100%. The plan also allows the committee to increase the incentive payments ratably to the extent the Company exceeds the earnings per share target. The committee has the discretion whether and in what amounts to award any incentive bonuses.

(Continued on next page)

Table 2.1 (continued)

Panel B: Observations included in DIVERSE	
	Actel Corp. *(proxy dated 04/08/2002)*
1. Explicit weights on diverse measures (IMPL_DIVERSE=0)	Under Actel's Executive Bonus Plan for 2001, incentive cash payments were based on Actel's revenues and profits, the achievement of corporate goals, and the growth of Actel relative to its principal competitors. The revenue and profitability objectives were established […] so that the percentage achievement of each was determinable objectively at the end of the year. The corporate goals for 2001 included engineering, selling, and marketing objectives, which were weighted in the order indicated. The engineering objectives included silicon, software, and process goals. The selling objectives included sales and design-win goals. The marketing objectives included product launch and product planning goals. The revenue, profitability, and corporate goals were weighted differently under the Executive Bonus Plan for some executive officers, based on relevance to their positions, but had an aggregate weighting of 80% for all executive officers. The "competitive performance" objective accounted for the other 20%, and it was also determinable objectively at the end of the year.
	J & J Snack Foods Corp. *(proxy dated 02/08/2001)*
2. Implicit weights on diverse measures (IMPL_DIVERSE=1)	Annual performance standards for each executive officer's area of responsibility are established by the Chief Executive Officer for other executive officers. In some cases, bonuses are linked primarily to achieving increases from the prior year's sales and/or earnings. In other cases, bonuses reflect a more subjective view of an individual's performance. The bonus for Mr. Shreiber was not linked to any specific formula. The Compensation Committee considers both the long term aspect of the Company's performance and year to year results. Among the items considered by the Committee were J & J's Sales, Operating Income, Operating Income as a percent of sales, Net Earnings, Earnings Per Share, Return on Equity and Stock Price. These items were reviewed for the previous year and for a five year period. The Committee also considers matters which are likely to have a long term impact on the Company but may not be reflected on the annual financial statements. The above factors were considered subjectively without specific weight to any item.

2.3.3 Independent variables

I measure NOISE based on the variability in the median 3-digit industry accounting returns. Higher fluctuations in accounting returns of the median firm in a respective industry are assumed to proxy for the extent to which firm accounting performance is vulnerable to factors beyond a manager's control (Ittner et al. 1997). I include the variability in ROA, ROE, and ROS over five years preceding the proxy data. Principal component analysis reveals one factor with eigenvalue greater than unity. I use the factor score as the measure of noise (cf. Ittner et al. 1997).

Following Demsetz and Lehn (1985) and Core and Guay (1999), I proxy for the degree of environmental unpredictability by using return volatility. The volatility in returns is driven by changes in expectations and thus the greater the volatility the less predictable the environment. I measure the standard deviation of the residuals from a market-model, i.e., a regression of a firm's monthly stock returns on the CRSP value-weighted index estimated over period of 12-60 months prior to the proxy data. I subsequently take the natural logarithm of the standard deviation to arrive at my measure (UNPREDICTABILITY).

I measure the monitoring intensity of the board of directors by computing a factor score including board size, the proportion of busy outside directors, and the proportion of busy inside directors. My arguments to include these items are driven by the claim that they reflect a lack of time and board dialogue needed for discretion to be applied correctly.[9] Board size is presumed to be associated with a lack of dialogue and difficulty in reaching consensus (Lipton and Lorsch 1992). The more difficult it is to reach consensus the more likely it is that discretion will be based on inaccurate signals. I include the proportion of busy outside directors (i.e. directors with three or more directorships) and busy inside directors (i.e. directors with two or more directorships) as they often adopt a "one solution fits all" approach to exerting corporate control due to a lack of director time (Core et al. 1999; Larcker, Richardson and Tuna 2007). This approach is detrimental to the use of discretion because it lowers the ability of directors to correctly interpret performance data and hence will lead to assessments based on inaccurate signals. Further, as the number of busy outsiders increases, boards are inclined to become distracted and monitoring intensity is likely to suffer (Fich and Shivdasani 2006). Although the criteria determining director business (two or more directorships for inside; three or more directorships for outside directors) are set

[9] Note that I make no claim that board size and the proportion of busy outside/inside directors are measures of poor corporate governance and less *effective* monitoring. I claim that they measure monitoring intensity and that it is optimal for a board with lower monitoring intensity to de-emphasize the use of unverifiable information (Petersen and Rajan 2002).

somewhat arbitrarily, I use these cutoffs for the following reasons. First, they reflect the recommendation by the Council for Institutional Investors concerning the maximum directorship of board members. Second, the definition at hand is consistent with prior work by Core et al. (1999), Ferris et al. (2003), Fich and Shivdasani (2006) and Larcker et al. (2007) who portrait monitoring problems associated with busy directors as defined by the two- and three-directorship threshold, respectively.[10] Principal component analysis reveals one factor with eigenvalue greater than unity. As monitoring intensity decreases with these measures, I take the inverse of the factor score to make sure that higher values of MONIT_INTENS imply *more* intense monitoring.

2.3.4 Control variables

In the analysis of the determinants of the use of discretion in earnings-based contacts, I control for firm size, the relative power of the CEO over the board of directors, industry, and year. In the existing literature, firm size has proxied for growth opportunities and the difficulties of monitoring an agent (Holthausen and Larcker 1992; Gaver and Gaver 1993; Bushman et al. 1996; Core et al. 1999). I measure firm size by the natural logarithm of firm sales measured in millions of US Dollars (FIRM_SIZE). On the one hand, higher growth opportunities of the firm may require more discretion, as the impact of future investments may be difficult to grasp formulaically. On the other hand, larger firms are more complex in factors such as geographical dispersion and product diversity, rendering the board's judgment of the CEO's impact on firm value per-se difficult, making the incidence of discretion less likely. Overall, I formulate no directional prediction with regard to the effects of firm size on the decision for implicit performance measure application.

I further control for the possibility that CEOs possessing power over the board of directors may prefer contracts that are not administered by a formula and are consequently less transparent to outsiders. In that way, CEOs can exercise their influence and force a performance assessment for bonus determination that reflects a favorable picture of their actions during the measurement period. I compute the CEO power measure (CEO_POWER) as a three-item factor score including an indicator variable for CEO duality, the proportion of outside directors appointed by the CEO, and the proportion of inside directors appointed by the CEO.[11] Principal component analysis reveals one factor with eigenvalue greater than unity.

[10] Inside directors fulfill additional tasks in the firm and the detrimental effects of busyness on monitoring intensity are assumed to become evident at lower levels (i.e. two or more) of additional outside appointments compared to additional appointments held by outside directors (e.g. Larcker et al. 2007).

[11] Note that these items are the only three items that significantly load on the latent variable "CEOPOWER" in Ittner et al. (1997).

In the analysis of the determinants of the use of discretion in multi-measure contacts, I control for CEO equity incentives in addition to controlling for firm size and CEO power. Murphy and Oyer (2003) expect that the effects provided by ex-post flexibility in weighting performance measures may be similar to those provided by equity incentives, as the market 'weights' the consequences of CEO actions in setting the firm's stock price. I measure the variable EQUITY_INC by calculating the sensitivity of the CEO's equity portfolio to price using the method described in Core and Guay (2002).

Table 2.2 provides summary statistics of all variables for the total sample and the sub-samples EARNINGS and DIVERSE. To control for potential effects of outliers, all continuous variables are winsorized at their 1st, 99th percentiles. Table 2.3 presents Pearson correlations between the independent variables, none of which cause multicollinearity concerns.

2.3.5 Empirical specification and estimation techniques

Based on the hypotheses and the above description of variables, I estimate the following equations:

$$\begin{aligned} &P(IMPL\_EARN_i = 1 \mid EARNINGS_i = 1) = \alpha_0 + \alpha_1 NOISE_i + \\ &\alpha_2 MONIT\_INTENS_i + \alpha_3 NOISE_i \times MONIT\_INTENS_i + \\ &\alpha_4 CONTROLS_i + \sum_{k=1}^{11} \kappa_k INDUSTRY_{ki} + \sum_{l=1}^{5} \lambda_l YEAR_{li} + \varepsilon_i \end{aligned} \tag{2.1}$$

$$\begin{aligned} &P(IMPL\_DIVERSE_i = 1 \mid DIVERSE = 1) = \alpha_0 + \\ &\alpha_1 UNPREDICTA\ BILITY_i + \alpha_2 MONIT\_INTENS_i + \\ &\alpha_3 UNPREDICTA\ BILITY_i \times MONIT\_INTENS_i + \alpha_4 CONTROLS_i + \\ &\sum_{k=1}^{11} \kappa_k INDUSTRY_{ki} + \sum_{l=1}^{5} \lambda_l YEAR_{li} + \varepsilon_i \end{aligned} \tag{2.2}$$

For ease of interpretation, I center NOISE and UNPREDICTABILITY at the mean and rescale MONIT_INTENS in such a way that the coefficient for NOISE (UNPREDICTABILITY) in equation (2.1) ((2.2)) reflects the impact of NOISE (UNPREDICTABILITY) for the highest observed level of monitoring intensity. Following my hypotheses, I expect the coefficient α_1 and α_3 to be positive in both equations.

Table 2.2

Descriptive statistics of variables in the total samples and the subsamples EARNINGS and DIVERSE.

	TOTAL SAMPLE (n=1,753)		EARNINGS (n=812)		DIVERSE (n=941)	
Variable	Mean	St. Dev.	Mean	St.Dev.	Mean	St.Dev.
IMPL_EARN	-	-	0.26	0.44		
IMPL_DIVERSE	-	-			0.80	0.40
NOISE	0.00	0.98	–0.11	0.89	0.10	1.04
UNPREDICT-ABILITY	–2.25	0.39	–2.24	0.36	–2.25	0.41
MONIT_INTENS	0.00	0.99	0.11	0.95	–0.09	1.02
CEO_POWER	0.00	1.00	0.04	1.01	–0.04	0.99
EQUITY_INC	5.60	1.63	5.60	1.60	5.61	1.65
FIRM_SIZE	7.32	1.40	7.27	1.26	7.36	1.51

The variables are defined as follows:

IMPL_EARN	=	Indicator variable taking the value 1 if the board applies discretion in linking earnings performance to pay, and 0 otherwise;
IMPL_DIVERSE	=	Indicator variable taking the value 1 if boards leave relative weights on diverse measures implicit, and 0 otherwise;
NOISE	=	Time series variability in median industry accounting returns measured five years prior to the proxy data. The factor score is calculated using variability of (1) return on assets, (2) return on sales, and (3) return on equity;
UNPREDICT-ABILITY	=	Extent of environmental unpredictability. Time series variability of monthly stock returns 60 months prior to the proxy data;
MONIT_INTENS	=	Monitoring intensity of the board, calculated as the inverse of a factor score including (1) board size, (2) the proportion of busy outside directors, and (3) the proportion of busy inside directors, higher values implying more intense monitoring;
CEO_POWER	=	CEO influence over the board of directors measured as a factor score of (1) the proportion of outside directors appointed by the CEO, (2) the proportion of inside directors appointed by the CEO, and (3) CEO duality;
EQUITY_INC	=	The sensitivity of the CEO's equity portfolio to a 1% change in stock price;
FIRM_SIZE	=	Natural logarithm of total firm sales (mio. US $).

I estimate equations (2.1) and (2.2) using three methods. First, I pool all observations and estimate a probit regression using firm-clustered standard errors. Second, I run annual probit regressions and calculate average coefficients and the corresponding Z-statistic. Finally, I use a bootstrapping procedure where I (1) randomly select a single observation for each firm, (2) estimate the probit regression for the randomly selected sample, (3) repeat this analysis for 1,000 random samples, and (4) estimate the average coefficients and corresponding bootstrapped confidence intervals.

Table 2.3

Pearson correlation coefficients between the independent variables (n=1,753)

Variable	NOISE	UNPREDICTABILITY	MONIT_INTENS	CEO_POWER	EQUITY_INC	FIRM_SIZE
NOISE	**1.00**					
UNPREDICTABILITY	0.33*	**1.00**				
MONIT_INTENS	–0.11*	–0.41*	**1.00**			
CEO_POWER	0.04	0.10*	–0.04	**1.00**		
EQUITY_INC	0.09*	0.08*	0.10*	0.36*	**1.00**	
FIRM_SIZE	–0.19*	–0.38*	0.56*	0.12*	0.37*	**1.00**

* Denotes statistical significance at the 5% level or higher (two-tailed).

The variables are defined as follows:

NOISE = Time series variability in median industry accounting returns measured five years prior to the proxy data. The factor score is calculated using variability of (1) return on assets, (2) return on sales, and (3) return on equity;

UNPREDICTABILITY = Extent of environmental unpredictability. Time series variability of monthly stock returns 60 months prior to the proxy data;

MONIT_INTENS = Monitoring intensity of the board, calculated as the inverse of a factor score including (1) board size, (2) the proportion of busy outside directors, and (3) the proportion of busy inside directors, higher values implying more intense monitoring;

CEO_POWER = CEO influence over the board of directors measured as a factor score of (1) the proportion of outside directors appointed by the CEO, (2) the proportion of inside directors appointed by the CEO, and (3) CEO duality;

EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price;

SIZE = Natural logarithm of total firm sales (mio. US $).

2.4 Results

2.4.1 Main analysis

Table 2.4 presents the probit regression results for the probability of the use of discretion in incentive contracts solely written on earnings. The results of the pooled sample are shown in Column three. I find that noise in accounting earnings (NOISE) exhibits a positive and significant relationship with the likelihood of using discretion in earnings-based contracts. I further find a positive and significant interaction effect of NOISE×MONIT_INTENS. This indicates that the impact of noise on the probability of using discretion is more positive the higher the monitoring intensity of the board.[12] All other independent variables have no significant effect on the probability of using discretion in earnings-based contracts.

Columns four and five of Table 2.4 show the results for the annual probit regressions and the random sample probit regressions. The results are similar to those for the pooled sample with one notable exception. That is, in the annual regressions, MONIT_INTENS has a significant positive effect on the probability of using discretion, which implies that, at the (sample) average level of noise in earnings, boards with higher monitoring intensity are more likely to use discretion. It should, however, be noted that this result hinges on the assumption of independence among years.[13]

Overall, my results are consistent with the expectation that discretion in the application of earnings is more likely the noisier the accounting numbers and that this likelihood is higher the higher the monitoring intensity of the board. The results thus provide strong support for hypothesis 1 and 3a.

Table 2.5 reports the probit regression results for the likelihood of implicit incentive weights in incentive contracts based on both accounting and non-accounting information. The results of the pooled sample, shown in Column three of Table 2.5, show that my environmental unpredictability proxy (UNPREDICTABILITY) is positively associated with the probability of applying implicit incentive weights. Thus, the greater the unpredictability the more likely the use of implicit incentive weights, which is consistent with expectations. The interaction of unpredictability and monitoring intensity (UNPREDICTABILITY×MONIT_INTENS) is positive and

[12] As explained by Ai and Norton (2003), interpreting the coefficient on the interaction term in a probit model can be problematic, since the sign of this coefficient need not be identical to the sign of the marginal effect for each observation. Additional analysis based on the Ai and Norton (2003) procedure shows that our results are not troubled by this potential problem. More specifically, the marginal effect of the cross-partial is positive for more than 99% of the individual observations, 97% of which is statistically significant.

[13] Further analysis indicates that it takes approximately three independent years (out of five) for the coefficient of MONIT_INTENS to be significant.

Table 2.4

Probit estimations of the choice of discretionary bonus adjustments in earnings-based contracts

	Predicted	Pooled Sample	Annual Samples	Random Samples
NOISE	+	0.311** (0.039)	0.572*** (0.000)	0.331*** (0.001)
MONIT_INTENS	?	0.090 (0.407)	0.183** (0.047)	0.064 (0.458)
NOISE×MONIT_INTENS	+	0.325*** (0.003)	0.537*** (0.000)	0.309*** (0.000)
CEO_POWER	?	0.050 (0.591)	0.047 (0.378)	0.027 (0.642)
FIRM_SIZE	?	–0.063 (0.552)	–0.062 (0.262)	–0.054 (0.380)
Industry dummies		Yes	Yes	Yes
Year dummies		Yes	-	Yes
Firm-clustering		Yes	-	-
Pseudo R^2		4.2%	7.8%	6.6%
Sample size		812	152 – 186	185 – 207

***, ** is statistically significant at the 1% and 5% level, respectively (one-tailed for predictions, two-tailed otherwise). P-values reported in parentheses.
The variables are defined as follows:

NOISE = Time series variability in median industry accounting returns measured five years prior to the proxy data. The factor score is calculated using variability of (1) return on assets, (2) return on sales, and (3) return on equity;

MONIT_INTENS = Monitoring intensity of the board, calculated as the inverse of a factor score including (1) board size, (2) the proportion of busy outside directors, and (3) the proportion of busy inside directors, higher values implying more intense monitoring;

CEO_POWER = CEO influence over the board of directors measured as a factor score of (1) the proportion of outside directors appointed by the CEO, (2) the proportion of inside directors appointed by the CEO, and (3) CEO duality;

FIRM_SIZE = Natural logarithm of total firm sales (mio. US $).

significant, which is consistent with the expectation that the impact of unpredictability is more positive the higher the monitoring intensity of the board.[14]

Further, contrary to expectations, EQUITY_INC has a significant positive impact on using implicit weights, suggesting that equity incentives and implicit weights are used in a complementary manner to trigger adaptive CEO behavior. The other control variables are not significant at conventional significance levels.

[14] Additional analysis based on the Ai and Norton (2003) procedure corroborates these findings and shows that the marginal effect of the cross-partial is positive for 97% of the individual observations, 15% of which is statistically significant.

Table 2.5

Probit estimations of the choice of implicit weights in multi-measure contracts

	Predicted	Pooled Sample	Annual Samples	Random Samples
UNPREDICTABILITY	+	0.997% (0.024)	1.197*** (0.000)	1.203*** (0.001)
MONIT_INTENS	?	0.058 (0.525)	0.047 (0.568)	0.056 (0.608)
UNPREDICTABILITY ×MONIT_INTENS	+	0.321* (0.097)	0.476*** (0.001)	0.323 (0.116)
EQUITY_INC	-	0.153** (0.011)	0.162*** (0.000)	0.172*** (0.001)
CEO_POWER	?	-0.026 (0.777)	-0.023 (0.000)	-0.058 (0.480)
FIRM_SIZE	?	0.033 (0.705)	0.012 (0.830)	0.098* (0.092)
Industry dummies		YES	YES	YES
Year dummies		YES	-	YES
Firm-clustering		YES	-	-
Pseudo R^2		12.4%	15.3%	15.2%
Sample size		941	172-204	217-239

***, ** is statistically significant at the 1% and 5% level, respectively (one-tailed for predictions, two-tailed otherwise). P-values reported in parentheses.

The variables are defined as follows:

UNPREDICATBILITY = Extent of environmental unpredictability. Time series variability of monthly stock returns 60 months prior to the proxy data;

MONIT_INTENS = Monitoring intensity of the board, calculated as the inverse of a factor score including (1) board size, (2) the proportion of busy outside directors, and (3) the proportion of busy inside directors, higher values implying more intense monitoring;

EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price;

CEO_POWER = CEO influence over the board of directors measured as a factor score of (1) the proportion of outside directors appointed by the CEO, (2) the proportion of inside directors appointed by the CEO, and (3) CEO duality;

FIRM_SIZE = Natural logarithm of total firm sales (mio. US $).

The results of the annual probit regressions and random sample probit regressions are presented in Column four and five, respectively. The results are similar to the pooled sample results with two notable exceptions. First, in the random sample probit regressions, the interaction UNPREDICTABILITY×MONIT_INTENS is positive, but not significant. Second, in the random sample probit regressions, firm size has a significant positive effect on the probability of using implicit weights, which indicates that the overall monitoring environment is associated with implicit multi-measure contracts.

Overall, I find strong evidence that the value of implicit weights applied in multi-measure contracts increases with environmental unpredictability, but only moderate evidence that this effect is dependent on the monitoring intensity of the board. The results thus provide strong support for hypothesis 2 and moderate support for hypothesis 3b.

In sum, I provide evidence consistent with the argument that, in earnings-based contracts, discretion is used to reduce the risk imposed on the agent and that this use is conditional on the monitoring intensity of the board. I further provide evidence consistent with the argument that, in multi-measure contracts, discretion is used to improve congruity in objectives between the principal and agent when it is difficult to ex-ante establish the optimal course of action. As a result, discretion improves incentive contracting through risk reduction and congruity improvement.

2.4.2 Additional analysis

I argue that discretionary bonus adjustments in earnings-based contracts are used for risk reduction purposes and my empirical results are consistent with this argument. To provide further support for my argument, I examine the level of short-term incentive compensation based on earnings. In general, more (less) incentives can be provided when there is less (more) exposure to risk. Thus, if discretionary bonus adjustments are used to reduce risk, then, ceteris paribus, the level of short-term incentive compensation should be higher when discretion is part of the contract versus when it is not.

To test this prediction, I focus on the target bonus as a percentage of salary as the measure of short-term incentive compensation. I gather target bonus data from the proxy statements for the EARNINGS subsample, which results in a usable sample of 230 observations; 151 that exclude and 79 that include the use of discretionary bonus adjustments.

A comparison of the raw means of the target bonus between the use and non-use of discretion shows that the target bonus equals 84.53% when discretion is used versus 78.68% when it is not, and the difference is statistically significant (p=0.07; one-tailed). This difference becomes larger and more significant when I examine the least squares means and control for the level of noise and industry. More specifically, the least squares means of the target bonus equals 86.31% when discretion is used versus 77.74% when it is not. The difference is more than a month's salary and is statistically significant (p=0.02; one-tailed).[15] In sum, these results provide further support for my argument that discretionary bonus adjustments are used to reduce risk.

[15] This finding is robust to the inclusion of additional controls, such as firm size, equity incentives, environmental unpredictability, monitoring intensity, and CEO power.

In the main analysis, I examine the choice of discretion within either a sample with earnings-based contracts or a sample with contracts that include diverse measures. Although this structure is consistent with my theory, I additionally examine the choice among all four possible contracts using a multinomial logit analysis.[16] Following previous research (see e.g. Bushman et al. 1996; Ittner et al. 1997), I include, over and above the variables used in estimating equations (1) and (2), a number of variables that influence the choice of earnings versus multiple measures (informativeness proxies). First, the strategy of a firm is an important determinant of how complete accounting earnings are in assessing managerial performance (Ittner et al. 1997). Following the defender-prospector categorization proposed by Miles and Snow (1978), I expect earnings to be more informative for firms operating at the defender end of the continuum. I compute the construct STRATEGY as a three-item factor score of a firm's market-to-book, employees-to-sales, and R&D-to-sales ratios. I use averages of these ratios five years prior to the proxy data; lower values are associated with firms near the defender end of the continuum (cf. Ittner et al. 1997).

Second, the lengths of firm product development and product life cycles determine how well accounting earnings assess immediate effects of managerial long-term oriented actions. Using the National Academy of Engineering classification (1992), I use two indicator variables that take on the value of one if a firm is characterized as having long product development cycle (D_CYCLE) and a long product life cycle (L_CYCLE).

Finally, I also include the firm's financial stability using Altman Z-Scores (Altman 1968) averaged five years prior to the proxy data (ALTMAN). Financially distressed firms need to emphasize financial measures to direct managerial focus to the improvement of short-term profits to ensure firm survival (Ittner et al. 1997).

The results of the multinomial response model provide the same inferences for the choice of discretion in the EARNINGS subsample and DIVERSE subsample as those based on the results in Table 2.4 and 2.5; I therefore do not report these results. Noteworthy, however, is that none of the informativeness proxies (STRATEGY, D_CYCLE, L_CYCLE, and ALTMAN) have an effect on the use of discretion within the two subsamples. This implies that the use of discretion, as examined in this study, is not driven by informativeness.

The results for the remaining four choices among contracts are presented in Table 2.6. I find that the choice of each of the multi-measure contracts versus each of the earnings-based contracts is primarily driven by monitoring intensity and the informativeness proxies. Increased monitoring intensity increases the preference for earnings-based contracts over multi-measure contracts, while the latter contracts are

[16] I use multinomial logit instead of multinomial probit because the latter, although theoretically attractive, has severe practical problems with the estimation (Wooldridge 2002).

Table 2.6

Multinomial Logit Analysis of Alternative Contracts

Independent Variables	Diverse with Explicit weights vs. Earnings only	Diverse with Implicit weights vs. Earnings only	Diverse with Explicit weights vs. Earnings with Discretionary Bonus	Diverse with Implicit weights vs. Earnings with Discretionary Bonus
NOISE	0.055 (0.824)	0.209 (0.285)	–0.328 (0.261)	–0.174 (0.490)
UNPREDICTABILITY	–0.794 (0.488)	0.714 (0.191)	–1.02 (0.392)	0.491 (0.463)
MONIT_INTENS	–0.328* (0.086)	–0.212 (0.109)	–0.401* (0.066)	–0.285 (0.107)
NOISE × MONIT_INTENS	0.009 (0.958)	–0.062 (0.645)	–0.425* (0.077)	–0.496** (0.019)
UNPREDICTABILITY × MONIT_INTENS	–0.391 (0.510)	0.135 (0.630)	–0.428 (0.469)	0.097 (0.759)
EQUITY_INC	–0.262* (0.059)	–0.072 (0.455)	–0.133 (0.394)	0.057 (0.618)
CEO_POWER	0.010 (0.954)	–0.032 (0.790)	–0.081 (0.681)	–0.123 (0.428)
FIRM_SIZE	0.083 (0.673)	0.192 (0.109)	0.073 (0.766)	0.183 (0.337)
STRATEGY	0.341 (0.118)	0.406** (0.026)	0.123 (0.611)	0.188 (0.387)
D_CYCLE	0.877 (0.106)	0.265 (0.476)	1.440** (0.023)	0.828 (0.108)
L_CYCLE	0.098 (0.843)	0.190 (0.597)	0.151 (0.802)	0.243 (0.607)
ALTMAN	0.038 (0.280)	0.036 (0.155)	0.031 (0.425)	0.029 (0.316)
Pseudo R^2: 8.64%				
Sample size: 1,753				

***, **, * is statistically significant at the 1%, 5%, and 10% level, respectively (two-tailed based on firm-clustered standard errors; P-value in parenthesis).
The analysis includes industry dummies and year dummies.
The variables are defined as follows:
UNPREDICATBILITY = Extent of environmental unpredictability. Time series variability of monthly stock returns 60 months prior to the proxy data;

(Continued on next page)

Table 2.6 (continued)

NOISE	=	Time series variability in median industry accounting returns measured five years prior to the proxy data. The factor score is calculated using variability of (1) return on assets, (2) return on sales, and (3) return on equity;
MONIT_INTENS	=	Monitoring intensity of the board, calculated as the inverse of a factor score including (1) board size, (2) the proportion of busy outside directors, and (3) the proportion of busy inside directors, higher values implying more intense monitoring;
EQUITY_INC	=	The sensitivity of the CEO's equity portfolio to a 1% change in stock price;
CEO_POWER	=	CEO influence over the board of directors measured as a factor score of (1) the proportion of outside directors appointed by the CEO, (2) the proportion of inside directors appointed by the CEO, and (3) CEO duality;
STRATEGY	=	The firm's prospective strategy measured as a factor score of the ratios (1) research and development to sales (2) market-to-book value, and (3) the employees to sales;
L_CYCLE	=	A dummy variable that takes on the value of 1 if the firm is classified as having long term product life cycles, and 0 otherwise;
D_CYCLE	=	A dummy variable that takes on the value of 1 if the firm is classified as having long term product development cycles, and 0 otherwise;
ALTMAN	=	A variable accounting for the firm's degree of financial stability. Calculated using Altman's (1968) financial stability model, values below 1.8 implying a high likelihood of firm bankruptcy;
FIRM_SIZE	=	Natural logarithm of total firm sales (mio. US $).

preferred over the former the lower the informativeness of accounting performance (e.g. Bushman et al. 1996; Ittner et al. 1997).

Further, the effect of monitoring intensity on the preference for earnings-based contracts with discretionary bonus adjustments over the two multi-measure contracts is greater the greater the noise in earnings. This is consistent with higher monitoring intensity allowing the risk reduction benefits of discretion in earnings-based contracts to be exploited to a greater extent. Finally, greater use of equity incentives increases the preference for explicit earnings-based contracts over explicit multi-measure contracts, which suggests that equity incentives and the use of diverse measures act as substitutes.

2.4.3 Robustness checks

To test the robustness of my results, I perform the following tests. First, in the previous analyses, I examined the choice of discretion within two different subsamples without controlling for potential sample selection effects. To correct for the possibility that a firm's choice of a specific type of discretion is also related to the likelihood of the firm choosing diverse performance measures, I use a Heckman (1979) procedure. More specifically, I apply partial maximum likelihood to fit a probit model with sample

selection to examine both the use of discretionary bonus adjustments and implicit weights (Wooldridge 2002). To usefully apply the procedure, I include several factors that influence the use of diverse measures in incentive contracts, but are not expected to influence the use of discretion, i.e., I include STRATEGY, D_CYCLE, L_CYCLE, and ALTMANN in the selection model.

Consistent with my previous multinomial response model, the results of the selection models (not tabulated) show that the incidence of multi-measure contracts is positively associated with a prospector strategy (STRATEGY) and financial stability (ALTMAN), and negatively associated with monitoring intensity (MONIT_INTENS). Further, the results of the main analysis presented in Table 2.4 and 2.5 remain unchanged after controlling for sample selection in the probit model. Finally, based on the Wald test, I cannot reject the null hypothesis of independence between the selection model and the probit model. Overall, these results corroborate my previous inferences.

Second, I test whether my argument that specific factors lead to a preference for a specific type of discretion holds. More specifically, I argue that noise, not unpredictability, leads to discretion in earnings-based contracts to reduce risk, while unpredictability, not noise, leads to discretion in multi-measure contracts to reduce noncongruity. To test this, I examine whether my results for equation (2.1) in Table 2.4 (equation (2.2) in Table 2.5) are sensitive to the inclusion of UNPREDICTABILITY and UNPREDICTABILITY×MONIT_INTENS (NOISE and NOISE×MONIT_INTENS). The results from these regressions (not tabulated) lead to the same inferences as those discussed above. More importantly, UNPREDICTABILITY and UNPREDICTABILITY×MONIT_INTENS (NOISE and NOISE×MONIT_INTENS) have no significant effects in equation (2.1) ((2.2)). These insignificant effects remain when I replace NOISE by UNPREDICTABILITY in equation (2.1) and replace UNPREDICTABILITY by NOISE in equation (2.2).

Third, to further analyze the unexpected result that the use of equity incentives increases the use of implicit weights in multi-measure contracts, I examine whether this result is driven by lower board monitoring intensity and/or more powerful CEOs. I include the interaction terms EQUITY_INC×MONIT_INTENS and EQUITY_INC×CEO_POWER in the probit estimation of the use of implicit weights. The results (not tabulated) show that the interaction EQUITY_INC×MONIT_INTENS is negative and marginally significant ($p=0.169$ two-tailed), while the interaction EQUITY_INC×CEO_POWER is not significant. All other inferences are similar to those presented in Table 2.5. These findings indicate that the positive association

between equity incentives and implicit weights is at least partly driven by boards with lower monitoring intensity.[17]

Finally, to examine whether the million-dollar-tax-rule, which follows from Internal Revenue Code Section 162(m), affects the use of discretion and its disclosure within the proxy statement, I include a dummy variable that equals 1 if lagged salary plus bonus exceeds $1 million and zero otherwise.[18] The inclusion of this dummy variable in examining both the use of discretion in earnings-based contracts and the use of implicit weights in multi-measure contracts shows no significant effects. All other inferences are identical to those shown in Table 2.4 and 2.5.

2.5 Summary and conclusion

In CEO incentive contracts, discretion by the board of directors is often present in one form or another. In this study, I examine whether this behavior can be explained by optimal contracting considerations. Two important considerations in incentive contracting are the risk premium paid to a risk averse agent and the level of congruence achieved and I argue that discretion can play a role in addressing these considerations. First, discretion can be used to reduce the risk imposed on an agent by subjectively adjusting for uncontrollable factors. This role is especially important in a single-measure contract and increases in importance the higher the noise. Second, discretion can lead to a congruity improvement, a role which is especially important in multi-measure contracts. Discretion can lead to a congruity improvement by subjectively weighting the multiple performance measure ex-post, the benefits of which are higher the more unpredictable the environment.

In the empirical analysis, I focus on bonus contracts solely based on accounting earnings and bonus contracts based on both accounting and non-accounting information. My empirical results are in line with expectations and show that the use of discretion is positively related to (1) the noise in accounting earnings, once accounting measures are the sole performance measures used and (2) the extent of environmental unpredictability, once the firm combines accounting and nonaccounting measures. I further find that the monitoring intensity of the board of directors

[17] The marginal effect of the cross-partial of EQUITY_INC×MONIT_INTENS is negative for 98% of the observations, 56% of which is statistically significant. None of the observation-specific marginal effects of the cross-partial of EQUITY_INC×CEO_POWER are significant.

[18] Under Section 162(m) of the Internal Revenue Code, corporations may not deduct annual compensation in excess of $1 million paid to certain employees, generally its Chief Executive Officer and its four other most highly compensated executive officers, unless that compensation qualifies as performance-based compensation. As board discretion and its effect on executive compensation are generally deemed non-performance based, boards providing target bonuses above $1million may be reluctant to use discretion in order to ensure tax deductibility of compensation expenses.

positively affects the impact of noise and environmental unpredictability on implicit contracts.

Overall, I find that the use of discretion in annual bonus contracts by boards of directors is consistent with optimal contracting. Boards use discretion in an attempt to resolve the contracting problems associated with compensation risk and goal congruence and are more likely to do so when there is more intense monitoring. This evidence provides an important counterbalance to the view that executive compensation is driven by rent extraction motives.

Chapter 3

Bonus Contracts, Private Information and CEO Turnover[19]

Abstract

I address the question whether performance measures that are specified in annual bonus contracts represent overall performance dimensions used by boards of directors in making governance decisions. Recent studies claim that managerial incentives are predominantly provided by equity holdings rather than short-term cash compensation. Given the dominance of equity compensation and the fact that firms invest resources in the design and use of bonus contracts, it is unclear why the vast majority of firms continue to use annual bonus contracts if these would create only minor, or no incentive benefits. I argue that boards of directors use bonus contracts as a channel to ex-ante communicate how performance will be evaluated annually and thus signal the measures relevant for CEO termination decisions, which provides significant incentives. Further, the resulting cash compensation communicates the board's actual performance evaluation of the CEO, which can disclose private information to the capital market. My empirical results are consistent with these arguments and show that the incentive weight on privately observed performance measures in bonus contracts is systematically related to the importance of these measures for CEO turnover. I further show that the stock market reaction to a management change depends on bonus contract design. I specifically find a positive reaction when boards of directors have signaled to solely use public information in CEO performance evaluation (good news about the board) and a negative reaction when they (also) use private information (bad news about the CEO). Overall, I show that the care taken in designing annual bonus contracts can be explained by its link with governance decisions and indicate that performance measurement issues are an important part of the corporate governance process.

[19] This chapter is based on a working paper co-authored with Frank Moers.

3.1 Introduction

In this study, I examine whether performance measures that are specified in annual bonus contracts represent performance dimensions used by boards of directors in making governance decisions. Recent studies claim that managerial incentives are predominantly provided by managerial equity holdings rather than short-term cash compensation because the latter is relatively small in monetary terms (Hall and Liebman 1998; Murphy 1999; Core et al. 2003). Annual bonus contracts used by organizations, however, exhibit substantial heterogeneity in their design and, with few exceptions, exclude stock price measures. Given that firms invest resources in the design of bonus contracts, it is unclear why the vast majority of firms continue to use annual bonus contracts if these would create only minor, or no incentive benefits (see also Bushman and Smith 2001). Assuming that boards optimally design incentive contracts, I seek evidence for the existence of a link between annual bonus contracts and CEO incentives beyond the direct, supposedly trivial, monetary component.

One of the primary functions of boards of directors is to hire and fire the CEO. The threat of employment termination provides significant CEO incentives, especially during the last decade (Kaplan and Minton 2006). Given this, the board's annual performance evaluation of the CEO is of crucial importance to providing incentives (The Business Roundtable 1990; Lipton and Lorsch 1992; Bushman and Smith 2001). I argue that boards of directors use bonus contracts as a channel to ex-ante communicate how performance will be evaluated annually, while the resulting cash compensation communicates the actual performance evaluation by the board. Using bonus contracts for this purpose is beneficial because they (1) provide a credible process of periodic performance evaluation, (2) provide formal performance feedback to CEOs, (3) provide formal discharge of the boards' monitoring responsibilities, and (4) disclose boards' private information to the capital market in way that is not pertinent to decisions by competitors. I examine whether CEO turnover is associated with performance measures defined in annual bonus contracts and thereby test the expectation that one reason for boards to write formal annual bonus contracts is to communicate valued performance categories that are used in compensation and continuation decisions.

In addition, I examine to what extent the stock market reaction to the announcement of CEO turnover is conditional on bonus contract design. If investors believe that a CEO turnover is significant, i.e. they interpret the event as an incentive mechanism following poor performance, a stock price reaction should become evident around announcement. However, as prior literature indicates, even if the change is due to poor performance and in the shareholders' interest, this reaction can differ

depending on the type of information that is carried to outsiders along with the CEO change. Following Hermalin and Weisbach (1998), I expect a positive reaction when boards of directors have signaled to solely use public information in CEO performance evaluation (good news about the board) and a negative reaction when they (also) use private information (bad news about the CEO).

To test my predictions, I employ an extensive dataset of firms that disclose the relative weights placed on accounting (public) and private performance measures in the proxy statement. I model the CEO replacement decision for 348 (303 non-turnover, 45 turnover) public firms in the year 2002. I estimate CEO turnover as a function of past market and accounting performance, CEO demographics, and the extent to which boards of directors rely on accounting earnings only or add other, private measures. Subsequently, I use a standard event study approach (Brown and Warner 1985) to measure abnormal returns around the announcement of CEO dismissal and explain the cross-sectional variation in returns using bonus contract characteristics.

In line with expectations, I find that, after controlling for market and accounting performance, the performance assessment of the board, as approximated by cash compensation (cf. Hayes and Schaefer 2000), is more negatively associated with CEO turnover the more weight is placed on measures capturing private performance dimensions. Further, the event study results are consistent with expectations and show that the market reacts positively to a CEO change made by boards that signal to use public information and negatively to a change made by boards that signal to (also) use private information. I interpret these findings as evidence of my expectation that annual bonus contracts have incentive spillovers through their implicit link with CEO continuation decisions and that private information plays a role in CEO replacement.

I contribute to the literature in several related ways. First, by showing a systematic link between observed bonus contract characteristics and CEO turnover, I point to the role of these contracts for corporate boards in making governance decisions. By investigating the role of annual bonus contracts in CEO replacement, I also provide evidence for how these measures are used to create significant managerial incentives. Previous studies show that although equity compensation dominates cash compensation, boards play an important role in guiding executive actions, by measuring and evaluating performance information that is not available to outsiders. The present work adds to this literature by pointing to the threat of dismissal as an incentive to enforce valuable managerial actions. In this context, I also provide the first evidence I am aware of, about the role of performance that is not measured by publicly available measures in CEO replacement decisions. While prior studies point to the relevance of accounting and market performance in CEO turnover, the present results suggest that the incidence of CEO turnover is also a function of performance on private dimensions and whether and how these dimensions are contracted upon.

Finally, I show that stock market reactions to CEO turnover differ depending on the type of information used in governance decisions, which is consistent with a yet untested prediction by Hermalin and Weisbach (1998) and provides a plausible explanation for the mixed evidence in previous event studies in this area.

The remainder of this chapter is structured as follows. In section 2, I discuss the theory and develop the hypotheses. In section 3, I describe the sample selection, method, and variable measurement and in section 4 I discuss the empirical results. Finally, in section 5 I provide a conclusion.

3.2 Theory and hypothesis development

3.2.1 The role of annual bonus contracts in CEO turnover decisions

The dominant role of equity compensation in CEO compensation has led researchers to question the incentive relevance of cash compensation in general, and bonus contracts in particular (e.g. Core et al. 2003). If firms administer short-term compensation contracts for the purpose of providing incentives, there must be an alternative mechanism by which these incentives are created other than the direct but small effect they have on CEO compensation. I argue that the accounting literature attempting to predict management changes allows valuable insights into this issue.

Boards of directors can determine optimal equity holdings and delegate equity compensation to the capital market via price setting, but boards cannot delegate employment decisions (Bushman and Smith 2001). In order to make such decisions they need to interpret signals about the effects of CEO actions. Agency theory predicts that any (costless) performance measure that is informative about the agent's effort should be used for incentive purposes (Holmstrom 1979). While firms that perform poorly on the stock market are more likely to change CEOs, the effects of accounting performance are consistently more predictive of management turnover (e.g. Engel et al. 2003). One explanation for this is that stock prices include market expectations and therefore provide a noisier signal than accounting performance or private information held by the board. Further, markets are not always sufficiently informed about companies' plans, reducing their ability to predict future firm prospects. One reason for this is firms deliberately treating information about their strategic configuration (e.g. R&D spending, new product development, customer satisfaction) confidentially because the immediate positive effect of such information on financial markets is potentially outweighed by the negative consequences of sharing it with competitors, for instance at early investment stages. Consequently, a company's stock performance

is unlikely to provide boards with CEO related information that is not also more accurately measured internally.

The importance of non-price performance measures is not only prevalent in executive turnover decisions but also in observed bonus contracting practices. Numerous studies investigating the design of annual bonus contracts report that executive short-term bonuses are determined almost exclusively based on accounting performance measures and measures that are privately observed (e.g. Bushman et al. 1996; Ittner et al. 1997). Expecting an association between short-term bonus contracts and CEO turnover is appealing for at least two reasons. First, in contrast to the direct monetary impact, CEO turnover represents a strong incentive mechanism, as turnover results in a loss of guaranteed future income, decreased reputation in the labor market, and a corrosion of the value of equity held.

Second, annual bonus contracts allow boards to communicate job aspects it deems important and provide them with timely measures for performance evaluation. Regarding the evaluation taking place in the bonus determination procedure, boards will detect deviations of actual performance from planned targets informing them about courses of actions taken by the CEO. It therefore seems logical that boards, in making the decision over continued CEO employment, will benchmark the results of CEO actions against the same indicators it commits to in determining compensation.

As mentioned earlier, previous research shows that the probability of CEO turnover is inversely related to market and especially accounting performance. Given that these performance measures are generally considered important and are also publicly observable, it is of particular importance for boards to use bonus contracts to signal the extent to which they use private information in making governance decisions. As a result, I predict that the higher the incentive weight placed on measures of private performance, the more these measures are being used in governance decisions and thus the stronger the inverse relationship between privately observed performance and the probability of CEO turnover. Hence, I formulate the following hypothesis.

H1: The explicit weight on private information in bonus contracts is positively related to the impact of private information on CEO turnover decisions.

3.2.2 Stock market reactions to CEO turnover based on public vs. private signals

As noted by Furtado and Rozeff (1987), Jensen and Warner (1988), Warner, Watts and Wruck (1988), and Bonnier and Bruner (1989), the abnormal return at the announcement of a management change is the aggregate of an information component and a real component. The information component can be negative in case the turnover event implies unanticipated negative information. The real effect is positive if outsiders perceive the change to be in shareholders' interest. A positive net effect can thus be expected in case the real component is larger than the information component, while worse than expected information can outweigh the benefits of the management change and result in a negative net effect. Following this reasoning, Bonnier and Bruner (1989) find empirical evidence for financially distressed firms (i.e. the real component should be higher than the information component) experiencing positive abnormal returns around the announcement of management changes. Mahajan and Lummer (1993) argue that smooth management changes are perceived as less negative by outsiders than changes implying unsatisfactory CEO performance. They find that CEO changes taking place before common CEO retirement age, and when the leaving CEO does not assume an alternative position afterwards are associated with negative abnormal returns surrounding announcement of top-management changes.

More directly related to my setting is the paper by Hermalin and Weisbach (1998). They show analytically that boards basing the decision to fire the CEO on private information reveal to outsiders that their previous expectations about CEO quality were above actual performance. They predict that the stock price decreases as investor expectations about the incumbent CEO are lower than they were previously about the leaving CEO. In contrast, a firing based on public signals conveys no new information about the CEO but signals good news about board independence, which results in an increase in stock price.

In sum, if investors process the type of information used (in expectation) in CEO turnover, I expect the following reactions to the announcement of the event. First, CEO turnover by a board that signals only to use publicly observable measures is evaluated positively by investors and results in positive stock price reaction. Second, CEO turnover that is based on private information conveys a negative signal as the CEO change signals that actual performance is worse than anticipated based on publicly observable performance. Moreover, this negative effect is expected to be stronger the greater the importance of private information in making governance decisions. As a result, I state the following hypotheses.

$H2_a$: Abnormal returns to shareholders around announcements of CEO turnovers are positive if the turnover is (in expectation) conditioned on public performance measures only.

$H2_b$: Abnormal returns to shareholders around announcements of CEO turnovers are negative if the turnover is (in expectation) conditioned on a combination of public and private performance measures.

H3: Abnormal returns to shareholders are more negative around CEO turnover announcements, the greater the ex-ante incentive weight on private performance measures.

3.3 Sample, data, and method

3.3.1 Probability of CEO turnover

3.3.1.1 Sample and data

My analysis is based on CEO incentive contracts described in the compensation section of SEC Proxy Statements (DEF 14a) as described in the previous chapters of this dissertation. Proxy statements do not only provide information about specified performance measures but also whether and how the measures are weighted ex-ante. Following the approach of previous studies, I identify a company with turnover whenever the same individual is not identified in EXECUCOMP as CEO in fiscal year 2002. This results in 139 publicly listed firms with CEO turnover taking place between fiscal years 2001 and 2002.[20] As I require the turnover to happen after the formal annual performance evaluation, as represented by the release date of the proxy statement of fiscal year 2001, 53 firms drop out because the CEO left office before the 2001 proxy statement was released. In the remaining 86 firms, the turnover announcement was made after the CEO served the full fiscal year 2001 and proxy information refers to that year. I further search each firm's annual reports for causes of changing CEOs that are unrelated to firm performance (position "inherited" from family member, health problems, death of current CEO) and exclude those firms (14

[20] I focus on CEO changes in this period because it represents the maximum data availability per year in the panel data described in chapter 2 across the 1998 – 2002 period. I restrict the focus of this study to one CEO turnover year due to the cumbersome and time consuming endeavor of reading and coding additional proxy statement information of the identified turnover firms.

obs.), as well as firms not administering a formal annual bonus program (6 obs.), which reduces the sample to 66 observations.

As I require turnover firms to fix the performance measures it will commit to in the performance evaluation process, I identify the *ex-ante* specification of annual bonus contracts as indicated in the Proxy statement. This includes the bonus terms for the fiscal year in which the turnover decision is made. The information is taken from the Compensation Committee's report on executive compensation of each sample firm. I first focus on performance measures the board indicates to be used in awarding bonuses. I distinguish between non-price performance measures that are (i) publicly observable and (ii) private performance measures that originate from the firm's internal information environment.[21] Table 2.1 of the preceding chapter provides excerpts from a proxy statement for each of the two groups (panel A and B, respectively).

Subsequently, I search for the weights that are explicitly attached to the respective performance dimensions in deriving bonus payouts.[22] Of the remaining 66 firms, 18 firms (27%) use a flexible approach (implicit weights) in deriving bonuses, in which incentive weights are determined *ex-post*. I delete these observations, resulting in a total turnover sample comprised of 48 firms that administer an annual bonus program including an *ex-ante* definition of relative weights attached to performance measures in use.

As the control group, I use publicly listed firms without CEO replacement from 1998 onwards including the period of interest (2001-2002). The data is taken from the data set described in the previous chapter and encompasses 2,575 firm year observations in the 1998-2002 period. As mentioned earlier, the data includes the relevant annual bonus contract information described above. Of the 519 firms from that sample in the fiscal year of interest, 216 firms (41%) use a flexible approach in deriving bonuses.[23] I exclude these firms, which results in a total of 303 non-turnover observations. Hence, the total sample is comprised if 351 firms with explicit ex-ante contract specifications in 2001-2002. The unreported distribution of sample firms as classified by two-digit SIC code shows no noteworthy abnormalities in distribution among turnover and non turnover firms. I use COMPUSTAT to obtain returns and accounting data, and EXECUCOMP to obtain compensation data.

[21] Examples of public non-price performance measures are "Earnings per Share", "ROE", and "Profits". Examples of performance measures that are related to the "private" performance dimension are "boards' subjective evaluations", "Quality", "Leadership", and "Innovativeness".

[22] Next to the naming of actual percentages attached to specific performance measures, I also search for semantic structures that allow an indirect deduction of weightings used. Examples include "[…] these measures were weighted *equally*" or "Bonus payments are based *exclusively* on the achievement of pre-specified Earnings per share targets".

[23] As already mentioned in chapter 2 of this dissertation, the reading and coding of Proxy statements was undergone with two other researchers to ensure the validity of extracted information.

3.3.1.2 Method

The empirical model is a probit regression in which the dependent variable equals 1 when a CEO turnover occurs and 0 otherwise. The hypothesis is that contract specifications with regard to the explicit weights attached to public and non-public dimensions of CEO performance explain the impact of different measures of firm performance on the likelihood of CEO turnover. In particular, I expect the impact of privately observed performance on turnover probabilities to be higher the more important private information is in the performance evaluation process, as indicated on an *ex-ante* basis. Thus, if a systematic link between performance, contract specifications and CEO turnover exists, I expect a significant interaction effect between private performance and the respective incentive weight ($EW\_PRIVATE_t$) on turnover.

An empirical problem is that, while public performance is per definition observable, private performance cannot be measured directly. I circumvent this problem by approximating private performance with variation in current cash compensation that is unexplained by variations in current public performance. This is in line with Hayes and Schaefer (2000) who show that, controlling for public performance, the unexplained variation in CEO cash compensation is informative about future operating performance. I measure $\Delta CASHCOMP_t$ as the change in the logarithm of CEO cash compensation from fiscal year t-1 (2000) to the turnover fiscal year t (2001) and calculate the interaction term $\Delta CASHCOMP_t \times EW\_PRIVATE_t$.

As the measure of public non-price performance, I calculate the change in Return on Assets (ΔROA_t) and as the measure public price performance, I use the change in stock market returns (ΔRET_t). Further, I include one lagged change of the publicly observable performance measures, which reduces the sample by three CEO turnover observations (n=45). In addition, I include CEO age ($CEOAGE_t$) and a dummy variable taking on the value one if the CEO is older than 64 years ($OLDER64_t$). The above mentioned controls are in line with previous studies predicting management changes (e.g. Coughlan and Schmidt 1985; Engel et al. 2003). While turnover probabilities are shown to be negatively related with public performance and age, a usual practice of firms is to have mandatory retirement policies at the age of 64 thereby increasing the likelihood of observing CEO turnover. Based on the above, I test the following probit regression to model the CEO turnover likelihood.

$$\begin{aligned} P(TURNOVER_{it+1}) = {} & \beta_0 + \beta_1 \Delta RET_{it} + \beta_2 \Delta ROA_{it} + \beta_3 \Delta CASHCOMP_{it} + \\ & \beta_4 \Delta EW\_PRIVATE_{it} + \beta_5 EW\_PRIVATE_{it} \times \Delta CASHCOMP_{it} + \beta_6 CEOAGE_{it} + \\ & \beta_7 OLDER64_{it} + \beta_8 \Delta RET_{it-1} + \beta_9 \Delta ROA_{it-1} + \varepsilon_{it} \end{aligned} \quad (3.8)$$

I expect the sign of the coefficient of the interaction term, public performance, and age to be negative, and the age dummy to be positive. I formulate no directional expectations concerning β_3 and β_4.

3.3.1.3 Descriptive Statistics

Table 3.1 presents the descriptive statistics of the cross-sectional sample in the main turnover analysis, including summary statistics for the total sample, for the firms experiencing CEO turnover, and for the firms without a changing CEO in the period of interest. To control for potential effects of outliers, all continuous variables are winsorized at their 1st, 99th percentiles. The mean difference of stock and accounting performance is lower for the turnover sample as well as compensation changes. Further, the turnover sample has a higher average CEO age and also a higher proportion of CEOs older than 64. The proportion of turnover firms (15%) is slightly higher than proportions reported in previous turnover studies, which is consistent with Kaplan and Minton (2006) who observe an increase of CEO replacements from 1998 onwards.

3.3.2 Market reactions to CEO turnover announcements

3.3.2.1 Sample

To investigate investor's reactions on turnover announcements, I focus on the 66 CEO turnovers for which EXECUCOMP indicates that the respective executive's last fiscal year in office was 2001. I define the event day as the first occurrence of the turnover in business press and/or the respective firm's news releases, which are searched for using Lexis/Nexis. Moreover, I identify confounding news (release of 10-Q, 10-K, 8-K; annual shareholder's meeting) five days before and after the event, as I require potential stock market reactions not to occur due to other events, such as earnings announcements. In total, 17 of the 66 CEO turnovers are announced in combination with other material information, leaving a "clean" sample of 49 events.

3.3.2.2 Univariate analysis

To test whether outsiders infer signals regarding the CEOs annual compensation at announcement, I employ a standard event study methodology proposed by Brown and Warner (1985). I test whether cumulative abnormal returns (CAR) significantly differ from zero around announcement of CEO turnover, where I partition the sample according to whether turnovers are expected to be based on public performance

Table 3.1

Descriptive Statistics of Explanatory Variables

Variable	Turnover Sampe (n=45)			Control Sample (n=303)			Total Sample (n=348)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
ΔROA_t	-.116	-0.03	.377	-.019	0	.061	-.03	0.01	.153
ΔRET_t	-.25	-0.22	1.08	-.045	0.05	.9	-.078	0.02	1.03
ΔROA_{-1}	-.002	0	.119	.001	0	.066	.001	0	.075
ΔRET_{t-1}	-.156	-.08	1.6	.033	0.04	.971	.009	0.03	1.072
$\Delta CASHCOMP_t$	-.095	-0.08	.495	-.056	0.02	.456	-.061	0.01	.461
$EW\_PRIVATE_t$	.131	0	.2	.07	0	.189	.074	0	.192
$CEOAGE_t$	61.11	61	8.74	59.14	59	6.83	59.39	59.33	7.12
$OLDER64_t$	.266	0	.198	.092	0	.293	.115	0	.319
ROA_t	-0.07	0.01	0.42	0.04	0.04	0.07	0.02	0.04	0.16
RET_t	-0.08	-0.11	0.47	0.16	0.07	0.46	0.13	0.06	0.47

The variables are defined as follows:

ΔROA_t = Percentage change in return on assets from year t-1 to year t;
ΔRET_t = Percentage change in stock market returns year t-1 to year t;
ΔROA_{t-1} = Percentage change in return on assets from year t-2 to year t-1;
ΔRET_{t-1} = Percentage change in stock market returns year t-2 to year t-1;
$\Delta CASHCOMP_t$ = Percentage change in cash compensation to the CEO from year t-1 to year t;
$EW\_PRIVATE_t$ = Explicit incentive weight on private performance information held by the board in year t;
$CEOAGE_t$ = CEO age in years in year t;
$OLDER64_t$ = Indicator variable that takes the value 1 if the CEO is older than 64 in year t and the value 0 otherwise.

measures only (PUBLIC) or also on private performance (PRIVATE). Given my prediction regarding the direction of investor reactions, I expect *CAR* to be positive and significantly different from zero if turnover is conditioned on public information only, and negative and significantly different from zero if boards condition the turnover decision on private information as well. The abnormal stock returns for firm i on day t in the event period is the difference between firm i's stock return and the return of the size decile portfolio obtained from CRSP:

$$AR_{it} = R_{it} - E(R_{it}) \tag{3.3}$$

where:

AR_{it}	abnormal (excess) return of firm i at day t;
R_{it}	total daily stock returns of firm i, adjusted for dividends and stock splits;
$E(R_{it})$	returns of the respective size decile portfolio obtained from CRSP at day t.[24]

Then for day t, the cross-sectional mean abnormal return is calculated as:

$$MAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{3.4}$$

where N is the number of firms in the sub-samples PUBLIC, PRIVATE.
For the event window ranging from day K to day L around the event date, CAR in each sub-sample is derived by:

$$CAR_{KL} = \sum_{t=K}^{L} MAR_t \tag{3.5}$$

I choose the event windows on a three day (-1, +1) and a six day (-1, +4) period relative to event day 0. For a univariate test assessing whether CAR in the sub-sample for the respective event window are significantly different from zero, the test statistic is:

$$t_{CAR_{KL}} = CAR_{KL} \Big/ \sqrt{\left(\sum_{t=K}^{L} \hat{S}^2 (MAR_t)\right)} \tag{3.6}$$

Where $\hat{S}(MAR_t)$ is the time series standard deviation of MARs in the estimation period, which I choose as 290 trading days prior to the event day starting at day t=-300 ranging to t=-10. For the specific estimation period, this standard deviation is given by:

[24] Alternatively, I also estimate firm i's abnormal daily stock performance by using the residuals from a market model regression where $\hat{AR}_{it} = \hat{R}_{it} - (\hat{a}_i + \hat{\beta}_i R_{mt})$ over a period of 290 trading days (i.e. t=-300 to t=-10) prior to the event date and R_{mt} equaling (i) daily returns of the S&P 500 index, and (ii) the value weighted market portfolio (both obtained from CRSP).

$$\hat{S}(MAR_t) = \sqrt{\left(\sum_{t=-300}^{t=-10} (MAR_t - \overline{MAR})^2 / (289) \right)} \tag{3.7}$$

3.3.2.3 Regression Analysis

As stated in H3, I expect outsiders to react more negatively to CEO turnover announcements, the higher the ex-ante incentive weight on private measures. To test this, I focus on those turnover firms whose boards fix incentives weights ex-ante and run a regression that explains the cross sectional variance of firm excess returns. I estimate the firm specific CAR as a function of the ex-ante explicit incentive weight on private performance measures and control variables:

$$CAR_{i,KL} = \beta_0 + \beta_1 EW\_PRIVATE_i + \beta_2 CONTROLS_i + \varepsilon_i \tag{3.8}$$

where:

$CAR_{i,KL}$	Cumulative abnormal returns for firm i measured over event window K, L (-1, +1; -1,+4);[25]
$EW\_PRIVATE_i$	Explicit incentive weight on private performance measures specified in the annual CEO bonus contract written at the beginning of the fiscal year in which the turnover is announced.

In line with H3, I expect β_0 to be positive and significantly different from zero. That is, in the absence of explicit incentive weights on private measures, all CEO relevant performance signals are already recognized at the turnover date. This is followed by a positive stock price reaction, which, if present, appears in the intercept.

Next, I predict β_1 to be negative and significantly different from zero. That is, the more the CEO change is motivated by private information the more negative the share price reaction to that event.

Following prior literature, I include control variables that potentially influence investors' reactions to CEO turnover at announcement. I control for whether the turnover announcement takes place at the CEO age of 64 or 65, as firms commonly employ mandatory retirement practices around that age. Mahajan and Lummer (1993) show that markets react less negatively to CEO turnover announcements when these are part of a smooth CEO transition, of which mandatory turnover can be indicative.

[25] Specifically, firm CARs are measured as: $CAR_{i,KL} = \sum_{t=K}^{L} AR_{it}$

The variable RETIRE takes on the value of 1 if the CEO age is 64 or 65 at announcement date and 0 otherwise. In line with this reasoning, I also include the indicator variable ASSSUME, which takes on the value 1 if the turnover announcement indicates that the leaving CEO will assume a different position in the firm afterwards, and zero otherwise. *Ceteris paribus*, I expect that outsiders will react less negatively to announcements when the board believes that retaining the CEO within the firm is important.

Finally, I control for the firm's strategic orientation along the defender – prospector continuum. Previous research shows that incentive weights on private performance measures in CEO contracts are driven by the firm's strategic orientation, where prospector firms place greater emphasis on non-financial performance measures and board subjectivity, both being assumed to be private in this study. In case outsiders systematically react to the firm's strategic orientation, then the incentive weight variable potentially captures effects that are triggered by strategy and not the information due to the incentive weight on private measures. To control for this potential endogeneity problem, the variable STRATEGY is included in the estimation of CAR and measured as a three item factor score, including a firm's market-to-book, employees-to-sales and R&D spending-to-sales ratios (cf. Ittner et al. 1997).

As indicated by Roon and Veld (1998), estimating CAR such as in Equation (3.8) is unlikely to be efficient, because the AR_{it}'s from Equation (3.3) measure firm i's idiosyncratic risk, which is probably not homogeneous across all sample firms. That is, running Equation (3.8) using OLS violates its constant variance assumption resulting in biased estimators. I therefore obtain the standard deviation of firm i's abnormal returns $\hat{\sigma}_i$ over the estimation period (-300, -10) preceding the event date to obtain an estimator of firm i's true abnormal returns' variance. Then I apply Weighted Least Squares (WLS) to deflate each of the variables in Equation (3.8) by $\hat{\sigma}_i$ in order to obtain efficient estimates.[26]

[26] Specifically, the WLS estimation takes the form: $\frac{CAR_i}{\hat{\sigma}_i} = \frac{\beta_0}{\hat{\sigma}_i} + \beta_1 \frac{EW\_PRIVATE}{\hat{\sigma}_i} + \beta_2 \frac{Controls}{\hat{\sigma}_i} + u_i, u_i = \frac{\varepsilon_i}{\hat{\sigma}_i}$

3.4 Results

3.4.1 Turnover regressions

Table 3.2 presents the marginal probabilities for the probit regression predicting the likelihood of a CEO turnover.[27] The marginal probabilities reflect the change in the probability for an infinitesimal change in each of the independent continuous variables and the discrete change in the probability for the dummy variable OLDER64. I first run the regression without the bonus contract variables. The results in Column 3 show that both current accounting and market performance affects CEO turnover in the expected direction, i.e., poorer performance increases the likelihood of turnover.

Although past accounting and market performance also have a negative effect, these effects are only marginally significant. The marginal probabilities further show that accounting performance is a more important driver of turnover than market performance. Further, CEOs who are older than 64 are far more likely to leave office, while age as a continuous variable has no effect. Finally, the Pseudo R^2 of the model equals 10.69%.

Column four of Table 3.2 presents the results after adding the contract variables and shows that current, but not past, accounting and market performance negatively affects turnover, while OLDER64 positively affects turnover, consistent with the results in Column three. More importantly, I find that the interaction term $\Delta CASHCOMP_{it} \times EW\_PRIVATE_{it}$ is significantly negative. Furthermore, the marginal probability of the interaction effect indicates that the use of private information is economically relevant and dominates the turnover decision together with accounting performance. Finally, the Pseudo R^2 of the model equals 16.61%, which is more than 1.5 times that from the model excluding the contract variables.[28]

In sum, the decision of boards to change CEOs is structurally related to actual performance in view of actual bonus contracts used. If boards announce to use public measures only, then turnover is only related to actual public performance, especially accounting. If boards base cash compensation also on other signals that are private, then the impact of that performance is greater the greater the relative weight in the bonus contract. Consequently, I provide evidence for the argument that bonus contracts are used by boards of directors to signal performance dimensions that they use to make employment related decisions and hence to incentives.

[27] All marginal effects are evaluated at the mean and the marginal effects related to the interaction term and its components are measured in line with the procedure described in Ai and Norton (2003).
[28] The above reported results are robust to the inclusion of industry dummies.

Table 3.2

Probit Estimation of CEO Turnover (n=348) [a]

Variable	Predicted	ΔMarginal Probability	ΔMarginal Probability
ΔROA_{it}	-	-0.70*** (2.97)	-0.74*** (3.03)
ΔROA_{it-1}	-	-0.20 (0.86)	-0.14 (0.61)
ΔRET_{it}	-	-0.04** (1.93)	-0.04** (1.95)
ΔRET_{it-1}	-	-0.01 (0.52)	-0.01 (0.47)
$\Delta CASHCOMP_{it}$	?		0.04 (0.84)
$EW\_PRIVATE_{it}$	?		0.14* (1.65)
$\Delta CASHCOMP_{it} \times EW\_PRIVATE_{it}$	-		-0.84*** (3.03)
$CEOAGE_{it}$	-	0.00 (0.15)	-0.00 (0.18)
$OLDER64_{it}$	+	0.22*** (2.51)	0.26*** (2.85)
Pseudo R^2		10.69%	16.61%

[a] $P(TURNOVER_{i,t+1}=1)= \beta_0+\beta_1\Delta RET_{it}+\beta_2\Delta ROA_{it}+\beta_3\Delta CASHCOMP_{it}+\beta_4 EW\_PRIVATE_{it}+ \beta_5\Delta CASHCOMP_{it}\times EW\_PRIVATE_{it}+\beta_6 AGE_{it}+\beta_7 OLDER64_{it}+\beta_8\Delta RET_{it-1}+ \beta_9\Delta ROA_{it-1}+ \varepsilon_{it}$

***, **, * denotes significance at the 1%, 5%, and 10% level, respectively (one-tailed for predicted signs, two-tailed test otherwise, Z statistics in parentheses).

The variables are defined as follows:

ΔROA_t	=	Percentage change in return on assets from year t-1 to year t;
ΔRET_t	=	Percentage change in stock market returns year t-1 to year t;
ΔROA_{t-1}	=	Percentage change in return on assets from year t-2 to year t-1;
ΔRET_{t-1}	=	Percentage change in stock market returns year t-2 to year t-1;
$\Delta CASHCOMP_t$	=	Percentage change in cash compensation to the CEO from year t-1 to year t;
$EW\_PRIVATE_t$	=	Explicit incentive weight on private performance information held by the board in year t;
$CEOAGE_t$	=	CEO age in years in year t;
$OLDER64_t$	=	Indicator variable that takes the value 1 if the CEO is older than 64 in year t and the value 0 otherwise.

3.4.1.1 Robustness check

To test the robustness of the results, I replace changes in raw firm performance with industry adjusted accounting and stock performance, as boards typically compare firm performance relative to that of peers in making CEO retention decisions (e.g. Barro and Barro 1990; Engel et al. 2003). The presence of relative performance evaluation potentially affects the interpretation of results if the board's judgment of relative accounting and stock performance rather than the expected evaluation of privately observed CEO performance is reflected by the interaction term $\Delta CASHCOMP_{it} \times EW\_PRIVATE_{it}$. I calculate industry adjusted changes of ROA and stock returns by subtracting mean (median) industry ROA and stock returns from each firm specific observation of ROA and stock returns, respectively.

The inferences drawn from the results (untabulated) are identical to those based on the regressions including raw firm accounting and stock performance, both using industry mean as well as median performance as the base for adjustment. Industry adjusted accounting and stock performance as well as the interaction of compensation changes and incentive weights on private measures remain negatively and significantly related to the marginal turnover probability. The only noteworthy difference is that the current change in ROA is about half in size compared to the regression employing raw firm performance and is slightly less significant.

Overall, the additional analyses indicate that boards apply relative performance evaluation in CEO replacement decisions but that such adjustment is not systematically related to boards' evaluations of privately observed CEO performance.

3.4.2 Event study, univariate results

Table 3.3 summarizes the univariate results for the total sample of 66 cases and the partitioned samples PUBLIC and PRIVATE, were the CAR reported are based on the corresponding size deciles portfolio as the performance benchmark.[29] Panel A gives an overview of the samples that include turnovers announced along with confounding news, while Panel B reports the clean samples. In the total sample, CAR is not statistically discernible from zero in neither of the event windows, which is in line with unconditioned announcement effects reported by prior studies (e.g. Mahajan and Lummer 1988; Warner et al. 1988). In PRIVATE, CAR is negative and significantly different from zero in both the sample including confounding news and the clean sample, and in both of the event windows.

[29] Results for the market-model returns (untabulated) lead to the same inferences as the ones reported.

TABLE 3.3

Excess returns to shareholders in total sample and sub-samples PUBLIC, PRIVATE around the CEO turnover announcement

PANEL A: Event samples including confounding news							
SAMPLE$_{[K,L]}$ [§]	**N**	**CAR$_{[KL]}$**	**t-statistic**	**proportion positive**	**Median CAR$_{i\,[KL]}$**	**Min. CAR$_{i\,[KL]}$**	**Max. CAR$_{i\,[KL]}$**
TOTAL$_{[-1,+1]}$	66	-0.01	-1.1	0.48	-0.004	-0.452	0.187
TOTAL$_{[-1,+4]}$	66	-0.014	-1.12	0.40	-0.017	-0.490	0.246
PRIVATE$_{[-1,+1]}$	34	-.0339	-2.92	0.35	-0.014	0.45	0.173
PRIVATE$_{[-1,+4]}$	34	-0.0475	-2.96	0.27	-0.029	0.49	0.124
PUBLIC$_{[-1,+1]}$	32	0.0148	1.032	0.62	0.016	-0.424	0.17
PUBLIC$_{[-1,+4]}$	32	0.0211	1.042	0.56	0.0276	-0.404	0.246
PANEL B: Clean event samples							
TOTAL$_{[-1,+1]}$	49	-0.01	-1.01	-1.01	-0.006	-0.453	.17
TOTAL$_{[-1,+4]}$	49	-0.01	-0.71	-0.71	-0.015	-0.49	0.246
PRIVATE$_{[-1,+1]}$	25	-.05	-4.13	-4.13	-0.21	-0.45	0.07
PRIVATE$_{[-1,+4]}$	25	-0.07	-3.66	-3.66	-0.29	-0.49	0.06
PUBLIC$_{[-1,+1]}$	24	0.035	2.26	2.26	0.019	-0.07	0.17
PUBLIC$_{[-1,+4]}$	24	0.05	2.25	2.25	0.032	-0.1	0.24

[§] TOTAL refers to all turnover events regardless of performance measures in CEO annual bonus contracts. PRIVATE includes firms using a combination of (observable) accounting measures and (non-observable) private measures, PUBLIC includes firms using (observable) accounting measures exclusively. K,L indicate the event period in trading days relative to the turnover announcement day (t=0).

Specifically, in the sample including confounding news, the abnormal returns are -3.3% and -4.75% in the three and six day window, respectively. In the clean sample, the abnormal returns portrayed are even higher, with -5% and -7% in the corresponding event windows. Hence, the univariate results for excess returns in PRIVATE provide strong support for my argument that CEO turnovers conditioned on private information held by the board signal negative performance to outsiders, who, in turn, adjust expectations about firm value downwards.

In PUBLIC, CAR is positive but not significantly different from zero in neither of the event windows in the confounded sample. In the clean sample, however, CAR is positive and significant in both the three and six day event windows (3.5 %, 5 %). This is consistent with my expectation that CEO turnovers based on publicly observable measures deliver a positive signal to investors. This finding adds to prior studies finding positive market reactions to CEO turnovers when bad performance prior to the event was fully known by outsiders (e.g. Bonnier and Bruner 1989).

3.4.3 Event study, regression results

Table 3.4 presents the results for the cross sectional variation in CAR for different time windows. Panel A reports regression results for the sample including confounding news, Panel B presents results in the "clean" sample. In the different specifications, the coefficient on EW_PRIVATE (β_1) is negative and significant, supporting the argument that the negative signal at turnover announcement is stronger the more important private measures become in bonus contracts. For example, the regression results depicted in Panel B, Column 3 indicate that firm CAR over a three day period around announcement is about -13 % when a board fixes half of the incentive weight on private measures.

Regarding the results for the sole use of public measures (β_0), the specifications including control variables do indicate that the intercept takes on the predicted positive sign, but show no significance at conventional levels, which might be due to the small sample size and degrees of freedom. In contrast, regressing CAR on EW_PRIVATE only, β_0 is positive and significant over the six day event window (Panel B, Column 5). Although taking on the predicted sign in most of the cases, none of the control variables is significant.

Table 3.4

WLS regression for the cross-sectional variation in excess returns to shareholders as a function of explicit incentive weights on private performance measures in CEO annual bonus contracts [a]

Panel A: Sample including confounding news (n=49)

		CoefficientEstimate (t-Ratio)			
Variable	Predicted	$CAR_{i,[-1,+1]}$		$CAR_{i,[-1,+4]}$	
INTERCEPT	+	0.1 (0.65)	0.006 (0.25)	0.014 (0.78)	0.026 (0.93)
EW_PRIVATE	-	-0.115* (-1.63)	-0.126** (-1.71)	-0.158*** (2.05)	-0.172*** (-2.15)
RETIRE	+		-0.003 (-0.13)		-0.186 (-0.58)
ASSUME	+		0.118 (0.42)		-0.005 (-0.19)
STRATEGY	?		0.011 (0.803)		0.016 (0.96)
Adj. R^2		3.41%	-1.5%	6.37%	4.01%

(Continued on next page)

Overall, I provide evidence that the negative signal of CEO turnovers conditioned on private measures increases with the explicit incentive weight on private measures so that outsiders react more negatively to the event. Combining the univariate results with the regression results, I provide evidence that markets negatively react to turnovers, once boards use private information in bonus contracts and positively react to turnovers on public information that has already been recognized before the event. The extent to which the above described effects occur, depend on the relative importance of private vs. public information in bonus contracts.

3.5 Summary and conclusion

Firms design cash compensation contracts consistent with principal-agent predictions (Core et al. 2003). However as recent research documents, the incentives provided by cash compensation are low as compared to the effects of equity ownership. This raises the question why firms administer costly bonus programs if they would not influence management behavior. In this chapter, I argue that boards can delegate some decisions to capital markets, like that of CEO equity compensation, but still have to make some decisions internally, like the decision to continue or quit the employment relationship

with a current CEO. I further argue that boards, in making this decision, are likely to gain CEO related information from measures other than noisy price measures.

I advance the hypothesis that boards can benefit from communicating desired dimensions of managerial performance to CEOs by means of annual bonus contracts. Thereby they can signal to executives which measures serve as standards for evaluating performance and will also become relevant in the decision of whether or not employment should be continued. As loosing the CEO position results in several negative consequences for the individual, a systematic link illustrates that bonus contracts create significant incentives. The results of the empirical analyses support this view, by showing that the effect of non-price measures on the likelihood of observing CEO turnover is affected by the extent to which different performance dimensions (public and private) are contracted upon in annual bonus contracts.

Table 3.4 (continued)

Panel B: Clean sample (n=35)					
INTERCEPT	+	0.019 (1.15)	0.0001 (0.01)	0.034** (1.72)	0.027 (0.96)
EW_PRIVATE	-	-0.267*** (-3.37)	-0.28*** (-3.31)	-0.32*** (-3.37)	-0.34*** (-3.88)
RETIRE	+		0.0133 (0.44)		-0.0008 (-0.28)
ASSUME	+		0.027 (0.95)		0.016 (0.51)
STRATEGY	?		0.015 (1.07)		0.0184 (1.19)
Adj. R^2		23%	21%	27%	21%

***, **, * denotes significance at the 1%, 5%, and 10% level, respectively (one-tailed test for predictions, two-tailed test otherwise).

[a] $\frac{CAR_i}{\hat{\sigma}_i} = \frac{\beta_0}{\hat{\sigma}_i} + \beta_1 \frac{EW\_PRIVATE}{\hat{\sigma}_i} + \beta_2 \frac{Controls}{\hat{\sigma}_i} + u_i, u_i = \frac{\varepsilon_i}{\hat{\sigma}_i}$

The Variables are defined as follows:

EW_PRIVATE = Explicit incentive weight on private performance information held by the board in year t;

RETIRE = Indicator variable taking the value 1 if the CEO leaves the firm at the age of 64 or older; and the value 0 otherwise;

ASSUME = Indicator variable taking the value 1 if the turnover announcement indicates that the leaving CEO will assume a different position in the firm afterwards, 0 otherwise;

STRATEGY = The firm's prospective strategy measured as a factor score of the ratios (1) research and development to sales (2) market-to-book value, and (3) the employees to sales.

Further, I investigate whether investors process the disclosure of performance measures and the incentive weights attached to them in forming expectations about the impact of CEO turnover on firm value. The results of an event study of abnormal returns to investors around CEO turnover announcements support my hypothesis that turnovers likely to be motivated by public measures provide a positive signal about the board to outsiders, resulting in positive abnormal returns. The results are further supportive of my argument that turnovers based on private information convey a negative signal about the CEO, which results in negative share price reactions upon announcement.

In sum, boards of directors play a crucial role in providing incentives not only because they determine the optimal level of equity incentives, but also because they hire and fire management. I show that the care taken in designing annual bonus contracts can be explained by its link with governance decisions and indicate that performance measurement issues are an important part of the corporate governance process.

Chapter 4

The Incentive and Signaling Effects of Annual Bonus Schemes: Evidence from Firm Innovation

Abstract

In this study, I examine whether the structure of annual bonus contracts for corporate CEOs fosters innovation within the firm. Boards of directors observe CEO initiatives and their effects on performance dimensions not instantly reflected by accounting numbers and may base bonus payments on such private signals about the creation of firm value. In doing so, boards provide CEO incentives to spur firm innovation. I predict that private performance measures in CEO annual bonus contracts are positively related to firm innovation. Secondly, private performance measures in bonus contracts result in cash payments to CEOs containing information not captured by accounting numbers. Firms can thereby convey private information about CEO performance to financial markets, allowing the firm's share price to adjust to the additional information. I argue that this renders CEO equity holdings more sensitive to value enhancing actions, which subsequently result in a higher incentive intensity of equity. I predict that innovation is positively related to the interplay of private performance measures in annual bonus contracts and CEO equity holdings. The empirical results based on patent citation measures and incentive contract data for 197 CEOs of public U.S., R&D intensive firms confirm my expectations.

4.1 Introduction

The goal of this study is to investigate whether firm innovation can be systematically traced to the CEO's performance evaluation made by boards of directors, and specifically whether or not performance dimensions unobserved by firm outsiders are inherent in the evaluation of the CEO.

Innovation is a key factor to securing the profitability of firms and growth of economies (Schumpeter 1936; Solow 1956). For corporations, the ultimate goal of R&D expenditures is to generate new knowledge for commercial purposes. Outsiders recognize the value of new products and technological advances, attributing higher value to more innovative firms (Hall, Jaffe and Trajtenberg 2005). Innovation is a multi facetted concept which can differ significantly in attributes like economic value or technical sophistication. For example, CEOs may invest in R&D to fund pet projects or to merely broaden the scope of firm activities. Given the importance of innovation to secure future profitability, the question if and how managers are motivated to secure innovation is important (e.g. Kachelmeier, Reichert, and Williamson 2007; Xue 2007).

One option to promote innovative behavior is to provide management with firm equity, for example by providing managers with company stock or stock options. Stock prices presumably incorporate the impact of innovation on firm value (e.g. Lerner and Wulf 2006). However, providing innovation oriented incentives via equity ownership is likely to be problematic, because investors need not be sufficiently informed about the firm's prospects with regard to the identification of innovative processes or products. For instance, firms deliberately keep details of research efforts confidential so that the value of innovative activity often requires significant time spans to become obvious to outsiders.

Still, CEOs undergo annual performance evaluations by corporate boards that are likely to gain more innovation related information than capital markets (Lipton and Lorsch 1992; Bushman and Smith 2001). This is especially true when the assessment of desirable CEO initiatives (a situation of which innovation is representative) is per-se difficult and when their effects are not directly reflected in financial statements (Bushman, Indjejikian, and Smith 1996).

As indicated earlier in this dissertation, the performance dimensions used in evaluating the CEO are formally represented by performance measures specified in CEO bonus programs. While direct monetary incentives in the form of cash payments are low, boards' evaluations provide significant CEO incentives as they are related to the CEO turnover and continuation decision (chapter 3 of this dissertation). In

reviewing CEO performance, boards frequently consider private information about the CEO's impact on factors that are "competitively sensitive" or reward "the attainment of technological advances". I argue that, if innovation is an objective of the firm, the evaluation of CEOs based on such privately observed measures should provide CEO incentives to secure innovation, and expect the presence of private performance measures in annual bonus contracts to have a positive relation with firm innovation.

A further implication of boards evaluating the CEO based on private performance information is that cash payments from boards to CEOs signal value creation from the firm's internal environment to capital markets (Hayes and Schaefer 2000). Hayes and Schaefer (2005) show that bonus payments can credibly signal private information about valuable CEO actions, without disclosing 'too much' (e.g. confidential or competitively sensitive) information. Innovations vary in their value, and the value of individual projects undertaken is unknown by investors. Based on this, I expect that bonus payments in R&D intensive firms convey value potential of the firm's innovative endeavors to capital markets, if private measures are used. This renders a firm's share price more sensitive to the creation of valuable innovations, which ultimately increases the incentive intensity of existing CEO equity holdings.

I test these predictions using a data set of 197 U.S. publicly listed, R&D intensive firms, in the period from 1998 to 2000. Following prior studies (Ittner et al. 1997; Said et al. 2003), I assess boards' reliance on private measures in evaluating CEO performance by reading and coding bonus compensation practices described in the SEC Proxy Statements. Firm financial data is obtained from Compustat. I operationalize firm innovation using information on patents granted by the U.S. Patent and Trademark Office (UPSTO), obtained from the National Bureau of Economic Research (NBER) database described in detail by Hall, Jaffe, and Trajtenberg (2002). Four measures depicting firm innovation are included in the analyses. Apart from patent counts, I concentrate on citations based measures to capture patents' technical sophistication (originality, generality) and impact on future patents (Jaffe and Trajtenberg 2002).

I examine the incentive effects of private performance measures on firm innovation by investigating the association between the innovation measures and an indicator variable capturing whether or not boards opt to include private measures of future oriented CEO actions in bonus contracts. I construct a matched sample of firms that differ in their use of private measures, but are similar with respect to operational and strategic configurations that theoretically drive the use of private measure for incentive purposes (Dehija and Waba 2002). In doing so, I account for the endogenous nature of the choice of performance measures used to evaluate the CEO, as not all firms are equally likely to profit from universal performance measure combinations (e.g. Bushman, Indjejikian, and Smith 1996). As a result of this procedure, I divide

sample firms into ones making expected, or alternatively, surprising performance measure choices conditional on determinants of private measures.

The analysis proceeds in two steps. First, mean innovation is compared among the two sets of firms with similar characteristics except for the use of private measures. Second, I regress innovation measures on an indicator variable for the use of private measures in the sample of expected private measure users. To test the second expectation regarding the signaling effects of cash payments leading to increased incentive intensity of equity holdings, I add the interaction of private measures and CEO equity incentives.

The empirical results support my predictions. Firms using private performance measures are awarded more patents of greater technological significance and impact on future patents if their CEO evaluation practices are in line with theoretical predictions. On the contrary, companies that are unlikely to profit from private measures but still employ them do not benefit in terms of innovation. Consistent with my second hypothesis, the interaction of private measures and CEO equity incentives is positively related to the amount of patent awards as well as the technical sophistication and future impact of the awarded patents. Hence, CEO equity holdings provide stronger incentives to innovate, if private knowledge about innovative output is conveyed to financial markets. Additional analyses reveal that these effects are economically significant.

The following study adds to the existing literature in several ways. First, accounting studies have so far focused on the effect of compensation packages on R&D expenditures (e.g. Baber, Fairfield and Haggard 1991; Dechow and Sloan 1991; Cheng 2005). This study shows that R&D spending is not per-se informative about firm innovation and that incentives provided by boards are important in the transformation of R&D investments into innovation. It further adds to research from other disciplines, by showing that incentive issues are inherent in the innovation process.

Second, this chapter adds to an ongoing discussion about the role of boards of directors in influencing CEO behavior. For example, Hall and Liebmann (1998) and Core, Guay, and Verrechia (2003) show that CEO wealth is predominantly influenced by her holdings of firm equity, suggesting that the ultimate task of evaluating the CEO for the sake of providing incentives is imposed on capital markets. However, apart from determining the optimal level of equity incentives, other important decisions rest upon boards. They may base such decisions on information that is not necessarily held by capital markets. For example, chapter 3 of this dissertation indicates that board evaluations of the CEO are systematically related to CEO firing, thereby providing high-powered incentives due to several negative repercussions linked to that decision.

In this context, the present study provides evidence of the effects of governance decisions on the achievement of firm objectives.

Last but not least, the present study is among the first empirical studies providing evidence for the use of CEO evaluations (and the resulting cash payments) to credibly signal private and potentially confidential information to capital markets (e.g. Moers, Peek, and Roomberg 2007).

This study continues as follows. Section 4.2 provides the hypothesis development. Section 4.3 describes the data and empirical specifications, section 4.4 presents the results, section 4.5 concludes.

4.2 Hypothesis Development

4.2.1 Previous research

Investors react positively to R&D spending and patents filed, representing firms' innovative inputs and observable effects, respectively (e.g. Griliches 1981; Hall, Jaffe and Trajtenberg 2005). There is a vast theoretical and empirical literature in various fields explaining the propensity of corporations to innovate, ranging from firm-specific effects such as size (Schumpeter 1942), competition and market structure (e.g. Cohen and Levin 1989), to the impact of firms' integration in R&D networks (e.g. Gomez-Casseres, Hagedoorn and Jaffe 2006).

The accounting literature has so far predominantly focused on management incentives to invest in R&D as a necessary means of firm innovation. By allocating R&D funds among business units, executives are in charge of driving firm innovation. Personal motives of corporate management can deviate from overall firm objectives, resulting in opportunistic cut-backs on R&D spending, for example in the presence of horizon and myopia problems (e.g. Baber, Fairfield and Haggard 1991; Dechow and Sloan 1991). Compensation arrangements between boards and CEOs can mitigate these problems to assure R&D spending (Cheng 2005).

However, variation in R&D expenses does not per-se imply variation in innovation. Investors are ultimately interested in generated innovative outcomes but not the amount of the R&D expenditure itself. Firm innovations vary significantly in attributes like economic value and technical sophistication. Besides, CEOs may fund individual projects due to a feeling of personal attachment, the reluctance to consider certain investments as sunk costs, or invest in R&D to increase firm size (Lerner and Wulf 2006). Thus, understanding the dynamics how R&D investments are transformed into valuable innovations is important (Hall et al. 2005; Jaffe and Trajtenberg 2002).

Evidence related to the effect of incentives on innovation is scarce except for two notable studies. Holthausen, Larcker and Sloan (1995) find at most weak evidence for R&D managers' equity ownership being related to innovative activity within their respective business units. Lerner and Wulf (2006) document that higher levels of equity held by business unit managers in centralized R&D organizations are associated with more patents of higher originality receiving more future citations.

While these studies provide insights into the impact of compensation arrangements on firm innovation, two somewhat questionable assumptions are made. First, financial markets are sufficiently informed about the value of innovations and second, stock prices are sensitive to actions of lower hierarchy management. However, in the absence of value relevant signals, financial markets are unlikely to immediately adjust share prices to presumably privately known patent value and the impact of lower hierarchical managers' actions on share price is likely to be low.[30]

This study takes on an alternative approach to examine incentive effects on firm innovation. First, the analysis is conducted at the CEO level. Although not directly being involved in the day-to-day activities that result in innovative outputs, CEOs are responsible for vital activities inherent in the innovation process of which the allocation of financial resources and the selection of promising R&D projects are but two examples. Stock prices capture the effects of such activities with a considerable time lag diluting the incentives to innovate provided by equity. Yet, CEOs undergo annual performance evaluations by the board (Lipton and Lorsch 1992; Bushman and Smith 2001). Boards hold more CEO related information than capital markets and in evaluating his actions, often rely on privately observed performance measures (Hayes and Schaefer 2000). Performance reviews, in turn, provide significant CEO incentives as they are related to CEO compensation and continuation decisions. Given the importance of innovation to corporations, it consequently seems logical that the board's monitoring and rewarding of innovation oriented behavior triggers corresponding CEO actions and thus, firm innovation.

Further, the measurement and reward of privately observed CEO performance has also important implications on the information conveyed to capital markets by CEO cash payments and thus the expectations on which stock prices are based.

In the following I will draw on agency predictions to formulate two testable hypotheses concerning above considerations.

[30] One possibility for finding an association between R&D managers' equity holdings and firm innovation is that equity holdings and firm innovation are jointly related to factors outside the structural model, which results in endogeneity problems. For instance, Lerner and Wulf (2006) do not account for the endogenous nature of equity held by business unit managers. Alternative explanations for their significant findings may be that retaining and attracting qualified managers are major concerns for firms where expected innovation is high, resulting in higher levels of equity awards.

4.2.2 Private performance measures in CEO bonus contracts and firm innovation

Agency theory provides important insights into how CEO incentives provided by annual bonus contracts can induce CEOs to exert innovation oriented actions. Agency theory focuses on incentive contracts between firm owners and managers. The aim of these contracts is to motivate managers to take actions that are in line with firm objectives. As management actions are unobservable to owners, contracts are written on performance measures serving as indicators of the agent's action choice. An important concern is how well firms' financial statements account for the consequences of value enhancing actions taken by the manager, as this has implications for the optimal selection of performance measures. Firms adopting a long-term orientation to value creation experience a considerable time lag until desired contemporaneous actions positively translate into financial results (e.g. Banker, Potter and Srinivasan 2000). In this case, exclusive reliance on accounting performance measures directs management actions away from long-term value creating actions to day-to-day activities realizing short-term financial outcomes (Holmstrom and Milgrom 1991). Agency theory suggests that performance rewards should be based on all measures that are informative about managers' actions (Banker and Datar 1989; Holmstrom and Milgrom 1991; Feltham and Xie 1994).

The impact of CEO actions on the creation of innovation is difficult, if not impossibly accounted for by performance measures that are obvious to outsiders (Jaffe and Trajtenberg 2002). This calls for private performance measures of boards' subjective evaluations and their inclusion in incentive contracts (e.g. Bushman et al. 1996). Agency theory predicts that this establishes a balance in the trade-off between day-to-day activities and innovation-oriented long-term actions.

Based on the above, I formulate the following hypothesis.

H1: Firm innovation is positively related to the incidence of private performance measures in CEO annual bonus contracts.

4.2.3 Signalling effects of bonus payments on private performance measures

Hayes and Schaefer (2000) show that bonus payments beyond levels justified by firms' observable accounting and stock price performance are positively related to future operating performance. Bonus payments that are conditioned on private performance information observed by the board can be a credible signal of value enhancing actions of the CEO. This influences investors' expectations about firm value, stock price, and ultimately the value of equity held by the CEO.

Hayes and Schaefer (2005) show analytically that investors can infer the magnitude of "good news" about unobserved performance from bonus amounts paid. In their model this signal is credible, as the authors require payments to be sufficiently high to discourage firms without private good news to mimic real good news firms. They further point to the implicit nature of contracts written on private information, which renders the contract non-enforceable in court. Therefore, higher potential bonuses increase the owners' temptation to renege on the contract, bounding bonus payments within the two limits described.

The results of Hayes and Schaefer (2005) indicate why private measures and equity holdings can be complements, especially when the firm is constrained in its ability to signal information to capital markets in a way that is not pertinent to decisions by competitors. For example, dense competition induces firm reluctance to instantly inform investors about strategic initiatives or new product development, in order to shorten time spans for competitors to take responsive actions. Still, firms may want to credibly communicate internal value creation to capital markets because investors will adjust the firm's stock price accordingly. In Chapter 3 of this dissertation, I show empirically that boards' internal assessments of CEO performance are communicated to outsiders via cash payments and that investors use this signal in forming expectations of firm value.

The above described mechanism affects CEO incentives because share price and thus, the value of the CEO's equity holding becomes more sensitive to his own actions whenever these are signalled to the capital market via bonus payments made. In the context of innovation, this leads to the prediction that, at a given level of equity held, CEOs have greater incentives to increase the value of innovation in the presence of private measures compared to a situation when private measures are absent. This leads to the second hypothesis:

H2: The impact of CEO equity incentives on innovation is higher in the presence of private performance measures in CEO annual bonus contracts compared to the absence of private measures.

4.3 Sample, method, and variable measurement

4.3.1 Sample selection

The analysis is based on CEO incentive contracts described in the compensation section of SEC Proxy Statements (DEF 14a). Proxy statements provide information about specified performance measures and specifically whether the board chooses to

condition bonus payments on private performance measures that stem from its direct monitoring of the CEO. The sample consists of publicly listed firms included in EXECUCOMP without a change in the CEO position in the period from 1998 to 2002. Thereby, I obtain an initial sample of 2,895 observations for 579 firms across five years. The full sample initially reduces to 2,575 observations due to three sources of missing compensation-related information: lacking proxy information (63 obs.), companies not administering annual incentive programs (127 obs.), and missing indication of performance measures (130 obs.). I merge the remaining observations with stock market and financial statement data obtained from COMPUSTAT and CRSP, by firm and fiscal year, which reduces the sample to 2,073 observations due to missing information. I delete firms without R&D expenses over the time period as indicated by COMPUSTAT, because investment in R&D is a necessary precondition to generate innovation. The focus on R&D intensive firms to study firm innovation has precedence in the literature (e.g. Holthausen et al. 1995). 1,625 observations drop out of the sample, because the respective firms report no R&D expenses over the sample period.

An additional data constraint is connected with how I operationalize the output of firms' innovative performance. Following prior studies, I assess data on patents awarded to corporations by the USPTO. I obtain the necessary information from the NBER patent database, which contains details on patents granted from 1963 to 2002. Due to an average time lag of two years between the filing and awarding of patents, I link patents awarded in 2002 to bonus contract and other firm characteristics in 2000 (e.g. Lerner and Wulf 2007).[31] Due to this requirement, 418 observations of the 2001-2002 period are deleted, because a major part of patent applications were still under review at that time. Lastly, 12 observations are deleted due to missing COMPUSTAT data. The resulting sample encompasses 520 observations, for 197 firms across three years in 10 different industries, as classified by two digit SIC code.

4.3.2 Dependent Variables

As indicated above, I operationalize firm innovation by assessing heterogeneity in different attributes of firm patents filed by the USPTO. The choice to use patent data as a proxy for innovation is motivated by the following reasons. First, patent data include references to previous patents, fulfilling an important legal function by identifying what portion of the individual patent application is not covered by "prior art". Patents are therefore per-se informative of the construct innovation as they

[31] The economics literature argues that R&D expenditures and the following patent applications are generated within narrow time spans (Hall, Griliches, and Hausman, 1986). Likewise, I assume that proposed CEO incentive effects on innovation become instantly evident to boards.

indicate whether or not a specific idea or product extends existing knowledge. Second, patent measures are subject to thorough screening by engineers, patent lawyers and patent office officials, which results in standardized criteria to determine the novelty of patent applications. In contrast, alternative innovative output measures (most notably new product introductions) hinge on the firm's internal classification of what constitutes a new product (Hagedoorn and Cloodt 2003). Third, the NBER data base is the most extensive publicly accessible data on firms' innovative activity, experiencing high acceptance and wide use in the economics and management literatures. [32]

The economics literature assumes that not every patent filed is equally valuable and proposes citation based measures of patents' technological significance and impact as proxies for the value added by patents (Jaffe, Trajtenberg, and Henderson 1998; Jaffe and Trajtenberg 2002).[33] Patents of technological significance yield broad commercial applicability, making them valuable for businesses. Two prominent measures capturing technological significance are originality and generality. First, a patent is said to be more original if it draws upon a broader array of technologies among earlier patents it refers to. Patent *i's* originality is measured as one minus the Herfindahl Index of the citations made to antecedent patents across different technology classes. Specifically, the measure is calculated as:

$$ORIGINALITY_i = 1 - \sum_{j}^{n_j} m_{ij}^{\,2} \tag{4.1}$$

Where m_{ij} denotes the percentage of citations made by patent *i* that belongs to patent class *j*. Thus, if a patent cites previous patents that belong to a narrow set of technologies, the originality score will be low, whereas drawing upon a wide set of

[32] Although patent data offers a variety of appealing features, potential drawbacks are in order, as well. Most notably, firms may not actively patent innovations when the potential of imitations by competitors are low. Next to that, firms may also not apply for patents to disguise innovative efforts over longer time spans (Jaffe and Trajtenberg 2002). In order to affect the analysis at hand, either of the two motives would have to systematically translate into incentive design choices of interest. However, although these motives may affect the propensity to patent, they are unlikely to affect innovation oriented incentives, as firms would still benefit from their use. That is, even if motives against patenting innovations were present among sample firms, such motives would merely translate as unsystematic noise into the analysis.

[33] Citation measures account for the fact that research activity of firms, just like academic research, is an ongoing process in which a technical or knowledge based novelty builds upon prior knowledge over time (the "ancestors" of a patent). To get a patent awarded, firms have to convincingly state why the innovation at hand is a nontrivial and useful contribution to the previous state of knowledge. In this process, prior patents need to be cited to delimit the property rights awarded by the patent. This implies that patents awarded may also receive varying numbers of citations of different technologies from patents to follow (the "descendants" of a patent). Using the research analogy again, one can draw value implications by assessing patterns of patents' ancestors and descendents, in a comparable way as inferring a research publication's "value" by references made and received later on (Jaffe and Trajtenberg 2002).

technologies results in a high originality score.[34] The variable ORIGINAL is computed as the mean originality measure for all patents awarded to a firm in every year.

Quite similar, the variable GENERAL is the mean generality of awarded patents. An individual patent *i*'s generality refers to the broadness of technology classes of descending patents citing patent *i*:

$$GENERALITY_i = 1 - \sum_{j}^{n_j} r_{ij}^{\,2} \tag{4.2}$$

Where r_{ij} denotes the percentage of citations received by patent *i* that belongs to patent class *j*. Again, if a patent is cited by patents that belong to a narrow set of technologies, the generality score will be low, whereas receiving citations from diverse technologies results in a high generality score. As noted by Hall (2002), these measures tempt to increase mechanically with the number of citations made and received. I apply the correction proposed by Hall (2002) to deflate these measures by citations made and received.[35]

I proxy for patent impact by calculating the mean number of citations received by the firm's patents awarded in a given year (IMPACT). More valuable patents are assumed to more heavily affect inventions to come, which increases their likelihood of being cited by future patents more often (Hall et al. 2005).

Lastly, I calculate the variable PATENT_COUNT to measure a firm's patent output in a given proxy year, by calculating the sum of all patents filed at the UPSTO per year, conditional on the patent actually being awarded later. This measure has precedence in related studies (Holthausen et al. 1995; Lerner and Wulf 2006). The innovation literature suggests that more patents awarded are indicative of higher innovative effort, but allow no per-se implications about innovativeness of individual patents (Jaffe and Trajtenberg 2002). With respect to this, I leave the question whether or not long-term incentives are associated with more patent awards open to empirical examination.

[34] Suppose, for example, that a patent refers to a total of five earlier patents from four different technology classes and that two citations are made to a certain technology class and the remaining three citations are made to three different technology classes. The resulting originality score of the respective patent would be calculated as: $1-[(2/5)^2+(1/5)^2+(1/5)^2+(1/5)^2] = 18/25$

[35] Specifically, the estimator $\hat{\eta} = \frac{N \cdot HHI - 1}{N - 1}$ is an unbiased estimator of η, which is the true population herfindahl index of interest (in this case the herfindahl indices of originality and generality). N is the citations made and received for originality and generality, respectively. HHI is the biased estimator of the summation in (4.1) and (4.2).

4.3.3 Independent Variables

4.3.3.1 Private performance measures in CEO annual bonus contracts

The interest of this study lies on the incentive effects of private performance measures on valuable innovations created by firms. To capture the independent variable of interest, I read all individual proxy statements, together with two researchers. The variable USE_PM takes on the value 1 if boards indicate that bonus payments to the CEO (partly) depend on their private information of the CEO's long-term oriented actions. Examples include "innovation", "strategic positioning", "achievement of strategic objectives", "impact on long-term value", and "leadership". The mean of the variable USE_PM equals 60 per cent (313 obs.), of which 94 per cent (294 obs.) exhibit private performance measures in combination with accounting performance measures, and 6 per cent (19 obs.) rely on private performance measures only. Table 2.1 (Panel B) of chapter 2 provides an overview of excerpts from proxy statements that are representative of private measures in CEO annual bonus contracts.

4.3.3.2 Equity incentives

I measure the variable EQUITY_INC by calculating the sensitivity of the CEO's equity portfolio to stock price using the method described in Core and Guay (2002).

4.3.4 Empirical specification and estimation technique

Based on the hypotheses and the above description of variables, I estimate the following equations:

$$INNOVATION_i = \gamma_0 + \gamma_1 USE\_PM_i + \gamma_2 CONTROLS_i + \sum_{k=1}^{10} \kappa_k INDUSTRY_{ki} + \sum_{l=1}^{3} \delta_{dl} YEAR_{li} + \varepsilon_i \quad (4.3)$$

$$INNOVATION_i = \gamma_0 + \gamma_1 USE\_PM_i + \gamma_2 EQUITY\_INC_i + \gamma_3 USE\_PM_i \times EQUITY\_INC_i + \gamma_4 CONTROLS_i + \sum_{k=1}^{10} \kappa_k INDUSTRY_{ki} + \sum_{l=1}^{3} \delta_{dl} YEAR_{li} + \varepsilon_i \quad (4.4)$$

where INNOVATION represents the innovation measures presented earlier. I estimate equations (4.3) and (4.4) by pooling all observations in Tobit regressions, because a significant number of observations in each of the innovation variables has the value 0.

The existence of such a corner solution potentially causes biased OLS estimators for which Tobit adjusts by taking the probability of individual response values being greater than 0 into account (Wooldridge 2002). Year and industry fixed effects are included to control for unobserved variation of firm innovation across years and industries. Further, I include the variable EQUITY_INC in the estimation of (4.3) to control for direct effects of equity incentives on innovation (Holthausen et al. 1995; Lerner and Wulf 2006). For ease of interpretation, I center EQUITY_INC at the mean so that the coefficient for USE_PM in equation (4.4) reflects the effect of USE_PM for the sample average of equity incentives. Hypothesis 1 (2) predicts that the coefficient for γ_1 (γ_3) in (4.3) ((4.4)) is positive.

I also control for the possibility that the choice variable USE_PM causes endogeneity within the structural model (4.3) and (4.4).[36] One remedy for the endogeneity problem is to control for variables affecting the choice and the dependent variable alike. However, as there is no guarantee for the inclusion of all relevant control variables in equations (4.3) and (4.4), I also apply the propensity matching technique described by Deheija and Wahba (2002) to assess variation in innovation of similar firms making different performance measure choices. This takes into account that firms are not equally likely to profit from the incentives provided by private measures.[37] Before turning to the results of the main analysis, I describe the propensity matching approach in more detail in the next section.

4.3.5 The endogenous nature of private measures in CEO evaluations

An ideal test isolating the effects of bonus contract design would be to compare a firm's innovative activity conditional on optimal contracts with its own innovation had it used economically infeasible contracts. As this is implausible, an alternative is to assume that not all firms optimize compensation practices all of the time, and at least sometimes exhibit contracting wise disequilibrium. This allows differences in innovation to be examined by assessing the extent to which innovation performance of firms behaving as predicted is superior to that of firms making surprising contracting choices (cf. Hogan and Lewis 2005). To do so, I will apply the propensity matching technique described by Deheija and Wahba (2002). This method is appropriate when multiple matching characteristics that theoretically drive a choice variable are present. The propensity score is the likelihood of observing private performance measures in

[36] For detailed discussions see, for example, Chenhall and Moers (2007), and Moers (2006).

[37] For instance, firms pursuing strategies aimed at maximizing contemporaneous cash flows may invest in R&D due to a demand for relatively basic innovations that concern refinements of already existing processes and products (Davelaar and Nijkamp 1989). In this case, valuable CEO actions have a contemporaneous effect on financial performance, rendering forward looking private measures superfluous. On the contrary, firms taking on a future oriented strategy but failing to reward corresponding actions will create CEO incentives to concentrate on "wrong" activities, negatively affecting value adding innovation.

bonus contracts. This likelihood is the fitted value from a probit regression and incorporates the different matching attributes. I apply it as the criterion to match private performance measure users with similar firms choosing not to use these measures. In that way, the latter serve as control firms to indicate how private measure users would have performed in the absence of private measures.

4.3.5.1 Prediction model for the use of private measures in annual bonus contracts

In order to estimate firms' propensity to include private performance measures in annual bonus contracts, I estimate a probit model where the dependent variable equals one if boards include private performance measures in the determination of CEO bonuses and zero otherwise.

Following previous research (e.g. Bushman et al. 1996; Ittner et al. 1997; HassabElnaby, Said and Wier 2003), I include a number of variables that influence the choice of private measures in bonus contracts, among which, variables capturing the expected innovation opportunity set, the informativeness of long-term oriented performance measures, firm size and financial health, the CEO's long-term incentives provided by equity holdings, and the noise inherent in accounting numbers.

First, the strategy of a firm is an important determinant of the firm's expected innovation opportunity set. Firms adopting a strategy aiming at long-term value creation attempt to identify new products and markets and need to quickly adapt to changes in the competitive environment, which positively influences the need for innovation (Miles and Snow 1978). Firms should therefore provide CEO incentives to take actions that correspond to the competitive strategy (Ittner et al. 1997). Following the defender-prospector categorization proposed by Miles and Snow (1978), I predict the expected innovation set and hence, the incentive benefits of private measures to increase the closer a firm is operating at the prospector end of the continuum. I compute the construct STRATEGY as a three-item factor score of a firm's market-to-book, employees-to-sales, and R&D-to-sales ratios. I use averages of these ratios five years prior to the proxy data; lower values are associated with firms near the defender end of the continuum. Principal component analysis reveals one factor with Eigenvalue greater than unity.

Second, the lengths of firm product development and product life cycles determine how well accounting earnings assess immediate effects of managerial long-term oriented actions. Using the National Academy of Engineering classification (1992), I use two indicator variables that take on the value of one if a firm is characterized as having long product development cycle (D_CYCLE) and a long product life cycle (L_CYCLE), respectively. I expect that private performance

measures are more informative about long-term oriented CEO actions given longer product development and -life cycles.

I also include the firm's financial stability using Altman Z-Scores (Altman 1968) averaged five years prior to the proxy data (ALTMAN). Financially distressed firms need to emphasize financial measures to direct managerial focus to the improvement of short-term profits to ensure firm survival, and therefore rely less on long-term oriented measures (Ittner et al. 1997).

Further, I include the variable EQUITY_INC described earlier in this dissertation to control for correlation between equity incentives and the use of private performance measures (Ittner et al. 1997).

In addition, I measure NOISE based on the variability in the median 3-digit industry accounting returns. Higher fluctuations in accounting returns of the median firm in a respective industry are assumed to proxy for the extent to which firm accounting performance is vulnerable to factors beyond a CEO's control, increasing the contracting benefits of alternative performance measures (Ittner et al. 1997). I include the variability in ROA, ROE, and ROS over five years preceding the proxy data. Principal component analysis reveals one factor with eigenvalue greater than unity. I use the factor score as the measure of noise.

Finally, I include firm size (SIZE) to account for the firm's overall monitoring environment, along with fixed year, and industry effects. I estimate the following probit regression:

$$\begin{aligned} &P(USE\_PM_i = 1) = \lambda_0 + \lambda_1 STRATEGY_i + \lambda_2 D\_CYCLE_i + \lambda_3 L\_CYCLE_i \\ &+ \lambda_4 ALTMAN_i + \lambda_5 EQUITY\_INC_i + \lambda_6 CONTROLS_i + \\ &\sum_{k=1}^{10} \kappa_k INDUSTRY_{ki} + \sum_{l=1}^{3} \delta_{dl} YEAR_{li} + \varepsilon_i \end{aligned} \tag{4.5}$$

The initial sample of R&D intensive firms reduces to 452 observations [273 (170) private measure (non-) users], because of missing information on variables included in equation (4.5) but not in equations (4.3) and (4.4).

4.3.5.2 Parameter estimates

Table 4.1 provides the parameter estimates of the prediction model of private performance measures in CEO bonus contracts. Significance tests are based on firm-cluster standard errors. As expected, I find that the incidence of private performance measures is positively and significantly related to firms' being positioned near the prospector end of the strategy continuum, the noise in accounting earnings, and the length of product life cycles. The likelihood of observing private performance

measures is negatively related to the degree of financial distress and stronger equity incentives. Finally, the model's Pseudo R^2 equals 19.98%.

Table 4.1

Probit Estimation for the incidence of private performance measures in CEO annual bonus contracts (n=452) [a]

Variable	Predicted	Dependent variable *P(USE_PM=1)*
STRATEGY	+	0.28** (0.14)
SIZE	+	0.27*** (0.57)
L_CYCLE	+	0.93*** (0.25)
D_CYCLE	+	-0.018 (0.19)
NOISE	+	0.18** (0.11)
EQUITY_INC	-	-0.123** (0.05)
ALTMAN	+	0.03*** (0.13)
Pseudo R^2		19.98%

[a] $P(USE\_PM=1)_i=\alpha+\beta_1 STRATEGY_i+\beta_2 SIZE_i+\beta_3 L\_CYCLE_i+\beta_4 D\_CYCLE_i+\beta_6 NOISE_i+\beta_6 EQUITY\_INC_i+\beta_7 ALTMAN_i+\beta_8 YEAR+\beta_9 INDUSTRY_i+\varepsilon_i$

***, **, * denotes significance at the 1%, 5%, and 10% level respectively (one tailed, cluster robust standard errors reported in parentheses).

Fixed year- and industry effects are unreported, as is the intercept.

The variables are defined as follows:

STRATEGY = The firm's prospective strategy measured as a factor score of the ratios (1) research and development to sales (2) market-to-book value, and (3) the employees to sales;

SIZE = Natural logarithm of total firm sales (mio. US $);

L_CYCLE = Indicator variable taking the value 1 if the firm is classified as having long term product life cycles, 0 otherwise;

D_CYCLE = Indicator variable taking the value 1 if the firm is classified as having long term product development cycles, 0 otherwise;

EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price;

ALTMAN = A variable accounting for the firm's degree of financial stability. Calculated using Altman's (1968) financial stability model, values below 1.8 implying a high likelihood of firm bankruptcy;

NOISE = The time series variability in median industry accounting returns measured five years prior to the proxy data. The factor score is calculated using variability of (1) return on assets, (2) return on sales, and (3) return on equity. Noise in accounting numbers is assumed to increase with greater time series variability in industry returns;

4.3.5.3 Propensity score matching method

I use the fitted values from the probit regression to divide all available observations into ones that exhibit high and low probabilities of observing private performance measures in bonus contracts. Comparing fitted values with actual firm choices, I estimate the critical value (the value above which a firm is classified as a high probability firm) that minimizes the sum of Type I and Type II errors. At the cutoff value of 48%, the ratio of correct classifications is 70.8%. Taking the probability of 48% as the benchmark, I assume that firms above that likelihood theoretically benefit from the incentives provided by private measures, while firms below do not.

In both the high and low probability group, firms may behave as expected or make surprising choices. Based on this, I classify observations into four subgroups: i) Firms that include private measures in bonus determination as expected, ii) firms that use financial measures only, but have the characteristics of private measure firms, iii) firms without private measures as expected and iv) firms using private measures contrary to expectations. Subsequently, I match the groups of expected performance measure choices with comparable firms making surprising choices [i.e. i) with ii), and iii) with iv)] per proxy year, allowing a 10% interval around their adoption likelihoods. This identifies a matched sample for 89 observations of expected users and 46 observations of expected non-users. Consequently, the subsequent analysis is based on 270 matched observations (2*89 obs. + 2*46 obs.), as a result of the above described procedure.

As a final step, I perform t-tests to identify whether there are significant differences in the determinants of performance measure choices (defined in the previous section) across the matched samples. If the matching process is successful, there should be no differences in factors affecting propensity scores, rendering concerns about systematic associations between innovation and matching attributes void (Deheija and Wahba, 2002). As none of the determinants of private measures significantly differs (table unreported), the propensity matching procedure succeeded and differences in innovation performance can be attributed to the presence or absence of private performance measures.

4.3.6 Additional controls

In estimating (4.3) and (4.4), I further control for barriers to entry and market structure, factors that potentially influence innovation but unlikely to affect the private measure choice. That is, the propensity scores do not guarantee firm comparability among theses factors.

Market structure, and specifically the extent of competition, is assumed to affect firms' tendency to innovate. In markets where sales are concentrated among a few firms innovation may be spurred as individual players are more likely to reap the profits from R&D investments made (Schumpeter 1942). On the other hand, less competition may also hinder innovation, because competitive pressures and consequently incentives to innovate are low. Following Holthausen et al. (1997), I measure competition density by computing a four-firm concentration ratio. The variable COMP_DENS is calculated by accumulating the sales of the four largest firms and dividing it by the respective total industry sales as defined by three-digit SIC code.

Barriers to entry refer to the overall capital intensity needed to compete in a given product market. In essence, the logic of how this factor influences innovation is comparable to the effects of competition, as firms operating in an environment with high barriers to entry may be shielded from external pressures, which allows them to profit from marketing its own innovations. On the other hand, this may create organizational "laziness" with respect to innovation. Barriers to entry are measured by computing the median capital expenditures-to-sales, R&D to sales, and advertising-to-sales ratios for all firms classified by the same three-digit SIC code. Finally, these individual ratios are summed up to form the variable BARRIERS (Holthausen et al. 1995). I formulate no directional prediction for the variables COMP_DENS and BARRIERS due to their alternative possible effects on innovation proposed by prior literature.

It is also noteworthy that firm size is commonly controlled for in related studies due to the potential effects of economies of scale or lacking organizational flexibility on firm innovation which may be captured by size (Schumpeter 1942; Holmstrom 1989). However, firm size serves as a criterion in the above described matching procedure. This ensures that no systematic size effects are introduced when estimating regressions in the matched samples (Deheija and Wahba 2002).

4.3.7 Descriptive statistics

Table 4.2 summarizes descriptive statistics of all endogenous and explanatory variables in the innovation regressions (4.3) and (4.4).[38] Pearson correlations reveal no sign of multicollinearity between the explanatory variables (Table 4.3).[39] As noted above, all innovation measures are censored at the value 0 with non-trivial amounts of

[38] To control for potential effects of outliers, all continuous variables are winsorized at their 1st, 99th percentiles.
[39] An exemption is the correlation between competition density and investment barriers, neither of these variables, however, exhibits noteworthy correlation with USE_PM, which is the variable of interest in this context.

Table 4.2

Descriptive statistics of Innovation and explanatory variables for matched observations (n=270)

Variable	Mean	Median	Std. Dev.	Q1	Q3
USE_PM	0.5	0.5	0.5	0	1
SIZE	6.8	6.99	1.38	6.02	7.87
COMP_DENS	0.58	0.51	0.21	0.4	0.72
BARRIERS	0.13	0.11	0.08	0.06	0.18
EQUITY_INC	0	-0.21	1.49	-1.12	0.99
ORIGINALITY	0.21	0	0.25	0	0.47
GENERALITY	0.12	0	0.22	0	0
IMPACT	0.32	0	0.58	0	0.37
PATENT_COUNT	31.2	0	99.44	0	13

The variables are defined as follows:

USE_PM = Indicator variable taking the value 1 if the board uses private information of CEO performance in determining annual bonuses, and 0 otherwise;

SIZE = Natural logarithm of total firm sales (mio. US $);

COMP_DENS = Competition density. Measured by computing a four-firm concentration ratio. This is calculated by accumulating the sales of the four largest firms and dividing it by the respective total industry sales as defined by three-digit SIC code;

BARRIERS = Barriers to entry new product markets. Measured by computing the median capital expenditures-to-sales, R&D to sales, and advertising-to-sales ratios for all firms classified by the same three-digit SIC code (Individual ratios summed up to form the variable);

EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price;

ORIGINALITY = The mean originality of patents awarded to a firm in year t, where originality is the citation intensity of individual patents *made* with respect to prior patents, across technology classes;

GENERALITY = The mean generality of patents awarded to a firm in year t, where originality is the citation intensity of individual patents *received* by later patents, across technology classes;

IMPACT = The mean future citations received by firm patents in a given year;

PATENT_COUNT = Number of firm patents granted.

Table 4.3

Pearson correlation coefficients between the independent variables (n=270)

Variable	USE_PM	SIZE	COMP_DENS	BARRIERS	EQUITY_INC
USE_PM	**1.00**				
SIZE	-0.03	**1.00**			
COMP_DENS	-0.05	0.2*	**1.00**		
BARRIERS	0	-0.27*	-0.63*	**1.00**	
EQUITY_INC	-0.04	0.43*	-0.16*	0.25*	**1.00**

* Denotes statistical significance at the 5% level or higher (two-tailed).

The variables are defined as follows:

USE_PM = Indicator variable taking the value 1 if the board uses private information of CEO performance in determining annual bonuses, and 0 otherwise;
SIZE = Natural logarithm of total firm sales (mio. US $);
COMP_DENS = Competition density. Measured by computing a four-firm concentration ratio. This is calculated by accumulating the sales of the four largest firms and dividing it by the respective total industry sales as defined by three-digit SIC code;
BARRIERS = Barriers to entry new product markets. Measured by computing the median capital expenditures-to-sales, R&D to sales, and advertising-to-sales ratios for all firms classified by the same three-digit SIC code (Individual ratios summed up to form the variable);
EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price.

observations, while being continuously distributed for innovation measures greater than 0, justifying the choice to apply the tobit procedure in estimating (4.3) and (4.4). I also assess whether patent characteristics in the employed sample are representative of overall innovation characteristics by comparing variable distributions to those reported in related studies. I concentrate on 207 firm year observations where PATENT_COUNT>0. The means and medians of the innovation variables as well as their significant skewness (i.e. much higher means than medians) are comparable to figures reported in earlier work (e.g. Pakes 1989, Trajtenberg 1990, and Trajtenberg et al. 1997). One notable exception is the distribution of the variable GENERALITY where even the third quartile exhibits the value 0, which indicates that the variable in the present sample is even more skewed as compared to prior work. [40]

[40] A potential explanation for this observation is that the time span after the grant date of an individual patent is relatively short in the present sample, which understates the amount of citations a patent may possibly receive in the future. Consequently, as the likelihood of receiving patents from more diverse technologies increases with more patents received over time, the limited time span underlying this study may result in generality scores that are different today compared to measuring the variable in future periods (see also Hall et al. 2001). However, the respective variable should still be informative of firm innovativeness as patents not only receiving early citations but also from a broad set of technologies are inherently important. That is, innovation gaps observed among relatively young patents can be expected to widen over time (Jaffe and Trajtenberg 2002).

The skeweness of the variables indicates that most patents are relatively basic in technological terms, cite relatively narrow industry fields, and receive few citations in the first years after being granted (Trajtenberg et al. 1997).

4.4 Results

4.4.1 Innovation performance of anticipated (non-) users of private measures

Table 4.4 presents mean innovation comparisons across the two matched samples. Panel A (B) features comparisons of expected users (non-users) of private measures with the respective matched control firms. Columns 2-4 present the raw means and the corresponding two-sample t-tests assessing mean differences. Columns 5-7 provide Least Squares Means and their difference across firms, where I control for the variables BARRIERS and COMP_DENS defined above.[41,42]

First, I turn to the differences between 89 anticipated users and the matched sample of surprise non-users. The t-statistics indicate that anticipated users experience significantly higher innovation, in terms of technical sophistication and future impact,

Table 4.4
Comparison of mean patenting activity of firms making expected, surprising choices with regard to private performance measures in CEO annual bonus contracts

PANEL A: Expected private measure users (EPM) vs. surprise private measure non-users (SPM) (n=89)

	Raw Means			Adjusted Means[a]		
Variable	(1) ENPM	(2) SPMU	Δ, Pr [(1)=(2)]	(3) ENPM	(4) SPMU	Δ, Pr [(3)=(4)]
ORIGINALITY	0.32	0.19	0.13 (0.0005)	0.32	0.19	0.12 (0.0003)
GENERALITY	0.21	0.11	0.10 (0.002)	0.21	0.12	0.09 (0.0031)
IMPACT	0.46	0.32	0.14 (0.07)	0.47	0.32	0.15 (0.06)
PATENT_COUNT	54.46	38.59	15.78 (0.27)	52.5	37	15.5 (0.316)

(Continued on next page)

[41] In computing LS-Means, covariates of interest are set to mean values, applying equal weight to different response levels PRIVATE_PM=1 vs. PRIVATE_PM=0.
[42] R&D intensity is a component of STRATEGY. Its effects on innovation are consequently controlled for by the propensity matching procedure. This is also true regarding SIZE which is included in (4.5).

Table 4.4 (continued)

PANEL B: Expected private measure non-users (ENPM) vs. surprise private measure users (SPMU) (n=46)

	Raw Means			Adjusted Means[a]		
Variable	(1) ENPM	(2) SPMU	Δ, Pr [(1)=(2)]	(3) ENPM	(4) SPMU	Δ, Pr [(3)=(4)]
ORIGINALITY	0.10	0.11	-0.01 (0.79)	0.1	0.11	0.01 (0.85)
GENERALITY	0.03	0.02	0.01 (0.82)	0.03	0.02	0.01 (0.72)
IMPACT	0.16	0.12	0.04 (0.71)	0.14	0.11	0.03 (0.79)
PATENT_COUNT	1.95	1	0.95 (0.96)	5.67	2.48	3.19 (0.87)

[a] Least Squares Means adjusting for BARRIERS and COMP_DENS
P-Values (reported in parentheses) are the likelihood of committing Type I error in rejecting H_0: Innovation (Group 1) = Innovation (Group 2), using a two-tailed test.

The variables are defined as follows:

ORIGINALITY = Average originality of patents in a given year. Measured as one minus the Herfindahl Index of the citations made to earlier patents across different technology classes;

GENERALITY = Average originality of patents in a given year. Measured as one minus the Herfindahl Index of the citations received by future patents across different technology classes;

IMPACT = Average number of future citations received by firm patents granted in a given year;

PATENT_COUNT = Number of firm patents in a given year.

both comparing the raw and adjusted means. Means of the variable PATENT_COUNT do not significantly differ. These results suggest that the incentives to take long-term value related actions provided by private measures are associated with patents of higher potential future value, when performance measures are in line with the strategic and operational environment the firm operates in. By contrast, the absence of corresponding incentives is associated with less innovation.

Second, Panel B reveals no significant differences among innovation measures comparing 46 expected non-users with surprise users of private measures. That is, the provision of long-term incentives via private measures has no effect, if strategic and operational configurations do not require their use. Given that model (4.5) classified more than 70% of sample firms correctly, I conclude that boards' reviews of CEO performance create, on average, incentives that work optimal for the firm.

4.4.2 Regression results

The above comparison of innovation measures support the suspicion of an endogenously determined private measure choice. In this section, I turn to the results of regressing innovation measures on the private measure indicator to estimate (4.3) and also include the interaction with CEO equity incentives to estimate (4.4).

The regressions are based on the matched sample of firms with high propensities to use private measures. As indicated in the mean analysis, innovation is a major firm objective of high propensity firms, while low propensity firms seemingly invest in R&D to obtain marginal developments not subject to the ownership protection guaranteed by patents. Therefore, including low propensity firms in estimating (4.3) and (4.4) is neither interesting nor informative because expected innovation does not change conditional on the use of private measures.

4.4.3 Innovation regressions on indicator variable USE_PM

Table 4.5 presents tobit results for model (4.3) regressing measures of patent output, technical sophistication and impact on the indicator variable capturing the incidence of private measures in boards' evaluations of CEO performance, with and without the control variables COMP_DENS and BARRIERS. For all innovation measures in all specifications, the coefficient for the variable USE_PM is significant and takes on the predicted positive sign. That is, in a sample of firms whose boards should evaluate the CEO using private performance information, the firms whose boards actually do obtain significantly more patents of greater technological significance and future impact than firms whose boards neglect such information.

The results corroborate the findings of the univariate mean comparisons and again indicate that innovation is a positive function of the "match" between firm operational and strategic configurations and the CEO's evaluation, and thus, incentive-structure. In sum, I find strong support for hypothesis 1.

4.4.4 Interaction effects of private measures and CEO equity incentives

The second research hypothesis predicts that private measures in CEO evaluations allow cash payments to signal private information about CEO performance to capital markets which leads to stronger innovation oriented incentives of CEO equity holdings. Model (4.4) therefore incorporates the interaction term of private measures and CEO equity, as the hypothesized conditional effects of CEO equity will, if present, be captured by the coefficient of the interaction term. Further, the variable EQUITY_INC is included in the structural model for the sake of consistency.

Table 4.5

Tobit Estimation of the effect of private measures in CEO performance evaluation on innovation (n=178) [a,b]

		Dependent variable *INNOVATION*							
		(1)		(2)		(3)		(4)	
Variable	Pred.	ORIGINALITY		GENERALITY		IMPACT		PATENT_COUNT	
USE_PM	+	.226*** (.065)	.234*** (.685)	.281*** (.111)	.281*** (.111)	.365** (.168)	.378** (.163)	67** (22.9)	64.82** (28.8)
COMP_DENS	?		-.262 (.203)		-.423 (.336)		-.562 (1.63)		-159.21 (88.59)
BARRIERS	?		-1.37** (.685)		-.702 (1.06)		.296 (.513)		-219.52 (283.03)
Adj. R^2		7.2%	8%	3.6%	3.8%	1.2%	1.7%	0.38%	0.6%

[a] $INNOVATION_i=\alpha+\beta_1 USE\_PM_i+\beta_2 EQUITY\_INC_i+\beta_2 CONTROLS_i+\beta_4 YEAR+\beta_5 INDUSTRY_i+\varepsilon_i$

[b] Using a sample of expected private measure users matched to surprise non-users, with propensities to use as the matching criterion. The propensity score incorporates the factors STRATEGY, SIZE, L_CYCLE, D_CYCLE, NOISE, EQUITY_INC, and ALTMAN in order to hold potential effects on the use of private measures and innovation constant (for variable descriptions, see Table 4.1). ***, **, * denotes significance at the 1%, 5%, and 10% level respectively (one-tailed test for predictions, two-tailed test otherwise, standard errors reported in parentheses). Fixed year- and industry effects are unreported, as is the intercept.

The variables are defined as follows:

USE_PM	=	Indicator variable taking the value 1 if the board uses private information of CEO performance in determining annual bonuses, and 0 otherwise;
COMP_DENS	=	Competition density. Measured by computing a four-firm concentration ratio. Calculated by accumulating the sales of the four largest firms and dividing it by
BARRIERS	=	Barriers to entry new product markets. Measured by computing the median capital expenditures-to-sales, R&D to sales, and advertising-to-sales ratios for all firms classified by the same three-digit SIC code (Individual ratios summed up to form the variable).

Table 4.6 presents the corresponding tobit results, again ex- and including the control variables COMP_DENS and BARRIERS. Consistent with hypothesis 2, the coefficient of the interaction term takes on the predicted positive sign in all regressions and is significant for the count of patent awards and both measures of technical sophistication, both ignoring and holding constant market structure and investment barriers.

The adjusted R^2 of all models including interaction effects are higher than the respective models excluding interactions as presented in the previous table (see Table 4.5). That is, a given level of CEO equity incentives is positively and significantly associated with firm innovation, conditional on the use of private measures. Hence, supporting hypothesis 2, the possibility to communicate privately observed innovation to outsiders increases the incentive intensity provided by equity, as this renders stock

Table 4.6

Tobit Estimation of the interaction effect of private measures in CEO performance evaluation and CEO equity on innovation (n=178) [a,b]

		Dependent variable *INNOVATION*							
		(1)		(2)		(3)		(4)	
Variable	Pred.	ORIGINALITY		GENERALITY		IMPACT		PATENT_COUNT	
USE_PM	+	.215***	.221***	.253***	.254***	.345**	.358**	57.41**	55.61**
		(.065)	(.064)	(.109)	(.109)	(.169)	(.17)	(28.66)	(28.26)
EQUITY_INC	?	-.001	.009	.002	.003	.02	.031	10.25	11.04
		(.029)	(.029)	(.049)	(.05)	(.077)	(.077)	(13.157)	(13.13)
USE_PM× EQUITY_INC	+	.059*	.056*	.105*	.104*	.075	.07	25.52*	25.69*
		(.043)	(.043)	(.073)	(.072)	(.115)	(.113)	(19.32)	(19.02)
COMP_DENS	?		-.291**		-.454		.261		-176.2**
			(.203)		(.33)		(.516)		(87.73)
BARRIERS	?		-1.54**		-.93		-.823		-313.63
			(.7)		(1.08)		(1.675)		(285.9)
Adj. R^2		9.1%	9%	5.4%	5.4%	1.6%	2.1%	1.8%	1.7%

[a] $INOVATION_i=\alpha+\beta_1 USE\_PM_i+\beta_2 USE\_PM_i \times EQUITY\_INC_i+\beta_3 EQUITY\_INC_i+\beta_4 CONTROLS_i+\beta_5 YEAR+\beta_6 INDUSTRY_i+\varepsilon_i$

[b] Including expected private measure users matched to surprise non-users, with propensities to use as the matching criterion. The propensity score incorporates the factors STRATEGY, SIZE, L_CYCLE, D_CYCLE, NOISE, EQUITY_INC, and ALTMAN in order to hold potential effects on the use of private measures and innovation constant. ***, **, * denotes significance at the 1%, 5%, and 10% level respectively (one-tailed test for predictions, two-tailed test otherwise, standard errors reported in parentheses). Fixed year- and industry effects are unreported, as is the intercept.

The variables are defined as follows:

USE_PM = Indicator variable taking the value 1 if the board uses private information of CEO performance in determining annual bonuses, and 0 otherwise;

COMP_DENS = Competition density measured by computing a four-firm concentration ratio. Calculated by accumulating the sales of the four largest firms and dividing it by the respective total industry sales as defined by three-digit SIC code;

BARRIERS = Barriers to entry new product markets. Measured by computing the median capital expenditures-to-sales, R&D to sales, and advertising-to-sales ratios for all firms classified by the same three-digit SIC code (Individual ratios summed up to form the variable).

EQUITY_INC = The sensitivity of the CEO's equity portfolio to a 1% change in stock price.

prices more sensitive to CEO actions. Contrary to prior studies and consistent with the arguments set forth in this study, CEO equity incentives exert no direct effects on any innovation measure.

I acknowledge that a significant amount of firms is included in the panel of observations twice or even in the entire 1998-2000 sample period. That is why firm observations are likely to be dependent over time. Firm clustering can therefore be an issue, which results in biased standard errors and significance tests. Tobit does not provide clustering-robust standard errors, for why I re-estimate all regressions using OLS and cluster-robust standard errors to assess the sensitivity of significance tests to that potential issue. None of the conclusions changes as OLS leads to the same inferences.

4.4.5 Additional analysis and economic significance

An important question is whether the above presented incentive effects on firm innovation are worth the investigation in view of the economic consequences of more or less innovation. In the remainder of this section I will describe the approach taken to attach economic meaning to the above results, along with problems this approach may result in and potential remedies to these problems.

4.4.5.1 Value implications of patent impact and truncation in IMPACT

To investigate the economic significance of incentives in view of more or less innovation, I require an estimate of the value implied by innovation as measured by the innovation proxies used. Until so far, there is only one study I am aware of, that investigates the value attached to patent attributes by investors. Hall et al. (2005) show that firms' market value increase by 3% with each future citation received by patents awarded to respective firms. This corresponds to the measure of innovation impact in the present study, allowing the imputation of the economic effects by using parameters found here and the Hall et al. market value estimator.

4.4.5.2 Interpretation of interaction term in the Tobit model

Another problem regarding economic implications is that Tobit coefficients are difficult to interpret at the margin which holds in particular for interaction coefficients (Wooldridge 2002). I therefore calculate marginal effects where all effects are evaluated at the mean and marginal effects of the interaction term are based on the

cross partial derivative of patent impact with respect to USE_PM and EQUITY_INC.[43] The marginal effects reflect the change in future patent impact for a discrete change in the variable USE_PM and an infinitesimal change in each of the independent continuous variables.

4.4.5.3 Results

The results (untabulated) for 112 observations for 56 matched firms in the 1998-1999 period confirm the expectation that truncation of IMPACT is an issue as the strength of results hinges on the time span in which patents may have possibly received citations by later patents. The coefficients on USE_PM and USE_PM×EQUITY_INC are both positive (0.29 and 0.11, respectively) and significant ($p<0.01$ and $p=0.085$ respectively, one-tailed tests).

4.4.5.4 Economic significance

As revealed by the preceding analysis, the coefficient of the variable USE_PM implies that citation intensity of individual patents awarded to private measure firms is about one third higher in the time window until the end of the NBER data base in 2004. I apply this estimator to a 1998 example where an expected private measure firm obtains 40 patents in a given year as does a similar firm surprisingly not using private measures receives (about the mean values of the latter group, see table 4.3). In this arbitrary selected case, the firm providing incentives would have a market value which is about 34% higher than the firms of comparison due to the greater impact of innovations, assuming that each patent citation received is associated with 3% higher market value (0.29*40*3%=34.8%). Next, the coefficient of the interaction term predicts that a given level of CEO equity is associated with additional 0.11 citations received per patent, conditional on the presence of private measures.

Again, applying this estimate to the example above and assuming that equity incentives in the matched sample do not systematically differ, shows that the incentive firm's market value exceeds the comparison firm's value by another 13%, due to the additional incentives provided by CEO equity (40*0.11*3%=13.2%). The effects provided by this example appear high at first glance. Still, economic effects remain significant even if a conservative 1% instead of the 3% estimator derived in Hall et al. is applied (11.6% higher market value due to the main effect on USE_PM, 4% due to the interaction effect). Overall, the admittedly simplistic example gives at least a crude

[43] This procedure is similar to the one described by Ai and Norton (2002) with respect to interaction terms in Probit and Logit regressions.

approximation of the value relevance of CEO innovation oriented incentives provided by boards and their evaluation of CEO performance on that dimension.

4.5 Conclusion

In the evaluation of CEO performance, private information held by board of directors about the impact of CEO actions on firm value is often present. Innovation is a major driver of firm value and boards frequently review and reward CEOs on such "soft" performance dimensions that are not instantly obvious to outsiders or captured by the firm's accounting numbers. The evaluation of CEO impact on firm innovation is per-se difficult and capital markets are unlikely to be sufficiently informed to perform this task very well. In this chapter, I argue that boards can add to the alignment of interests between firm owners and the CEO when they communicate desired standards for evaluating CEO performance.

Assuming that firms invest resources into R&D to identify innovative products and production processes, I examine in a sample of R&D intensive firms whether boards' evaluation of CEO performance triggers innovative behavior when performance is assessed using privately held information the board gains from observing the CEO.

I further argue that cash payments carry private information from the firm's internal environment to capital markets, which leads a firm's share price and also the CEO's equity holdings to become more sensitive to internally known value creation, such as the existence of high prospect innovations. I test the prediction that the incentives provided by a given level of equity holdings are stronger in the presence of private measures in annual incentive contracts, positively affecting firm innovation

Empirical results support these arguments. Controlling for the endogeneity of the decision to use private measures and holding R&D investments constant, the incidence of private measures is positively related to the number, technical sophistication and impact of awarded patents. I also find that the interplay of private measures and equity holdings is positively related to all aspects of innovation used in this study.

In sum, results indicate that the investment in R&D does not always yield innovation but that corresponding incentives positively influence this linkage. Boards play an important role in providing incentives to innovate as they observe the CEO more closely than outsiders. Thus, boards via CEO performance measurement and evaluation take an important part in the corporate governance process.

Chapter 5

Conclusion

5.1 Introduction

This dissertation examined board evaluations of the CEO and their relevance for incentive contracting from two perspectives. Chapter 2 and 3 focused on the use of CEO performance evaluations and chapter 4 focused on their effects. More specifically, in chapter 2, I isolated determinants of board discretion in the annual performance review and evaluation, investigating whether optimal contracting, or alternatively, organizational power considerations underlie the choice to apply discretion. In chapter 3, I studied whether board evaluations provide CEO incentives. In chapter 4, I analyzed the decision-influencing role of board evaluations in the firm's innovation process. In this final chapter, I review the empirical findings of each study included in this dissertation in section 5.2. Section 5.3 presents conclusions and implications. Finally, potential limitations and suggestions for future research are presented in section 5.4.

5.2 Summary of empirical results

The aim of the first study was to investigate the determinants of board discretion in CEO annual bonus contracts of U.S. publicly listed firms. On the one hand, discretion can add informational value to incentive contracts. For example, discretion allows boards to incorporate information about external factors beyond the CEO's control and/or to determine whether her actions taken adequately respond to changes in the firm's environment. On the other hand, discretion depends on the board's subjectivity, rendering performance evaluations non-transparent, which facilitates the CEO's opportunity to extract rents from the company. I examined which of the two views underlie the decision to use discretion. I drew on agency theory to characterize different ways in which discretion can be applied to improve incentive contracts. I emphasized two, largely unexplored, types of discretion, (1) discretionary bonuses and (2) implicit incentive weights on pre-specified performance measures. I advanced the hypotheses that discretionary bonuses are valuable when accounting performance is open to events beyond the CEO's control, and that implicit incentive weights are

valuable when the CEO's optimal effort allocation across different tasks is ex-ante unknown. I tested these hypotheses in contracting settings where either the problem of uncontrollable factors or ex-ante unknown optimal effort allocation is dominating. The empirical findings support both hypotheses as the use of discretionary bonuses (implicit incentive weights) is positively related to the firm's accounting noise (environmental unpredictability). Furthermore, applying discretion is a non-trivial task requiring intense monitoring of the CEO by the board. Based on this, I hypothesize that boards are more likely to choose discretion as the remedy for expected contracting problems the more intense they monitor the CEO. Empirical results are in line with this expectation. CEO power considerations have no effect on the discretion choice. Overall, the results in chapter 2 indicate that boards of directors take care in the administration of annual bonus contracts as their design systematically reflects optimal contracting considerations.

In chapter 3, I examined the question why boards invest resources into the design and administration of bonus contracts if not for incentive purposes. Boards may very well delegate certain compensation related decisions to the capital market but still retain other important duties. For the CEO, one of the most important duties of the board concerns her employment and boards are likely to incorporate privately held information in deciding over continuing and terminating her position in the firm. I argued that boards use bonus contracts as a device to ex-ante convey what the board's annual evaluation of the CEO is comprised of. This practice offers multiple advantages among which the credible communication of regular performance evaluation, and the disclosure of boards' private information to capital markets. To test this expectation, I studied whether the incidence of CEO dismissal is related to the performance measures specified in annual bonus contracts.

In addition, CEO turnover provides information content to capital markets, due to the fact that boards may base the firing decision on private information. Unlike the case where the turnover decision is entirely based on public information such as accounting performance, a firing based on boards' private information signals that the situation is worse than expected. I tested the expectation that stock price reactions around CEO turnover announcements differ conditional on whether or not private information becomes relevant in the annual review of CEO performance and thus, the ultimate decision to terminate her job.

Empirical results support both expectations. Controlling for market and accounting performance, I find that the board's CEO performance assessment is more negatively associated with CEO turnover the greater the ex-ante weight on private performance measures in the bonus contract. Further, the stock market reaction around announcement differs according to the information signaled to the capital market along with CEO dismissal. Firings based on public information are followed by positive

stock price reactions while firings based on private information are associated with negative stock price reactions. Overall, the results indicate that annual bonus contracts provide incentives as they spill over to the CEO turnover decision and that board evaluations are relevant for investors in forming expectations.

After showing that boards' performance evaluations are in line with economic rationale and provide incentives in chapter 2 and 3 respectively, chapter 4 examined their effects on management behavior. Boards observe the CEO regularly and are likely to learn about her value enhancing activities that have no direct effect on the firm's accounting or stock performance. Innovation is a prominent example for the relevance of CEO information held by boards beyond that included in accounting or stock performance. Firms need to innovate to secure long-term profitability while both accounting numbers and stock prices fail to provide an accurate and timely picture of innovative efforts. In this study, I tested the expectation that boards' evaluations of the CEO's performance on dimensions that affect the firm's long-term value creates incentives to innovate, for why I predicted a positive relationship between private performance measures in board evaluations and firm innovation.

Further, firms are likely to be reluctant to disseminate innovation related information to the capital market in detail, as this practice leaves competitors unaware of the firm's future prospects. However, cash compensation to the CEO can carry internal information of value creation to outsiders who can react to this signal by adjusting the firm's stock price. Due to this mechanism, the CEO's existing equity holdings provide greater incentives to innovate as the stock price becomes more sensitive to value enhancing actions taken. Based on this consideration, I advanced the hypothesis that the impact of CEO equity incentives on innovation is higher when innovative efforts are allowed to be signaled to outsiders via cash payments compared to a situation where this signal is absent.

The empirical results confirm both expectations. When boards monitor the CEO's contribution to long-term value and use the information gained in evaluating CEO performance, the firm files higher numbers of more innovative patents. As R&D spending as an input factor to innovation is held constant, the results show that innovation is more than just a logical consequence of R&D investments, but that boards fulfill an important task in the innovation process by aligning CEO and firm interests by reviewing and rewarding corresponding initiatives by the CEO. Moreover, firm equity incentives are positively related to firm innovation when the CEO performance evaluation is conditioned on private board information, allowing cash payments to signal innovation to the capital market. This provides empirical support for the view that cash payments can be used to credibly signal news about internal value creation and that investors use the resulting signal to form expectations about firm value. Further, certain information can be too sensitive to be directly spread to

outsiders and the results indicate that combining CEO cash pay and equity holdings can enhance incentives.

5.3 Implications

The results of this dissertation yield implications for academics concerned with principal agent theory, financial investors, and practitioners in the field of management control.

Incentive contracts may result in different contracting problems that relate to the agent's compensation risk and choice of congruent managerial actions. Different forms of ex-post flexibility and supervisor discretion related to how the contracts translates into rewards offer potential remedies for given contracting problems and theoretical agency research provides valuable insights into how this may be the case. However, earlier empirical work has to a great extent ignored the varying nature of the benefits provided by discretion, given alternative contracting problems at hand, thereby failing to support theoretical arguments. This dissertation took an alternative route by conceptually and empirically differentiating between contracting problems and the respective response offered by supervisor discretion. Specifically, important theoretical implications of the preceding work on existing agency theory are discretionary bonuses being used to reduce the risk born by the agent, and implicit incentive weights promoting situation specific adaptive behavior.

The results set forth in this dissertation further indicate that corporate boards are very well aware of whether or not they can improve incentives by applying discretion depending on the relative intensity the CEO is monitored with. On average, large boards and boards including busy members are aware that their CEO specific knowledge gained in the fiscal year is limited. In this case, improving the CEO's performance evaluation by deviating from ex-ante specified performance measurement practices is economically infeasible due to likelihood of inaccuracies introduced in the process of evaluating the CEO. On the one hand, this result supports the view that certain board structures are inefficient in exerting corporate control, as intensively monitoring boards are able to provide more efficient incentives compared to less intensively monitoring boards. On the other hand, less intense monitoring does not, as one might expect, result in 'chaotic' compensation arrangements that facilitate rent-extraction. On the contrary, respective boards recognize present contracting problems and choose transparent compensation contracts, which are economically optimal in that situation.

The preceding findings thus invalidate speculations about the ineffectiveness of corporate boards in fulfilling their given duties. Boards actively fulfill their tasks of

appointing, evaluating, and motivating management and this goes far beyond simply providing executives with firm equity and letting capital markets discipline them. This also adds to the ongoing discussion about justification of exorbitant wealth of top executives compared to that of average employees. The results indicate that CEO incentives systematically vary with economic determinants. Compensation received is thus predominantly performance driven and this is in the interest of shareholders. While this study cannot answer whether such income inequality is ethical or socially desirable, it suggests that it results from firms' demand for managerial talent.

Underlying the preceding work is a situation of partial equilibrium, that is, the analysis is conducted using a subset of all variables that affect organizational design. This is important with respect to implications on optimal corporate governance in general and specifically boards' monitoring intensity of the CEO. For example, a firm's endowment can at some point in time favor board members with directorships in multiple firms, as a main objective may be the formation of alliances with other organizations. Such busy directors, in turn, can monitor the CEO less closely and boards consisting of busy directors can provide relatively inefficient CEO incentives. Yet, as the benefits of the firm being positioned in a strategic network will outweigh the net incentive losses, the actual board structure operates optimally. However, firms and their endowment are subject to constant change and board structures that may function in certain points in time can not live up to demands later on. In general, this dissertation confirms theoretical arguments for smaller boards including less busy directors being associated with closer monitoring of firm management, speedier decision making, and less difficulty in finding consensus. Boards of directors should exhibit structures that best fit primary organizational objectives and the recent tendency of downsized boards of directors for the above cited reasons support this view.

Moreover, directors gain more information of the firm's prospects than the shareholders themselves. Share prices are consequently far from being perfect indicators of firm value, for example because firms are reluctant to disseminate competitively sensitive information to capital markets. In this context, chapter 3 and 4 yield the following two insights. First, in making the decision whether or not to fire the CEO, stock performance is largely irrelevant as stock prices contain investor expectations but no information the board does not already hold. Thus, a firm's deteriorating stock performance does not necessarily imply the present CEO to lack required skills, unless her main objective is to secure public accounting performance. The results further show that whenever boards promote future value creation, adhering to the present CEO is, in expectation, perceived as a positive signal. Investors are aware of the superior knowledge held by firm insiders and, as long as the CEO is in office, expect this being justified by unobserved but valuable actions. Conversely, if

CEO dismissal occurs, investors learn that their expectations were wrong and adjust expectations downward. Firing recently grew in importance as a mechanism to discipline CEOs, and this dissertation shows that investors *should* and, on average, *do* distinguish between value implications that it brings along.

Second, board evaluations translate into cash compensation, which can consequently be below or exceed levels justified by accounting performance. In that way boards can use cash compensation as an alternative to release value relevant information, as it allows insights into the outcome of CEO performance evaluation. Again, the above presented findings show that investors acknowledge the information content provided by cash payments and use it to form expectations of firm prospects. The results presented in chapter 4 are further interesting because they show that this mechanism enhances the incentives provided by CEO holdings of firm equity. As noted above, using the share price to evaluate CEO performance comes with disadvantages as it contains noisy investor expectations. Still, firms may have motives to provide managers with equity for other reasons than incentives in the first place. For instance, firms may have to provide incumbent CEOs with percentages of stock that are common in the respective labor market for executives, consider tax consequences, or grant time vesting stock options to achieve management retention. Given such alternative motives, the present results imply that the additional information included in cash payments render stock prices more sensitive to management initiatives and thereby increases the incentive value of given equity holdings. This allows insights into when combining CEO annual bonus programs and equity holdings can be optimal.

Lastly, conclusions of chapter 4 support theoretical arguments and are relevant for practitioners concerning the design and administration of strategic management control systems. Specifically, results indicate that firms whose incentive practices are imbalanced with economic determinants lack innovation, although their strategic orientation resembles that of innovation oriented firms. This suggest that innovation is not the mere consequence of investing into costly research laboratories and personnel but that incentives play an important role in turning investments into measurable outcomes. The theoretical arguments and empirical results presented in chapter 4 strongly indicate that firms should achieve a 'match' between their strategic configurations and incentive practices.

5.4 Limitations and suggestions for future research

A problem potentially affecting all empirical studies in this dissertation is that of omitted variables influencing the dependent variable of interest and one or more explanatory variables alike. Accounting decisions made by firms are a consequence of

various organizational factors and controlling for all factors that affect such decisions is an extremely difficult, if not impossible endeavor. In this dissertation, the potential for endogeneity is most obvious in chapter 4, as decisions made with respect to performance measurement and incentives are influenced by the firm's strategic and operational background, which also influence the firm's innovation potential. Overall, I cannot entirely resolve endogeneity problems but believe that responding countermeasures are taken as elaborate as possible to ensure the validity of results.

The second limitation concerns the CEO as the level of analysis as the findings may not generalize to all hierarchical levels. Specifically, a crucial reason for the existence of boards is that shareholders need a supervisory body to evaluate and motivate capable executives, and a significant amount of board effort is allocated to these tasks. On the contrary, managers at lower hierarchies often supervise several employees, and supervision is but one of many tasks comprising day-to-day work. Yet, lower level managers observe subordinates' actions on a more frequent basis which may favor the acquisition of the information needed to apply discretion in performance evaluations. Future research can address the tradeoff supervisors at lower hierarchical levels make with regard to the use of discretion in performance evaluation.

A further potential limitation of this dissertation is inherent in the selection of sample firms. For a firm to be included in the panel of firm years in chapter 2 and chapter 4, I require the CEO to be in office for the entire 1998-2002 period, as I am interested in firms' contracting practices over a period in which the board and the CEO interact steadily to achieve optimal incentives. A possibility is that the reported findings do not generalize to firms outside this sample as their CEO evaluation practices do structurally differ. Future research can address the question whether boards' CEO performance evaluation practices are different from the ones reported in this work, for example, in situations of frequent executive changes or incumbent CEOs.

In the study described in chapter 2, I argue that the use of discretionary bonuses is beneficial to reduce compensation risk borne by the CEO when accepting the contract. I test whether this argument holds by focusing on bonus contracts that are written on accounting performance only to see whether the incidence of discretionary bonuses is related to the accounting noise because a one-measure setting is the cleanest setting to analyze. Although the use of more diverse measure in addition to accounting measures offers per-se risk reduction benefits, as argued by principal agent theorists, it may be the case that discretionary bonuses are also used to reduce risk introduced by performance measures other than accounting ones. This dissertation ignores this possibility empirically but does so simply because an empirical proxy for the noise of such alternative measures is so far unavailable. In view of the attention of accounting researchers to aspects of alternative performance measures, a fruitful avenue for future

research is the identification of a plausible proxy for the risk introduced by performance measures that stem from the firm's internal environment. If such a proxy is devised, future research can also address how firms attempt to reduce noise in order to improve incentives in a multi measure setting.

In the study described in chapter 3, I argue that retaining her position in the firm provides a strong incentive for the CEO as this secures future wealth. Apart from the firing decision, board evaluations of CEO performance can affect incentives if salary increases or stock option grants are related to how the board assesses the CEO's contribution to firm value. Future research can potentially contribute by investigating how board evaluations spill over to other governance decisions. This effort would further add to the discussion whether boards effectively exert their duties with respect to the evaluation and motivation of key executives.

To measure the consequences of board evaluations in influencing CEO decision making in chapter 4, I use different patent based proxies for innovation. A potential limitation is that, except for the impact measure used, neither patent count nor technical justification measures are empirically validated proxies for firm innovation or value. On the contrary, one possibility is that these measures are mere artifacts that result from using different aspects of patent data that eventually result in varying measures but do not capture innovation as the underlying construct of interest. I have to rely on the innovation literature which assumes that the count of patent filings represents innovative effort and that technically sophisticated patents are both more innovative and valuable for businesses. The empirical results justify this choice ex-post, as firms filing patents with higher future impact also tend to have more and more sophisticated patents. Future research can identify implications on innovation and firm value if the firm accomplishes to file greater numbers as well as technically more sophisticated patents.

References

Ai, C. and E.C. Norton. 2003. Interaction Terms in Logit and Probit Models. Economics Letters 80, 123-129.

Altman, E. 1968. Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. Journal of Finance 23, 589-609.

Baber, W.R., P.M. Fairfield, and J.A. and Haggard. 1991. The Effect of Concern about Reported Income on Discretionary Spending Decisions: The Case of Research and Development; The Accounting Review 66, 818-29.

Baker G., R. Gibbons, and K.J. Murphy. 1994. Subjective performance measures in optimal incentive contracts. Quarterly Journal of Economics 109, 1125-1156.

Banker, R. and S.Datar. 1989. Sensitivity, precision, and linear aggregation of signals for performance evaluation, Journal of Accounting Research 27, 21-38.

Banker, R., G. Potter, and D. Srinivasan. 2000. An empirical investigation of an incentive plan that includes nonfinancial performance measures. The Accounting Review 75, 65-92.

Banker, R.D. and S.M. Datar. 1989. Sensitivity, precision, and linear aggregation of signals for performance evaluation. Journal of Accounting Research 27, 21-38.

Barro, J.R. and R.J. Barro. 1990. Pay, Performance, and Turnover of Bank CEOs. Journal of Labor Economics 8, 448-481.

Bebchuk, L.A., J.M. Fried, and D.I. Walker. 2002. Managerial power and rent extraction in the design of executive compensation. University of Chicago Law Review 69, 751-846.

Bonnier, K.A. and R.F. Bruner. 1989. An Analysis of Stock Price Reaction to Management Change in Distressed Firms. Journal of Accounting and Economics 11, 95-106.

Brown, S.J. and J.B. Warner. 1985. Using Daily Stock Returns: The Case of Event Studies. Journal of Financial Economics 14, 3-31.

Bushman, R. and A. Smith. 2001. Financial Accounting Information and Corporate Governance. Journal of Accounting and Economics 32, 237-333.

Bushman, R., R. Indjejikian, and A. Smith, 1996. CEO Compensation: the Role of individual Performance Evaluation. Journal of Accounting and Economics 21, 161-193.

Cheng, S. 2004. R&D Expenditures and CEO compensation. The Accounting Review 79,305-328.

Chenhall, R.H. and F. Moers. 2007. The Issue of Endogeneity within Theory-Based, Quantitative Management Accounting Research. European Accounting Review 16 , 173-195.

Cohen, W.M. and R.C. Levin. 1989. Empirical studies of innovation and market structure, in R. Schmalensee and R.D. Willing, eds. , Handbook of Industrial Oganization (Elsevier Science, Amsterdam) 1059-1107.

Core, J.E. and W.R. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. Journal of Accounting and Economics 28, 151-184.

Core, J.E. and W.R. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. Journal of Accounting Research 40, 613-630.

Core, J.E., R.W. Holthausen, and D.F. Larcker. 1999. Corporate governance, chief executive officer compensation, and firm performance. Journal of Financial Economics 51, 371-406.

Core, J.E., W. Guay, and R.E. Verrecchia. 2003. Price versus Non-Price Performance measures in Optimal CEO compensation contracts. The Accounting Review 78, 957-981.

Coughlan, A.T. and R.M Schmidt. 1985. Executive Compensation, Management Turnover and Firm Performance. Journal of Accounting and Economics 7, 43-66.

Daverlaar, E.J. and Nijkamp, P. 1989. Spatial Dispersion of Technological Innovation: A case study for the Netherlands by means of partial least squares. Journal of Regional Science 29, 325-346.

Dechow, P M. and R. G. Sloan. 1991. Executive Incentives and the Horizon Problem. Journal of Accounting and Economics 14, 51-89.

Dehejia, R. H. and S. Wahba.2002. Propensity Score Matching Methods for Non-Experimental Causal Studies. Review of Economics and Statistics 84, 151-61.

Demsetz, H. and K. Lehn. 1985. The structure of corporate ownership: causes and consequences. Journal of Political Economy 93, 1155-1177.

Dougherty, D. and C. Hardy. 1996. Sustained Product Innovation in large, mature Organizations: Overcoming Innovation-To-Organizations Problems. Academy of Management Journal 39, 1120-1153.

Ederhof, M. 2007. Discretion in bonus plans. Working Paper, Stanford University.

Engel, E., R.M. Hayes, and X.Wang. 2003. CEO Turnover and Properties of Accounting Information. Journal of Accounting and Economics 36, 197-226.

Feltham, G.A. and J. Xie. 1994. Performance measure congruity and diversity in multi-task principal/agent relations. The Accounting Review 69, 429-453.

Ferris, S.P., M. Jagannathan, and A.C. Pritchard. 2003. Too Busy to Mind the Business? Monitoring by Directors with Multiple Appointments. The Journal of Finance 58, 1087-1111.

Fitch, E.M. and A. Shivdasani. 2006. Are Busy Boards Effective Monitors? The Journal of Finance 61, 689-724.

Furtado, E.P.H. and M.S. Rozeff. 1987. Management changes and stock returns. Journal of Financial Economics 18, 147-160.

Gaver, J.J. and Gaver, K. M. 1993. Additional evidence on the association between the investment opportunity set and corporate financing, dividend, and compensation policies. Journal of Accounting and Economics 16, 125-160.

Gibbs, M., K.A. Merchant, W.A. Van der Stede, and M.E. Vargus. 2004. Determinants and effects of subjectivity in incentives. The Accounting Review 79, 409-436.

Gomez-Casseres, B., J. Hagedoorn, and A.B. Jaffe. 2006. Do alliances promote knowledge flows? Journal of Financial Economics 80, 5-33.

Grilliches, Z. 1981. Market Value, R&D, and Patents. Economics Letters 7, 183-187.

Hagedoorn, J. and M. Cloodt. 2003. Measuring innovative performance: is there an advantage in using multiple indicators? Research Policy 32, 1365-1379.

Hall, B. H, A.B. Jaffe, and M.Trajtenberg. 2005. Market Value and Patent Citations. RAND Journal of Economics 36, 16-38.

Hall, B.H., A. B. Jaffe, and M.Tratjenberg. 2001. The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools. NBER Working Paper 8498.

Hall, B.H., Z. Griliches, and J.A. Hausman. 1986. Patents and R&D: Is There a Lag? International Economic Review 27, 265-283.

Hall, B. J. and Liebman, J. B. 1998. Are CEOs Really Paid Like Bureaucrats? Quarterly Journal of Economics, 111 (3): 653-61.

HassabElnaby, H., A. Said, and B. Wier. 2003. An Empirical Investigation of the Performance Consequences of Nonfinancial Measures. Journal of Management Accounting Research 15:193-223.

Hayes, R.M., and S.Schaefer. 2000. Implicit Contracts and the Explanatory Power of Top Executive Compensation for Future Performance. RAND Journal of Economics, 279-293.

Hayes, R.M., and S.Schaefer. 2005. Bonus and Non-Public Information in Publicly Traded Firms. Review of Accounting Studies 10, 431-464.

Heckman, J. 1979. Sample Selection Bias as a Specification Error. Econometrica 47, 153-161.

Henderson, R.M., A.B Jaffe, and M. Trajtenberg. 1998. Universities As A Source Of Commercial Technology: A Detailed Analysis Of University Patenting, 1965-1988. The Review of Economics and Statistics 80, 119-127.

Hermalin, B.E. and M.S. Weisbach. 1998. Endogenously chosen Boards of Directors and their Monitoring of the CEO. American Economic Review 88, 96-118.

Hogan, C.E. and C.M. Lewis. 2005. Long-Run Investment Decisions, Operating Performance, and Shareholder Value Creation of Firms Adopting Compensation Plans based in Economic Profits. Journal of Financial and Quantitative Economics 40, 721-745.

Holmstrom, B. 1979. Moral Hazard and Observability. Bell Journal of Economics 10, 74-91.

Holmstrom, B. 1989. Agency Costs and Innovation. Journal of Economic Behavior and Organization 12, 305-327.

Holmstrom, B. and P. Milgrom. 1991. Multitask Principal Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design. Journal of Law, Economics & Organization 7,24-52.

Holthausen, R.W. and Larcker D. F. 1992. The prediction of stock returns using financial statement information. Journal of Accounting and Economics 15, 373-411.

Holthausen, R.W., D. F. Larcker, and R.G. Sloan. 1995. Business Unit Innovation and the Structure of Executive Compensation. Journal of Accounting and Economics 19, 279-313.

Ittner, C.D., D.F. Larcker, and M. Rajan. 1997. The choice of Performance Measures in annual Bonus Contracts. The Accounting Review 72, 231-255.

Ittner, C.D., D.F. Larcker, and M.W. Meyer. 2003. Subjectivity and the Weighting of Performance Measures: Evidence from the Balanced Scorecard. The Accounting Review 78, 725-758.

Jaffe, A. and M. Trajtenberg. 2002. Patents, Citations, and Innovations: A Window on the Knowledge Economy. Cambridge, Mass.: MIT Press.

Jensen, M.C. and J.B. Warner. 1988. The Distribution of Power among Corporate Managers, Shareholders, and Directors. Journal of Financial Economics 20, 3-24.

Kachelmeier, S.J., B.E. Reichert, and M.G. Williamson. 2007. Measuring and Motivating Quantitiy, Creativity, or Both. Journal of Accounting Research: forthcoming.

Kaplan, S.N. and Minton, B.A. 2006. How has CEO turnover changed? Increasingly performance sensitive boards and increasingly uneasy CEOs. Working Paper. National Bureau of Economic Research.

Larcker, D.A., S.A. Richardson, and I. Tuna. 2007. How Important is Corporate Governance? Working Paper, University of Pennsylvania.

Lerner, J. and J. Wulf. 2006**.** Innovation and Incentives: Evidence from Corporate R&D. Review of Economics and Statistics: forthcoming.

Lipton, M. and J.W. Lorsch. 1992. A modest proposal for improved corporate governance. The Business Lawyer 48, 59-77.

Mahajan, A. and S. Lummer. 1993. Shareholder Wealth Effects of Management Changes. Journal of Business Finance and Accounting 20, 393-410.

Miles, R. and C. Snow. 1978. Organizational Strategy, Structure and Process. New York, NY: McGraw-Hill.

Moers, F. 2005. Discretion and Bias in Performance Evaluation: The Impact of Diversity and Subjectivity. Accounting Organizations and Society 30, 67-80.

Moers, F. 2006. Performance Measure Properties and Delegation. The Accounting Review 81, 897-924.

Moers, F., E. Peek, and R.P. Roomberg. 2007. Bonus contract as disciplining mechanism. Working Paper, Maastricht University.

Morgenson, G. 2006. Big Bonuses Still Flow, Even if Bosses Miss Goals. The New York Times, June 1.

Murphy, K. 1999. Executive Compensation, in: O.C. Ashenfelter and D. Card (eds.), Handbook of Labor Economics, Volume 3 Part 2, North-Holland, Amsterdam, 2485-2563.

Murphy, K.J. and P. Oyer. 2003. Discretion in executive compensation contracts. Working Paper, University of Southern California and Stanford University.

National Academy of Engineering. 1992. Time horizons and technology investments (National Academy Press, Washington, DC).

Oyer, P. 2004. Why do firms use incentives that have no incentive effects? Journal of Finance 59, 1619-1649.

Pakes, A. 1986 Patents as Options: Some Estimates of the Value of Holding European Patent Stocks. Econometrica 54, 755-784.

Petersen, M.A. and R.G. Rajan. 2002. Does Distance still matter? The Information Revolution in Small Business Lending. Journal of Finance 57, 2533-2570.

Prendergast, C. and R.H. Topel. 1996. Favoritism in Organizations. Journal of Political Economy 104, 958-978.

Rajgopal, S., T. Shevlin, and V. Zamora. 2006. CEOs' outside employment opportunities and the lack of relative performance evaluation in compensation contracts. Journal of Finance 61, 1813-1844.

Roon, F. and C. Veld. 1998. Announcements Effects of Convertible Bond Loans and Warrant-Bond Loans: An Empirical Analysis for the Dutch Market. Journal of Banking and Finance 22, 1481-1506.

Schumpeter, J.A. 1942. Capitalism, Socialism, and Democracy. New York, NY: Harper.

Sloan, R.G. 1993. Accounting Earnings and Top Executive Compensation. Journal of Accounting and Economics 16, 55-100.

Smith, C. and R. Watts. 1992. The investment opportunity set and corporate financing, dividends, and compensation policies. Journal of Financial Economics 32, 263–292.

Solow, R. M. 1956. A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics 70, 65-94.

Trajtenberg, M. 1990. A penny for Your Quotes: Patent Citations and the Value of Innovations. RAND Journal of Economics 21, 172-187.

Trajtenberg, M., R. Henderson, and A. Jaffe. 1997. University versus Corporate Patents: A Window on the Basicness of Invention. Economics of Innovation and New Technology 5, 19-50.

Watts, R.L. and J.L. Zimmerman. 1986. Positive accounting theory. Edgewood Cliffs, NJ: Prentice Hall.

Warner, J.B, R.L. Watts and K.H. Wruck. 1988. Stock price and top management changes. Journal of Financial Economics 20, 461–492.

Wooldridge, J.M. 2002. Econometric Analysis of Cross Section and Panel Data. Cambridge, MA: MIT Press.

Xue, Y. 2007. Make or buy new technology: The role of CEO compensation contract in a firm's route to innovation. Review of Accounting Studies 12, 659-690.

Summary in Dutch (Nederlandse Samenvatting)

Dit proefschrift beschrijft drie empirische studies met betrekking tot impliciete contracten voor beoordelings- en beloningsdoeleinden van managers. In brede zin bestudeer ik omstandigheden waarin een bedrijfseigenaar niet zelf de bestuursfuncties van een bedrijf uitvoert maar daar een manager voor aanstelt. Deze setting kan tot problemen leiden omdat de manager niet per-se gemotiveerd is om de gegeven functies zo goed mogelijk te verrichten en een meer gedetailleerde informatiebasis over het bedrijf heeft dan de eigenaar. Het is daarom belangrijk een oplossing te vinden om ervoor te zorgen dat de manager de door hem overgenomen taken zo verricht als of hij zelf de eigenaar van het bedrijf zou zijn. Economische theorie voorspelt dat door het contracteren op prestatiemaatstaven die een functie zijn van "goed gedrag", de manager, tenminste, tot een bepaald niveau, gemotiveerd kan worden om doelstellingen van de organisatie te bereiken.

In dit proefschrift definieer ik, in brede zin, een impliciet contract als een contract waarin de bedrijfseigenaar, voor het begin van de te beoordelen periode de prestatiemaatstaven bepaald waarop de manager beoordeeld gaat worden, maar daarbij de optie open houdt na afloop van de periode zijn eigen kennis over het handelen van de manager tijdens de periode te gebruiken om de uiteindelijke beloningsbetaling te bepalen (vanaf hier aangeduid met "private information" of "private knowledge"). Deze praktijk baseert op private information en heeft belangrijke implicaties voor het bestuur van ondernemingen. Additionele informatie over de agent kan namelijk gebruikt worden om de interesses van de eigenaar en de manager beter op elkaar af te stemmen. Aan de andere kant kan deze vorm van betaling als ontransparant ervaren worden en daardoor problemen creëren.

Specifiek bestudeer ik het gebruik van impliciete contracten, die door boards gebruikt worden om de uitkering van korte termijn bonussen van Amerikaanse CEOs te bepalen. Hierbij streef ik drie doelen na. Het eerste doel is determinanten voor impliciete contracten in het beoordelings- en beloningssysteem te identificeren, waarbij onderscheid gemaakt wordt tussen verschillende manieren om impliciete contracten toe te passen om naar theoretisch voorbeeld, optimale prikkels te geven. Het tweede doel van dit proefschrift betrekt zich op de vraag of het algemene gebruik van variabele korte termijn beloningen in de VS überhaupt prikkels geeft en hoe die

werking daarvan uitziet. Het laatste doel van dit proefschrift bestudeert of en ik welke mate impliciete contracten ervoor zorgen dat managers weten wat van hen wordt verwacht en dat ze gemotiveerd zijn om inzet te leveren aangezien dit tot een bepaalde beloning zal leiden.

In hoofdstuk 2 onderzoek ik de determinanten van verschillende manieren om impliciete contracten toe te passen. Verwacht wordt dat bedrijven kiezen voor impliciete contracten als de beschikbare prestatiemaatstaven niet zuiver te meten zijn (ook aangeduid met "noise" in prestatiemaatstaven) of de operationele omgeving van een bedrijf onvoorspelbaar is (ook aangeduid met "environmental unpredictability"). In het eerste geval is het namelijk mogelijk dat een board na afloop van het jaar vaststelt in welke mate de prestatiemaatstaven door andere factoren dan de acties van management beïnvloed zijn. Hierdoor wordt de betalingsrisico voor de CEO lager. Deze reductie in compensatierisico leidt daarom, in theorie, tot efficiëntere prikkels voor de CEO. In het tweede geval kan de eigenaar het optimale handelen van de manager voor een te beoordelen periode niet precies inschatten. Daarom kan het optimaal zijn de manager ex-ante te informeren welke acties geobserveerd zullen worden, en toch het relatieve belang van acties in het bepalen van de uiteindelijke bonus achteraf vast te stellen. Deze praktijk kan ertoe leiden dat de manager gegeven de onzekerheid in zijn bedrijfsomgeving optimale acties kiest, in de verwachting dat dergelijk flexibel gedrag positief geëvalueerd en beloond zal worden. Ik voorspel verder dat een board de vaardigheid moet hebben om de additionele informatie goed te kunnen gebruiken, zodat impliciete contracten een positieve functie zijn van deze vaardigheiden en van de gegeven contractuele situatie (i.e. noise in prestatiemaatstaven, of environmental unpredictability).

De resultaten tonen aan dat bedrijven impliciete contracten gebruiken zoals voorspelt door economische theorie. De waarschijnlijkheid van het gebruik van impliciete contracten stijgt met de hoeveelheid noise in contracteerbare prestatiemaatstaven, bovendien bepalen boards het relatieve belang van prestatiemaatstaven flexibel als er meer onzekerheid in de operationele omgeving van het bedrijf is. Daarnaast tonen de resultaten aan dat boards die informatie over de CEO beter kunnen beoordelen in situaties waarbij boven beschreven problemen groter worden een hogere waarschijnlijkheid hebben impliciete contracten te gebruiken. De resultaten laten niet zien dat impliciete contracten vaker woorden gebruikt als de invloed van de CEO binnen de board toeneemt. De resultaten van Hoofstuk 2 laten dus zien dat optimal contracting theorie het gebruik van impliciete contracten verklaard.

In Hoofdstuk 3 bestudeer ik de invloed van korte termijn bonuscontracten op de prikkels die CEOs daardoor wel of niet hebben om bedrijfsdoelstellingen te bereiken. Recent onderzoek laat zien dat een groot deel van CEO rijkdom bepaald wordt door het bezit van bedrijfsaandelen. Dit toont aan dat boards een niveau van aandeel- en

optiebeloningen vastleggen, maar de CEO uiteindelijk door financiële markten geëvalueerd en beloond wordt. Een belangrijke functie van de board blijkt daarom uitbesteed te zijn aan aandeelhouders en investeerders, hoewel deze eigenlijk minder CEO gerelateerde informatie hebben dan boards zelf. Desalniettemin gebruiken alle bedrijven korte termijn bonuscontracten en de daarin verwerkte maatstaven sluiten meestal de aandelenprijs als prestatiemaatstaf uit. Verder laat empirisch onderzoek zien dat de beslissing top managers te ontslaan in grote mate gebaseerd is op winsten en accounting informatie en bijna niet afhankelijk is van aandelenprijzen. Dit toont aan dat niet alleen financiële markten de evaluatie en de beoordeling van de CEO overnemen, maar dat boards en de door hen gehouden informatie over de CEO een belangrijke rol spelen in het corporate governance proces.

In deze studie formuleer ik de hypothese dat korte termijn bonuscontracten voor CEOs door boards gebruikt worden om voorafgaande aan de te beoordelen periode aan te tonen welke prestatiegedeeltes en daaraan gerelateerde maatstaven gebruikt worden om de bijdrage van de CEO aan het bereiken van bedrijfsdoelen te beoordelen, en indien nodig, de beslissing over ontslag te kunnen rechtvaardigen. Dit biedt een aantal voordelen. Bijvoorbeeld kunnen boards op het beschreven manier geloofwaardig aantonen dat ze hun taken op een jaarlijkse basis uitvoeren. Dit maakt het verder mogelijk om op een zo efficiënt mogelijke manier formeel feedback aan te CEO te geven. Een ander doel van dit proces is dat boards gevoelige informatie aan investeerders willen verspreiden, zonder te gedetailleerde informatie te geven.

De mate van intern bekende informatie die gebruikt wordt om CEO ontslag te motiveren is verder belangrijk gegeven de reactie van investeerders op de bekendmaking van het ontslag. Ontslag kan namelijk primair gebaseerd zijn op publieke informatie en het feit dat de board zijn verplichtingen uitoefent is een goed signaal aan investeerders. Dit signaal zal een positief effect op de aandelenprijs hebben. Aan de andere kant levert ontslag dat door private information gemotiveerd is, in eerste instantie slecht nieuws op waardoor financiële markten negatief reageren met als gevolg een daling van de aandelenprijs. De resultaten van het laatste deel van hoofdstuk 3 bevestigen beide voorspellingen.

Concluderend kan naar aanleiding van de studie in hoofdstuk 3 gesteld worden dat ten eerste de specificatie van korte termijn bonus contracten significant gerelateerd is aan de manier waarop boards beslissen over het ontslag van de CEO. Dit resultaat toont dus aan dat CEOs prikkels ondervinden als gevolg van deze contracten. Ten tweede laten de resultaten zien dat financiële markten de prestatiemaatstaven van betalingssystemen gebruiken om de aandelenprijs te bepalen. Deze resultaten tonen dus aan dat de informatieomgeving van invloed is op ontslagbeslissingen en belangrijk is voor investeerders.

Hoofdstuk 4 behandelt de invloed van private information in korte termijn bonus contracten op het gedrag van CEOs. Specifiek onderzoek ik of het observeren door de board van CEO acties die op innovatie gericht zijn ook tot meer innovatie leiden dan in een situatie waarin deze informatie afwezig is. Innovatie is niet alleen belangrijk voor de groei van economieën als geheel maar is net zo belangrijk voor bedrijven die competitief willen blijven in de toekomst. Een belangrijke vraag is daarom hoe gedrag gestimuleerd kan worden dat op het lange termijn succes van een bedrijf gericht is. In de academische literatuur wordt vaak beschreven dat het geven van aandelen een antwoord is op deze vraag, ervan uitgaande dat acties die de toekomst van het bedrijf positief beïnvloeden ook in de aandelenprijs weergegeven worden, wat dus prikkels voor de CEO geeft om deze acties te verrichten.

Met betrekking tot innovatie kan dit problematisch zijn omdat financiële markten vaak niet helemaal geïnformeerd zijn over de innovatieve strategie die het bedrijf kiest. Vaak zijn bedrijven namelijk niet heel duidelijk over hoe zij op de lange termijn gerichte strategieën willen bereiken en welke trajecten gekozen worden om de bedrijfswaarde te verhogen, om concurrenten niet over strategische keuzes te informeren. Deze observatie toont dus aan dat boards en hun CEO gerelateerde kennis belangrijk is voor het creëren van prikkels, wat tot mijn eerste hypothese leidt. Zij voorpelt dat het gebruik van private information over op de toekomst gericht gedrag van de CEO in korte termijn bonuscontracten positief gerelateerd is aan de innovatie van het bedrijf.

Het meenemen van dergelijke private information leidt verder tot een betalingsniveau dat positief of negatief afwijkt van het niveau wat door publiekelijk observeerbare informatie, bijvoorbeeld winsten, verklaarbaar is. Dit betekent dat bonus betalingen die bijvoorbeeld hoger zijn dan wat het niveau van winsten voorspelt, een goed en geloofwaardig teken zijn voor investeerders over het verhogen van de ondernemingswaarde zoals door innovaties. Investeerders zullen dus positief op dergelijke positieve signalen reageren. Dit mechanisme leidt tot intensievere prikkels dan de prikkels die een CEO alleen door zijn aandelen en opties heeft, omdat hun waarde als gevolg van de positieve reacties van de financiele markten stijgt. De tweede hypothese voorspelt dus dat innovatie positief gerelateerd is aan het samenspel van private information in korte termijn bonuscontracten en aandelengerelateerde prikkels van de CEO.

De resultaten geven aan dat private information in korte termijn bonus contracten significant en positief gerelateerd is aan de innovatie van bedrijven. Verder vind ik, in lijn met mijn verwachtingen, dat het effect van toekomst georiënteerde prikkels van aandelen en optie paketten hoger zijn in de aanwezigheid van private information in bonuscontracten.

Samengevat laten de resultaten van de drie studies zien dat het gebruik van impliciete contracten in grote mate verklaard kunnen worden door economische determinanten. Een belangrijke implicatie is dat flexibiliteit in het meten en beoordelen van managers gebruikt wordt om prikkels op een efficiëntere manier te geven, en niet, zoals vaak in de ligatuur beschreven, bonussen ongerechtvaardigd te verhogen. Verder is een belangrijke implicatie van dit proefschrift dat de beoordeling van CEOs door boards op gebieden die geen directe invloed hebben op publiekelijk beschikbare prestatiemaatstaven tenminste deels zichtbaar wordt in beslissingen die de board maakt in verband met compensatie en ontslag van de CEO. In deze context laat dit proefschrift zien dat investeerders belangrijke informatie uit deze beslissingen kunnen krijgen en ook gebruiken om verwachtingen over de waarde van een bedrijf vast te stellen. Het observeren van de CEO door boards en de daaraan gebonden prikkels zijn verder belangrijk om doelstellingen van de organisatie, in de vorm van innovatie, te bereiken.

Curriculum Vitae

Felix Höppe was born on 12 September 1977 in Wickede (Ruhr), Germany. From 1998 to 2003 he studied International Business Studies at the faculty of Economics and Business Administration of Maastricht University, where, after graduation, he started working on his doctoral dissertation at the Department of Accounting and Information Management. Since May 2008 he is an Assistant Professor at the Department of Accounting and Information Management of Maastricht University.