경영학박사학위논문

Essays on Pay-Performance Sensitivity

경영자 성과-보상 민감도에 관한 연구

2019년 8월

서울대학교 대학원

경영학과 경영학 전공

최 세 라

Abstract

Essays on Pay-Performance Sensitivity

Sera Choi
College of Business Administration
The Graduate School
Seoul National University

This dissertation is comprised of two essays on pay-performance sensitivity. The first essay is entitled: "Understanding CEO Ability and Pay-Performance Sensitivity Relationship: Evidence from the First year of a CEO's Service". While theoretical research has proven that the pay-performance sensitivity increases with CEO ability under the optimal compensation schemes, a related empirical study is lacking. This study empirically investigates whether more competent CEOs receive a higher pay-performance sensitivity as in the theory. I find strong evidence of a positive relation between CEO ability and delta using the sample of CEOs with long stay ("continuing CEOs"). When I use the sample of CEOs in the first year of their service ("new CEOs"), I also find a positive association but, not as strong as the result for continuing CEOs. This finding suggests that, due to information asymmetry and/or uncertainty about CEO ability at the time of contracting, the hiring firm struggles to compensate new CEOs according to their ability level. Moreover, I investigate the consequences of heterogeneous incentive-ability arrangements for new CEOs in their first years. First, I find that high ability CEOs provided with higher delta result in higher firm value than those provided with lower delta, consistently showing that the provision of high delta to high ability CEOs is optimal. I also find that high ability CEOs provided with lower delta are more likely to voluntarily leave the firm, additionally supporting the theory. In contrast with the theory though, I find evidence showing that the provision of lower delta is not optimal for low ability CEOs. I find that low ability CEOs provided with lower delta are more likely to be fired in a short period, and those with rather higher delta lead to higher valuation. Collectively, this study uncovers the initial compensation schemes, given the imperfect information about new CEO ability.

The second essay, entitled "Pay-Performance Sensitivity by the Direction of Sales Change", investigates whether the direction of sales change affects the role of accounting earnings in CEO incentive schemes. Earnings in sales-decrease periods are less reflective of managerial effort and its contribution to a firm's performance. Given the lower information content in earnings in sales decreasing periods, I reveal that when sales decrease, firms lower the pay sensitivity of current earnings for all type of compensation including cash compensation and equity-based compensation. This result is not affected by CEO power, providing the supporting evidence for optimal contracting, rather than rent extraction. Furthermore, I find that when sales decrease, firms shift the pay sensitivity from current to past earnings but, this is only for equity compensation. Overall, my findings demonstrate that sales change direction as an important economic source by suggesting the evidence that earnings do not play as an important role in compensation for sales decreasing periods as for sales increasing periods.

Keywords: Managerial ability, CEO pay-performance sensitivity, Delta, Matching quality, CEO turnover, Optimal incentive contracts, Sales change direction, Sales decrease.

Student Number: 2015-30159

TABLE OF CONTENTS

Essay 2. Pay-Performance Sensitivity by the Direction of Sales Change

LIST OF TABLES

Essay 1. Understanding CEO Ability and Pay-Performance Sensitivity Relationship: Evidence from the First year of a CEO's Service

Essay 2. Pay-Performance Sensitivity by the Direction of Sales Change

LIST OF FIGURES

Essay 1. Understanding CEO Ability and Pay-Performance Sensitivity Relationship: Evidence from the First year of a CEO's Service

Essay 1

Understanding CEO Ability and

Pay-Performance Sensitivity Relationship

: Evidence from the First Year of a CEO's Service

1. Introduction

The importance of human capital in creating firm value has increased over time (Rajan and Zingales 2000). Manager-specific features such as ability, talent, reputation, or style, significantly influence the economic outcomes of a firm (Hambrick and Mason 1984). In this regard, deciding whom to hire for a chief executive officer (CEO) position and how to compensate them according to their ability or talent are important issues in economics, finance, accounting, and management research as well practice.

Theoretical research has identified that the optimal pay-for-performance sensitivity increases with CEO ability (Banker et al. 2013; Milbourn 2003; Palia 2001; Dutta 2008). That is, to maximize firm value, the principal of the firm gives higher incentives to the high-ability managers. For example, Milbourn (2003) propose a theory that the optimal equity-based pay sensitivity increases with the reputational assessment of the CEO or the perceived CEO ability at the time of contracting. Banker et al. (2013) also suggest optimal compensation schemes that differ across types of managers. Their analytical model shows that the higher an agent's type, the more sensitive his pay is to performance. Dutta (2008) also demonstrates that, for CEOs who have more outside options in the labor market, the firm designs the compensation contract in a way that CEO pay is more closely linked to firm performance. The motive for such a compensation contract is to attract and retain those CEOs with greater expertise. Together, extant theoretical literature suggests that more competent managers must receive higher-powered incentives while the provision of lower incentives is optimal for less competent managers.

While theoretical research has proven the optimal pay-performance sensitivity for CEO with different ability level, the empirical evidence is insufficient. It is an empirical question of whether the optimality in compensation contracts also emerges in data. As Core and Guay (1999) explain, equity incentives may become misaligned with the optimal incentive levels as manager characteristics change over time. In particular, a new CEO's ability is highly uncertain and thus the initial incentive contracts may diverge from the optimal. Although the uncertainty about a CEO ability alleviates over time as the learning takes place (Gibbons and Murphy 1992; Holmstrom 1999; Pan et al. 2015), it is unclear whether and how the incentive level adjusts toward the optimal. This must be of greater interest, particularly when information asymmetry and uncertainty about CEO ability is higher. My dissertation builds on the recent analytical studies on the optimal executive compensation for both unknown effort and unknown ability and empirically investigates how firms incentivize CEOs with different level of ability in the initial design of their compensation contracts, given incomprehensive information about CEO ability.

To begin with, I resort to theoretical models to help me formulate the empirical predictions regarding how managerial ability affects the pay-performance sensitivity. I conjecture that, when the CEO ability is well discerned, equity incentives increases with CEO ability as suggested from the optimal compensation contracting theory. However, in the situation where the CEO ability is highly unpredictable, I expect there would exist suboptimal arrangements between ability and incentive; for instance, a low(high) pay-performance sensitivity for a high(low)ability managers. To test my hypothesis, I analyze with two different samples, one that consists of "continuing CEOs" where the ability is mostly reveled (18,210 firm-years) and the other of "new CEOs" with their ability barely revealed (2,535 firm-years). Using managerial ability scores developed by Demerjian et al. (2012) and the pay-performance sensitivity of equity pay (delta), which is estimated following Core and Guay (2002), I find the results are largely consistent to my hypothesis.

Specifically, I find strong evidence of a positive relation between CEO ability and delta using the sample of continuing CEOs. However, the positive association for new CEOs is not as strong as the results for continuing CEOs.

Next, I turn to investigate the economic consequences of heterogeneous ability-incentive arrangements for new CEOs, considering the possibility of suboptimal contracts under the deficient information about managerial ability. To execute empirical tests, I double sort the firms based on two criteria: how much the CEO efficiently manages resources to generate sales (i.e. managerial ability scores) and how much incentive power is provided to the CEO in the first year of his/her service, thereby construct the four differential ability-incentive arrangements (i.e., high-ability-high delta, high ability-low delta, low ability-high delta and low ability-low delta). Using this framework, I investigate the matching quality of incentive and ability for each partition. The positive association between ability and incentive arises in theoretical models because firms maximize value. Therefore, firms who violate the optimal ability-incentive arrangement (for whatever reason) should have lower firm value. This is indeed the case for high-ability CEOs. I find that high ability CEOs provided with higher delta result in higher firm value than those provided with lower delta, consistently showing that the provision of high delta to high ability CEOs is optimal. In contrast with the theory however, the provision of the lower delta is not optimal for low ability CEOs. Rather, low ability CEOs provided with higher delta result in higher valuation and higher operating performance.

In addition, I examine the retention/dismissal decisions by directly tracking CEO turnovers following the first year arrangement between ability and incentive. I find that high ability CEOs provided with lower delta are more likely to voluntarily leave the firm, consistent with the view that the provision of lower delta to high ability CEOs is suboptimal and fail to retain competent CEOs. However, low ability CEOs provided with lower delta are more likely to be fired within a short time, suggesting that either the lower delta may not be an optimal incentive for low ability CEOs or it is not sustainable in the practice.

To further extent, I conduct tests to support the results on CEO turnover. First, instead of using an indicator variable for CEO turnover as the dependent variable, I count the years between the year the individual became CEO and the year left use this variable as the dependent variable. I find that high ability CEOs with lower delta and low ability CEOs with lower delta show significantly shorter stay relative to CEOs with both ability and delta in the moderate level, holding the remaining variables constant. Secondly, I employ the Cox semiparametric proportional hazard model to estimate the relation between the likelihood of CEO turnover for each group (Campbell et al. 2011). The conclusion of both tests remains unchanged that lower delta results in higher likelihood of turnover for both ability type, high and low.

Meanwhile, the uncertainty about a CEO ability alleviates over time as the learning takes place (Gibbons and Murphy 1992; Holmstrom 1999; Pan et al. 2015). As the firms learn about their CEO's ability, the firms may make adjustments. Core and Guay (2002) document that CEOs have optimal equity incentive levels and, whenever there is a deviation between the actual and the optimal equity incentives, firms adjust the incentive level toward the optimal. This adjustment process is also supported by Hermanson et al. (2012), which conducts interviews on compensation committee members and find that one of the important responsibility of compensation committee members is making the CEO compensation adjustments following CEO performance assessment each year. Therefore, as additional analysis, I examine the adjustment of delta towards the optimal level following the first year of a new CEO's service for each ability-incentive arrangements. To test, I develop a model to gauge the adjustment speed of delta toward the optimal level by taking an idea from recent finance studies on the adjustment speed of cash and leverage (e.g., Jiang and Lie 2016; Devos et al. 2017). Using the adjustment speed model of delta, I investigate whether differential adjustment speed appears for differential ability-incentive arrangements. Specifically, I examine how the firm adjusts the level incentive when it is above or below the optimal level, separately for each arrangement. I find that given relatively higher delta in the first year, regardless of whether the ability is low or high (i.e., high-ability-high delta and low ability-high delta), firms quickly make adjustments toward the optimal level. However, when the CEOs are provided with lower delta in the first year (i.e., high-ability-low delta and low ability-low delta), firms tend to only make faster upward adjustments toward the optimal, leaving the ones above the optimal remain unchanged. These results suggest that firms move toward the provision of higher-powered incentives for both ability type over time.

Collectively, my study suggests the theory that the optimal pay-performance sensitivity should increase with ability is consistent only for high ability CEOs, but not for low ability CEOs. Firms seem to be inclined more to the benefit of higher-powered incentive in motivating low ability CEOs than to the benefit of matching incentive to ability[1].

My study makes the following contributions. First, I empirically show that the optimal compensation contracts take the type of managerial ability into account, as proven by theoretical research (Milbourn 2003; Dutta 2008; Banker et al. 2013). The findings

[1] In Dutta (2008) and Banker et al. (2013) model that managerial effort and ability are additive in producing outcome. That is, the productivity of effort is the same regardless of managerial ability. This may be a strong assumption, which might lead to the empirical results disagreeing with the theory.

enrich our understanding of the determinants of executive incentive contracts. In particular, the study uncovers how the initial compensation schemes for different ability types can diverge from the optimal compensation contracting, given the imperfect information about new CEO ability. Although I conduct an additional test to investigate the adjustment process of delta, how the imperfect first-year arrangement between ability and incentive converges to the optimal over a longer horizon can be further investigated.

Second, I examine the matching quality between CEO ability and compensation incentive to demonstrate the optimal incentive for competent CEOs. While CEO ability can be identified as the important determinant of incentive contracts, the consequence or the quality of a match between ability and incentive power is not directly examined in prior studies. My results on matching quality suggest that the higher-powered incentives are optimal for high ability managers as in the theory. However, if lower incentives are awarded to high ability managers, they are more likely to voluntarily leave the firm in a short period, providing evidence of match failures. Although I do not examine the matching process per se, my study considers the matching quality as an additional source of uncertainty when hiring new CEOs and attempts to provide empirical evidence for CEO-firm matching (e.g., Gabaix and Landier 2008; Edmans and Gabaix 2011; Eisfeldt and Kuhnen 2013).

Section 2 describes the theory and motivates the hypotheses. Section 3 describes data, variable measurement and, research design. Section 4 discusses the empirical results, Section 5 shows the additional analyses regarding incentive adjustments and, Section 6 concludes.

2. Literature Review and Hypotheses Development

2.1 Theoretical Background

The question of optimal compensation schemes awarded to the CEOs is one that has received great attention over the years. Under the agency framework, when the agent is effort-averse, he is only motivated to behave in their shareholders' best interest if they are offered incentive contracts that "pay for performance". Thus, a stream of theoretical literature demonstrates that to induce higher levels of effort from the agent, the optimal compensation level should increase with performance (Lambert and Larcker 1987; Sloan 1993; Antle and Smith 1986; Jensen and Murphy 1990; Janakiraman et al. 1992; Hall and Liebman 1998). In particular, Jensen and Murphy (1990) find that the average CEO's firm-related wealth changes \$3.25 for every \$1,000 change in shareholder wealth using large publicly traded U.S firms for the 1974-1986 period.

Indeed, the use of equity-based compensation, in the form of both stock and options, has grown dramatically since the 1990s (Frydman and Jenter 2010). Due to the growth in equity compensation, the pay-for-performance sensitivity also has surged in the 1990s. Accordingly, Hall and Liebman (1998) find that an average pay-for-performance sensitivity is \$25.11 for every \$1,000 change in shareholder wealth, an average approximately eight times greater than that of Jensen and Murphy (1990). By effectively granting managers ownership stakes in their firm, equity-based compensation aims to align the incentives of managers with interests of shareholders. As compensation is more tied to stock price outcomes, managers are more likely to take actions that benefit shareholders because managers share both gains and losses with shareholders.

While researchers in the compensation literature have extensively examined the pay-for-performance sensitivity from the motivation standpoint, there is only scarce research that approaches the pay-for-performance sensitivity from the perspective of attraction or retention. The recent literature has started explaining optimal compensation contracts concerning CEO ability. Milbourn (2003) is one of the studies that relate to a CEO's incentive pay schemes to his or her ability. His analysis proposes that the optimal equity-based pay sensitivity should increase with the reputational assessment of the CEO or the perceived CEO ability at the time of contracting. Milbourn (2003) argues that more competent CEOs are likely to serve for the firm over a longer tenure and contribute to the firm value to a greater extent. Assuming the rational market embeds this higher retention probability into the stock price, Milbourn (2003) posits that the stock price measure is more informative of the managerial effort for more competent managers, and therefore, anticipates the optimal incentive power has to be more tightly aligned to the firm's stock price. In contrast, if the incumbent CEO's ability is low, the stock price weights more heavily the value of a potential replacement, thereby reducing its sensitivity to the incumbent CEO's effort choices.

While Milbourn (2003) brings the managerial ability as a source that involves the informativeness of a performance measure, stock price, Arya and Mittendorf (2005) develop a pure adverse selection model that views variable pay schemes as a device to screen ability. Their main research question is that firms may not achieve the optimal pay schemes concerning managerial ability because managers' ability is not known by the firm particularly at the onset of an employment relationship. Arya and Mittendorf's (2005) analytical analyses show that firms can provide a menu of compensation contracts by varying the portion of variable pay and infer a CEO's ability level from his/her choice over the strength of incentive power. In other words, more talented managers will have a higher probability of achieving greater performance, and thus are likely to demand the compensation package with a steeper pay-performance sensitivity than less talented managers.

Dutta (2008) and Banker et al. (2013) further seek for optimal incentive compensation structure by incorporating both moral hazard (unobservable effort) and adverse selection (unknown manager type). Dutta (2008) theoretically shows how managerial expertise affects optimal pay-performance sensitivity. As managerial skills become a more important determinant of performance and are transferable in the labor market, the optimal pay-performance sensitivity increases. The rationale behind this prediction is as follows. In the presence of asymmetric information, CEOs who have more outside options tend to overstate their ability to bargain for higher pay. The firm, as the counterparty contracting process, rationally anticipates such tendency and thus design the compensation contract in a way such that CEO pay is more closely linked to firm performance. Banker et al. (2013) also propose a theory that the sensitivity of pay to performance needs to differ across types of agents. Their analytical model suggests that the higher an agent's type, the more sensitive his pay is to performance. Alternatively, an agent of low ability must receive lower-powered incentives to reach the optimal compensation contracts. Combined, theoretical research provides guidelines regarding how ability levels would affect pay for performance sensitivity in optimal contracting.

2.2 The Association between Ability and Pay-Performance Sensitivity

Theoretical research (e.g., Darrough and Melumad 1995; Milbourn 2003; Banker et al. 2013) suggests that the optimal pay-for-performance sensitivity is increasing in the CEO ability, considering non-motivation purposes such as screening or retaining capable managers. Because of difficulty in measuring managerial ability, extant research provides only limited empirical documentation upon the association between managerial ability and incentive schemes. Milbourn (2003) relies on the number of citation as the proxy for managerial ability in testing his theorem. Banker et al. (2013) use past performance as a key indicator of managerial ability in testing their propositions. An earlier study, Palia (2001) empirically documents an increasing relation between CEO experience and CEO equity incentives.

Demerjian et al. (2012) develop a measure of managerial ability that estimates the extent to which CEOs generate output, given resources within a firm. The idea behind estimating managerial ability based on output revenues and input resources is that managers differ in their ability to manage resources and to synchronize management processes in ways that enhance firm performance (Sirmon et al. 2008). High managerial ability, being a source of resource value creation, contributes to the creation of latent value from resources that firms control. (Holcomb et al. 2009). Demerjian et al. (2012) provide several robustness tests that their new measure of managerial ability performs as good as extant proxies.[2]

Demerjian et al.'s (2012) method to estimate managerial ability has triggered an increasing number of studies to investigate various implications of managerial ability in

[2] Managerial capital can be classified into two types: general human capital and firm-specific human capital General human capital refers to skills not specific to any organization, transferable across firms; firm-specific human capital refers to the skills valuable only within an organization (Custódio et al. 2013; Custódio et al. 2017). Since Demerjian et al. (2012) states that the managers' ability score from the old firm can be carried over to the new firm (i.e. transferable across firm), their ability scores could be viewed as general human capital. By construction however, Demerjian et al.'s ability scores are intended to capture the manager-specific characteristic. Demerjian et al.'s ability scores capture the "match" of the CEO and the firm because it measures as the interactions between specific aspects of ability and firm features that make a match more or less suitable.

accounting research areas. My dissertation also takes advantage of their measure to examine the role of managerial ability in incentive compensation schemes. I first investigate whether the incentive power increases in managerial ability. As prior studies theoretically suggest that firms need to offer stronger incentive schemes to the right "type" of managers to encourage greater efforts from managers and retain better managers, I conjecture that differential pay for performance sensitivity of equity-based compensation would be offered to managers according to their ability level. I conjecture this positive relation between CEO ability and incentive will appear especially for CEOs with a considerable amount of time in the firm, because the information asymmetry about the ability level is more likely to be alleviated through learning in periods, leading to the optimal level of incentives according to their revealed ability. Using the method outlined in Core and Guay (2002) to estimate the pay-performance sensitivity of CEO equity pay (delta), I conjecture that ability is positively associated with delta for continuing CEOs. I posit the following hypothesis in an alternative form:

H1a: A continuing CEO's ability is positively associated with the pay-performance sensitivity of equity-based compensation (delta), *ceteris paribus*.

However, the competence of a new CEO is not revealed at the time of contracting. When a potential new CEO and a firm goes through the process of negotiating compensation contracts, the hiring firm must bear the prior uncertainty about the ability of the new CEO because the new CEO will withhold negative information about himself. Even if the new CEO truthfully reveals their ability with full disclosure, a CEO's ability to perform effectively is, to some extent, unknown due to questions about the quality of the match between the CEO and the hiring firm. Given the imperfect information about CEO ability at the initial compensation schemes, it is an empirical question whether the optimal arrangements between ability and incentive appears. Due to the imperfect information about the ability level of a new CEO, the initial compensation contracts may be far from the optimal. To test this possibility, I turn to focus on the sample of CEOs in their first year in office and investigate whether firms offer strong incentive schemes to the managers who found out to be with high ability *ex post*, as theoretical research suggests.

Of course, if the labor market operates efficiently, high-powered equity incentives will be provided to high-ability managers. Then, I expect to find a positive association between delta and managerial ability even in the first year of a new CEO's service. Since the influence of CEO on firm value is nontrivial, firms will choose their new CEO very carefully, using all the available information that reflects the new CEO's capability, such as his performance at his old firm (Banker et al. 2013). If firms have sufficient information to identify the type, then higher-powered incentives will be given to new CEOs with high ability. However, if the information asymmetry and uncertainty about the quality of the CEO remain to obscure the optimal arrangement between ability and incentive then, the expected positive association between delta and ability may not be observed. In other words, compensation schemes at the initial stage would diverge from the optimal.[3] Therefore, I state the hypothesis in a null form as follows.

---

[3] However, such suboptimal arrangements between ability and incentive would be adjusted over time as the learning about CEO ability takes place. Holmstrom (1999) proposes a theoretical model in which an agent's abilities are revealed over time through observations of performance. Pan et al. (2015) find that stock return volatility is unusually high around the time of CEO turnover however, attenuates with CEO tenure, which they interpret as a reduction in uncertainty about management capability over time through learning effect. Related, based on interviews of U.S. public company compensation committee members, Hermanson et al. (2012) suggest that assessing CEO performance and making the CEO compensation decisions with adjustments after the evaluation are one of the primary responsibilities of the compensation committee.

H1b: CEO ability is not associated with pay-performance sensitivity of equity-based compensation (delta) in the first year the new CEO operates, *ceteris paribus*.

2.3 Firm Valuation Analyses

For new CEOs, I hypothesize that the ability-incentive alignment maybe not as strong in the real contracts as expected by the theory due to the incomplete information about new CEOs' ability or because the revelation principle in the analytical model might be a too strong assumption considering various frictions in practice. For example, at the time of contracting, potential new CEOs may face strong incentives to withhold negative information about themselves and rather exaggerate their ability to obtain better bargaining power when they negotiate with the firm about their initial compensation contracts. Then, a natural question arising such misalignment is how it impacts on the firm value.

Rosen (1981; 1982) argues that a good match between a CEO and a firm can create economic synergies. Specifically, the match theory suggests that good matches have better firm performance and are more stable and last longer than do bad matches (Bishop 1990; Allgood and Farrell 2003). For instance, CEOs with conglomerate work experience better match with firms with a higher degree of diversification and, CEOs with technical education match well with firms with higher R&D intensity (Pan 2017). Both matches provide evidence of higher performance and a higher likelihood of CEO retention. More related to my research, Li et al. (2014) suggest that the optimal match between CEO knowledge and pay level shows higher firm value compared to the suboptimal ones. Overall, among the heterogeneous match between a CEO and a firm, a good match has a higher firm value relative to a match not as good.

Building upon the prior studies on CEO-firm matches and its implication on firm value, I apply the matching perspective to the context of CEO ability and compensation incentive. I conjecture that the optimal match between ability and incentive power will exhibit higher firm value and/or firm performance. Under the optimal compensation schemes, higher-powered incentives should be rewarded to more competent managers. Because such optimal incentive schemes are driven in order to maximize the principal's payoffs, I anticipate the firm's value is higher when the incentive power is aligned with its CEO's ability as in theory than when they are mismatched—in other words, when low(high)-powered incentives are provided to managers with high(low) ability. Firms who violate the optimal incentive-ability arrangement should have lower firm value or operating performance relative to firms with a good match. In other words, when the ability is not compensated optimally in an organization, firm value suffers. Such suboptimal firms can present in the market, particularly when firms don't know much about their new CEO in the first year after being hired.[4]

The specific causes and the mechanisms by which some firms become suboptimal are heterogeneous; for example, although the new CEO has high ability, he might not clearly know about his capability (due to the lack of experience) at the time of contracting, and also is not sure about whether he would fit well with the firm. Therefore, certain CEOs with high ability may end up signing lower-powered compensation contracts. I predict firms with the suboptimal arrangement between ability and incentive to have lower valuations (and/or lower operating performance) compared to those with the optimal

[4] Job match models assume heterogeneity in the productivity of worker-firm matches and the quality of these matches is not initially known by either party (Garen 1988), given the job-match heterogeneity in the CEO labor market.

arrangement. State formally:

H2a: For high ability CEOs, firms who provide higher-powered incentives will have higher valuations (operating performance) than those providing lower-powered incentives, *ceteris paribus*.

Although matching would matter less for CEOs with low ability, lower pay-for-performance sensitivity is optimal according to the theory. Thus, if higher-powered incentives are provided to managers with low ability, the firm value will decrease, as evidence of suboptimal incentive for low ability managers. The forces that move the arrangement between ability and incentive to suboptimal may vary cross-sectionally however, one potential explanation is that an overconfident or aggressive CEO (with low ability) may undue influence over compensation schemes, despite the CEO's lack of ability (Finkelstein 1992). Therefore, I expect for low ability CEOs, firms who provide higher incentives to have lower valuation (and/or lower operating performance) than those deemed to be optimal under the theory.

H2b: For low ability CEOs, firms who provide lower-powered incentives will have higher valuations (operating performance) than those providing higher-powered incentives, *ceteris paribus*.

2.4 CEO Turnover Analyses

The previous hypotheses are developed from the principal's optimal contract design. In this section, I consider the CEO's response (i.e., voluntary turnover) to the incentive schemes. Given various ability-incentive arrangements, voluntary departures decided by CEOs only after a few years following the appointments would indicate the newly hired CEO is not satisfied with their incentive contracts. Of course, if the unsatisfied CEOs success to make adjustments to their incentive contracts through the negotiation process with the compensation committee, he or she may stay in the firm.[5] However, if the unsatisfied CEOs fails to make adjustments in a way they prefer and are with higher competence, then they may voluntarily leave the firm and find the new place to work since they have more outside options in the CEO labor market. Therefore, in this section, I aim to investigate which ability-incentive arrangement leads to a higher likelihood of CEO turnovers and to further extent, which group shows a higher likelihood of voluntary CEO turnovers.

According to the theory on a CEO-firm match, good matches last longer, while bad matches are quitted by either party (Allgood and Farrell 2000; 2003). In other words, as the firm learns about the new CEO's ability and as both the firm and the CEO learns about how well they fit each other, only the group with both parties satisfied would keep their current relationship whereas, the other remaining groups would end quickly by either the firm or the CEO. Only those with both groups satisfy will endure however if neither of them is satisfied, the CEO will be dismissed or leave voluntarily in a short period (Allgood and Farrell 2003). Empirical studies show that there is a substantial percentage of CEO turnovers occur in the first few years of CEO tenure (e.g., Sebora 1996; Allgood and Farrell 2000; 2003).[6] Sebrao (1996) find that 34% of all CEO tenures in his sample ended by the

---

[5] The adjustment process is supported by Hermanson et al. (2012), which conduct interviews on compensation committee members and find that one of the important responsibility of compensation committee members is making the CEO compensation adjustments following CEO performance assessment each year.

[6] The early CEO turnovers are also supported by anecdotal evidence. Douglas Ivester stepped down as CEO of Coca-Cola after serving only two years at the helm. Mattel dismissed Jill Barad after she had been its CEO

CEO's fourth year. Related, Allgood and Farrell (2000) find that new CEOs (those with 1-3 years of tenure) are more likely to be dismissed than are CEOs with 4-10 years of tenure. Those CEOs with more than 10 years are less likely to be dismissed. In the same vein, Dikolli et al. (2014) provide evidence that a CEO's dismissal reduces in his or her tenure as the revelation of uncertain ability takes place as time goes by.[7] Put differently, the firm begins to learn about the CEO's type over time and, the failure of a match between the CEO and the firm is manifested by a higher probability of turnover in early years of the CEO's service.

Of course all CEO turnovers cannot be explained by suboptimal ability-incentive arrangements however, the usefulness of thinking about CEO turnover in the matching context is to better understand why we observe such a high percentage of CEO turnovers in the early years of tenure. Zhang (2008) finds that the level of information asymmetry at the time of CEO change increases the likelihood of dismissal after a short tenure, further supporting a higher likelihood of CEO turnovers in the early years.

By investigating CEO turnover following the first-year arrangement between ability and incentive power, I can discern which arrangement lasts longer, thus higher quality of matching. And by identifying whether the turnover is voluntary or not, I can distinguish the managers of which type are not satisfied with their current incentive compensation contracts. Building upon the optimal incentive contracting theory, I expect high ability CEOs compensated with high delta will be the best combination. In contrast, high ability CEOs compensated with low delta would be unsatisfied with their

---

for only 3 years.

[7] Dikolli et al. (2014) suggest that lower demand for monitoring the CEO over his or her tenure also influences the negative relationship between CEO tenure and the probability of dismissal.

compensation contracts and thus, may leave the firm voluntarily and search for a better match in the market.[8] State formally:

H3a. For high ability CEOs, firms who provide lower-powered incentives will have a higher likelihood of CEO turnover than those providing higher-powered incentives, *ceteris paribus*.

For low ability CEOs, the theory argues that it is optimal for such CEOs to be compensated with low-powered incentives yet, whether evidence consistent with theory can be supported by empirical results, *ex ante*. According to the theory, for low ability CEOs, I predict that CEO turnovers are less likely when lower-powered incentives are given since such combination is optimal. Alternatively, this leads to expect that CEO turnovers are more likely when higher-powered incentives are provided to low ability CEOs. State formally:

H3b. For low ability CEOs, firms who provide higher-powered incentives will have a higher likelihood of CEO turnover than those providing lower-powered incentives, *ceteris paribus*.

[8] Since providing high-powered incentives is costly to the firm, the firm may attempt to reduce screening costs by offering low-powered incentives to high ability managers however, they fail to retain those able managers.

3. Research Design

3.1 Data and Sample Selection

The sample period is from 1994 to 2015. I obtain CEO turnover data, CEO compensation data and data for the variables of CEO characteristics (except CEO ability) from the Execucomp database. The forced CEO turnovers are identified following Peters and Wagner (2014) and Jenter and Kanaan (2015) and, the data is provided by Florian Peters and Alexander Wagner.[9] I obtain firms' financial data from the Compustat and the stock return data from the monthly CRSP. I use managerial ability data that are made available by Demerjian et al. (2012).[10]

Table 1 provides detail on the sample selection criteria. Panel A reports the sample selection procedure for continuing CEOs and Panel B for new CEOs. In Panel A, for the sample of continuing CEO, the financial firms (i.e., SIC codes 6000-6999), utility firms (i.e., SIC code 4900-4999) and firms with the negative book value of equity are excluded from the sample. Finally, I require firm-year observations to have the key variables, that are managerial ability and delta, and control variables. Then, I exclude CEO turnover years since both the old CEO and the new CEO engage in management. Finally, to identify CEOs who stay in the office with a considerable amount of time, I delete the observations in the CEOs' early years of service. I define the early years as the first three years of CEOs' service as in Ali and Zhang (2015). In other words, the CEOs with more than their fourth years are defined as continuing CEOs. This procedure yields a final sample of 18,210 firm-year observations and refers the sample as "Continuing CEOs".

---

[9] The author thanks Florian Peters and Alexander Wagner for generously allowing her to use their forced CEO turnover data.

[10] The *Ability* and *Abilityr* data are available at: http://faculty.washington.edu/pdemerj/data.html

More importantly, though, my research question is on how compensation incentives are determined when a new CEO is hired and his or her ability is first revealed to the hiring firm. Therefore, I remain the sample of CEOs in the first years of their service. This is the time when the new CEOs first give full play to their capability. To construct my sample of new CEOs, I first identify CEO change years and then define the following years as the first years that that new CEOs take office. Focusing on the sample of new CEOs in their first years, I aim to investigate whether the positive relation between CEO ability and incentive power holds in compensation schemes at the initial stage of compensation contracts. The detailed sample selection procedure is demonstrated in Panel B of Table 1. The sample for new CEOs in their first years contains 2,535 firm-year observations. I refer to this sample as "New CEOs" throughout the paper. The timeline for defining continuing CEOs and new CEOs is illustrated in Figure 1.

[Insert Figure 1 here]

Table 1, Panel C summarizes the annual distribution of observations for both samples for "Continuing CEOs" and "New CEOs", respectively. Except for the year 1994 and 1995 in the sample of "New CEOs", the frequency of observations is almost evenly distributed across the sample period 1994-2015.

[Insert Table 1 here]

3.2 Variable Measurement

3.2.1 Measurement of Pay-Performance Sensitivity

I use CEO portfolio delta, which is defined as the dollar change in a CEO's stock and option portfolio for a 1% change in stock price, as the primary measure of equity incentives. I calculate delta by using the one-year approximation method outlined in Core and Guay (2002). In general, prior studies use portfolio delta either unscaled (e.g., Burns and Kedia 2006) or scaled by pay (e.g., Bergstresser and Philiippon 2006; Efendi et al. 2007). I take the natural logarithmic transformation of portfolio delta to mitigate the right skewness in its distribution. In particular, my measure of the CEO's portfolio delta, *Delta*, is the natural logarithm of one plus the CEO portfolio delta. To assess the robustness of my results to measurement choices, I use portfolio delta scaled by total cash compensation as an alternative measure, *ScaledDelta*. Specifically, it is defined as the CEO portfolio delta deflated by total cash compensation (i.e. the sum of salary and bonus pay) as in prior studies (Bergstresser and Philiippon 2006; Efendi et al. 2007).

3.2.2 Measurement of Managerial Ability

This study uses Demerjian et al. (2012)'s measures of managerial ability. Demerjian et al. (2012) construct a proxy of managerial ability by adopting the data envelopment analysis (DEA) method, which is a non-parametric method of estimating organizational efficiency. In particular, Demerjian et al. (2012) use DEA to create a measure of the relative efficiency of the firm within its industry. Firm efficiency however, relies not only on firm-specific factors but on managerial ability. Therefore, Demerjian et al. (2012) decompose the DEA-driven firm efficiency into firm-level operational excellence and managerial impact by developing a two-stage analysis. Specifically, in the first stage, Demerjian et al. (2012) estimate firm efficiency using DEA methodology. Then, in the second stage, the authors regress the DEA-driven firm efficiency scores on firm-level contextual variables that are expected to affect firm efficiency such as firm size, firm market share, cash availability, life cycle, operational complexity, and foreign operations. They attribute the unexplained portion of firm efficiency to management, therefore interpret the residual of the second stage regression as managerial ability.

The validity of the measure is proven by a battery of tests. First, Demerjian et al. (2012) show that their managerial ability measure is economically and significantly associated with CEO fixed effects rather than firm fixed effects. Second, the measure is negatively associated with abnormal stock returns around a CEO turnover announcement. Third, hiring a relatively more and less capable manager is systematically related to changes in the subsequent market and accounting performance. To further extent, Demerjian et al. (2012)'s managerial ability measure outperforms in the above tests when compared with the tests using alternative measures of managerial ability from prior studies, such as historical stock returns, historical return on assets, CEO compensation, CEO tenure and media citation. The results of these validity analyses suggest that the DEA-driven measure developed by Demerjian et al. (2012) capture a management-specific characteristic while being less noisy than other alternative measures of the managerial ability which are previously used, as it represents management impact more systematically. An increasing number of studies are using Demerjian et al. (2012)'s managerial ability data, so does this study. I use Demerjian et al. (2012)'s managerial ability measure (*Ability*), as well as managerial ability in decile ranks (by industry and year) (*Abilityr*) to make the measure more comparable across years and industries and to mitigate the effect of extreme observations affecting my results (Demerjian et al. 2013).

3.3 Empirical Model

3.3.1 Test of H1

To test Hypothesis 1a, I use the sample of "Continuing CEOs". I specify the following model to examine the association between managerial ability and pay-for-performance sensitivity of equity-based compensation measured by delta:

$$Delta_{i,t} = \beta_0 + \beta_1 Ability_{i,t} + \beta_2 Vega_{i,t} + \beta_3 CashComp_{i,t} + \theta_n Controls_{i,t} + Industry\ FE + Year\ FE + \varepsilon_{i,t}, \qquad (1),$$

where the dependent variable, *Delta* is the natural logarithm of one plus the sensitivity of the CEO's equity portfolio to a 1% change in stock price, *Ability* is the managerial ability estimated by Demerjian et al. (2012). I expect a positive coefficient on *Ability* that more talented CEOs receive a steeper pay-for-performance sensitivity of equity-based compensation (i.e., higher delta) than their less talented CEOs, consistent with the optimal compensation schemes evidenced in theoretical research.

Along with CEO portfolio delta, compensation contracting alters CEO portfolio vega. The combination of delta and vega likely varies substantially across firms (Guay 1999) and the combination also creates incentives faced by managers (Coles et al. 2006). Higher delta exposes managers to more risk thus induces managers to avoid risk-taking. Meanwhile, higher vega helps offset such risk-avoiding tendencies introduced by delta. Therefore, unlike delta, portfolio vega provides managers with an incentive (or less of a disincentive in the case of a risk-averse manager) to increase firm risk. Following Core and Guay (2002), I calculate CEO portfolio vega (*Vega*) as the dollar change in the CEO's equity portfolio for a 0.01 change in the firm's stock return volatility and include *Vega* in the regression model to effectively isolate the relation between *Delta* and *Ability.* In addition, I include annual total cash compensation (*CashComp*), which is salary plus bonus, in the model specification because cash compensation may have a substitutive relation with equity-based compensation. Because equity-based pay requires no contemporaneous cash payout, firms with cash constraints are more likely to use equity compensation, instead of cash compensation (Yermack 1995; Dechow et al. 1996). In addition, annual total cash compensation provides the manager with his reservation utility and short-term incentives, which distinguish from long-term incentive generated by equity-based compensation (Banker et al., 2013).

In Equation (1), *Controls* is a vector of control variables. I control for certain firm characteristics that can influence delta following prior studies (e.g., Core and Guay 1999). I control for firm size because CEO incentive strength differs by firm size (Baker and Hall 2004). I use the natural logarithm of total assets at the beginning of the year to measure the firm size (*SIZE*). Jensen (1986) and Harvey and Shrieves (2001) find that leverage is inversely related to the use of incentive compensation because debt may provide an important substitute control mechanism in reducing agency problems. Thus, I include a firm's leverage (*Leverage*), measured as the ratio of total debt to total assets. I also control for a firm's performance (ΔROA, *RET*), and the volatility of a firm's performance and stock returns (*STDROA*, *STDRET*) following Aggarwal and Samwick (1999). Several research reports that firms with more growth opportunities use more incentive pay to compensate their managers (Baber et al., 1996; Gaver and Gaver, 1993; Smith and Watts, 1992). Thus, I control for market-to-book ratio (*MB*) (See Appendix for detailed variable definitions). Finally, I control for industry-fixed effects and year-fixed effects and inferences are based on standard errors clustered by firm.

To test Hypothesis 1b, I estimate Equation (1) exclusively for CEOs in the first year of their service (i.e. the sample of new CEOs). I aim to investigate whether the positive association between CEO ability and equity incentive appears in the initial compensation schemes where information asymmetry and uncertainty about CEO ability is particularly high. Specifically, I test whether the positive association between managerial ability and delta consistently holds for the first years that new CEOs takes their full responsibility. If higher delta is provided to CEOs who find out to with high ability, I expect a positive coefficient on *Ability* meaning that high ability managers are optimally matched with high delta even in the first year of their service. Or, the positive relation between ability and delta in the first years of CEO tenure can be explained by the effective sorting mechanism of delta in identifying CEO unknown characteristics. However, it is also likely that higher delta is not particularly matched with CEOs with higher ability, leading to an insignificant association between delta and ability since the information asymmetry and the uncertainty regarding a new CEO's management capabilities are at its peak in the first year of a new CEO's service.

3.3.2 CEO Ability-Incentive Arrangements

To investigate the economic consequences of heterogeneous ability-delta arrangements, using the sample of new CEOs, I double sort the firms based on how much the CEO efficiently manages resources to generate sales (i.e. managerial ability) and how much incentive power is provided to the CEO (i.e. delta). Specifically, as in Figure 2, I sort observations independently into quartiles of *Ability* and quartiles of *Delta* and construct the groups of High *Ability*-High *Delta*, High *Ability*-Low *Delta*, Low *Ability*-High *Delta*, Low *Ability*-Low *Delta*, and Mid *Ability*-Mid *Delta*. The firms in High *Ability*-High *Delta* are ones where the new CEO's ability and incentive strength are aligned as expected by theory, thus higher valuation (operating performance) than the firms in High *Ability*-Low *Delta*. Alternatively, for low ability managers, lower-incentive power is optimal. Therefore, the firms in Low *Ability*-Low *Delta* expects to exhibit higher valuation (operating performance) than the firms in Low *Ability*-High *Delta*. Accordingly, I deem the firms in High *Ability*-Low *Delta* and Low *Ability*-High *Delta* are ones that deviate from the optimal ability-incentive arrangements expecting lower firm value (operating performance). Meanwhile, the firms in Mid *Ability*-Mid *Delta* would operate as the benchmark group, assuming a moderate level of ability and equity incentive that do not have a priori expectation.

[Insert Figure 2 here]

3.3.3 Test of H2

Hypothesis 2 predicts that the firms with CEOs in the optimal incentive according to their ability would have higher valuations (operating performance) compared to suboptimal firms in the first year the CEOs take place, indicating better quality of a match between a CEO and a hiring firms.

To test whether differential ability-incentive arrangements result in different firm value and firm performance, I use the following model specification:

$$
\begin{aligned}
TobinQ\ (OperPerf)_{i,t+1} = \beta_0 &+ \beta_1 High\ Ability\text{-}High\ Delta_{i,t} + \beta_2 High\ Ability\text{-}Low\ Delta_{i,t} \\
&+ \beta_3 Low\ Ability\text{-}High\ Delta_{i,t} + \beta_4 Low\ Ability\text{-}Low\ Delta_{i,t} \\
&+ \beta_5 Vega_{i,t} + \beta_6 CashComp_{i,t} + \theta_n Controls_{i,t}
\end{aligned}
$$

$$+ \mathit{Industry\ FE} + \mathit{Year\ FE} + \varepsilon_{i,t} \qquad (2)$$

Ordinary least squares (OLS) regression is used to estimate Equation (2). The definitions of the variables used in Equation (2) are as follows. The dependent variable, *TobinQ* is the industry-adjusted Tobin's q as the measure of firm value and, the other dependent variable is *OperPerf*, which is the accounting performance measured as the industry-adjusted return on assets (ROA).[11] *High(Low) Ability-High(Low) Delta* are indicator variables constructed according to Figure 2. In particular, *High Ability-High Delta* is an indicator variable equal to one for observations in the group High *Ability*-High *Delta*; *High Ability-Low Delta* is an indicator variable equal to one for observations in the group High *Ability*-Low *Delta*; *Low Ability-High Delta* is an indicator variable equal to one for observations in the group Low *Ability*-High *Delta*; *Low Ability-Low Delta* is an indicator variable equal to one for observations in the group Low *Ability*-Low *Delta.* By including indicator variables for each group, our variables of interest capture differences in economic consequences relative to the firms in Mid *Ability*-Mid *Delta*, where both ability and incentives are in moderate level. In this respect, the firms in Mid *Ability*-Mid *Delta* act as my control group, while the other groups are my treatment groups.

H2a predicts that for high-ability managers, firms providing higher incentives exhibit higher valuation (or higher operating performance) than firms providing lower incentives. This is based on the theory, suggesting that higher-powered incentive schemes are optimal for managers with greater competence. In Equation (2), this would be supported

[11] Tobin's q is the market value of assets divided by the book value of assets. Return on assets (ROA) is the ratio of income before extraordinary items to total assets at the beginning of the year. Consistent with prior literature, we subtract the industry-year median value of Tobin's q (ROA) to mitigate the unobservable industry- and year-specific effects.

by having significantly higher coefficient on *High Ability-High Delta* than the coefficient on *High Ability-Low Delta.* H2b predicts that for low ability managers, the provision of lower incentives in their initial compensation schemes is optimal. Therefore, I expect that the coefficient on *Low Ability-Low Delta* is significantly higher than the coefficient on *Low Ability-High Delta*, if the results turn out to be consistent with the theory.

I add the set of control variables including *Vega*, *CashComp*, *Size*, *Leverage*, Δ*ROA*, *RET*, *STDROA*, *STDRET* and *MB* as in Equation (1). I also control for industry-fixed effects and year-fixed effects and inferences are based on standard errors clustered by firm (All variables are defined in the Appendix). The inclusion of year fixed effects removes the effects of macroeconomic conditions that might be associated with firm valuation or performance, while the inclusion of industry effects removes cross-sectional effects of industry on the economic consequences.

3.3.4 Test of H3

In Hypothesis 3, I examine whether ability-incentive arrangements influence the probability of a CEO turnover event using the following linear probability model:

$$\begin{aligned} CEO\ Turnover_{i,t+1} = {} & \beta_0 + \beta_1 High\ Ability\text{-}High\ Delta_{i,t} + \beta_2 High\ Ability\text{-}Low\ Delta_{i,t} \\ & + \beta_3 Low\ Ability\text{-}High\ Delta_{i,t} + \beta_4 Low\ Ability\text{-}Low\ Delta_{i,t} \\ & + \beta_5 Vega_{i,t} + \beta_6 CashComp_{i,t} + \lambda_n Controls_{i,t} \\ & + Industry\ FE + Year\ FE + \varepsilon_{i,t} \qquad (3) \end{aligned}$$

Linear probability models generate ordinary least squares (OLS) estimates of a binary dependent variable.[12] A logit specification is additionally used to further support my inference. *CEO Turnover* is an indicator variable capturing the event of CEO turnover. The variables of interests are *High Ability-High Delta*, *High Ability-Low Delta*, Low *Ability*-High *Delta*, and *Low Ability-Low Delta* which are defined in the bottom of Equation (2).

As explained in H3, I conjecture that the probability of CEO turnover increases for firms in suboptimal ability-incentive arrangements. In particular, for high ability managers, firms providing lower delta expects to have higher probability of CEO turnover while, for low ability mangers, firms providing higher delta expects to have higher probability of CEO turnover since both group of firms violate the optimal compensation schemes for each ability type according to the theory. Therefore, in Equation (3), the coefficient on *High Ability-Low Delta* expects to be significantly greater than the coefficient on *High Ability-High Delta* while, the coefficient on *Low Ability-High Delta* to be significantly greater than the coefficient on *Low Ability- Low Delta.*

I add multivariate controls for firm characteristics including *Vega*, *CashComp*, *Size*, *Leverage*, Δ*ROA*, *RET*, *STDROA*, *STDRET* and *MB* as in Equation (2). I supplement the set of controls to include additional determinants of turnover from prior literature (e.g., Menon and Williams, 2008; Gallemore et al., 2014; Chyz and Gaertner, 2018). Ali and

---

[12] I use a linear probability model (LPM) to simplify the interpretation of my coefficients. According to Wooldridge (2002), "the LPM should be seen as a convenient approximation to the underlying response probability." Wooldridge (2002) suggests that the key drawback to using LPM is that it may produce fitted values outside the unit interval (i.e., outside of the 0 and 1 range). According to Wooldridge (2002), however, "even with these weaknesses, the LPM often seems to give good estimates of the partial effects of the response probability." Further, Wooldridge (2002) suggest that LPMs are especially suited to discrete variables of interest. Given that I do not require fitted values as part of my analysis, and the variables of interests are discrete, I believe my setting is particularly suited to a linear probability approach. I also note that LPMs have been shown to perform as well on categorical variables as specifications that do not assume linearity, and have been used in prior accounting studies (Shi 2003; Hanlon and Hoopes 2014; Chyz and Gaertner 2018). However, I find that the results are unchanged using a logit specification.

Zhang (2015) find that earnings overstatement is greater in the early years of CEOs' service due to CEOs' career concerns. Or, the new CEOs may take "big bath" in their first year of service. Thus, I control for *Discretion*, which is the absolute value of discretionary accruals measured using Kothari et al. (2005) model and *Loss*, a binary variable indicating a loss in the current year.

To further extent, I include several CEO characteristics that are known to affect the occurrence of CEO change. I control for CEO ownership (*CEOown*), CEO age (*CEOage*), and whether a CEO is also the chair of the board (*CEOchair*). A stream of literature reports that managerial ownership relates to the occurrence of CEO turnover (e.g., Mikkelson and Partch 1997). Thus, I control for *CEOown*, measured as the number of shares owned by the CEO divided by total shares outstanding. I further control for CEO age (*CEOage*) because the CEO nearing retirement has a higher turnover likelihood. Additionally, powerful CEOs may extract rents by manipulating the terms of their incentive-based pay (Morse et al. 2011). Thus, I control for CEO's power, such as whether the CEO is also board chairman (*CEOchair*). I also control for industry-fixed effects and year-fixed effects. The inclusion of industry fixed effects removes cross-sectional effects of industry on turnover, while the inclusion of year fixed effects removes the effects of macroeconomic conditions that might be associated with CEO turnover.

As an additional test, I investigate whether CEOs are fired or leave voluntarily for each ability-incentive arrangements. To test, I use the following linear probability model.

$$
\begin{aligned}
(Un)Forced\ CEO\ Turnover_{i,t+1} = \beta_0 &+ \beta_1 High\ Ability\text{-}High\ Delta_{i,t} + \beta_2 High\ Ability\text{-}Low\ Delta_{i,t} \\
&+ \beta_3 Low\ Ability\text{-}High\ Delta_{i,t} + \beta_4 Low\ Ability\text{-}Low\ Delta_{i,t} \\
&+ \beta_5 Vega_{i,t} + \beta_6 CashComp_{i,t} + \lambda_n Controls_{i,t}
\end{aligned}
$$

$$+ \textit{Industry FE} + \textit{Year FE} + \varepsilon_{i,t} \quad (4),$$

where *Forced CEO Turnover* is an indicator variable capturing forced CEO turnover and is equal to 1 for firm-years, which Peters and Wagner (2014) and Jenter and Kanaan (2015) code the turnover event as a forced out, and 0 otherwise. *Unforced CEO Turnover* is an indicator variable that equals to one for CEO departures that are not classified as forced turnovers. In other words, *Unforced CEO Turnover* indicates voluntary CEO turnovers. The remaining variables are the same as those defined in Equation (3) and, industry and year fixed effects are also controlled in the model.

4. Empirical Results

4.1 Descriptive Statistics

Table 2 presents descriptive statistics. Panel A compares the statistics of key variables between the sample with continuing CEOs and the sample with new CEOs, while Panel B presents summary statistics on firm characteristics for the sample of new CEOs in their first years. Panel C reports summary statistics on the consequence variables used to test H2 and H3. To alleviate the potential outlier problem, I winsorize those observations for which the value of any continuous variable lies in the top and bottom 1 percent of its distribution.

By construction, managerial ability (*Ability*) has a mean and median close to 0, as this is a residual. Therefore, as shown in Panel A of Table 2, for both sample of continuing CEOs and new CEOs, the managerial ability (*Ability*) has a mean (median) of 0.01 (-0.024) and 0.008 (-0.027), respectively. For both samples, the mean and median is slightly higher than prior studies (e.g., Demerjian et al. 2012; 2013) because firms included in the Execucomp database tend to be larger and such firms are more likely hire better managers (Gabaix and Landier 2008). The difference in *Ability* between two samples are not statistically significant (*t*-statistic = 0.49). To mitigate the influence of extreme observations, I employ *Abilityr*, which is decile ranks of *Ability* by year and industry, to make the score more comparable across time and industries following prior studies (e.g., Demerjian et al. 2013). *Abilityr* takes the value from 1 to 10, divided by 10. The mean (median) of *Abilityr* is 0.564 (0.6) for continuing CEOs, while 0.55 (0.5) for new CEOs. The difference is significant, indicating that *Abilityr* is higher for continuing CEOs. Next presents the statistics of various incentives variables. Both *Delta* and *Vega* measured in the first year of a new CEO's service is significantly lower than those for continuing. For continuing CEOs, the mean (median) of the natural logarithm of Core and Guay portfolio sensitivities, *Delta* is 5.407 (5.389) and 4.555 (4.613) for new CEOs. Thus, *Delta* is significantly higher for continuing CEOs which in line with a positive association between CEO tenure and incentive levels evidenced by Core and Guay (1999). Since the risk borne by the CEO due to uncertainty about his ability is reduced over time, firms impose more incentive risk on him (Gibbons and Murphy 1992). New CEOs in their first years have significantly lower vega than continuing CEOs in their later years, consistent with prior literature showing that vega increases with CEO tenure (Coles et al. 2006). In addition, annual total cash compensation (*CashComp*) is also lower for new CEOs.

Panel B reports descriptive statistics on several firm characteristics for the sample with new CEOs. In particular, the average firm size is 7.356 in my sample and the average leverage is 0.21. The average performance measured by stock returns is 0.136, while about

34% of firms experience a loss. The CEOs in the first year of their service hold approximately 0.03% of their firms' shares and they are 53 years old (3.978 if transformed into natural logarithm as reported) on average.

Panel C reports descriptive statistics for the variables used to analyze the economic consequences of various ability-incentive arrangements. The industry-adjusted Tobin's q (*TobinQ*) and the industry-adjusted ROA (*OperPerf*) in the subsequent year has a mean of 0.174 and 0.04. Approximately 10% of new CEOs experience a turnover in the subsequent year, and among those turnovers, about 2% is a forced turnover while, the remaining 8% is an unforced or voluntary turnover. The average probability of CEO turnover and the proportion of forced and voluntary turnovers among CEO turnovers is similar to prior studies (Peters and Wagner 2014; Jenter and Kanaan 2015).

[Insert Table 2 here]

4.2 Correlations

Table 3 presents Pearson correlation coefficients for the main variables used in the study. In Panel A, for the sample of continuing CEOs, I find that *Ability* has a significant positive correlation with *Delta*, consistent with H1a. Similar patterns appear when I use *Abilityr*. When I use the sample of new CEOs in their first years, in Panel B, the positive correlation between *Ability* and *Delta* remains significant. This result indicates that higher delta is more likely to be used to compensate more competent managers at the initial compensation schemes, although the factors affecting first-year delta hasn't been properly controlled.

For both samples of continuing CEOs and new CEOs, *Delta* is positively associated with other incentive variables, *Vega* and *CashComp* consistent with prior studies (e.g., Coles et al. 2006). These findings indicate that high-ability managers tend to be compensated higher delta, vega, and annual total cash compensation on average. In addition, *Delta* has significant correlations with various firm characteristics such as firm size (*Size*), both the first moment and second moment of performance (ΔROA, *STDROA*), and a firm's growth potential (*MB*). These correlations indicate the need to control for such factors in my model specification as I do in Equation (1).

[Insert Table 3 here]

4.3 Delta by Ability Deciles

In Figure 3, I plot the average dollar amount of delta scaled by total cash compensation by ability deciles separately for the sample of continuing CEOs and new CEOs. For continuing CEOs, I find that managers receive higher delta as their ability moves from low to high. This offers support for H1a, which expects a positive association between ability and delta, consistent with the economic theory of optimal contracting. For new CEOs, I also find an increasing pattern of delta as CEO ability increases however, the positive relation is weaker than that of continuing CEOs. The weaker relation may be attributed to the fact that the information about CEO ability is not fully comprehensive in the first years operated by new CEOs thus, incentive strength is not properly matched according to one's ability.

[Insert Figure 3 here]

4.4 Regression Results on the Association between CEO Ability and Delta

4.4.1 Continuing CEOs

Table 4 presents the regression results on the association between managerial ability and delta. Panel A of Table 4 reports the results using the sample of continuing CEOs. As expected in H1a, I find evidence that CEO managerial ability is positively associated with delta. In particular, as shown in column (1) and (2), regardless of whether I use managerial ability in raw values (*Ability*), or in decile ranks (*Abilityr*), I still find a positive association with *Delta*, which is the natural logarithm of one plus the CEO portfolio delta. In addition, when I use delta scaled by annual total cash compensation (*ScaledDelta*) as the dependent variable as in column (3) and (4), I consistently find that it is positively associated with both *Ability* and *Abilityr*. Taken together, the results in Table 4 support my prediction on H1a, suggesting that high ability CEOs receive a steeper pay-performance sensitivity in their compensation contracts. To gauge the economic significance of the estimates, I calculate the effect of a one standard deviation change in ability score in delta. In column (1), the coefficient on *Ability* measures the percentage increase in delta with the increase in ability score. Since the dependent variable, *Delta*, is logarithmic, I transform the measure to raw value when I compute the economic significance. Accordingly, the result suggests that one standard deviation of 0.142 increase in *Ability* is associated with a 7.3% increase in the raw values of delta (i.e., exp $(0.142\times0.497) - 1$).

To further provide evidence on the positive association between CEO ability and equity incentives, I analyze whether high (low) ability managers relative to peers tend to receive higher (lower) delta. To test, I construct a dummy variable of *HighAbility* (*LowAbility*) that equals 1 for CEOs in the highest (lowest) quintile of *Ability*, and 0 otherwise.[13] In both the model with *Delta* and *ScaledDelta*, I find a positive and significant coefficient on *HighAbility* and a negative and significant coefficient on *LowAbility*, suggesting that CEOs with high (low) ability are more (less) likely to receive steeper pay-performance sensitivity relative to CEOs with ability in the middle three quintiles, holding the remaining variables constant.

Turning to other compensation incentive variables, *Vega* is positively associated with *Delta*, suggesting that firms take both vega and delta into consideration when designing compensation contracts (Coles et al. 2006; Armstrong et al. 2013). In addition, *CashComp* has a positive association with *Delta*, but a negative association with *ScaledDelta*. Consistent with prior studies (e.g., Baber et al. 1996; Core and Guay 1999; Gaver and Gaver 1993; Harvey and Shrieves 2002; Mehran 1995; Smith and Watts 1992; Yermack 1995), firm size (*Size*), firm performance (ΔROA, *RET*) and growth potential (*MB*) are positively associated with delta, but leverage (*Leverage*) is negatively associated with delta.

4.4.2 New CEOs

Panel B of Table 4 investigates the association between managerial ability and delta focusing on newly appointed CEOs in their first year of their service. New CEO's ability is measured based on how efficiently the new CEO manages resources and convert them into sales revenue in the first year in the firm. Then, to examine whether the new CEO's ability revealed in the first year relates with their compensation incentive *ex post*, I

[13] If I define a dummy variable of *HighAbility* (*LowAbility*) that equals 1 for CEOs in the highest (lowest) *Ability* quartile instead of quintile, the inference remains the same.

regress the new CEO managerial ability on the pay-performance sensitivity. As shown in column (1), I find that the new CEO's ability (*Ability*) is positively related to *Delta*. I find consistent results if I use either ability ranks (*Abilityr*) and/or *ScaledDelta.* In terms of economic significance, the result in column (1) suggests that one standard deviation increase in *Ability* is associated with a 5.2% increase in the raw values of delta (i.e., exp $(0.142\times0.356) - 1$). The effect of *Ability* on *Delta* becomes smaller when tested with newly appointed CEOs.

Next, I divide the sample by managerial ability (*Ability*) quintiles and construct a dummy variable for the CEOs in the highest (lowest) quintile as *HighAbility* (*LowAbility*). In both the *Delta* and *ScaledDelta* models, I find a positive coefficient on *HighAbility*, but insignificant result for *LowAbility.* These results suggest that new CEOs with high ability relative to peers tend to receive higher delta but, those with low ability do not particularly receive lower delta. Although the hiring firms are mostly uncertain about the newly appointed CEOs, the extent of prior uncertainty might be greater for low ability CEOs. New CEOs with high ability are more likely to have an outstanding job history and such output is well evaluated in the labor market. However, new CEOs with low ability relative to peers are more likely to exaggerate their capability and negotiate to receive higher incentives by taking advantage of the current situation of high information asymmetry. In the perspective of the hiring firm, it is difficult to correctly identify the new CEO's type, especially the one with low ability, therefore, high delta is matched to low ability managers in the first year.

[Insert Table 4 here]

4.5 Additional Analyses

4.5.1 Alternative Measures of CEO Ability

In Table 5, I replicate the analysis for the alternative measures of managers' ability used in prior research: historical industry-adjusted ROA, historical industry-adjusted stock returns, CEO tenure, and media citations (Fee and Hadlock 2003; Milbourn 2003; Rajgopal et al. 2006; Tervio 2008; Demerjian et al. 2010).[14] In addition to alternative measures of ability, I alternative use the lagged value of DEA-based ability scores (i.e., $Ability_{t-1}$ or $Abilityr_{t-1}$).

Panel A of Table B reports the results using the sample of continuing CEOs. I find that all of the alternative ability measures present a significant and positive relation with delta. Panel B presents the results using the sample of new CEOs. For new CEOs, I trace their prior ability scores, historical industry-adjusted ROA, historical industry-adjusted stock returns, CEO tenure and media citations which are estimated while employed at the prior firm. I find that a positive and significant coefficient on historical industry adjusted stock returns and CEO tenure among the alternative measures of ability.

Overall, for continuing CEOs, the positive association between ability and delta consistently appears when replicated with alternative measures of ability. On the other hand, for new CEOs, I mostly find insignificant results. The ability estimated at the prior firm is not significantly associated with the new CEO's delta provided at the current firm. Meanwhile, in Panel B of Table 4, I find a significant and positive association between the new CEO's ability measured in the first year of the current firm and the level of delta. This may indicate that the level of delta is properly matched with the new CEO's ability

[14] The author thanks Sam Lee for generously allowing her to use his media coverage data.

estimated at the current firm since it better captures the firm-specific ability, rather than the ability at the prior firm.

[Insert Table 5 here]

4.5.2 Alternative Pay-Performance Sensitivity Measures

In this section, I adopt an alternative measure of pay-performance sensitivity to test the robustness of the association between ability and delta. Following Milbourn (2003), Equation (5) below is the empirical model that I use.

$$Ln(Comp)_{i,t} = \beta_0 + \beta_1 Ability_{i,t} + \beta_2 Ability_{i,t}\times RET_{i,t} + \beta_3 RET_{i,t} + \beta_4 Vega_{i,t} + \beta_5 CashComp_{i,t} + \theta_n Controls_{i,t} + Industry\ FE + Year\ FE + \varepsilon_{i,t} \quad (5)$$

Comp is defined as either (i) the sum of a CEO's equity and stock grants during the year, or (ii) the annual CEO's total compensation. *RET* is stock returns, indicating stock market performance. In this way, the coefficient on *RET* reflects the pay sensitivity of stock return performance. The coefficient on the interaction term between *Ability* and *RET* indicates the incremental effect of managerial ability on pay-performance sensitivity. The results are separately reported for continuing CEOs and new CEOs. As shown in Table 6, for continuing CEOs, I find that the interaction term *Ability*×*RET* is positive and significant for both types of compensation, indicating that pay-performance sensitivity is steeper for the more able CEOs. This provides additional support for H1a. However, I find that for new CEOs, I find that the interaction term *Ability*×*RET* is insignificant, suggesting that due to imperfect information about new CEOs in the first year they operate, their compensation contracts are not properly designed according to their ability level.

[Insert Table 6 here]

4.5.3 Alternative Model Specifications

Core and Guay (1999) points out that the incentive provided by a given portfolio of stock and options change over time because managers periodically sell and purchase stock, and exercise options. In particular, the incentives provided by an option portfolio vary with stock price, stock return volatility, and time remaining until the options expire. Thus, one may raise a concern that a positive association between ability and portfolio delta is driven by the managers' decision over their shares and options. However, the above concern may apply only to continuing CEOs who are in their service for more than three years. To mitigate the concern on continuing CEOs, I employ alternative model specifications for the sample of continuing CEOs, such as change regression and models controlling for various fixed effects. The results are presented in Table 7.

Panel A provides the results using a change specification to mitigate the effect of potential confounding variables that are invariant over time. I also control for industry/year fixed effects in column (1) and (2) and firm/year fixed effects in column (3) and (4). In column (1) and (3), I find that the change in *Ability* is positively associated with changes in *Delta*, indicating that increases in the level of ability is associated with increases in portfolio delta. Although I find insignificant results when tested with changes in *Abilityr* in column (2) and (4), this might be attributed to the reduced variation in the independent variable by transforming the rank variable (i.e., *Abilityr*) into a change variable.

In Panel B, I estimate the association between CEO ability and delta controlling for various fixed effects. First, I include firm and year fixed effects. Firm fixed effects would control for time-invariant firm characteristics that drive the level of portfolio delta. In addition, I expect that including firm fixed effects takes way any firm-specific factors contaminated in the managerial ability measure, this would allow me to test with a purer measure of managerial ability. Next, I control for CEO and year fixed effects. This would rule out the effect of time-invariant CEO characteristics (e.g., attitude toward risk and gender) on the relation between managerial ability and delta. Finally, I further control for CEO-firm and year fixed effects because the time-invariant factors may differ for CEO-firm pairs. Across all models, I consistently find that equity incentive of more talented CEOs is more sensitive to stock price.

[Insert Table 7 here]

4.6 Results on Firm Valuation Analyses

The previous results of a positive association between new CEO ability and delta provide evidence that the hiring firms compensate more talented managers with steeper pay-performance sensitivity. However, as evidenced in the results for new CEOs, due to the high level of information asymmetry in the first year the new CEO is hired, there exists firms who violate the optimal incentive-ability arrangements and correspondingly, I expect that such firms to have lower firm value or lower operating performance in the subsequent years, reflecting lower matching quality.

To test, I employ the framework suggested in Figure 2, where I double sort observations independently into quartiles of *Ability* and *Delta* and construct the following CEO-firm match: Low *Ability*-Low *Delta*, Low *Ability*-High *Delta*, High *Ability*-High

Delta, High *Ability*-Low *Delta*, and Mid *Ability*-Mid *Delta.* The firms in High *Ability*-High Delta and the firms in Low *Ability*- Low Delta are the ones where the new CEO's ability and incentive strength are aligned as expected by theory, thus higher valuation and operating performance.

Table 8 shows the economic consequences following the initial compensation contracts for different ability type. Univariate results are reported in Panel A. I report the average industry-adjusted Tobin's *q* and industry-adjusted ROA in the year following the first year of new CEO's management for each ability-incentive arrangements. Consistent with H2a, for both measures of economic consequence, *High Ability_High Delta* presents higher values than that for *High Ability_Low Delta* and the difference is significant. However, I find inconsistent results regarding H2b. I find that both the average firm value and operating performance is significantly higher for *Low Ability_High Delta* when they are compared with those for *Low Ability_Low Delta*. This indicates that, in contrast to the notion that the provision of lower delta is optimal for CEOs of low ability, higher-powered incentives do motivate low ability CEOs to exert more efforts. Consequently, the univariate tests offer support for H2a, not for H2b.

Panel B of Table 8 presents the multivariate regressions results estimating Equation (2). The dependent variables are the industry-adjusted Tobin's *q* and industry-adjusted ROA in the subsequent three years, respectively. Column (1) to (3) report the results regarding firm valuation estimated using Tobin's *q* and column (4) to (6) report the results regarding accounting performance measured using ROA. The investigation of long-term firm value and performance would allow new CEOs to have sufficient time to generate incremental value and performance. In regression analyses, I use the firms in Mid *Ability*-Mid *Delta* as the benchmark group, which falls into the intercept of Equation (2).

Accordingly, I examine whether each of four groups has differential consequences compared to the firms in Mid *Ability*-Mid *Delta* group, where both ability and incentives are at moderate level.

For new CEOs who find out to be with high ability, I find that those compensated with high delta results in higher firm value and higher operating performance relative to the CEOs in Mid *Ability*-Mid *Delta* group, holding the remaining variables constant. The coefficients on *High Ability_High Delta* is positive and significant across all models. In contrary, the coefficients on *High Ability_Low Delta* are insignificant, suggesting that when high ability CEOs are compensated with low delta, it seems like that they do not fully exert their capability to enhance firm value or performance. In particular, the coefficients on *High Ability_High Delta* are significantly higher than the coefficients on *High Ability_Low Delta*, supporting H2a. Therefore, I can conclude that the arrangement of High *Ability*-High *Delta* group is optimal, leading to superior consequences consistent with the theory. The above inferences remain when I extend to investigate long-term firm performance, yet the combined effects of ability and incentive seem to diminish over time.

Interestingly, I find inconsistent results for H2b. Theoretical research argues that the provision of lower delta is optimal for low ability managers thus, I predict that low ability managers incentivized with lower delta lead to higher valuation and higher operation performance compared to those with higher delta. However, the results say the opposite. For low ability CEOs, I consistently find negative and significant coefficients on *Low Ability_ Low Delta* throughout all model specifications, suggesting that low ability CEOs compensated with lower delta results in significantly lower valuation and lower operating performance relative to the CEOs in Mid *Ability*-Mid *Delta* group, holding the remaining variables constant. Meanwhile, I find positive and significant coefficients on *Low*

Ability_High Delta when tested with industry-adjusted Tobin's *q*, indicating that firms with their new CEOs provided with higher delta despite their low ability exhibit higher valuations. One potential reason for the result is that the market also suffers from the information asymmetry and the uncertainty about the new CEO's ability. Therefore, the market may mislead low-ability CEOs selecting higher delta as high-ability CEOs and perceive the firms with such CEOs to have high valuations. However, the market misperception does not last since the significant coefficient on *Low Ability_High Delta* diminishes over time when I extend the measurement period of firm valuation into long-term. Moreover, when I test with long-term accounting performance in column (4) to (6), the coefficients on *Low Ability_High Delta* are insignificant while, the coefficients on *Low Ability_Low Delta* are significantly negative. This indicates that the positive market valuation of *Low Ability_High Delta* is not supported by superior accounting performance yet, the performance of firms in *Low Ability_High Delta* is similar to the firms in *Mid Ability_Mid Delta*. Overall, regardless of what was intended by low-ability CEOs to choose high delta, the increased delta may motivate such managers of low ability to perform better (when compared with low ability managers with low delta), if such CEOs stay or survive in the firms they choose.

[Insert Table 8 here]

4.7 Results on CEO Turnover Analyses

Next, I examine the CEO retention/dismissal decision following the first-year incentive contracts. I compare the probability of CEO turnover for different ability-incentive arrangements, which are constructed as in Figure 2. If high-ability CEOs matched with lower delta dissatisfy with the current incentive contracts, such group will exhibit higher probability of turnover, suggesting the coefficient on *High Ability_Low Delta* to be significantly higher than the coefficient on *High Ability_High Delta*. This would support H3a. For low ability CEOs, the economic theory of optimal contracting suggests that lower delta is better. In this regard, if the provision of higher delta leads to dissatisfaction by either contracting party (the firm or the CEO) relative to lower delta, then I predict that *Low Ability_High Delta* to present significantly higher coefficient than that of *Low Ability_Low Delta.* This would support H3b.

Table 9 reports the results for CEO turnover analyses. I first present the univariate results in Panel A of Table 9. I report turnover likelihoods by each ability-incentive arrangements. First of all, consistent with H3a, the mean probability of turnover for *High Ability_Low Delta* is significantly higher than that for *High Ability_High Delta.* Further, the probability of forced turnover is not different for two groups but, the difference comes from voluntary turnover. This suggests that high ability CEOs rewarded with lower delta are more likely to voluntarily leave the firm. For low ability CEOs however, I find that the probability of turnover is higher for *Low Ability_Low Delta* than *High Ability_High Delta*, inconsistent with H3b. Moreover, the higher turnovers of *Low Ability_Low Delta* comes from forced turnovers. The univariate tests offer support for H3a, not for H3b.

Next, I turn to multivariate results since the factors that affect turnover decisions are not properly controlled in the univariate analyses. Panel B of Table 9 reports the results using CEO turnover, forced turnover, and unforced (i.e. voluntary) turnover. First, for CEOs of high ability, I find a positive and significant coefficient on *High Ability_Low Delta*, and the coefficient is significantly different from the coefficient on *High Ability_High Delta*. This suggests that the high ability CEOs rewarded with lower delta are more likely to leave the firm. Thus, I find multivariate support for H3a. In addition, as evidenced in the univariate test, the turnovers of *High Ability_Low Delta* refer to unforced or voluntary turnovers. For low ability CEOs, I find a positive and significant coefficient on *Low Ability_Low Delta*, instead of *Low Ability_High Delta*, inconsistent with H3b. Interestingly, I find that CEOs in *Low Ability_Low Delta* are more likely to be fired. This finding indicates that the optimal pay-performance sensitivity increases with ability is consistent only for high ability CEOs, but not for low ability CEOs. The benefit of higher-powered incentive in motivating low ability CEOs to work harder seems to dominate.

[Insert Table 9 here]

4.7.1 Robustness Tests

I conduct several robustness tests to support the results of CEO turnover. First, instead of using an indicator variable for CEO turnover as the dependent variable, I calculate CEO tenure left (*Leftyrs*) and use this as the dependent variable. The measure of *Leftyrs* requires a CEO to leave the firm within the sample period of 1994 to 2015. The average *Leftyrs* in my sample is 5.845. I find that high-ability CEOs with lower delta and low ability CEOs with lower delta show significantly shorter stay relative to CEOs with both ability and delta in the moderate level, holding the remaining variables constant. Second, I employ the Cox semiparametric proportional hazard model to estimate the relation between the likelihood of CEO turnover for each group (Campbell et al. 2011). The conclusion of both tests remains unchanged that lower delta results in a higher likelihood of turnover for both ability type, high and low.

[Insert Table 10 here]

5. Adjustments Toward the Optimal Level of Incentives

The uncertainty about the new CEOs' competence after being appointed alleviates as time goes by through faster learning in periods immediately following the CEO change. Once the new CEO starts their operation, the uncertainty about CEO ability will quickly disappear. This is supported by Pan et al. (2015), which find that stock return volatility is unusually high around the time of CEO change but, the increased volatility declines with CEO tenure in a convex manner, suggesting that the learning curve is convex. Accordingly, after the first full year in office in which the firm performance of that year is solely responsible to the new CEO, the uncertainty that the firm has on the capability of the new CEO will resolve, all other things being equal. As the learning takes place, firms can identify the type of new CEO and the quality of the match between a CEO and a firm (Gibbons and Murphy 1992). Theoretical research also formally models the mechanism by which a principal learns about an agent's ability, by showing that shows that the inferences about the agent's ability become more accurate over time due to a longer series of observations (Holmstrom 1999).

As the firms learn about their CEO's ability, the firms may make adjustments. Core and Guay (2002) document that CEOs have optimal equity incentive levels and, whenever there is a deviation between the actual and the optimal equity incentives, firms adjust the incentive level toward the optimal. This adjustment process is also supported by

Hermanson et al. (2012), which conduct interviews on compensation committee members and find that one of the important responsibility of compensation committee members is making the CEO compensation adjustments following CEO performance assessment each year. Therefore, as additional analysis, I examine the adjustment of delta towards the optimal level following the first year of a new CEO's service for each ability-incentive arrangements.[15]

5.1 Model Specification

I first estimate the optimal level of delta using the model specification below.

$$Delta_{i,t+1} = \beta_0 + \beta_1 Ability_{i,t} + \beta_2 Delta_{i,t} + \beta_3 Vega_{i,t} + \beta_4 CashComp_{i,t} + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 \Delta ROA_{i,t} + \beta_8 RET_{i,t} + \beta_9 STDROA_{i,t} + \beta_{10} STDRET_{i,t} + \beta_{11} MB_{i,t} + Industry\ FE + \varepsilon_{i,t} \quad (6)$$

As the determinants of equity incentives, I include the set of variables that are known to determine the level of equity incentive (delta) such as firm size (*Size*), leverage (*Leverage*), firm performance (ΔROA, *RET*), the volatility of a firm's performance and stock returns (*STDROA*, *STDRET*), growth opportunities (*MB*) as prior studies (e.g. Core and Guay 2002). Further, I include managerial ability (*Ability*) because firms may adjust

[15] I additionally test the possibility of CEOs managing their level of delta by voluntarily buying shares. I measure voluntary ownership and examine whether new CEOs with high ability but provided with low delta (i.e. who are not satisfied with the current level of delta thus are more likely to leave) in the first year increase their delta by voluntarily purchasing the shares of their firm in the second year. I find that for those CEOs, about 65% do purchase additional shares of their firm but, the probability of voluntary turnover is still higher than high ability CEOs with high delta. Overall, an increase in voluntary ownership by buying shares does not significantly deter high ability CEOs with low delta to leave the firm.

the level of incentive as they get to know more about CEO ability. I also include the current year delta (*Delta*), vega (*Vega*) and total cash compensation (*CashComp*), since the current compensation contracts can affect the equity incentive in the subsequent year. All variables are defined in the Appendix. I include industry indicator variables in the specification to control for industry effects and estimate yearly regressions to the optimal level of incentive in the subsequent year. Therefore, the optimal level of a CEO's portfolio equity incentives is approximated by the fitted value ($Delta_{i,t+1}^{*}$) from Equation (6).

Then, I develop a model to gauge the adjustment speed of delta toward the optimal ($Delta_{i,t+1}^{*}$). I develop the following adjustment speed model of delta by getting the idea from the recent prior literature the adjustment speed of cash and/or capital structure (Jiang and Lie 2016; Devos et al. 2017):

$$(Delta_{i,t+1} - Delta_{i,t}) = \beta_0 + \beta_1(Delta_{i,t+1}^{*} - Delta_{i,t}) + \beta_2 Vega_{i,t} + \beta_3 CashComp_{i,t} + \beta_4 Size_{i,t} + \beta_5 Leverage_{i,t} + \beta_6 \Delta ROA_{i,t} + \beta_7 RET_{i,t} + \beta_8 STDROA_{i,t} + \beta_9 STDRET_{i,t} + \beta_{10} MB_{i,t} + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (7)$$

In Equation (7), I define the difference of the optimal delta ($Delta_{i,t+1}^{*}$) from the actual delta ($Delta_{i,t}$) as *Deviation*. The coefficient on *Deviation* captures average adjustment speed of incentive towards the target. A positive and significant coefficient on *Deviation* would indicate that firms close the gap between optimal and actual delta. To examine whether the firms actively adjust CEO's delta toward its optimal following the first year of a new CEO's service, I estimate Equation (7) for each ability-incentive arrangements. Thus, I expect the coefficient on *Deviation* to be significantly positive for the group of firms who actively adjust their CEO's incentive power.

5.2 Results on Incentive Adjustments

Table 11 shows the results regarding incentive adjustments. Panel A reports the mean optimal delta ($Delta_{i,t+1}^{*}$), the mean actual delta ($Delta_{i,t}$) and the mean difference between the two (*Deviation*). I also present whether the mean *Deviation* is significantly different from zero. I find that *Deviation* is all positive for all type of ability-incentive arrangement, but the magnitude of *Deviation* is larger for *High Ability_Low Delta* and *Low Ability_Low Delta.*

Panel B shows the regression results of Equation (7) for each ability-incentive arrangement. In addition, for each arrangement, I estimate Equation (7) separately for CEOs with delta above and below the optimal level. This allows to investigate whether the adjustment is asymmetry, depending on the magnitude of delta compared to the optimal level.

The results are summarized as follows. I find that given relatively higher delta in the first year, regardless of whether the ability is low or high (i.e., *High Ability_High Delta* and *Low Ability_High Delta*), firms quickly make adjustments toward the optimal level. However, when the CEOs are provided with lower delta in the first year (i.e., *High Ability_Low Delta* and *Low Ability_Low Delta*), firms tend to only make faster upward adjustments toward the optimal, leaving the ones above the optimal remain unchanged. These results suggest that firms move toward the provision of higher-powered incentives for both ability type over time. This is consistent with my prior findings suggesting that firms seem to be inclined more to the benefit of higher-powered incentive in motivating low ability CEOs than to the benefit of matching incentive to ability

[Insert Table 11 here]

6. Conclusion

This study empirically investigates how managerial ability affects the pay-performance sensitivity. While theoretical research has proven that the optimal pay-performance sensitivity increases with CEO ability (Milbourn 2003; Banker et al. 2013; Palia 2001; Dutta 2008), it is an empirical question whether the CEO ability is reflected in the incentive contracts. In particular, it is unclear how managerial ability affects the pay-performance sensitivity, particularly when information asymmetry and uncertainty about CEO ability is high. Therefore, I focus on the initial design of their compensation contracts, given that the information about CEO ability is not fully comprehensive.

I analyze with two different samples, the sample of continuing CEOs where the ability is mostly reveled (18,210 firm-years) and new CEOs with their ability barely revealed (2,535 firm-years). Specifically, I find strong evidence of a positive relation between CEO ability and delta using the sample of continuing CEOs. However, the positive association evidenced using the sample of new CEOs is not as strong as the results for continuing CEOs. Given the possibility of suboptimal compensation contracts for new CEOs, I further turn to investigate the economic consequences of heterogeneous ability-incentive arrangements for new CEOs. First, I find that high ability CEOs provided with higher delta result in higher firm value than those provided with lower delta, consistently showing that the provision of high delta to high ability CEOs is optimal. I also find that high ability CEOs provided with lower delta are more likely to voluntarily leave the firm, additionally supporting the theory. In contrast with the theory though, the provision of lower delta is not optimal for low ability CEOs. Although firms would not prefer to hire low-ability CEOs, I provide evidence that the provision of higher delta for such CEOs would be better. Those provided with higher delta lead to higher valuation. However, if low-ability CEOs are provided with lower delta, they are more likely to be fired (whatever the reason is) in a short period.

My study makes the following contributions. First, I empirically show that the optimal compensation contracts take the type of managerial ability into account, as proven by theoretical research (Milbourn 2003; Dutta 2008; Banker et al. 2013). The findings enrich our understanding of the determinants of executive incentive contracts. In particular, the study uncovers how the initial compensation schemes for different ability types can diverge from the optimal compensation contracting, given the imperfect information about new CEO ability. How the imperfect first-year arrangement between ability and incentive converges to the optimal can be further investigated.

Second, I examine the matching quality between CEO ability and compensation incentive to demonstrate the optimal incentive for competent CEOs. While CEO ability can be identified as the important determinant of incentive contracts, the consequence or the quality of a match between ability and incentive power is not directly examined in prior studies. My results on matching quality suggest that the higher-powered incentives are optimal for high ability managers as in the theory. However, if lower incentives are awarded to high ability managers, they are more likely to voluntarily leave the firm in a short period, providing evidence of match failures. Although I do not examine the matching process per se, my study considers the matching quality as an additional source of uncertainty when hiring new CEOs and attempts to provide empirical evidence for CEO-firm matching (e.g., Gabaix and Landier 2008; Edmans and Gabaix 2011; Eisfeldt and Kuhnen 2013).

References

Aggarwal, R. K., and A. A. Samwick. 1999. Executive compensation, strategic competition, and relative performance evaluation: Theory and evidence. *The Journal of Finance*. 54(6): 1999-2043.

Ali, A., and W. Zhang. 2015. CEO tenure and earnings management. *Journal of Accounting and Economics*. 59(1): 60-79.

Allgood, S., and K. A. Farrell. 2003. The match between CEO and firm. *The Journal of Business*. 76(2): 317-341.

Allgood, S., and K. A. Farrell. 2000. The effect of CEO tenure on the relation between firm performance and turnover. *Journal of Financial Research*. 23(3): 373-390.

Antle, R., and A. Smith. 1986. An empirical investigation of the relative performance evaluation of corporate executives. *Journal of Accounting Research* 24(1): 1-39.

Armstrong, C. S., D. F. Larcker, G. Ormazabal, and D. J. Taylor. 2013. The relation between equity incentives and misreporting: The role of risk-taking incentives. *Journal of Financial Economics* 109(2): 327-350.

Baber, W., S. Janakiraman, and S. Kang. 1996. Investment opportunities and the structure of executive compensation. *Journal of Accounting and Economics* 21(3): 297-318.

Baker, G. P., B. J. Hall. 2004. CEO incentives and firm size. *Journal of Labor Economics* 22(4): 767-798.

Banker, R., M. Darrough, R. Huang, and J. M. Plehn-Dujowich. 2013. The relation between CEO compensation and past performance. *The Accounting Review* 88(1): 1-30.

Burns, N, and S. Kedia. 2006. The impact of performance-based compensation on misreporting. *Journal of Financial Economics* 79(1): 35-67.

Bergstresser, D., and T. Phillippon. 2006. CEO incentives and earnings management. *Journal of Financial Economics*. 80(3): 511-529.

Bishop, J. H. 1990. Job performance, turnover, and wage growth. *Journal of Labnor Econmoics*. 8(3): 363-383.

Campbell, T., M. Gallmeyer, S. Johnson, J. Rutherford, and B. Stanley. 2011. CEO optimism and forced turnover. *Journal of Financial Economics* 101(3): 695-712.

Carter, M. E., F. Franco, and I. Tuna. 2019. Matching Premiums in the Executive Labor Market. *The Accounting Review* forthcoming.

Chyz, J. A., and F. B. Gaertner. 2018. Can paying "too much" or "too little" tax contribute to forced CEO turnover? *The Accounting Review* 93(1): 103-130.

Coles, J. L., N. D. Daniel, and L. Naveen. 2006. Managerial incentives and risk-taking. *Journal of Financial Economics* 79(2): 431-468.

Core, J., and W. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40(3): 613-630.

Core, J., and W. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics* 28(2): 151-184.

Custódio, C., M. A. Ferreira, and P. Matos. Do general managerial skills spur innovation? *Management Science* 65(2): 459-476.

Custódio, C., M. A. Ferreira, and P. Matos. 2013. Generalists versus specialists: Lifetime work experience and chief executive officer pay. *Journal of Financial Economics 108*(2): 471-492.

Darrough, M., and N. Melumad. 1995. Divisional versus company-wide focus: The trade-off between allocation of managerial attention and screening of talent. *Journal of Accounting Research* 33(Supplement): 65-94.

Dechow, P., A. Hutton, and R. Sloan. 1996. Economic consequences of accounting for stock-based compensation. *Journal of Accounting Research* 34: 1-20.

Demerjian, P., B. Lev, M. F. Lewis, and S. McVay. 2013. Managerial ability and earnings quality. *The Accounting Review* 88(2): 463-498.

Demerjian, P., B. Lev, and S. McVay. 2012. Quantifying managerial ability: A new measure and validity tests. *Management Science* 58(7): 1229-1248.

Devos, E., S. Rahman, and D. Tsang. 2017. Debt covenants and the speed of capital structure adjustment. *Journal of Corporate Finance* 45: 1-18.

Dikolli, S. S., W. J. Mayew, and D. Nanda. 2014. CEO tenure and the performance-turnover relation. *Review of accounting studies* 19(1): 281-327.

Dutta, S. 2008. Managerial expertise, private information, and pay-performance sensitivity. *Management Science* 54(3): 429-442.

Edmans, A., and X. Gabaix. 2011. The effect of risk on the CEO market. *The Review of Financial Studies* 24(8): 2822-2863.

Eisfeldt, A. L., and C. M. Kuhnen. 2013. CEO turnover in a competitive assignment framework. *Journal of Financial Economics* 109(2): 351-372.

Efendi, J., M. Hanlon, and E. Maydew. 2006. Is there a link between executive equity incentives and accounting fraud? *Journal of Accounting Research* 44(1): 113-143.

Fee, C, and C. Hadlock. 2003. Raids, rewards, and reputations in the market for managerial talent. *Review of Financial studies* 16(4): 1315-1357.

Finkelstein, S. 1992. Power in top management teams: dimensions, measurement, and validation. *Academy of Management Journal* 35(3): 505-538.

Frydman, F., and D. Jenter. 2010. CEO compensation. *Annual Review of Financial Economics* 2(1): 75-102.

Gabaix, X., and A. Landier. 2008. Why has CEO pay increased so much? *The Quarterly Journal of Economics* 123(1): 49-100.

Gallemore, J., E. Maydew, and J. Thornock. 2014. The reputational costs of tax avoidance. *Contemporary Accounting Research* 31(4): 1103-1133.

Garen, J. E. 1988. Empirical studies of the job matching hypotheses. *Research in Labor Economics* 9: 187-224.

Gaver, J., and K. Gaver. 1993. Additional evidence on the association between the investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Accounting and Economics* 16(1-3): 125-160.

Gibbons, R., and K. Murphy. 1992. Optimal incentive contracts in the presence of career concerns: Theory and evidence. *The Journal of Political Economy* 100(3): 468-505.

Guay, W. R. 1999. The sensitivity of CEO wealth to equity risk: An analysis of the magnitude and determinants. *Journal of Financial Economics* 53(1): 43-71.

Hall, B. J., and J. B. Liebman. 1998. Are CEOs really paid like bureaucrats? *The Quarterly Journal of Economics* 113(3): 653-691.

Hambrick, D. C., and P. A. Mason. 1984. Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review* 9(2): 193-206.

Hanlon, M., and J. Hoopes. 2014. What do firms do when dividend tax rates change? An examination of alternative payout responses. *Journal of Financial Economics* 114(1): 105-124.

Harvey, K. D., and R. E. Shrieves. 2001. Executive compensation structure and corporate governance choices. *Journal of Financial Research* 24(4): 495-512.

Hermanson, D. R., J. G. Tompkins, R. Veliyath and S. Ye. 2012. The compensation committee process. *Contemporary Accounting Research* 29(3): 666-709.

Holcomb, T. R., R. M. Holmes Jr., and B. L. Connelly. 2009. Making the most of what you have: Managerial ability as a source of resource value creation. *Strategic Management Journal* 30(5): 457-485.

Holmstrom, B. 1999. Managerial incentive problems: A dynamic perspective. *The Review of Economic Studies* 66(1): 169-182.

Janakiraman, S., R. Lambert, and D. Larcker. 1992. An empirical investigation of the relative performance evaluation hypothesis. *Journal of Accounting Research* 30(1): 53-69.

Jenter, D., and F. Kanaan. 2015. CEO turnover and relative performance evaluation. *Journal of Finance*.70(5): 2155-2184.

Jensen, M. C. 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review*. 76(2): 323-329.

Jensen, M. C., and K. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy*. 98(2): 225-264.

Jiang, Z., and E. Lie. 2016. Cash holding adjustments and managerial entrenchment. *Journal of Corporate Finance*. 36: 190-205.

Kothari, S. P., A. J. Leone, and C. E. Wasley. 2005. Performance matched discretionary accrual measures. *Journal of Accounting and Economics*. 39(1): 163-197.

Lambert, R., and D. Larcker. 1987. An analysis of the use of accounting and market measures of performance in executive compensation contract. *Journal of Accounting Research*. 25(Supplement): 85-129.

Li, F., M. Minnis, V. Nagar, and M. Rajan. 2014. Knowledge, compensation, and firm value: An empirical analysis of firm communication. *Journal of Accounting and Economics*. 58(1): 96-116.

Menon, K., D. Williams. 2008. Management turnover following auditor resignations. *Contemporary Accounting Research*. 25(2): 567-604.

Mehran, H. 1995. Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics*. 38(2): 163-184.

Mikkelson, W., and M. Partch. 1997. The decline in takeovers and disciplinary managerial turnover. *Journal of Financial Economics* 44(2): 205-228.

Milbourn, T. T. 2003. CEO reputation and stock-based compensation. *Journal of Financial Economics* 68(2): 233-262.

Morse, A., V. Nanda., and A. Seru. 2011. Are incentive contracts rigged by powerful CEOs? *The Journal of Finance* 66(5): 1779-1821.

Palia, D. 2001. The endogeneity of managerial compensation in firm valuation: a solution. *The Review of Financial Studies* 14(3): 735-764.

Pan, Y. 2017. The determinants and impact of executive-firm matches. *Management Science* 63(1): 185-200.

Pan, Y., T. Y. Wang, and M. S. Weisbach. 2015. Learning about CEO ability and stock return volatility. *Review of Financial Studies* 28(6): 1623-1666.

Peters, F., and A. Wagner. 2014. The executive turnover risk premium. *Journal of Finance* 69(4): 1529-1563.

Rajan, R., and L. Zingales. 2000. The governance of the new enterprise. X. Vives, ed. Corporate Governance. University Press, Cambridge, UK, 201-227.

Rajgopal, S., T. Shevlin, and V. Zamora. 2006. CEO's outside employment opportunities and the lack of relative performance evaluation in compensation contract. *Journal* *of Finance* 61(4): 1813-1844.

Rosen, S. 1981. The economics of superstars. *The American Economic Review* 71(5):845-858.

Rosen, S. 1982. Authority, control, and the distribution of earnings. *The Bell Journal of Economics* 13(2): 311-323.

Sebora, T. C. 1996. CEO-board relationship evaluation: An explanatory investigation of the influence of base rate factors. *Journal of Managerial Issues* 8(Spring): 54-77.

Shi, C. 2003. On the trade-off between the future benefits and riskiness of R&D: A bondholder's perspective. *Journal of Accounting and Economics* 32(2): 227-254.

Sirmon, D. G., S. Gove, and M. A. Hitt. 2008. Resource management in dyadic competitive rivalry: The effects of resource bundling and deployment. *Academy of Management Journal* 51(5): 919-935.

Sloan, R. 1993. Accounting earnings and top executive compensation. *Journal of Accounting and Economics* 16(1-3): 55-100.

Smith, C., and R. Watts. 1992. The investment opportunity set and corporate financing, dividends, and compensation policies. *Journal of Financial Economics* 32(3): 263-292.

Tervio, M. 2008. The differences that CEOs make: An assignment model approach. *American Economic Review* 98(3): 642-668.

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

Yermack, D. 1995. Do corporations award CEO stock options effectively? *Journal of Financial Economics*. 39(2-3): 237-269.

Zhang, Y. 2008. Information asymmetry and the dismissal of newly appointed CEOs: An empirical investigation. *Strategic Management Journal*. 29(8): 859-872.

Appendix. Variable Definitions

Variables		Definitions
Ability Measure		
Ability	=	The proxy of managerial ability, which is based on the measure developed in Demerjian et al. (2012);
Abilityr	=	The decile rank (by industry and year) of *Ability*;
Incentive Variables		
Delta	=	Natural logarithm of one plus the sensitivity of the CEO's equity portfolio to a 1% change in stock price (e.g.,Core and Guay 2002);
Vega	=	Natural logarithm of one plus the sensitivity of the CEO's equity portfolio to a 0.01 change in volatility (e.g.,Core and Guay 2002);
ScaledDelta	=	The sensitivity of the CEO's stock and option portfolio to a 1% change in stock price scaled by CEO cash compensation (e.g., Bergstresser and Philiippon 2006; Efendi et al. 2007);
ScaledVega	=	The sensitivity of the CEO's stock and option portfolio to a 0.01 change in volatility scaled by CEO total compensation (e.g., Bergstresser and Philiippon 2006; Efendi et al. 2007);
CashComp		Natural logarithm of one plus the cash compensation (Execucomp item SALARY+BONUS) received by the CEO during the year;
Ability-Incentive Arrangements		
High Ability_High Delta	=	1 if a firm is included in group High *Ability*-High *Delta* as shown in Figure 2, and 0 otherwise;
High Ability_Low Delta	=	1 if a firm is included in group High *Ability*-Low *Delta* as shown in Figure 2, and 0 otherwise;
Low Ability_High Delta	=	1 if a firm is included in group Low *Ability*-High *Delta* as shown in Figure 2, and 0 otherwise;
Low Ability_Low Delta	=	1 if a firm is included in group Low *Ability*-Low *Delta* as shown in Figure 2, and 0 otherwise;
Mid Ability_Mid Delta	=	1 if a firm is included in group Mid *Ability*-Mid *Delta* as shown in Figure 2, and 0 otherwise;
Dependent Variables		
TobinQ	=	Industry-adjusted Tobin's *q* (Compustat items [AT+(PRCC_F×CSHO)-CEQ]/AT);

OperPerf	=	Industry-adjusted return on assets, which is the ratio of income before extraordinary items (Compustat item IB) to total assets (Compustat item AT) at the beginning of the year
CEO Turnover	=	1 if a CEO turnover occurs in period *t*, 0 otherwise;
Forced CEO Turnover	=	1 if a forced CEO turnover occurs in period *t*, 0 otherwise; Forced CEO turnover is identified following Peters and Wagner (2014) and Jenter and Kanaan (2015);
Unforced CEO Turnover	=	1 if a unforced (i.e. voluntary) CEO turnover occurs in period *t*, 0 otherwise; CEO turnovers that are not identified as forced turnovers are unforced turnovers;

<u>Control Variables</u>

Size	=	Natural logarithm of total assets (Compustat item AT) at the beginning of the year;
Leverage	=	Total debt divided by total assets (Compustat items [DLC+DLTT]/AT);
Δ*ROA*	=	The change in the ratio of income before extraordinary items (Compustat item IB) to total assets (Compustat item AT) at the beginning of the year;
RET	=	The annualized stock returns during fiscal year (CRSP item RET)
STDROA	=	The standard deviation of return on assets for the past five years;
STDRET	=	The standard deviation of stock returns for the past five years;
MB	=	Market-to-book ratio (Compustat item [PRCC_F×CSHO]/CEQ)
Loss	=	1 if income before extraordinary items is negative and coded equal to 0 otherwise;
Discretion	=	The absolute value of discretionary accruals measured using Kothari et al. (2005) model;
CEOown	=	The ratio of stock ownership (Execucomp item SHROWN_EXCL_OPTS) by the CEO to total shares outstanding (Compustat item CSHO), where missing observations are coded zero;
CEOage	=	Natural logarithm of CEO age (Execucomp item AGE)
CEOchair	=	1 if a firm's CEO is also the board of director's chairman and coded equal to 0 otherwise (Execucomp).

Alternative Measures of CEO Ability		
Historical ROA	=	The five-year industry-adjusted return on assets (cumulative income before extraordinary items scaled by average total assets from year *t-5* to year *t-1*);
Historical Return	=	The five-year historical value-weighted industry-adjusted return (from year *t-5* to year *t-1*);
CEOtenure	=	Natural logarithm of the number of years that an executive has been listed as CEO by Execucomp as of year *t-1*;
Media Citation	=	Natural logarithm of the number of articles mentioning the CEO over the preceding five-year period.

TABLE 1
Sample Selection

Panel A. Sample selection of "Continuing CEOs"

All Computstat-Execucomp merged firm-years			40,572
Less:	Financial and utilities industries	8,877	
	Negative equity	1,210	
	Observations missing *Ability*	495	
	Observations missing *Delta*	1,146	
	Observations missing control variables	1,759	
	CEO turnover years	2,802	
	CEOs in the first three year of their service	6,073	
Total firm-year observations for the sample from 1994 - 2015			**18,210**

Panel B. Sample selection of "New CEOs"

All Computstat-Execucomp merged firm-years			40,572
Less:	Financial and utilities industries	8,877	
	Negative equity	1,210	
	Observations missing *Ability*	495	
	Observations missing *Delta*	1,146	
	Observations missing control variables	1,759	
	CEOs not in the first year of the CEO's service	23,110	
	Observations missing Tobin's q and ROA in year $t+1$	1,065	
	CEOs missing turnover data in year $t+1$	375	
Total firm-year observations for the sample from 1994 - 2015			**2,535**

Panel C. Yearly distribution

Year	Continuing CEOs	New CEOs
1994	914	47
1995	894	85
1996	852	105
1997	818	104
1998	843	104
1999	866	105
2000	810	138
2001	726	172
2002	725	138
2003	786	116
2004	841	125
2005	813	115
2006	792	141
2007	925	110
2008	862	118
2009	858	130
2010	890	110
2011	876	94
2012	859	121
2013	813	107
2014	760	121
2015	687	129
Total Observations	18,210	2,535

Table 1 Panel A and Panel B reports sample selection procedure for the sample with continuing CEOs and the sample with new CEOs, respectively. Panel C reports the sample distribution by year for each sample of continuing CEOs and new CEOs.

FIGURE 1
Timeline for Defining Continuing CEOs and New CEOs

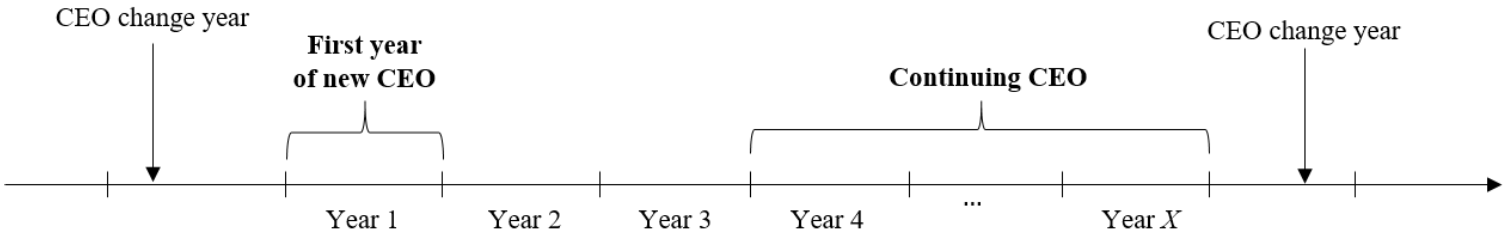

Figure 1 presents the timeline for defining variables related to the service years of a continuing CEO and a new CEO. The first full years managed by new CEO are defined as the sample of "new CEOs" while, the sample of "continuing CEOs" refers to the years excluding the early years, which correspond to the first three years of CEOs' service.

TABLE 2
Descriptive Statistics

Panel A. Measures of managerial ability and compensation incentives

	Continuing CEOs (N=18,210)		New CEOs (N=2,535)			
Variables	Mean	Median	Mean	Median	*Diff*	*t*-statistics
Ability	0.010	-0.024	0.008	-0.027	0.002	(0.49)
Abilityr	0.564	0.600	0.550	0.500	0.014	(2.42)**
Delta ($000)	1,499	262	255	100	1,244	(4.35)***
Vega ($000)	138	46	95	40	43	(6.96)***
Cash Compensation ($000)	1,159	854	1,101	832	58	(1.80)*
Delta	5.407	5.389	4.555	4.613	0.852	(32.92)***
Vega	3.675	3.879	3.480	3.714	0.195	(4.43)***
CashComp	6.785	6.762	6.731	6.725	0.054	(2.72)***

Panel B. Firm characteristics for the sample of new CEOs in their first years

Variables	N	Mean	STD	Q1	Median	Q3
Size	2,535	7.356	1.638	6.176	7.256	8.402
Leverage	2,535	0.210	0.168	0.056	0.200	0.315
ΔROA	2,535	0.005	0.110	-0.024	0.004	0.032
RET	2,535	0.136	0.507	-0.165	0.079	0.333
STDROA	2,535	0.070	0.104	0.020	0.039	0.080
STDRET	2,535	0.512	0.542	0.244	0.370	0.588
MB	2,535	3.361	4.410	1.419	2.195	3.503
Loss	2,535	0.339	0.473	0.000	0.000	1.000
Discretion	2,233	0.122	0.444	0.021	0.053	0.112
CEOown	2,535	0.003	0.010	0.000	0.000	0.001
CEOage	2,431	3.978	0.125	3.892	3.989	4.060
CEOchair	2,535	0.359	0.480	0.000	0.000	1.000

Panel C. Matching quality for the sample of new CEOs in their first years

Variables	N	Mean	STD	Q1	Median	Q3
$TobinQ_{t+1}$	2,535	0.174	1.055	-0.377	-0.035	0.462
$OperPerf_{t+1}$	2,535	0.040	0.138	-0.012	0.032	0.089
CEO Turnover$_{t+1}$	2,535	0.104	0.306	0.000	0.000	0.000
Forced CEO Turnover$_{t+1}$	2,535	0.024	0.154	0.000	0.000	0.000
Unforced CEO Turnover$_{t+1}$	2,535	0.080	0.271	0.000	0.000	0.000

Table 2 presents summary statistics over the sample period 1994-2015. Panel A compares the mean and median value of managerial ability and incentive variables used in my analysis. Panel B reports descriptive statistics for selected firm characteristics using the sample of new CEOs in their first years. Panel C reports descriptive statistics for measures of matching quality. All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles.

TABLE 3
Correlations

Panel A. Pearson Correlation using Continuing CEO Sample (N=18,210)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	*Ability*											
(2)	*Abilityr*	**0.804**										
(3)	*Delta*	**0.208**	**0.154**									
(4)	*Vega*	**0.139**	**0.080**	**0.442**								
(5)	*CashComp*	**0.101**	**0.056**	**0.354**	**0.420**							
(6)	*Size*	**0.091**	**0.031**	**0.426**	**0.469**	**0.583**						
(7)	*Leverage*	**-0.196**	**-0.188**	**-0.030**	**0.086**	**0.203**	**0.348**					
(8)	*ΔROA*	**0.048**	**0.049**	**0.057**	0.013	**0.073**	**-0.021**	**-0.038**				
(9)	*RET*	**0.040**	**0.036**	**0.128**	0.006	**0.036**	**-0.070**	**-0.065**	**0.263**			
(10)	*STDROA*	**0.124**	**0.087**	**-0.092**	**-0.044**	**-0.199**	**-0.278**	**-0.146**	**0.025**	**0.056**		
(11)	*STDRET*	**0.042**	**0.026**	**-0.038**	**-0.064**	**-0.162**	**-0.220**	**-0.074**	**-0.023**	0.008	**0.372**	
(12)	*MB*	**0.211**	**0.183**	**0.273**	**0.099**	**0.049**	**-0.016**	**0.043**	**0.081**	**0.196**	**0.101**	**0.048**

Panel B. Pearson Correlation using New CEO Sample (N=2,535)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	*Ability*											
(2)	*Abilityr*	**0.812**										
(3)	*Delta*	**0.230**	**0.164**									
(4)	*Vega*	**0.188**	**0.139**	**0.680**								
(5)	*CashComp*	**0.163**	**0.134**	**0.388**	**0.385**							
(6)	*Size*	**0.204**	**0.141**	**0.510**	**0.452**	**0.555**						
(7)	*Leverage*	**-0.121**	**-0.112**	0.033	**0.054**	**0.131**	**0.315**					
(8)	Δ*ROA*	0.013	-0.002	**0.055**	0.016	**-0.052**	**-0.052**	-0.014				
(9)	*RET*	0.015	0.009	**0.121**	0.024	**0.062**	-0.016	0.005	**0.158**			
(10)	*STDROA*	0.020	-0.012	**-0.108**	**-0.095**	**-0.159**	**-0.260**	**-0.102**	**0.147**	0.017		
(11)	*STDRET*	-0.014	-0.015	**-0.072**	**-0.113**	**-0.100**	**-0.170**	**-0.070**	0.034	-0.002	**0.320**	
(12)	*MB*	**0.070**	**0.068**	**0.070**	**0.059**	0.037	0.036	**0.172**	0.031	0.039	0.020	0.023

Table 3 reports Pearson correlations. All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Bold values indicate the statistical significance at 5% level.

FIGURE 2
CEO Ability-Delta Arrangements

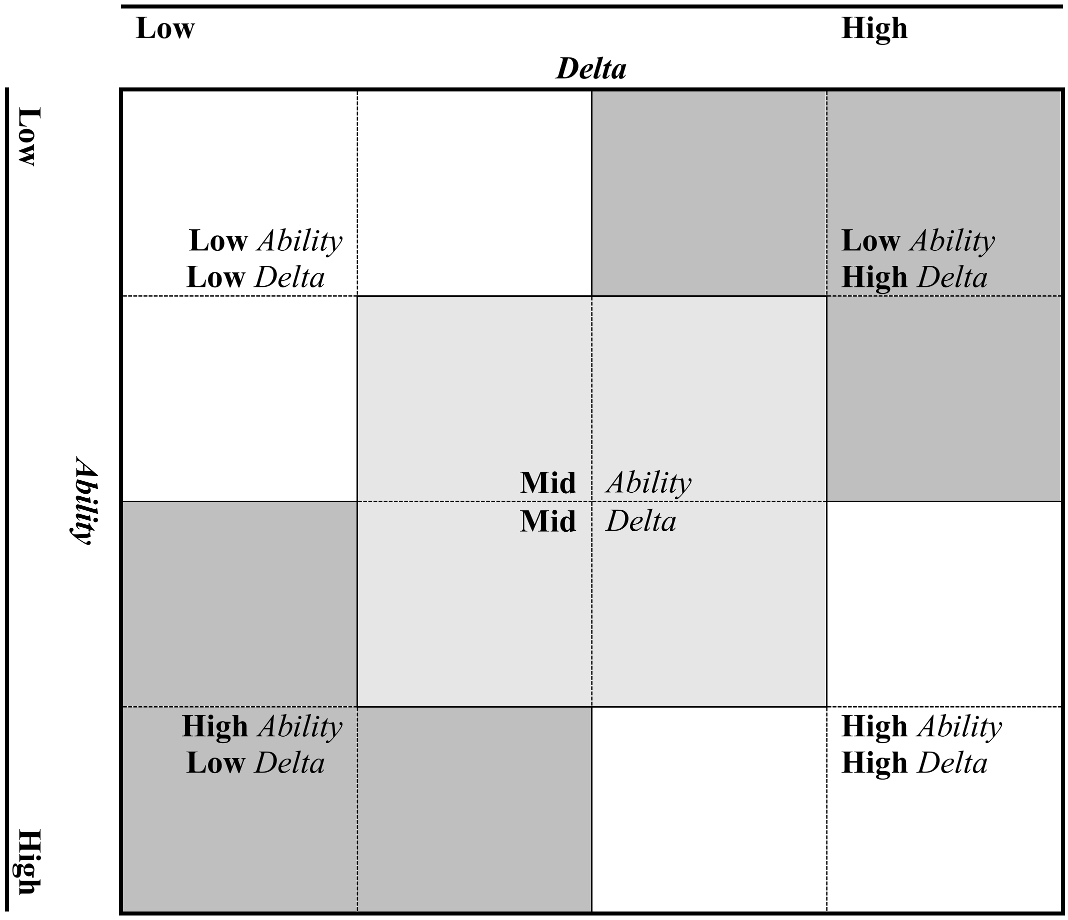

Figure 2 presents heterogeneous CEO ability-delta combinations. Using the sample of "new CEOs", I sort the sample into quartiles of *Ability* and quartiles of *Delta*. Then, I define the groups of Low *Ability*-Low *Delta*, Low *Ability*-High *Delta*, High *Ability*-Low *Delta*, High *Ability*-High *Delta* and *Mid* Ability-*Mid* Delta.

FIGURE 3
Delta by Ability Deciles

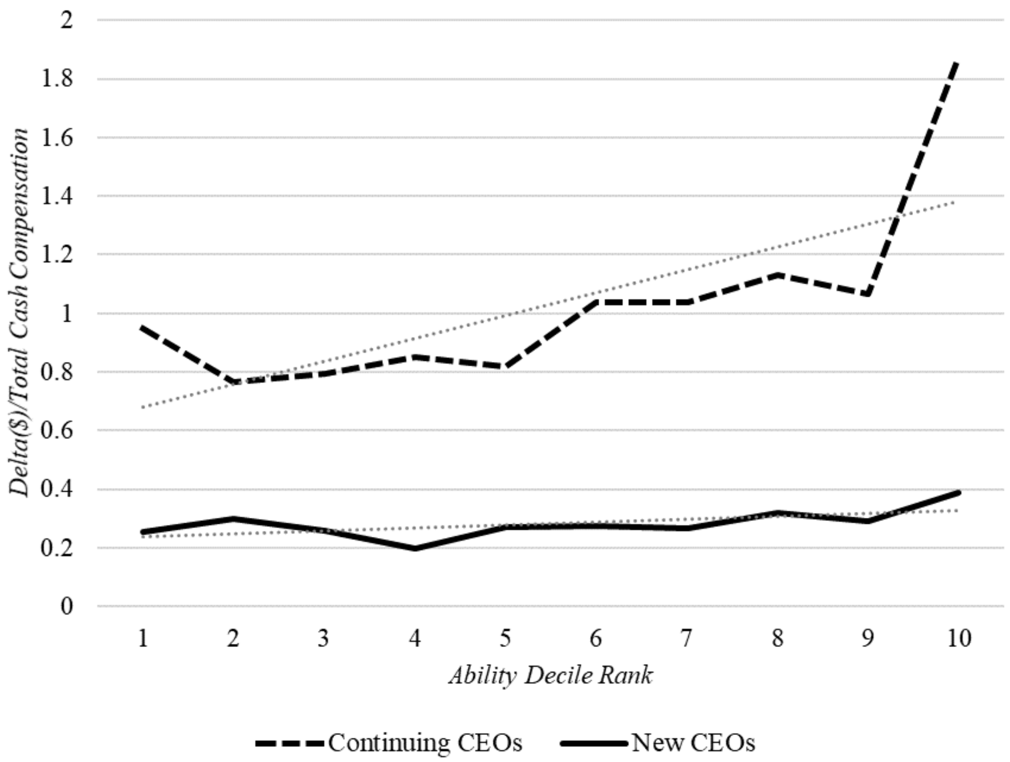

Figure 3 plots the delta in dollar amounts scaled by total cash compensation across *Ability* deciles (by industry and year), separately for continuing CEOs (dotted line) and new CEOs (solid line).

TABLE 4
The Association between CEO Ability and PPS

Panel A. Using Continuing CEO Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Dep.var =	*Delta*	*Delta*	*Scaled Delta*	*Scaled Delta*	*Delta*	*Scaled Delta*
Ability	0.497***		1.025**			
	(3.89)		(2.36)			
Abilityr		0.217***		0.288**		
		(3.97)		(2.04)		
HighAbility					0.109***	0.205*
					(2.72)	(1.85)
LowAbility					-0.058*	-0.115*
					(-1.94)	(-1.88)
Vega	0.182***	0.183***	-0.059	-0.057	0.183***	-0.057
	(10.51)	(10.52)	(-1.14)	(-1.11)	(10.54)	(-1.11)
CashComp	0.085*	0.086*	-2.231***	-2.227***	0.086*	-2.229***
	(1.81)	(1.83)	(-10.83)	(-10.80)	(1.82)	(-10.81)
Size	0.386***	0.390***	0.974***	0.987***	0.389***	0.981***
	(15.72)	(15.72)	(9.56)	(9.39)	(15.66)	(9.46)
Leverage	-1.712***	-1.717***	-2.973***	-3.052***	-1.741***	-3.043***
	(-12.91)	(-12.92)	(-8.58)	(-8.43)	(-13.17)	(-8.52)
Δ*ROA*	0.154*	0.155*	0.515**	0.533**	0.161*	0.532**
	(1.78)	(1.79)	(2.35)	(2.42)	(1.86)	(2.42)
RET	0.272***	0.271***	0.272***	0.268***	0.272***	0.270***
	(13.85)	(13.82)	(5.58)	(5.53)	(13.81)	(5.57)
STDROA	-0.830***	-0.795***	-0.142	-0.033	-0.803***	-0.077
	(-4.17)	(-3.99)	(-0.31)	(-0.07)	(-4.03)	(-0.17)
STDRET	0.159***	0.160***	0.213**	0.218**	0.160***	0.215**
	(4.75)	(4.79)	(2.45)	(2.50)	(4.78)	(2.48)
MB	0.113***	0.113***	0.193***	0.197***	0.114***	0.196***
	(16.20)	(16.26)	(9.20)	(8.97)	(16.35)	(9.04)
Constant	1.907***	1.722***	10.283***	9.933***	1.853***	10.156***
	(3.41)	(3.06)	(6.47)	(6.28)	(3.32)	(6.40)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	18,210	18,210	18,210	18,210	18,210	18,210
Adj. R^2	0.426	0.426	0.236	0.235	0.425	0.235

Panel B. Using New CEO Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Dep.var =	*Delta*	*Delta*	*Scaled Delta*	*Scaled Delta*	*Delta*	*Scaled Delta*
Ability	0.356**		0.263**			
	(2.32)		(2.10)			
Abilityr		0.111*		0.061		
		(1.68)		(1.31)		
HighAbility					0.085*	0.040
					(1.67)	(1.12)
LowAbility					-0.007	-0.012
					(-0.14)	(-0.37)
Vega	0.431***	0.431***	0.042***	0.043***	0.431***	0.043***
	(18.96)	(18.97)	(2.93)	(2.95)	(19.00)	(2.96)
CashComp	0.093	0.092	-0.628***	-0.629***	0.092	-0.628***
	(1.58)	(1.56)	(-8.06)	(-8.06)	(1.56)	(-8.06)
Size	0.269***	0.274***	0.195***	0.199***	0.271***	0.198***
	(10.32)	(10.49)	(7.80)	(7.87)	(10.22)	(7.78)
Leverage	-0.907***	-0.927***	-0.552***	-0.576***	-0.941***	-0.582***
	(-5.51)	(-5.61)	(-4.72)	(-4.87)	(-5.69)	(-4.99)
Δ*ROA*	0.311*	0.316*	0.276**	0.280**	0.315*	0.280**
	(1.74)	(1.76)	(2.20)	(2.22)	(1.76)	(2.21)
RET	0.401***	0.402***	0.087***	0.087***	0.399***	0.086***
	(9.40)	(9.41)	(2.69)	(2.69)	(9.33)	(2.65)
STDROA	-0.470**	-0.444*	-0.264*	-0.242	-0.457*	-0.247
	(-1.99)	(-1.89)	(-1.74)	(-1.60)	(-1.94)	(-1.64)
STDRET	0.171***	0.172***	0.030	0.031	0.172***	0.031
	(3.23)	(3.25)	(1.22)	(1.25)	(3.26)	(1.27)
MB	0.021***	0.022***	0.009***	0.010***	0.022***	0.010***
	(4.88)	(4.94)	(4.00)	(4.12)	(4.96)	(4.16)
Constant	-0.235	-0.355	3.393***	3.311***	-0.279	3.352***
	(-0.74)	(-1.12)	(5.26)	(5.17)	(-0.87)	(5.26)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	2,535	2,535	2,535	2,535	2,535	2,535
Adj. R^2	0.585	0.584	0.223	0.221	0.584	0.221

Table 4 reports the estimation results of the association between CEO ability and delta. Panel A reports the results for continuing CEOs; Panel B for new CEOs in their first year. The dependent variables are *Delta* in columns (1), (2) and (5), and *ScaledDelta* in columns (3), (4), and (6). *Ability* is managerial ability scores developed by Demerjian et al. (2012); *Abilityr* is the decile rank (by industry and year) of *Ability*. *High(Low)Ability* is an indicator variable that equals to one if Ability is in the top(bottom) quartiles, and 0 otherwise. All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and

99th percentiles. Industry/year fixed effects are included and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 5
Alternative Measures of CEO Ability

Panel A. Using Continuing CEO Sample

	(1)	(2)	(3)	(4)	(5)	(6)
X =	*Ability$_{t-1}$*	*Abilityr$_{t-1}$*	*Historical ROA*	*Historical Returns*	*CEO tenure*	*Media Citation*
X	0.428***	0.202***	0.546***	1.269***	0.686***	0.081**
	(3.40)	(3.66)	(11.61)	(16.25)	(21.61)	(2.50)
Vega	0.183***	0.183***	0.188***	0.191***	0.210***	0.103***
	(10.51)	(10.51)	(10.78)	(10.58)	(12.79)	(3.31)
CashComp	0.087*	0.088*	0.101**	0.070	0.014	0.119**
	(1.85)	(1.86)	(2.07)	(1.42)	(0.31)	(1.98)
Size	0.385***	0.389***	0.382***	0.403***	0.423***	0.397***
	(15.61)	(15.65)	(14.97)	(15.74)	(18.76)	(10.81)
Leverage	-1.726***	-1.724***	-1.521***	-1.598***	-1.702***	-1.800***
	(-12.96)	(-12.93)	(-11.25)	(-11.33)	(-13.50)	(-9.36)
ΔROA	0.233***	0.240***	0.655***	0.211**	0.301***	0.083
	(2.63)	(2.73)	(7.47)	(2.34)	(3.42)	(0.61)
RET	0.275***	0.275***	0.290***	0.338***	0.282***	0.198***
	(13.92)	(13.95)	(14.39)	(15.58)	(13.88)	(7.02)
STDROA	-0.819***	-0.786***	-0.288	-1.067***	-0.296	-0.591*
	(-4.09)	(-3.93)	(-1.30)	(-4.43)	(-1.53)	(-1.94)
STDRET	0.160***	0.161***	0.214***	-0.477***	0.177***	0.219***
	(4.77)	(4.79)	(6.08)	(-8.78)	(5.63)	(4.69)
MB	0.114***	0.114***	0.105***	0.093***	0.115***	0.130***
	(16.32)	(16.35)	(15.21)	(12.61)	(16.01)	(12.47)
Constant	1.891***	1.722***	1.760***	2.405***	0.320	1.782**
	(3.38)	(3.06)	(3.14)	(3.90)	(0.52)	(2.32)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	18,163	18,163	17,088	15,229	15,730	7,884
Adj. R^2	0.425	0.425	0.449	0.468	0.529	0.443

Panel B. Using New CEO Sample

X' estimated while hired at the prior firm =	(1) *Ability$_{t-1}$*	(2) *Abilityr$_{t-1}$*	(3) *Historical ROA*	(4) *Historical Returns*	(5) *CEO tenure*	(6) *Media Citation*
X'	0.032	-0.080	0.120	1.024*	0.545***	-0.160
	(0.04)	(-0.22)	(0.36)	(1.68)	(6.44)	(-0.40)
Vega	0.316**	0.321**	0.287**	0.239**	0.206***	0.201
	(2.49)	(2.50)	(2.28)	(2.14)	(3.09)	(0.59)
CashComp	-0.185	-0.187	-0.200	-0.101	-0.661***	0.146
	(-1.10)	(-1.11)	(-1.20)	(-0.53)	(-8.91)	(0.53)
Size	0.462***	0.462***	0.499***	0.472***	0.892***	0.174
	(4.10)	(4.18)	(4.36)	(4.11)	(11.41)	(0.43)
Leverage	-2.986***	-2.986***	-3.056***	-3.292***	-4.478***	-8.060*
	(-3.39)	(-3.37)	(-2.95)	(-3.07)	(-6.49)	(-1.81)
ΔROA	0.903	0.867	0.450	0.700	2.553***	-6.823
	(1.14)	(1.09)	(0.61)	(0.72)	(3.21)	(-0.99)
RET	0.666**	0.658**	0.625	0.547	0.822***	-0.119
	(2.09)	(2.09)	(1.54)	(1.52)	(3.06)	(-0.13)
STDROA	-3.777**	-3.739*	-3.250	-6.499**	-5.499**	-1.777
	(-1.99)	(-1.92)	(-1.34)	(-2.42)	(-2.63)	(-0.32)
STDRET	0.266	0.264	0.428**	0.052	0.337	0.268
	(1.45)	(1.44)	(2.03)	(0.18)	(1.67)	(0.72)
MB	0.001	0.002	-0.004	-0.007	0.040***	0.045*
	(0.11)	(0.13)	(-0.48)	(-0.83)	(11.05)	(1.81)
Constant	1.784	1.763	1.367	1.359	0.868	3.173**
	(1.25)	(1.30)	(1.08)	(1.00)	(1.39)	(2.06)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	129	129	121	112	56	34
Adj R^2	0.595	0.596	0.590	0.647	0.981	0.385

Table 5 reports the results of the association between CEO ability and delta using alternative measures of ability. Panel A reports the results for continuing CEOs; Panel B for new CEOs in their first year. The dependent variables are *Delta.* The following alternative measures of CEO ability are used. *Ability$_{t-1}$* is Demerjian et al. (2012)'s DEA-based managerial ability score estimated in year *t-1*; *Abilityr$_{t-1}$* is the decile rank of *Ability$_{t-1}$*; *Historical ROA* is the five-year industry-adjusted return on assets (cumulative income before extraordinary items scaled by total assets from year *t-5* to year *t-1*). *Historical Return* is the five-year historical value-weighted industry-adjusted return (from year *t-5* to year *t-1*). *CEO Tenure* is the natural logarithm of the number of years an individual has been listed as CEO by Execucomp as of year *t-1. Media Citation* is the natural logarithm of the number of articles mentioning the CEO over the preceding five-year period. For new CEOs in Panel B, the alternative measures of CEO ability are estimated when the newly appointed CEOs are employed at the prior company. All other variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 6
Alternative PPS Measures

	(1)	(2)	(3)	(4)
	Continuing CEOs		New CEOs	
Dep.var =	*Equity Grants*	*Total Comp*	*Equity Grants*	*Total Comp*
Ability	-0.118	0.194***	0.326	0.415***
	(-0.54)	(3.55)	(0.80)	(3.89)
Ability* × *RET	**0.540****	**0.133***	**0.004**	**0.028**
	(2.24)	**(1.87)**	**(0.01)**	**(0.16)**
RET	0.079**	0.035***	-0.134	-0.004
	(1.99)	(3.50)	(-0.98)	(-0.14)
Vega	0.567***	0.139***	0.486***	0.146***
	(20.81)	(20.71)	(10.97)	(13.06)
CashComp	0.345***	0.596***	0.333***	0.401***
	(4.61)	(24.90)	(2.93)	(8.84)
Size	0.281***	0.231***	0.318***	0.250***
	(7.69)	(23.45)	(5.63)	(15.32)
Leverage	-0.049	-0.171***	0.030	-0.111
	(-0.22)	(-3.33)	(0.08)	(-1.16)
ΔROA	-0.769***	-0.108*	-0.260	-0.010
	(-3.37)	(-1.75)	(-0.50)	(-0.08)
STDROA	1.329***	0.679***	0.185	0.418**
	(3.63)	(7.79)	(0.27)	(2.49)
STDRET	0.175***	0.119***	0.182*	0.113***
	(2.69)	(7.21)	(1.87)	(3.67)
MB	0.031***	0.025***	-0.001	0.001
	(3.36)	(9.90)	(-0.10)	(0.26)
Constant	-1.335**	1.100***	-0.855	2.574***
	(-2.06)	(6.08)	(-0.76)	(9.58)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm
N	18,210	18,210	2,535	2,535
Adj. R^2	0.287	0.692	0.223	0.646

Table 6 reports the results of the association between managerial ability and alternative measure of pay for performance sensitivity using Equation (5). The dependent variables are defined as follows. *EquityGrants* is the sum of a CEO's equity and stock grands during the year; *TotalComp* is total CEO compensation. All variables are defined in the Appendix and all continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. Industry/year fixed effects are included and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 7
Alternative Model Specifications for Continuing CEO Sample

Panel A. Change Regressions

Dep.var =	(1) Δ*Delta*	(2) Δ*Delta*	(3) Δ*Delta*	(4) Δ*Delta*
Δ*Ability*	0.117**		0.097**	
	(2.46)		(2.00)	
Δ*Abilityr*		0.021		0.014
		(1.25)		(0.80)
Δ*Vega*	0.332***	0.332***	0.324***	0.324***
	(29.98)	(29.99)	(27.74)	(27.74)
Δ*CashComp*	0.135***	0.136***	0.119***	0.119***
	(9.76)	(9.80)	(8.38)	(8.41)
Δ*Size*	0.046**	0.044**	-0.005	-0.006
	(2.33)	(2.26)	(-0.20)	(-0.27)
Δ*Leverage*	-0.584***	-0.586***	-0.565***	-0.565***
	(-9.80)	(-9.81)	(-8.84)	(-8.83)
Δ*ROA*	1.175***	1.186***	1.138***	1.148***
	(18.45)	(18.66)	(17.12)	(17.31)
Δ*STDROA*	0.155***	0.155***	0.151***	0.151***
	(20.87)	(20.82)	(19.74)	(19.69)
Δ*STDRET*	-0.147	-0.149	-0.152	-0.153
	(-1.08)	(-1.09)	(-0.98)	(-0.98)
Δ*MB*	0.215***	0.214***	0.249***	0.249***
	(9.08)	(9.04)	(9.67)	(9.64)
Constant	0.083***	0.083***	0.085***	0.085***
	(20.50)	(20.49)	(18.99)	(18.99)
Constant	-0.008	-0.007	0.041**	0.041**
	(-0.08)	(-0.07)	(2.28)	(2.28)
Industry FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm
N	16,448	16,448	16,448	16,448
Adj. R^2	0.447	0.447	0.448	0.447

Panel B. Various Fixed Effects Model Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
	Firm FE	Firm FE	CEO FE	CEO FE	CEO-Firm FE	CEO-Firm FE
Dep.var =	*Delta*	*Delta*	*Delta*	*Delta*	*Delta*	*Delta*
Ability	0.328***		0.395***		0.399***	
	(3.17)		(4.30)		(4.32)	
Abilityr		0.157***		0.164***		0.168***
		(3.72)		(4.49)		(4.62)
Vega	0.230***	0.230***	0.265***	0.265***	0.262***	0.262***
	(13.41)	(13.42)	(16.82)	(16.85)	(16.51)	(16.53)
CashComp	0.195***	0.195***	0.226***	0.228***	0.231***	0.233***
	(5.69)	(5.73)	(8.32)	(8.38)	(8.33)	(8.39)
Size	0.364***	0.369***	0.260***	0.264***	0.257***	0.262***
	(10.75)	(10.82)	(8.12)	(8.18)	(7.58)	(7.65)
Leverage	-1.203***	-1.203***	-1.126***	-1.132***	-1.127***	-1.131***
	(-10.04)	(-10.08)	(-10.43)	(-10.47)	(-10.34)	(-10.37)
ΔROA	0.203***	0.201***	0.217***	0.219***	0.218***	0.220***
	(2.68)	(2.67)	(3.22)	(3.28)	(3.24)	(3.29)
RET	0.202***	0.202***	0.176***	0.175***	0.174***	0.173***
	(12.69)	(12.68)	(12.98)	(12.93)	(12.79)	(12.74)
STDROA	-0.245	-0.244	-0.027	-0.022	-0.013	-0.009
	(-1.27)	(-1.26)	(-0.17)	(-0.13)	(-0.08)	(-0.05)
STDRET	0.230***	0.229***	0.140***	0.138***	0.143***	0.141***
	(6.04)	(6.01)	(3.74)	(3.70)	(3.77)	(3.72)
MB	0.108***	0.108***	0.093***	0.094***	0.094***	0.094***
	(15.70)	(15.72)	(13.18)	(13.22)	(12.99)	(13.03)
Constant	0.625**	0.509*	0.702***	0.578**	0.692***	0.561**
	(2.21)	(1.79)	(2.83)	(2.28)	(2.65)	(2.11)
Firm FE	Yes	Yes	No	No	No	No
CEO FE	No	No	Yes	Yes	No	No
CEO×Firm FE	No	No	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	CEO	CEO	CEO	CEO
N	18,210	18,210	18,210	18,210	18,210	18,210
Adj. R^2	0.776	0.776	0.866	0.866	0.867	0.867

Table 7 Panel A reports the results using change models. Panel B reports the regression results controlling for firm/year fixed effects in column (1) and (2), CEO/year fixed effects in column (3) and (4), and CEO-firm/year fixed effects in column (5) and (6). All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by firm (in column (1) and (2)) or CEO (in column (3) through (6)). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 8
Tobin's *q* (Operating Performance) by Ability-Incentive Arrangements

Panel A. Univariate analysis

Ability - Incentive Arrangements:	*High-High*		*High-Low*	*Diff*	*Low-High*		*Low-Low*	*Diff*
Mean $TobinQ_{t+1}$	0.696	>	0.117	0.579^{***}	0.126	>	-0.178	0.304^{***}
Mean $OperPerf_{t+1}$	0.101	>	0.028	0.073^{***}	0.048	>	-0.013	0.061^{***}

Panel B. Multivariate regression

	(1)	(2)	(3)	(4)	(5)	(6)
Dep.var=	$TobinQ_{t+1}$	$TobinQ_{t+2}$	$TobinQ_{t+3}$	$OperPerf_{t+1}$	$OperPerf_{t+2}$	$OperPerf_{t+3}$
[1] *High Ability _High Delta*	0.646***	0.609***	0.491***	0.027***	0.025***	0.019**
	(8.94)	(8.40)	(6.70)	(3.84)	(3.14)	(2.37)
[2] *High Ability _Low Delta*	0.055	0.063	0.077	-0.011	-0.002	0.003
	(0.98)	(1.08)	(1.19)	(-1.49)	(-0.28)	(0.39)
[3] *Low Ability _High Delta*	0.150***	0.131**	0.073	-0.004	0.008	0.008
	(2.94)	(2.50)	(1.29)	(-0.62)	(1.22)	(1.35)
[4] *Low Ability _Low Delta*	-0.141***	-0.126**	-0.137**	-0.033***	-0.025***	-0.012
	(-2.96)	(-2.45)	(-2.36)	(-4.89)	(-3.50)	(-1.51)
Vega	0.039**	0.031**	0.045**	0.001	0.003*	0.003
	(2.50)	(1.97)	(2.52)	(0.61)	(1.89)	(1.63)
CashComp	0.077**	0.076**	0.055	0.013***	0.013**	0.001
	(2.24)	(2.13)	(1.52)	(2.78)	(2.28)	(0.17)
Size	-0.096***	-0.096***	-0.077***	0.000	-0.001	0.002
	(-4.78)	(-4.79)	(-3.55)	(0.00)	(-0.55)	(0.68)
Leverage	-1.321***	-1.117***	-1.003***	-0.086***	-0.057***	-0.061***
	(-10.17)	(-8.22)	(-6.98)	(-4.91)	(-3.13)	(-3.33)
ΔROA	0.003	-0.545***	-0.472**	0.011	-0.073**	-0.062*
	(0.01)	(-2.75)	(-2.04)	(0.35)	(-2.31)	(-1.77)
RET	0.224***	0.184***	0.152***	0.058***	0.033***	0.021***
	(4.85)	(3.85)	(3.04)	(9.83)	(5.51)	(3.57)
STDROA	0.282	0.454	1.104***	-0.211***	-0.130***	-0.110**
	(0.99)	(1.44)	(2.97)	(-5.17)	(-3.40)	(-2.48)
STDRET	0.049	0.014	-0.062	0.003	-0.007	-0.010
	(0.87)	(0.25)	(-1.26)	(0.45)	(-1.13)	(-1.56)
MB	0.060***	0.055***	0.046***	0.003***	0.003***	0.003***
	(7.63)	(7.41)	(5.58)	(4.87)	(4.97)	(3.99)

Constant	1.323***	1.336**	1.130**	-0.014	-0.005	-0.026
	(2.60)	(2.38)	(2.33)	(-0.40)	(-0.13)	(-0.59)
***F*-test statistics**						
[*p*-value]						
[1] = [2]	65.08	49.63	25.70	39.37	10.34	2.63
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.105]
[3] = [4]	26.81	19.13	10.59	69.44	19.50	6.19
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.013]
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	2,535	2,415	2,175	2,535	2,418	2,178
Adj. R^2	0.320	0.275	0.216	0.392	0.407	0.391

Table 8 reports the results on the matching quality of different ability-incentive arrangements. Panel A reports mean industry adjusted Tobin's *q* (*TobinQ*) in year *t+1* and mean industry-adjusted ROA (*OperPerf*) in year *t+1* for each ability-incentive arrangement. Panel B reports the results for estimates of Equation (2). All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 9
CEO Turnover
by Ability-Incentive Arrangements

Panel A. Univariate analysis

Ability-Incentive Arrangements:	*High-High*	*High-Low*	*Diff*	*Low-High*	*Low-Low*	*Diff*
Mean *CEO Turnover*$_{t+1}$	0.062	0.123	-0.061***	0.060	0.116	-0.056***
Mean *Forced CEO Turnover*$_{t+1}$	0.015	0.030	-0.015	0.013	0.040	-0.027***
Mean *Unforced CEO Turnover*$_{t+1}$	0.047	0.093	-0.046***	0.048	0.076	-0.028

Panel B. Multivariate regression

	(1) LPM	(2) LPM	(3) LPM	(4) Logit	(5) Logit	(6) Logit
Dep.var =	*CEO Turnover*	*Forced CEO Turnover*	*Unforced CEO Turnover*	*CEO Turnover*	*Forced CEO Turnover*	*Unforced CEO Turnover*
	Coeff. (*t*-stat)	Coeff. (*t*-stat)	Coeff. (*t*-stat)	Odds ratio (*z*-stat)	Odds ratio (*z*-stat)	Odds ratio (*z*-stat)
[1] *High Ability*	-0.000	0.002	-0.002	0.915	1.064	0.889
_High Delta	(-0.00)	(0.14)	(-0.09)	(-0.25)	(0.08)	(-0.30)
[2] *High Ability*	0.044**	0.011	0.033**	1.774**	1.769	1.776**
_Low Delta	(2.46)	(1.19)	(1.99)	(2.46)	(1.30)	(2.06)
[3] *Low Ability*	0.008	0.005	0.003	1.007	1.249	0.951
_High Delta	(0.45)	(0.57)	(0.18)	(0.02)	(0.36)	(-0.15)
[4] *Low Ability*	0.043**	0.031***	0.012	1.860**	4.014***	1.341
_Low Delta	(2.21)	(2.73)	(0.69)	(2.45)	(3.00)	(0.96)
Vega	-0.005	0.003	-0.007*	0.953	1.310	0.900
	(-0.95)	(1.15)	(-1.66)	(-0.75)	(1.34)	(-1.57)
CashComp	-0.030**	-0.023***	-0.007	0.717*	0.443***	0.903
	(-2.02)	(-2.62)	(-0.57)	(-1.81)	(-2.67)	(-0.47)
Size	0.012*	0.003	0.009	1.176*	0.922	1.197*
	(1.74)	(0.88)	(1.45)	(1.89)	(-0.49)	(1.88)
Leverage	-0.071	-0.054**	-0.017	0.410	0.093**	0.768
	(-1.57)	(-2.43)	(-0.41)	(-1.48)	(-2.16)	(-0.37)
Δ*ROA*	-0.005	0.076*	-0.081	0.779	6.047*	0.271
	(-0.06)	(1.78)	(-1.28)	(-0.34)	(1.77)	(-1.40)
RET	-0.034**	-0.006	-0.028**	0.655*	0.917	0.600**
	(-2.11)	(-0.62)	(-2.21)	(-1.92)	(-0.28)	(-2.01)

STDROA	0.201*	0.102	0.100	6.633**	6.825	4.338
	(1.79)	(1.20)	(1.14)	(1.97)	(1.01)	(1.39)
STDRET	-0.007	-0.003	-0.004	0.950	0.980	0.963
	(-0.45)	(-0.31)	(-0.30)	(-0.30)	(-0.05)	(-0.21)
MB	0.001	0.001	-0.000	1.015	1.058**	0.998
	(0.82)	(1.45)	(-0.27)	(0.93)	(2.03)	(-0.10)
Loss	0.068***	0.014	0.054***	2.204***	1.622	2.328***
	(3.38)	(1.32)	(3.07)	(3.83)	(1.25)	(3.50)
Discretion	0.628	0.372	0.255	9.551	222.448	0.906
	(0.47)	(0.45)	(0.22)	(0.15)	(0.23)	(-0.01)
CEOown	-0.011	-0.009	-0.002	0.834	0.276	0.908
	(-0.24)	(-0.39)	(-0.05)	(-0.27)	(-0.54)	(-0.15)
CEOage	0.258***	0.011	0.248***	32.082***	2.312	83.183***
	(4.27)	(0.32)	(4.52)	(4.13)	(0.55)	(4.35)
CEOchair	0.005	0.001	0.004	1.086	1.075	1.106
	(0.41)	(0.14)	(0.37)	(0.44)	(0.18)	(0.48)
***F*-test statistics [*p*-value]**						
[1] = [2]	3.46	0.43	2.86	3.66	0.47	3.16
	[0.0631]	[0.5099]	[0.0911]	[0.0558]	[0.4949]	[0.0754]
[3] = [4]	2.51	4.45	0.20	3.71	3.16	0.80
	[0.1136]	[0.0351]	[0.6541]	[0.0540]	[0.0755]	[0.3718]
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	2,134	2,134	2,134	2,134	2,134	2,134
Adj. (Pseudo) R^2	0.043	0.043	0.031	0.141	0.272	0.154

Table 9 reports the results on CEO retention/dismissal decisions of different ability-incentive arrangements. Panel A reports mean probability of CEO turnover, forced CEO turnover and unforced (voluntary) CEO turnover in year *t+1* for each ability-incentive arrangement. Panel B reports the results for estimates of Equation (2). All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 10
Robustness Tests for CEO Turnover Analyses

	(1)	(2)	(3)	(4)
	OLS	OLS	Cox Model	Cox Model
Dep.var=	*Leftyrs*	*Leftyrs*	Hazard Ratio	Hazard Ratio
High Ability_High Delta	0.295	-0.141	0.950	1.110
	(0.93)	(-0.41)	(0.511)	(0.247)
High Ability_Low Delta	-0.789***	-0.661**	1.289***	1.256***
	(-2.76)	(-2.33)	(0.001)	(0.004)
Low Ability_High Delta	0.247	0.119	0.962	1.030
	(0.85)	(0.40)	(0.584)	(0.709)
Low Ability_Low Delta	-0.723**	-0.510*	1.273***	1.228***
	(-2.52)	(-1.79)	(0.001)	(0.008)
Controls	No	Yes	No	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	1,397	1,397	1,397	1,397
Adj. R^2	0.112	0.195	N/A	N/A

Table 10 reports the robustness results regarding CEO turnover analyses. All variables are defined in the Appendix and all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 11
Incentive Adjustments Toward the Optimal Level

Panel A. Univariate analysis

Ability-Incentive Arrangements	N	Mean *Optimal Delta*	Mean *Delta*	*Deviation*	Test:*Deviation=0* (*t*-statistics)
High Ability-High Delta	441	6.296	6.213	0.060	(3.48)***
High Ability-Low Delta	408	3.960	3.600	0.329	(15.73)***
Low Ability-High Delta	434	5.752	5.680	0.068	(4.27)***
Low Ability-Low Delta	399	3.550	3.127	0.398	(20.24)***

Panel B. Multivariate regression

	(1)	(2)	(3)	(4)	(5)	(6)
	High Ability-High Delta			*High Ability-Low Delta*		
	Full	Above *Deviation* <0	Below *Deviation* >0	Full	Above *Deviation* <0	Below *Deviation* >0
Deviation	0.670***	0.532**	0.643***	1.051***	1.112	0.909***
	(6.51)	(2.14)	(3.66)	(6.58)	(1.06)	(4.09)
Vega	0.040	-0.025	0.083**	-0.011	0.004	-0.025
	(1.55)	(-0.71)	(2.09)	(-0.41)	(0.02)	(-0.87)
CashComp	-0.001	0.053	-0.067	-0.023	-0.659	-0.060
	(-0.01)	(0.67)	(-1.03)	(-0.23)	(-1.02)	(-0.50)
Size	0.018	0.030	0.018	0.008	0.221	0.005
	(0.81)	(0.63)	(0.63)	(0.24)	(1.20)	(0.12)
Leverage	0.003	-0.077	0.082	0.412**	0.008	0.524**
	(0.02)	(-0.20)	(0.33)	(1.99)	(0.01)	(2.37)
Δ*ROA*	0.202	0.421	-0.286	0.527	1.623	0.105
	(0.53)	(0.65)	(-0.49)	(1.48)	(1.27)	(0.27)
RET	0.082	0.117	0.047	-0.022	-0.725	0.041
	(1.19)	(0.69)	(0.56)	(-0.23)	(-1.07)	(0.46)
STDROA	-0.095	0.127	0.172	0.132	-0.151	0.021
	(-0.22)	(0.15)	(0.26)	(0.31)	(-0.03)	(0.04)
STDRET	-0.003	-0.066	0.074	0.126*	0.028	0.088
	(-0.04)	(-0.37)	(0.76)	(1.88)	(0.11)	(1.02)
MB	0.000	0.003	-0.001	-0.000	-0.008	0.003
	(0.02)	(0.46)	(-0.15)	(-0.03)	(-0.19)	(0.67)
Constant	-0.513	-2.240***	-0.224	-0.286	2.981	-0.183
	(-1.21)	(-3.53)	(-0.41)	(-0.57)	(1.24)	(-0.20)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	441	181	260	408	75	333
Adj. R^2	0.296	0.097	0.161	0.278	0.089	0.107

(*continued*)

	(7)	(8)	(9)	(10)	(11)	(12)
	Low Ability-High Delta			*Low Ability-Low Delta*		
	Full	Above	Below	Full	Above	Below
		Deviation <0	*Deviation* >0		*Deviation* <0	*Deviation* >0
Deviation	0.719***	0.753*	0.541***	1.065***	2.404	1.092***
	(6.43)	(1.93)	(2.97)	(7.42)	(1.24)	(5.71)
Vega	0.008	0.004	0.014	0.011	-0.001	0.023
	(0.33)	(0.07)	(0.56)	(0.40)	(-0.00)	(0.77)
CashComp	0.070	0.103	0.055	-0.110	-1.375**	-0.077
	(1.37)	(0.85)	(0.97)	(-1.35)	(-2.15)	(-0.99)
Size	0.008	0.057	-0.026	0.040	0.194	0.029
	(0.26)	(0.77)	(-0.79)	(1.11)	(0.59)	(0.74)
Leverage	0.022	-0.289	0.166	-0.003	-1.629	-0.020
	(0.10)	(-0.53)	(0.74)	(-0.01)	(-0.52)	(-0.08)
Δ*ROA*	0.123	0.372	-0.497	0.376	0.818	0.409
	(0.31)	(0.39)	(-1.12)	(1.10)	(0.27)	(1.19)
RET	-0.077	-0.034	-0.064	-0.003	0.450	-0.011
	(-1.06)	(-0.20)	(-0.70)	(-0.04)	(0.54)	(-0.13)
STDROA	-0.416	-0.743	1.431	-0.075	-4.967	0.056
	(-0.95)	(-1.13)	(1.31)	(-0.23)	(-0.94)	(0.16)
STDRET	-0.045	-0.070	-0.001	-0.021	0.479	-0.122
	(-0.47)	(-0.25)	(-0.01)	(-0.32)	(0.63)	(-1.59)
MB	-0.001	0.004	-0.004	0.005	0.081	0.007
	(-0.22)	(0.29)	(-0.62)	(0.62)	(0.87)	(0.76)
Constant	-0.285	-0.358	-0.183	0.387	8.409**	0.205
	(-0.87)	(-0.40)	(-0.50)	(0.53)	(2.29)	(0.27)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	434	151	283	399	59	340
Adj. R^2	0.282	0.138	0.157	0.271	0.333	0.172

Table 11 reports the results on incentive adjustments for each ability-incentive arrangements. Panel A reports mean optimal delta, mean actual delta and the mean difference between the optimal delta and the actual delta for each ability-incentive arrangement. Panel B reports the results for estimates of Equation (7) for each arrangement. All variables are defined in the Appendix and all continuous variables are winsorized at the 1st

and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Essay 2

Pay-Performance Sensitivity by the Direction of Sales Change

1. Introduction

This paper investigates whether the sale change direction influences the pay sensitivity of earnings in CEO compensation contracts. The cost accounting literature (e.g., Anderson et al. 2003; Banker and Chen 2006; Banker and Byzalov 2014; Banker et al. 2016) has demonstrated the asymmetry in cost and earnings behavior with respect to sales change direction. These studies suggest that earnings contain different level of information via revenue movements. In this regards, earnings as a performance indicator should be interpreted differently conditioned on the sales change direction. Considering earnings as an important performance measure in determining CEO compensation, I examine whether firms adjust the pay sensitivity of earnings by the direction of sales change.

Cost stickiness can be a crucial influence on the asymmetry in earnings behavior. Prior studies on cost stickiness document that costs are “sticky” in the sense that they rise more for sales increases than they fall for equivalent decreases (Anderson et al. 2003). This asymmetric cost behavior demonstrates that the firm’s operation activities are changing according to the demand states, and costs are relatively higher during downturn periods. Anderson et al. (2003) point out that cost stickiness is not a random shock, but the asymmetric adjustment of operational resources hinges on the manager’s optimal behavioral response to changes in sales revenue. When sales decrease, managers maintain some slack resources there are maintained costs on slack resources to avoid incurring adjustment costs associated with cutting resources and future adjustment costs to restore resources when sales rebound. However, when managers make such resource retention decisions in response to sales declines because costs enter earnings with a negative sign, earnings become relatively lower in sales decrease period compared to that in sales increase periods (i.e. the asymmetry in earnings behavior). In other words, earnings in sales-decrease periods do not perfectly capture the true value of managerial effort and performance. In this regards, I posit the asymmetry in earnings behavior due to manager's asymmetric adjustment of operational resources as a crucial reason that I should separate pay sensitivity of earnings between sales-increase versus sales-decrease periods.

Moreover, the decreased information content in earnings in sales decreasing periods can be attributed to the following factors. First, sales-decrease is more of an anomaly than the norm in the long run from the perspective of the ongoing business concern. Earnings are likely to persist if the business forces that generate earnings in the current period continue into the next period (Dichev and Tang 2009). However, in response to dwindling demand, the management likely undertakes various transformations in business operations to avoid the further decrease in sales. It is indeed very uncommon to observe firms with a prolonged history of sales decrease. Thus, an earnings number associated with a sales-decrease is more likely to be transitory in nature and do not reflect a sustained relation between sales and earnings in the long run. Next, when an earnings increase is accompanied by a sales-decrease, it is more likely that the increase in earnings is attained by accrual management. Prior studies document various forms of earnings management when firms encounter adverse business circumstances such as losses, missing target or analysts' forecasts. A sales decrease, *ceteris paribus*, can be another important driver for such impairment of earnings, causing low earnings persistence or low quality of earnings. Moreover, there is great uncertainty regarding the outcome of managerial actions taken to boost future revenues under weak demand condition. In other words, it is harder to predict the value of managerial effort during sales decrease periods because such efforts are likely to be corrective actions to overcome the adverse conditions rather than proactive actions taken to sustain long term cash flows. Hence, earnings in sales-decrease periods are less reflective of managerial effort and its contribution to a firm's performance.

Meanwhile, CEO compensation literature has devoted considerable effort in investigating how firms allocate weights among the various performance measures in their incentive compensation contracts. Since both theory and empirical evidence support that premise that earnings are incrementally useful over other measures for contracting purposes (Holmstrom 1979; Lambert and Larcker 1987; Jensen and Murphy 1990; Sloan 1993; Baber et al. 1996), I focus on earnings. The weight placed on a specific performance measure depends on the signal-to-noise ratio of that measure (Banker and Datar 1989). The signal-to-noise ratio of performance measure can vary with the characteristics of a firm and changes in its business environment such as sales change direction. Bushman et al. (2006) investigate the weight placed on earnings in compensation contracts by measuring pay sensitivity to accounting earnings and suggest the role of earnings as one of the important performance measures in shaping incentive compensation. In my study, I investigate whether the pay sensitivity of earnings is greater for sales increase periods than sales decrease periods.

I analyze the pay sensitivity of earnings for each type of compensation, including cash compensation and equity-based compensation, and compare the magnitude for sales-increasing and sales-decreasing periods. I observe that firms place remarkably lower weights on earnings in determining the incentive compensation for CEO when sales decline; the results hold for both cash compensation and equity-based compensation. In addition, the results are more pronounced for the firms that experience earnings decrease than those with earnings increase. This implies that compensation committees understand the underlying reason for earnings decrease and places lower weights on earnings in sales-decreasing periods even if firms report lower earnings in the current year than the previous year. I argue that compensation committees offer the CEO an optimal incentive contract conditional on sales change direction. In contrast to the optimal contracting explanation, one may raise a concern of some powerful CEOs inducing boards to lower the pay sensitivity of earnings in sales decreasing periods. However, I find that the result of lower pay sensitivity of earnings in sales decreasing periods than in sales increasing periods does not differ by CEO power (measured using CEO/Chair duality and CEO age), potentially mitigating the concern of rigging incentive pay by powerful CEOs. To further extent, I find a shift of weight from contemporaneous earnings to past earnings for compensation purposes when sales decreases but, exclusively for equity compensation. The aforementioned results hold using both ordinary least squares (OLS) and median regression, which is less sensitive to the problem of outliers (Green 2008). The results are also robust to various fixed effects model. Overall, the decline in pay-performance sensitivity for sales-decrease firms indicates that pay-performance sensitivity changes over time with the sales change direction. The adjustment of pay-performance sensitivity is consistent with the argument that earnings lack informativeness in sales decreasing periods.

My findings provide executive compensation literature with new empirical insights. First, I demonstrate that sales revenue information is an important addition to earnings information for performance evaluation. I verify how associations between compensation and accounting earnings weaken with a decrease in sales revenue regardless of whether compensation takes the form of cash or stock. Second, I demonstrate a shift in weights from contemporaneous earnings to past earnings information when compensation takes the form of stock in sales-decreasing periods. This result is consistent with Banker et al. (2013), which demonstrates how past performance measures relate to compensation. I further elaborate on the findings in Banker et al. (2013) by adding sales change direction.

The remainder of the paper is organized as follows. I develop the research hypotheses in Section 2. I describe the sample selection procedure and sample descriptive statistics in Section 3 and present results of the empirical analysis in Section 4. I conclude the paper in Section 5.

2. Hypotheses Development

Firms' operations and activity consumptions are not consistent over periods but change according to demand conditions. Earnings are likely to persist if the business forces that generate earnings in the current period continue into the next period (Dichev and Tang 2009). However, the earnings process may discontinue and lack information content if managers make changes in business operations and such changes can be motivated by various "economic shocks" such as a sales decline.

Anderson et al. (2003) demonstrate that cost stickiness is not a random shock but the asymmetric adjustment of resource results from the manager's deliberate response to changes in volume. Banker and Byzalov (2014) provides a thorough review on the literature following Anderson et al. (2003) and elaborate the idea that the interaction between deliberate managerial discretion and resource adjustment costs introduces complex dynamics in the choice of resource levels. That is, earnings are output from the manager's decisions around cost dimensions, such as cost structure, operational conditions, adjustment costs, etc. Consequently, the manager's asymmetric adjustment of operational resources is another crucial reason that I should separate how earnings are used in CEO incentive contracts for sales increase versus sales decrease periods.

Asymmetric cost behavior bears important implications for earnings behavior.

Firms with a sales decrease are more likely to face unrealized losses. Managers tend to delay cutting committed resources because of the uncertainty in future demand and the high costs associated with retrenching and then restoring the resources if demand increases (Anderson et al. 2003). Thus, sales-decrease firms can have a significant amount of unrealized losses, such as the expected costs of severance pay and losses related to cutting committed resources. In a similar context, Banker et al. (2014) suggest that earnings as a performance indicator should be interpreted differently conditioned on the sales change direction. Banker et al. (2014) examine interaction effects among stock return, sales change, and operating cash flow change on conservatism phenomenon, and show that when the sales signal indicates bad news, the asymmetric timeliness coefficient for stock return is increased by up to 213 percent. This result indicates that earnings in a sales decrease period are largely subject to conservatism mechanism and thus far from representing the true performance of that period.

In addition, Anderson et al. (2007) document that the SG&A cost ratio carries implications for future earnings that are different between sales-increase and sales-decrease periods. First, they find that in sales-decrease periods the SG&A cost ratio increases with cost fixity. Not only does a higher SG&A cost ratio (i.e., a poorer earnings performance) in revenue-decrease periods not reflect managerial inefficiency, but it is associated with expectations of higher future earnings. Second, from the sticky cost perspective, they document that increases in SG&A cost ratio for sales-decrease periods may provide positive information about managers' optimistic expectation of future earnings because the higher SG&A cost ratio can result from managers deliberately trading off the costs of maintaining slack resources with expected adjustment costs. The findings in Anderson et al. (2007) indicate that lower earnings performance in revenue-decrease periods has little to do with managerial inefficiency or failure in cost control. If shareholders rely on earnings performance to evaluate managers' performance in sales-decrease periods to the same extent as in sales-increase periods, managers will be unfairly penalized due to the mechanical lower earnings realization due to the fixity of costs or the deliberate retention of resources.

Moreover, the asymmetry in earnings behavior associated with sales decrease can be attributed to the following factors. First, sales-decrease is more of an anomaly than the norm in the long run from the perspective of an ongoing business concern. In response to dwindling demand, the management likely undertakes various actions to avoid the further decrease in sales. It is indeed very uncommon to observe firms with a prolonged history of sales decrease. Thus, an earnings number associated with a sales-decrease is more likely to be transitory in nature and do not reflect a sustained relation between sales and earnings in the long run. Next, when an earnings increase is accompanied by a sales-decrease, it is more likely that the increase in earnings is attained by accrual management. Prior studies document various forms of earnings management when firms encounter adverse business circumstances such as losses, missing target or analysts' forecasts. A sales decrease, *ceteris paribus*, can be another important driver for such impairment of earnings, causing a lower earnings persistence. Moreover, there is great uncertainty regarding the outcome of managerial actions taken to boost future revenues under weak demand condition. In other words, it is harder to predict the value of managerial effort during sales decrease periods because such efforts are likely to be corrective actions to overcome the adverse conditions rather than proactive actions taken to sustain long term cash flows. Hence, earnings in sales-decrease periods do not perfectly capture the "true" relationship between demand dynamics and resource deployment decisions.

In sum, earnings in sales-decrease periods are negatively influenced by the manager's optimal decision of maintaining valuable slack resources, and hence, do not meaningfully reflect future cash flows expected from restored demand in the following periods with sales increases. In addition, earnings are not only influenced by managers' deliberate resource adjustment but also be managed by managers in an attempt to overcome the adverse business circumstances, represented by sales decline. Due to the effect of operational factor represented by the direction of sales change, the discontinuity in earnings behavior is more likely to appear between sales increase and sales decrease periods that earnings are less persistent following a sales decline.

Given the low information content in earnings in sales decreasing periods, I investigate whether the revenue signals influence pay-performance sensitivity. My argument can be materialized by examining pay sensitivity of accounting earnings when a firm experiences a sales decrease. Existing research indicates a strong contemporaneous correlation between accounting earnings and compensation (e.g., Lamber and Larcker 1987, Jensen and Murphy 1990; Baber et al .1996). Paul (1992) argues that the purpose of using earnings in incentive contracts hinges on its informativeness about how valuable the manager's effort. However, as described above, the earnings number associated with a sales decrease may not fully capture the value of managerial effort. Rather, the sales decrease is likely to be transitory hence, the transitory component in earnings in sales decreasing periods would lower the level of earnings persistence. Since compensation committee consider not only the current-period earnings innovations but also their time-series property or persistence into the future when rewarding managers based on earnings (Baber et al. 1998), I expect optimal CEO compensation schemes to have lower pay sensitivity of earnings in sales-decrease periods.

In sum, the "information content" of earnings regarding the management's effort and actions can be limited during the sales-decrease periods, and managers in sales-decrease periods should not be penalized for poor earnings performance. Thus, I hypothesize as follows:

H1: The pay sensitivity of earnings is lower for firms with a decrease in sales revenue.

3. Research Design

3.1 *Sample*

Table 1 Panel A shows the sample selection procedure. The sample comprises firm-years with CEO compensation data in Execucomp database for a period of 1993-2016. First of all, I exclude the financial firms (i.e., SIC codes 6000-6999), utility firms (i.e., SIC code 4900-4999) because such firms may have a different structure of financial statements and compensation contracting, which are incompatible with those of other firms. Following prior studies (Banker et al. 2013), I exclude any firm-year where there is a change in CEO. A change in CEO is usually accompanied by negotiation of new compensation contract whose structure can differ vastly from the one for the former CEO. Also, compensation for the new CEO takes into account the talent, experience and other personal factors of the new CEO, which likely differ from those of the former CEO. Thus, a comparison of the compensation of the former CEO with that of the new CEO contains a higher level of noise unrelated to firm performance. Hence, firm-years with a change in the CEO are excluded from the sample. In addition to restricting the sample for no CEO turnover during the year, I further impose the restriction that the CEO has served in the sample company for at least two consecutive years to ensure their rewards are more likely to be based on their performance. I ensure all types of CEO compensation, including cash compensation, which is the sum of salary and bonus, stock and option grants, and annual total compensation are not missing to examine the use of performance measures for each form of compensation. Finally, any firm-years without the required financial data are excluded. The procedure yields 24,429 firm-year observations. Panel B of Table 1 summarizes the annual distribution of observations for the sample. In general, the frequency of observations is evenly distributed across the sample period of 1993 to 2016.[16]

[Insert Table 1 here]

3.2 *Model Specification*

To test the hypothesis on the effect of sales decrease on pay sensitivity of earnings, I estimate the following empirical model.

$$\begin{aligned} Ln(Compensation)_{i,t} = {} & \gamma_0 + \gamma_1 ROA_{i,t} + \gamma_2 RET_{i,t} + \gamma_3 ROA_{i,t} \times SD_{i,t} + \gamma_4 RET_{i,t} \times SD_{i,t} \\ & + \gamma_5 SD_{i,t} + \gamma_6 Size_{i,t} + \gamma_7 Lev_{i,t} + \gamma_8 MB_{i,t} + \gamma_9 Persist_{i,t} \\ & + Industry\ FE + Year\ FE + \varepsilon_{i,t} \qquad (1) \end{aligned}$$

The dependent variable is the natural logarithm of *Compensation*, which is either

[16] Since the Execucomp database is available since 1992, there is a relatively small number of observations in the early 1990s. I start the sample period from 1993 due to too small observations in 1992.

Cash Pay, Equity Pay, or Total Pay for the CEO of firm *i* in year *t*. Specifically, *Cash Pay* is the sum of salary (*Salary*) and bonus pay (*Bonus*) and, *Equity Pay* is the CEO's stock-based compensation, including new grants of restricted stock and stock options. *Total Pay* is the CEO's annual total compensation. A firm's return on assets (*ROA*) is used as the accounting-based performance measure and stock performance is measured using annual stock return (*RET*).

The hypothesis predicts the lower pay sensitivity of earnings in sales-decreasing period because the information content of earnings regarding the management's effort and actions can be lacking. Accordingly, in the model, I expect to find a positive value for *ROA* while, a negative value for the interaction between *ROA* and *SD*, suggesting a lower weight placed on accounting earnings in the sales-decreasing period compared to that in the sales-increasing period. Although my focus is on accounting earnings, I include stock return performance since it is also a widely used performance measure in setting CEO compensation. The pay sensitivity of stock returns may increase in response to sales decline while the pay-sensitivity of accounting earnings diminishes, with firms shifting toward the use of alternative performance measures (Bushman and Smith 2001). Alternatively, the pay sensitivity of stock returns may also decrease in accordance with the pay sensitivity of earnings since stock returns are affected investors who do not fully understand the lower earnings due to the managers' optimal resource deployment decision in response to a sales decline.

In Equation (1), I control for several firm characteristics such as firm size (*Size*), leverage (*Lev*), growth potential (*MB*), and firm-level earnings persistence (*Persist*) (Core et al. 2008; Core et al. 1999; Rose and Shepard 1997). Specifically, Baker and Hall (2004) point out that the optimal pay-to-performance sensitivity of a CEO varies with firm size.

Thus, I include the natural log of total assets to control for firm size. I also control for leverage, which is the ratio of total debt to total assets, since highly leveraged and distressed firms have different compensation incentive plans (Nwaeze et al. 2006). Baber et al. (1996) find firms with greater growth opportunities have greater use of all incentive plans. Therefore, I control for a firm's growth potential using the market to book ratios. In addition, earnings persistence is shown to be positively related to the reliance on CEO compensation on earnings (Baber et al. 1998). Since accruals are found by many studies to be directly related to low persistence in earnings (Sloan 1996), I measure a firm-level earnings persistence by the absolute magnitude of total accruals scaled by total assets (Ashely and Yang 2004). Finally, I include both industry (SIC two-digit) and year fixed effects, and the standard errors are clustered by firm.

4. *Estimation Results*

4.1 *Descriptive Statistics*

Table 2 provides descriptive statistics. First of all, the key compensation variables are total cash pay (*Cash Pay*), equity-based pay (*Equity Pay*), and total pay (*Total Pay*). I take logarithmic transformation to each form of compensation to reduce the skewness in its distribution. After the transformation, the mean of each compensation variable is approximately equal to the median. The mean value of *ln*(*Cash Pay*) is 6.813 (median = 6.787). The mean value of *ln*(*Equity Pay*) is 7.415 (median = 7.517) where the distribution of bonus is slightly negatively skewed. The mean value of *ln*(*Total Pay*) is 8.171 (median = 8.173) thus, the distribution is quite symmetric. I also present descriptive statistics of return on assets (*ROA*) as a crucial performance measure in my analyses. The mean *ROA* is 0.044 (median = 0.055) and the standard deviation is 0.103, very similar to those reported in prior studies. Another performance measure, stock returns (*RET*) has a mean value of 0.155 (median = 0.100). The key variable, a sales decrease (*SD*), captures whether current sales revenue has decreased compared to prior sales revenue. The mean value of *SD* is 0.266, which implies that approximately 27% of the sample experienced a sales decline. I winsorize those observations in the bottom and top 1% of the sample to minimize the influence of outliers.

[Insert Table 2 here]

Table 3 presents correlations among the variables used in my analyses. Pearson (Spearman) correlations appear below (above) the diagonal. Inferences provided by Pearson and Spearman correlations are the same except that there is a negative Pearson correlation between bonus and equity pay which is -0.038 whereas, insignificant Spearman correlation. The accounting performance measure is measured using *ROA* and it is strongly correlated with all type of compensation (i.e. cash pay and equity pay). This is consistent with the existing research that finds accounting earnings as an important performance measure in determining CEO incentive contracts. (e.g., Lamber and Larcker 1987, Jensen and Murphy 1990; Baber et al 1996). A sales decline, *SD*, has a negative correlation with total cash compensation, in particular, bonus pay, and equity compensation. To test the impact of sales decreases on pay sensitivity of earnings, the interactive effect of *ROA* and *SD* on CEO compensation has to be examined. Therefore, I next turn to the multivariate regression results.

[Insert Table 3 here]

4.2 *Estimation Results*

4.2.1 *The Effect of Sales Declines on Pay Sensitivity of Earnings*

Table 4 reports the estimation results for the first hypothesis using Equation (1). The key dependent variables are the logarithm of CEO cash pay, equity pay, and total pay. In all regression models, industry and year fixed effects are controlled and standard errors are clustered by firm.

First of all, column (1) shows that regression results for a CEO's total cash compensation. The coefficients on contemporaneous ROA (ROA_t) are significantly positive (coefficient=0.685, *t*-statistics=8.90). In addition, the coefficient on stock return performance (RET_t) is also positive, consistent with prior studies (e.g. Core et al. 2008; Core et al. 1999). When a firm experiences a sales decline in year *t*, there is a decrease in the weight placed on current ROA (ROA_t), showing that the coefficient on $SD_t \times ROA_t$ is significantly negative (coefficient=-0.447, *t*-statistics=-5.56). This result supports my hypothesis that the increased noise and transitory elements in earnings during the sales decrease years lower the pay sensitivity of accounting earnings for cash compensation. Alternatively, it could be possible that the pay sensitivity of stock returns may increase in response to sales decline while the pay-sensitivity of accounting earnings diminishes, with firms shifting toward the use of alternative performance measures (Bushman and Smith 2001). However, according to the results, the coefficient on $SD_t \times RET_t$ is insignificant. This indicates that there is no shift toward stock price performance in response to reduced information content in earnings.

Next, the results for CEOs' equity pay are shown in column (2) of Table 5. The coefficient on current ROA (*ROA_t*) is significantly positive (coefficient=0.632, *t*-statistics=4.18). In addition, stock return performance (*RET_t*) is positively related to stock-based compensation. When a firm experiences a sales decrease in year *t*, there is a decrease in the pay sensitivity of ROA (*ROA_t*), suggesting negative and significant coefficients on $SD_t \times ROA_t$ (coefficient=-0.515, *t*-statistics=-3.28). The pay sensitivity of *RET* (*RET_t*) also reduces in response to the sales decline. Finally, column (3) shows the results regarding total pay. Because equity pay comprises the considerable portion of total pay, the results are similar to that of equity pay.

Consistent with our argument, when firms experience sales decrease, their earnings become less informative of the firm's future performance thus the transitory nature of earnings for sales-decrease firms lower the pay sensitivity of earnings in determining a CEO's various pay. The reduced sensitivity of earnings is not substituted by the enhanced sensitivity of alternative performance measure like stock price performance. Rather, the pay sensitivity of stock returns decreases for equity pay in response to a sales decrease, potentially because stock returns are affected by diminished information content in accounting earnings.

[Insert Table 4 here]

4.2.2 *The Effect of Earning Change Direction*

In Table 4, I find that the pay sensitivity of earnings is lower for sales decreasing periods than sales increasing periods. This can be explained by cost stickiness, which arises because of a deliberate decision by managers to adjust resources. When sales decrease, managers maintain some slack resources to avoid incurring adjustment costs associated with cutting resources and future adjustment costs to restore resources when sales rebound. Due to the asymmetry in cost, the fall in costs is less than proportional to the sales decrease, resulting in lower earnings. In other words, when managers make asymmetric resource adjustment in response to sales decreases, earnings in the current year are more likely to be lower than the prior year's earnings. If firms understand that the lower earnings are driven by managers' resource adjustment decision, firms would lower the pay sensitivity of earnings in sales-decrease periods, when current earnings are lower than the previous year's earnings.

To test the possibility, I divide the sample into two, firms who experience earnings decrease versus earnings increase. Then, I examine the effect of sales declines on the pay sensitivity of earnings for each subsample. In Table 5, column (1)-(3) report the results for firms whose *ROA* decreased from the prior to the current year (i.e. earnings decrease sample) and, column (4)-(6) for firms whose *ROA* increased from the prior to the current year (i.e. earnings increase sample). Consistent with my conjecture, firms lower the pay sensitivity of earnings in response to a sales decrease when earnings become lower than the prior year. Such adjustment is observed for all types of pay. This implies that firms understand the lower earnings due to the asymmetry in cost and thus make the modification in incentive contracts ex post. For firms with earnings increase, I find the decreased pay sensitivity of earnings in response to a sales decline for equity compensation but not for cash compensation. Since it is harder to predict the value of managerial effort during sales decrease periods, even if managers achieve higher earnings than the previous year, earnings are placed with the lower weight in determining CEO compensation.

[Insert Table 5 here]

4.2.3 *The Effect of CEO Power*

The lower pay sensitivity of earnings in sales-decrease periods can be viewed as the result of optimal contracting. It is harder to predict the value of managerial effort during sales decrease periods because such efforts are likely to be corrective actions to overcome the adverse conditions rather than proactive actions taken to sustain long term performance. In addition, earnings become mechanically low when managers make deliberate resource retention decision in response to a sales decrease. In this regards, the information content of earnings regarding the management's effort and actions can be limited during the sales-decrease period hence, compensation committees may lower the pay sensitivity of earnings so that managers in sales-decrease periods are not unfairly penalized for poor earnings performance.

However, others may interpret the lower pay sensitivity of earnings in sales-decrease periods as the result of powerful managers setting their own compensation incentives. Morse et al. (2011) provides evidence of ex post shifting of the weight toward better performance measures by some powerful CEOs (i.e. rigging of the incentive contract). Therefore, it could be possible that CEOs use their power to manipulate incentive contracts and generate rents by reducing pay sensitivity of earnings in sales decreasing periods.

To test the possibility, I use proxies of CEO power (i.e., CEO-chair duality and CEO age) and conduct cross-sectional analyses. First, I split the sample into firms with and without CEO-chair duality and estimate Equation (1) for each subsample. Panel A of Table 6 shows that for both subsamples, the coefficients on $SD_t \times ROA_t$ are significantly negative for all types of CEO pay. These results indicate that regardless of CEO power measured by CEO-chair duality, there is a decrease in the pay sensitivity of earnings when a firm experience a sales decrease. In particular, firms with less powerful CEOs also experience the reduced pay sensitivity of earnings in sales-decrease periods, suggesting that such a phenomenon is less likely to be consistent with rent extraction. In Panel B of Table 6, I test with CEO age, assuming that older CEOs have more power over their boards (Brockman et al. 2016). I separate the sample into CEO age quartiles and set the lowest(highest) quartile as firms with young(old) CEOs. For both firms with young CEOs and old CEOs, I find that the coefficients on $SD_t \times ROA_t$ are significantly negative across all types of compensation. Overall, the results suggest that the negative effect of sales decreases on the pay sensitivity of earnings in CEO incentive contracts is not influenced by CEO power, providing the supporting evidence for the optimal contracting explanation.

[Insert Table 6 here]

4.3 *Additional Analyses*

4.3.1 *Median Regression*

As a sensitivity check, instead of using traditional ordinary least squares (OLS) estimation, I estimate Equation (1) using the least absolute deviations estimator, also referred to as median regression, which is less sensitive to the problem of outliers (Greene 2008). This reduces the possibility of highly influential outliers, which might have rendered standard OLS estimation unreliable. Median regression results are presented in Panel A of Table 7 and the inferences remain constant.

4.3.2 *Various Fixed Effects Model Specifications*

To further extent, I employ various fixed effects model in examining the effect of sales declines on the pay sensitivity of earnings. In Panel B of Table 7, Model 1 (column (1) through (3)) reports the results using firm and year fixed effects model; Model 2 (column (4) through (6)) for CEO and year fixed effects model.

Although I control for observable firm characteristics (e.g., firm size, leverage, growth opportunities, and earnings persistence) in the model specification, the omitted variable may not be properly controlled. To the extent that the omitted relevant variables are time invariant, including firm fixed effects controls for unobservable time-invariant firm characteristics that drive the level of CEO compensation (i.e., cash compensation, equity-based compensation and total compensation). In Model 1 where I control for firm and year fixed effects, I find that the earnings pay-sensitivity in sales decreasing periods is significantly lower for all types of compensation, supporting the hypothesis.

Graham et al. (2012) point out that that unobservable manager characteristic explains a significant portion of the variation in CEO compensation. Using CEO and year fixed effects model in Model 2, I still find that the results are robust. To further extent, Graham et al. (2012) suggest the research in executive compensation to control for the combined influence of firm and manager fixed effects by including a dummy variable for each unique firm-manager pair. My results remain unchanged even after controlling for firm-manager fixed effects (untabulated).

[Insert Table 7 here]

4.3.3 *The Shift Toward the Past Performance*

Prior studies on performance evaluation have suggested that firms have shifted toward the use of alternative performance measures as the usefulness of the certain measure in setting executive pay diminishes (Bushman and Smith 2001). When sales decrease in this year, the contemporaneous earnings are less sensitive to managerial effort and carry less precise information on the effect of such effort on future performance; thus receiving relatively lower weights. Since the information content incorporated in accounting earnings reduces in sales-decreasing periods, firms are more likely to supplement accounting earnings with additional performance measure such as a market-based measure in compensation contracts. In Table 4, however, I provide evidence that the pay sensitivity of stock returns also reduces in response to sales decline, suggesting that firms do not shift toward stock returns in lieu of accounting earnings.

Meanwhile, several studies have investigated the relevance of past performance measures when setting the contract. For example, Banker et al. (2013) provide evidence that past performance measures are informative about the executive's ability thus, they are also relevant in optimal contracting. Accordingly, I investigate whether the shift of weight from current to past performance exists for earnings, which is the primary accounting performance measure widely used in compensation contracts. To test the shift toward the past performance, I use the following model specification:

$$Ln(Compensation)_{i,t} = \gamma_0 + \gamma_1 ROA_{i,t} + \gamma_2 ROA_{i,t-1} + \gamma_3 RET_{i,t} + \gamma_4 RET_{i,t-1}$$

$$+ \gamma_5 ROA_{i,t} \times SD_{i,t} + \gamma_6 ROA_{i,t-1} \times SD_{i,t} + \gamma_7 ROA_{i,t-1} \times SD_{i,t-1}$$

$$+ \gamma_8 SD_{i,t} + \gamma_9 SD_{i,t-1} + \gamma_{10} Size_{i,t} + \gamma_{11} Lev_{i,t} + \gamma_{12} MB_{i,t}$$

$$+ \gamma_{13} Persist_{i,t} + Industry\ FE + Year\ FE + \varepsilon_{i,t} \qquad (2),$$

where *Compensation* is either *Cash Pay, Equity Pay, or Total Pay* for the CEO of firm *i* in year *t*. *Cash Pay* is the CEO's total cash compensation; *Equity Pay* is the CEO's stock-based compensation, including new grants of restricted stock and stock options; *Total Pay* is the total compensation. If the reduced pay sensitivity of current ROA ($ROA_{i,t}$) in sales decreasing periods is complemented by the increased pay sensitivity of past ROA ($ROA_{i,t-1}$), I expect to observe the negative coefficient on $ROA_{i,t} \times SD_{i,t}$ while the positive coefficient on $ROA_{i,t-1} \times SD_{i,t}$.

The results are reported in Table 8. Column (1) shows that estimation results for the cash compensation regression. The coefficient on contemporaneous *ROA* and *RET* is significantly positive. The coefficient on past *RET* is also positive but, not past *ROA*.[17] When a firm experiences a sales decrease in year *t*, there is a decrease is the pay-sensitivity current ROA (ROA_t), showing that the coefficient on $SD_t \times ROA_t$ is significantly negative (coefficient=-0.429, *t*-statistics=-4.75), supporting the hypothesis. The variable of my interest is on the coefficient on $SD_t \times ROA_{t-1}$, which captures the shift toward the past ROA

[17] Banker et al. (2013) finds that the pay-for-performance sensitivity of past earnings for salary is positive while, it is negative for bonus compensation. Since past performance may signal the agent's ability, they find salary, the fixed component of total compensation, exhibit positive association with past performance. In contrast, bonus, the contingent part of incentive pay, is negatively related to past performance. This is explained based on the fact that the firm's past performance provides information about the agent's future ability and thus, mitigates the firm's adverse selection problem. When past performance is high, the principal can provide an agent with a higher salary and a less high-powered bonus. Given that the results appear in opposite directions for salary and bonus, the pay sensitivity of past earnings for cash pay (the sum of salary and bonus) is insignificant. My result is consistent with Banker et al. (2013).

in response to sales decline. I find that the coefficient on $SD_t \times ROA_{t-1}$ is insignificant, rejecting the conjecture.

Column (2) of Table 8 demonstrates the regression results for the equity pay. The coefficient on current *ROA* is significantly positive (coefficient=0.404, *t*-statistics=2.88). The coefficient on past *ROA* is positive, but not significant. When a firm experiences a sales decrease in year *t*, there is a decrease in the weight placed on contemporaneous *ROA* (ROA_t), but an increase in the weight placed on past *ROA* (ROA_{t-1}). This is provided by the evidence showing that the coefficient of $SD_t \times ROA_t$ is negative (coefficient-0.745, *t*-statistics=-4.24), whereas it is positive for $SD_t \times ROA_{t-1}$ (coefficient=0.432, *t*-statistics=2.54). Therefore, the shift of weight from current earnings to past earnings following a sales decline is only applied to CEO's equity compensation. To further extent, we find that when a firm experiences a sales decline in year *t-1*, the compensation weights placed on past *ROA* is also reduced, indicating that the coefficient on $SD_{t-1} \times ROA_{t-1}$ is significantly negative (coefficient=-0.607, *t*-statistics=-4.05). Since equity-based compensation takes a significant portion of a CEO's total compensation, a similar pattern appears when tested with total compensation. Overall, the findings suggest that when sales decrease, the pay sensitivity of earnings reduces and accordingly, the pay sensitivity shifts toward the past earnings.

It is unlikely that the compensation committee would differentiate compensation weights on performance measures between sales increase and decrease years to induce different levels of motivation. Rather, different weights are likely to be the output of *ex post* modification after observing the sales revenue performance as mentioned in footnote 1. In short, it is not a matter of providing incentives to managers upfront but a matter of the performance measure's informativeness in adjustment stage; therefore, firms are likely to alter each component of CEO compensation along with the *ex post* weight adjustment.[18]

[Insert Table 8 here]

5. Conclusion

In this paper, I examine how the direction of sales change affects the pay sensitivity of earnings in the CEO's incentive contracts. I discuss how the direction of sales change contains incremental information regarding earnings quality and persistence and thus affects CEO compensation contracts. Empirical results suggest that firms experiencing sales decrease do have a lower pay-for-performance sensitivity. Furthermore, I document a shift in weight from the current performance to the past performance for compensation evaluation purposes but, it appears only for equity-based pay.

The key contribution of this research is demonstrating that the sales change direction is an important economic source for the covariance between the marginal productivity of effort and the earnings sensitivity of effort because the implication of managerial effort to firm value and earnings performance can be substantially different when sales decline. My results suggest that sticky cost behavior, and the asymmetry in

[18] While the literature discusses *ex ante* designs of compensation terms, this research considers *ex post* adjustment in the weights. Prior studies on subjective performance evaluation document that firms frequently allow *ex post* flexibility in weighting performance measures as well as *ex post* discretional adjustments, because performance goals for the future period rely on the superior's subjective judgment on business environmental changes and strategic vision (Gibbs et al. 2004; Bol 2008). Thus, I expect that the CEO compensation committee is likely to include a clause to amend the compensation weight on earnings if sales decline (as far as the committee understands the logics in a low persistence along sales decrease) instead of committing to a predetermined rule (different pay-for-performance sensitivity) at the beginning of the contract period.

earnings behavior are drivers of the covariance, while the implication of these factors is collectively imbedded in the direction of sales change each period.

In addition, my results contribute to the understanding of the link between managers' compensation and firm performance. This link between managers' pay to firm performance has been the focus of the regulator, the government, and the media in recent years. The public outcry has been that there is no link between the two. My documentation of a shift in the compensation weights introduces an additional dimension to this debate by suggesting that it is likely to be optimal to have different weights placed on performance measure during economic boom versus recession periods. There can be other firm characteristics that either amplify or attenuate this linkage between firm performance and compensation. Future studies on other potential determinants of the link can shed new light on the pay-performance sensitivity and contribute to the current debate. Critics advocate regulatory guidelines on executive pay for firms. However, before imposing any further restrictions or regulations on executive pay, a more thorough investigation of the compensation structure should be conducted. A better understanding of the link between compensation and firm performance can avoid the costly mistake of imposing unnecessary laws to interfere with the self-regulatory mechanism.

References

Anderson, M., R. Banker, and S. Janakiraman. 2003. Are selling, general, and administrative costs "sticky"? *Journal of Accounting Research* 41(1): 47-63.

Anderson, M., R. Banker, R. Huang, and S. Janakiraman. 2007. Cost behavior and fundamental analysis of SG&A costs. *Journal of Accounting, Auditing & Finance* 22(1): 1-28.

Antle, R., and A. Smith. 1986. An empirical investigation of the relative performance evaluation of corporate executives. *Journal of Accounting Research* 24(1): 1-39.

Ashley, A. S., and S. S. Yang. 2004. Executive compensation and earnings persistence. *Journal of Business Ethics* 50(4): 369-382.

Atwood, T. J., M. S. Drake, and L. A. Myers. 2010. Book-tax conformity, earnings persistence and the association between earnings and future cash flows. *Journal of Accounting and Economics* 50(1): 111-125.

Baber, W., S. Janakiraman and S. H. Kang. 1996. Investment opportunities and the structure of executive compensation. *Journal of Accounting and Economics* 21(3): 297-318.

Baber, W., S. H. Kang, and K. Kumar. 1998. Accounting earnings and executive compensation: The role of earnings persistence. *Journal of Accounting and Economics* 25(2): 169-193.

Ball, R., and R. Watts. 1972. Some time series properties of accounting income. *The Journal of Finance* 27(3): 663.681.

Banker, R., S. Basu, and D. Byzalov. 2014. The role of multiple impairment indicators in conditional conservatism. Working paper.

Banker, R., and D. Byzalov. 2014. Asymmetric cost behavior. *Management Accounting Research* 26(2): 43-79.

Banker, R., M. Darrough, R. Huang, and J. Plehn-Dujowich. 2013. The relation between CEO compensation and past performance. *The Accounting Review* 88(1): 1-30.

Banker, R., and L. Chen. 2006. Predicting earnings using a model based on cost variability and cost stickiness. *The Accounting Review* 81(2): 285-307.

Banker, R., and S. Datar. 1989. Sensitivity, precision, and linear aggregation of signals for performance evaluation. *Journal of Accounting Research* 27(1): 21-39.

Bol, J. 2008. Subjectivity in compensation contracting. *Journal of Accounting Literature* 27: 1–24.

Brockman, P., H. S. Lee, and J. M. Salas. 2016. Determinants of CEO compensation: Generalist–specialist versus insider–outsider attributes. *Journal of Corporate Finance* 39: 53-77.

Bushman, R., and A. Smith. 2001. Financial accounting information and corporate governance. *Journal of Accounting and Economics* 32(1): 237-333.

Bushman, R., E. Engel, and A. Smith. 2006. An analysis of the relation between the stewardship and valuation roles of earnings. *Journal of Accounting Research* 44(1): 53-83.

Core, J. E., W. Guay, and D. F. Larcker. 2008. The power of the pen and executive compensation. *Journal of Financial Economics* 88(1): 1-25.

Core, J. E., R. Holthausen, and D. F. Larcker. 1999. Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics* 51(3): 371-406.

Dichev, I. D., and V. W. Tang. 2009. Earnings volatility and earnings predictability. *Journal of Accounting and Economics* 47(1-2): 160-181.

Ertimur, Y., J. Livnat, and M. Martikainen. 2003. Differential market reactions to revenue and expense surprises. *Review of Accounting Studies* 8(2-3): 185-211.

Frydman, C., and R. E. Saks. 2010. Executive compensation: A new view from a long-term perspective. *Review of Financial Studies* 23(5): 2099-2138.

Gabaix, X., and A. Landier. 2008. Why has CEO pay increased so much? *Quarterly Journal of Economics* 123(1): 49-100.

Ghosh, A., Z. Gu, and P. C. Jain. 2005. Sustained earnings and revenue growth, earnings quality, and earnings response coefficients. *Review of Accounting Studies* 10(1): 33-57.

Gibbs, M., K. Merchant, W. Stede, and M. Vargus. 2004. Determinants and effects of subjectivity in incentives. *The Accounting Review* 79(2): 409–436.

Graham, J. R., S. Li, and J. Qiu. 2012. Managerial attributes and executive compensation. *Review of Financial Studies* 25(1): 144-186.

Greene, W. H. 2008. *Econometric Analysis*. Sixth edition. London, U.K.: Prentice Hall International.

Hayn, C. 1995. The information content of losses. *Journal of Accounting Economics* 20(2): 125-153.

Holmstrom, B. 1979. Moral hazard and observability. *The Bell Journal of Economics* 74-91.

Janakiraman, S., R. Lambert, and D. Larcker. 1992. An empirical investigation of the relative performance evaluation hypothesis. *Journal of Accounting Research* 30(1): 53-69.

Jensen, M., and K. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy* 225-264.

Lambert, R., and D. Larcker. 1987. An analysis of the use of accounting and market measures of performance in executive compensation contracts. *Journal of Accounting Research* 85-125.

Lookabill, L. 1976. Some additional evidence on the time series properties of accounting earnings. *The Accounting Review* 51(4): 724-738.

Nwaeze, E T., S. S. Yang, and Q. J. Yin. 2006. Accounting information and CEO compensation: The role of cash flow from operations in the presence of earnings. *Contemporary Accounting Research* 23(1): 227-265.

Paul, J. 1992. On the efficiency of stock-based compensation. *Review of Financial Studies* 5(3): 471-502.

Petersen, M. A. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22(1): 435-480.

Pinnuck, M., and A. M. Lillis. 2009. Profits versus losses: Does reporting an accounting loss act as a heuristic trigger to exercise the abandonment option and divest employees? *Accounting Review* 82(4): 1031-1053.

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(4): 1813-1844.

Rees, L., and K. Sivaramakrishnan. 2007. The effect of meeting or beating revenue forecasts on the association between quarterly returns and earnings forecast errors. *Contemporary Accounting Research* 24(1): 259-290.

Rose, N. L., and A. Shepard. 1997. Firm diversification and CEO compensation: Managerial ability or executive entrenchment? *Rand Journal of Economics* 28: 489-514.

Sloan, R. 1993. Accounting earnings and top executive compensation. *Journal of Accounting and Economics* 16(1-3): 55-100.

Watts, R. and R. Leftwich. 1977. The time series of annual accounting earnings. *Journal of Accounting Research* 253-271.

Weiss, D. 2010. Cost behavior and analysts' earnings forecasts. *The Accounting Review* 85(4): 1441-1471.

Appendix. Variable Definitions

Variable		Description
Cash Pay	=	CEO's total cash compensation (salary+bonus) for firm *i* in year *t*;
Salary	=	CEO's salary for firm *i* in year *t*;
Bonus	=	CEO's bonus for firm *i* in year *t*;
Equity Pay	=	CEO's stock-based compensation, including new grants of restricted stock and stock options for firm *i* in year *t*;
Total Pay	=	CEO's total compensation for firm *i* in year *t*;
ln (*Cash Pay*)	=	Natural logarithm of *Cash Pay*;
ln (*Salary*)	=	Natural logarithm of *Salary*;
ln (*Bonus*)	=	Natural logarithm of *Bonus*;
ln (*Equity Pay*)	=	Natural logarithm of *Equity Pay*;
ln (*Total Pay*)	=	Natural logarithm of *Total Pay*;
SD	=	1 when sales revenue in year *t* is smaller than sales revenue in year *t-1*, and 0 otherwise;
LOSS	=	1 when earnings before extraordinary items is negative, and 0 otherwise;
ROA	=	Earnings before extraordinary items scaled by average total assets;
RET	=	12-month buy-and-hold stock return over year *t* for firm *i*;
Size	=	Natural logarithm of total assets;
MB	=	The ratio of market value of equity to book value of equity;
Lev	=	The ratio of total debt to total assets;
Persist	=	Firm-level earnings persistence measured as the absolute value of total accruals scaled by total assets in year *t-1* (Sloan 1996).

TABLE 1
Sample Selection

Panel A. Sample selection procedure

All Computstat-Execucomp merged firm-years from 1993 - 2016			43,677
Less:	Financial and utilities industries	9,631	
	CEO turnover years	3,518	
	CEOs who has served less than two years	919	
	CEOs missing compensation data	3,521	
	Observations missing relevant financial information	1,659	
Total firm-year observations for the sample from 1994 - 2015			24,429

Panel B. Yearly distribution

Year	N	%	Cumulative %
1993	603	2.47	2.47
1994	787	3.22	5.69
1995	866	3.54	9.23
1996	886	3.63	12.86
1997	897	3.67	16.53
1998	955	3.91	20.44
1999	994	4.07	24.51
2000	1,006	4.12	28.63
2001	1,012	4.14	32.77
2002	1,007	4.12	36.89
2003	1,019	4.17	41.07
2004	1,026	4.20	45.27
2005	1,036	4.24	49.51
2006	984	4.03	53.53
2007	1,116	4.57	58.10
2008	1,183	4.84	62.95
2009	1,166	4.77	67.72
2010	1,172	4.80	72.52
2011	1,164	4.76	77.28
2012	1,130	4.63	81.91
2013	1,150	4.71	86.61
2014	1,113	4.56	91.17
2015	1,096	4.49	95.66
2016	1,061	4.34	100.00
Total	24,429		

Table 1 Panel A reports the sample selection procedure. Panel B reports the sample distribution by year.

TABLE 2
Descriptive Statistics

	N	Mean	STD	Q1	Median	Q3
Cash Pay ($000)	24,429	1,131	911	601	886	1,288
Salary ($000)	24,429	730	349	476	676	938
Bonus ($000)	24,429	394	738	1	4	495
Equity Pay ($000)	24,429	3,413	4,483	723	1,838	4226
Total Pay ($000)	24,429	5,507	5,886	1,769	3,543	6,868
ln (*Cash Pay*)	24,429	6.813	0.634	6.399	6.787	7.161
ln (*Salary*)	24,429	6.477	0.505	6.168	6.518	6.844
ln (*Bonus*)	24,429	3.057	3.162	0.000	1.281	6.205
ln (*Equity Pay*)	24,429	7.415	1.310	6.583	7.517	8.349
ln (*Total Pay*)	24,429	8.171	0.947	7.478	8.173	8.835
SD	24,429	0.266	0.442	0.000	0.000	1.000
LOSS	24,429	0.177	0.382	0.000	0.000	0.000
ROA	24,429	0.044	0.103	0.018	0.055	0.093
RET	24,429	0.155	0.481	-0.128	0.100	0.354
Size	24,429	7.415	1.581	6.285	7.307	8.453
MB	24,429	0.473	2.183	0.253	0.413	0.636
Lev	24,429	0.226	0.181	0.070	0.213	0.335
Persist	24,429	0.081	0.073	0.033	0.062	0.103

Table 2 presents summary statistics of the variables. See the Appendix for detailed variable definitions.

TABLE 3
Correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	*ln* (*Cash Pay*)		**0.749**	**0.579**	**0.483**	**0.639**	**-0.065**	**-0.206**	**0.170**	**0.124**	**0.655**	**0.124**	**0.215**	**-0.118**
(2)	*ln* (*Salary*)	**0.736**		**-0.017**	**0.593**	**0.721**	**0.044**	**-0.131**	**0.067**	**0.013**	**0.752**	**0.049**	**0.261**	**-0.145**
(3)	*ln* (*Bonus*)	**0.536**	**-0.067**		0.001	**0.075**	**-0.147**	**-0.150**	**0.146**	**0.148**	**0.095**	**0.119**	0.012	-0.007
(4)	*ln* (*Equity Pay*)	**0.470**	**0.535**	**-0.038**		**0.937**	**-0.018**	**0.084**	**0.112**	**0.030**	**0.616**	**0.221**	**0.116**	**-0.025**
(5)	*ln* (*Total Pay*)	**0.640**	**0.673**	**0.026**	**0.920**		**-0.037**	**-0.139**	**0.153**	**0.082**	**0.711**	**0.216**	**0.162**	**-0.065**
(6)	*SD*	**-0.072**	**0.037**	**-0.149**	**-0.020**	**-0.041**		**0.296**	**-0.337**	**-0.183**	0.004	**-0.228**	**0.059**	**0.111**
(7)	*LOSS*	**-0.199**	**-0.130**	**-0.143**	**-0.081**	**-0.138**	**0.296**		**-0.661**	**-0.234**	**-0.149**	**-0.239**	**0.084**	**0.316**
(8)	*ROA*	**0.196**	**0.118**	**0.129**	**0.110**	**0.161**	**-0.311**	**-0.710**		**0.252**	**0.256**	**0.480**	**-0.267**	**-0.220**
(9)	*RET*	**0.076**	**-0.040**	**0.134**	0.012	**0.049**	**-0.153**	**-0.185**	**0.234**		**0.019**	**0.360**	**-0.068**	**-0.037**
(10)	*Size*	**0.629**	**0.702**	**0.039**	**0.596**	**0.709**	0.004	**-0.157**	**0.130**	**-0.041**		**0.041**	**0.366**	**-0.128**
(11)	*MB*	**0.073**	**0.028**	**0.049**	**0.168**	**0.164**	**-0.122**	**-0.110**	**0.210**	**0.236**	**0.017**		**-0.122**	**-0.013**
(12)	*Lev*	**0.163**	**0.216**	**-0.022**	**0.094**	**0.139**	**0.067**	**0.115**	**-0.193**	**-0.083**	**0.301**	**-0.046**		0.002
(13)	*Persist*	**-0.131**	**-0.167**	-0.010	**-0.021**	**-0.066**	**0.123**	**0.389**	**-0.424**	**-0.021**	**-0.157**	**-0.156**	**0.032**	

Table 3 reports pairwise correlations (Pearson in the lower triangle and Spearman in the upper triangle). All variables are defined in the Appendix; all continuous variables are winsorized at the 1st and 99th percentiles. Bold values indicate the statistical significance at 5% level.

TABLE 4
The Effect of Sales Declines on Pay Sensitivity of Earnings

	(1)	(2)	(3)
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.685***	0.632***	0.746***
	(8.90)	(4.18)	(7.48)
RET_t	0.104***	0.037**	0.107***
	(12.00)	(2.16)	(9.60)
$ROA_t \times SD_t$	-0.447***	-0.515***	-0.618***
	(-5.56)	(-3.28)	(-6.10)
$RET_t \times SD_t$	0.003	-0.085***	-0.049**
	(0.25)	(-2.75)	(-2.50)
SD_t	-0.005	-0.013	-0.026**
	(-0.60)	(-0.73)	(-2.25)
$Size_t$	0.260***	0.517***	0.433***
	(51.71)	(55.42)	(70.72)
MB_t	0.002	0.040***	0.025***
	(1.41)	(13.16)	(12.66)
Lev_t	-0.063*	-0.340***	-0.209***
	(-1.74)	(-4.53)	(-4.20)
$Persist_t$	-0.002	1.218***	0.751***
	(-0.03)	(9.05)	(8.12)
Constant	4.765***	2.243***	4.060***
	(49.31)	(8.10)	(25.28)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm
N	24,429	24,429	24,429
Adjusted R^2	0.498	0.485	0.611

Table 4 reports the regression results of the effect of sales decreases on pay sensitivity of earnings. The dependent variables are as follows: *ln*(*Cash Pay*) is the natural logarithm of a CEO's total cash compensation (the sum of salary and bonus pay); *ln*(*Equity Pay*) is the natural logarithm of stock-based compensation, including new grants of restricted stock and stock options; *ln*(*Total Pay*) is the natural logarithm of a CEO's total compensation. *ROA* is return on assets, which is earnings before extraordinary items divided by average total assets; *RET* is the 1-year buy-and-hold return. *SD* is a dummy variable defined as 1 when sales revenue in year *t* is smaller than sales revenue in year *t-1*, and 0 otherwise. All variables are defined in the Appendix; all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 5
The Effect of Sales Declines on Pay Sensitivity of Earnings Conditional on Earnings Change Direction

	(1)	(2)	(3)	(4)	(5)	(6)
	Earnings Decrease ($ROA_t < ROA_{t-1}$)			Earnings Increase ($ROA_t > ROA_{t-1}$)		
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.511***	0.366*	0.482***	0.644***	0.740***	0.820***
	(5.39)	(1.87)	(3.85)	(7.33)	(3.57)	(6.07)
RET_t	0.130***	0.078***	0.138***	0.056***	0.038*	0.084***
	(8.65)	(2.59)	(6.93)	(5.31)	(1.69)	(5.82)
$ROA_t \times SD_t$	-0.368***	-0.493**	-0.540***	-0.160	-0.496*	-0.454**
	(-3.85)	(-2.48)	(-4.26)	(-1.23)	(-1.73)	(-2.51)
$RET_t \times SD_t$	-0.021	-0.014	-0.040	0.031	-0.192***	-0.094***
	(-0.93)	(-0.29)	(-1.27)	(1.57)	(-4.14)	(-3.59)
SD_t	-0.005	-0.037	-0.040***	-0.009	0.013	-0.007
	(-0.45)	(-1.63)	(-2.74)	(-0.67)	(0.44)	(-0.39)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	12,013	12,013	12,013	12,416	12,416	12,416

Adjusted R^2	0.494	0.473	0.600	0.526	0.493	0.630

Table 5 reports the regression results of the effect of sales decreases on pay sensitivity of earnings conditional on earnings change direction. In particular, I divide the sample into firms with ROA in the current year is lower than the past year's ROA (i.e. earnings decrease sample) and, firms with ROA in the current year is higher than the past year's ROA (i.e. earnings increase sample) and estimate Equation (1) for each subsample. All variables are defined in the Appendix; all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 6
The Effect of CEO Power

Panel A. CEO/Chair Duality

	(1)	(2)	(3)	(4)	(5)	(6)
		CEO Duality = 0			*CEO Duality* = 1	
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.484***	0.605***	0.684***	0.996***	0.829***	0.921***
	(5.24)	(3.20)	(5.58)	(9.31)	(3.73)	(6.45)
RET_t	0.093***	0.039	0.108***	0.117***	0.033	0.106***
	(8.15)	(1.56)	(6.78)	(9.37)	(1.36)	(6.68)
$ROA_t \times SD_t$	-0.408***	-0.475**	-0.583***	-0.529***	-0.652***	-0.719***
	(-4.04)	(-2.26)	(-4.43)	(-4.52)	(-2.73)	(-4.60)
$RET_t \times SD_t$	-0.025	-0.059	-0.048*	0.025	-0.125***	-0.060**
	(-1.40)	(-1.34)	(-1.82)	(1.19)	(-2.93)	(-2.16)
SD_t	0.000	0.013	-0.015	-0.004	-0.014	-0.021
	(0.02)	(0.49)	(-0.92)	(-0.35)	(-0.59)	(-1.33)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	10,255	10,255	10,255	13,952	13,952	13,952

Adjusted R^2	0.456	0.465	0.589	0.507	0.500	0.624

Panel B. CEO Age

	(1)	(2)	(3)	(4)	(5)	(6)
	Young CEOs (*CEO Age* in the lowest quartile)			Old CEOs (*CEO Age* in the highest quartile)		
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.547***	0.484*	0.538***	0.555***	0.651**	0.928***
	(4.34)	(1.80)	(2.90)	(2.76)	(2.05)	(4.21)
RET_t	0.097***	0.047	0.116***	0.131***	0.046	0.114***
	(5.75)	(1.34)	(5.18)	(7.24)	(1.26)	(4.83)
$ROA_t \times SD_t$	-0.376**	-0.819***	-0.804***	-0.410**	-0.720**	-0.619***
	(-2.51)	(-2.63)	(-3.73)	(-2.36)	(-2.09)	(-2.96)
$RET_t \times SD_t$	0.002	-0.095	-0.047	-0.070**	-0.058	-0.054
	(0.06)	(-1.59)	(-1.27)	(-2.25)	(-0.84)	(-1.32)
SD_t	-0.001	-0.011	-0.033	0.006	-0.061	-0.037
	(-0.05)	(-0.30)	(-1.35)	(0.32)	(-1.55)	(-1.60)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	Firm	Firm	Firm
N	5,531	5,531	5,531	5,815	5,815	5,815
Adjusted R^2	0.475	0.457	0.571	0.468	0.500	0.632

Table 6 reports the regression results of the effect of sales decreases on pay sensitivity of earnings with respect to CEO power, which is measured based on two measures: CEO/Chair duality and CEO age. *CEO Duality* equals to 1 if the CEO is also the chairman of the board, 0 otherwise. *CEO Age* is the CEO's age in the sample year. All variables are defined in the Appendix; all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 7
Robustness Tests

Panel A. Median Regression

	(1)	(2)	(3)
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.608***	0.524***	0.681***
	(13.68)	(5.35)	(11.22)
RET_t	0.097***	0.022	0.118***
	(12.13)	(1.26)	(10.78)
$ROA_t \times SD_t$	-0.389***	-0.538***	-0.569***
	(-6.05)	(-3.79)	(-6.48)
$RET_t \times SD_t$	-0.006	-0.065**	-0.032
	(-0.40)	(-2.02)	(-1.60)
SD_t	0.016**	-0.018	-0.039***
	(2.15)	(-1.07)	(-3.72)
$Size_t$	0.250***	0.514***	0.439***
	(114.32)	(106.54)	(146.89)
MB_t	0.002**	0.041***	0.023***
	(2.08)	(20.81)	(19.26)
Lev_t	-0.043**	-0.416***	-0.262***
	(-2.23)	(-9.82)	(-9.96)
$Persist_t$	-0.002	1.214***	0.658***
	(-0.05)	(11.39)	(9.97)
Constant	4.802***	2.160***	3.936***
	(70.88)	(14.46)	(42.54)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm
N	24,429	24,429	24,429

Panel B. Various Fixed Effects Model Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1			Model 2		
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.697***	1.021***	0.974***	0.690***	1.080***	1.000***
	(9.76)	(7.35)	(10.61)	(10.44)	(7.88)	(11.23)
RET_t	0.100***	0.016	0.087***	0.098***	0.004	0.078***
	(12.60)	(0.99)	(8.61)	(12.56)	(0.24)	(7.37)
$ROA_t \times SD_t$	-0.381***	-0.277**	-0.462***	-0.276***	-0.267*	-0.409***
	(-5.13)	(-2.02)	(-5.18)	(-3.98)	(-1.78)	(-4.30)
$RET_t \times SD_t$	-0.026**	-0.142***	-0.082***	-0.029**	-0.141***	-0.075***
	(-2.02)	(-4.90)	(-4.61)	(-2.21)	(-4.70)	(-4.10)
SD_t	-0.027***	-0.001	-0.032***	-0.036***	0.003	-0.035***
	(-3.48)	(-0.05)	(-3.27)	(-4.93)	(0.15)	(-3.55)
$Size_t$	0.210***	0.441***	0.374***	0.178***	0.469***	0.360***
	(17.20)	(19.54)	(26.53)	(11.14)	(16.67)	(21.32)
MB_t	0.001	0.023***	0.015***	0.003**	0.017***	0.012***
	(1.06)	(8.62)	(8.29)	(2.38)	(6.43)	(6.60)
Lev_t	-0.179***	-0.515***	-0.366***	-0.223***	-0.559***	-0.420***
	(-4.26)	(-6.13)	(-6.73)	(-4.94)	(-6.21)	(-7.24)
$Persist_t$	0.167***	0.715***	0.563***	0.237***	0.667***	0.538***
	(2.68)	(6.02)	(7.30)	(4.14)	(5.52)	(6.94)
Constant	5.081***	3.091***	4.654***	5.086***	3.246***	4.778***
	(61.59)	(20.55)	(49.25)	(47.03)	(18.08)	(43.43)
Firm FE	Yes	Yes	Yes	No	No	No
CEO FE	No	No	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm	CEO	CEO	CEO
N	24,429	24,429	24,429	24,429	24,429	24,429
Adjusted R^2	0.683	0.670	0.764	0.782	0.739	0.820

Table 7 Panel A reports the median regression results of the effect of sales decreases on pay-performance sensitivity. Panel B reports the regression results for firm/year fixed effects in column (1) through (3), CEO/year fixed effects in column (4) through (6). All variables are defined in the Appendix and all continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. The standard errors are clustered by firm (in column (1) through (3)) or CEO (in column (4) through (6)). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 8
The Shift Toward the Past Performance

	(1)	(2)	(3)
Dep.var =	*ln*(*Cash Pay*)	*ln*(*Equity Pay*)	*ln*(*Total Pay*)
ROA_t	0.699***	0.404***	0.610***
	(9.65)	(2.88)	(6.45)
ROA_{t-1}	-0.070	0.121	0.033
	(-1.09)	(0.86)	(0.37)
RET_t	0.106***	0.052***	0.117***
	(13.50)	(3.44)	(12.13)
RET_{t-1}	0.043***	0.228***	0.172***
	(5.77)	(15.97)	(18.05)
$ROA_t \times SD_t$	-0.429***	-0.745***	-0.717***
	(-4.75)	(-4.24)	(-6.29)
$ROA_{t-1} \times SD_t$	-0.058	0.432**	0.178*
	(-0.71)	(2.54)	(1.67)
$ROA_{t-1} \times SD_{t-1}$	0.027	-0.607***	-0.379***
	(0.39)	(-4.05)	(-4.07)
SD_t	0.001	0.012	-0.004
	(0.15)	(0.72)	(-0.40)
SD_{t-1}	0.015*	-0.019	-0.003
	(1.82)	(-1.10)	(-0.24)
$Size_t$	0.261***	0.521***	0.436***
	(51.57)	(56.09)	(71.42)
MB_t	0.001	0.036***	0.022***
	(1.03)	(12.29)	(11.71)
Lev_t	-0.066*	-0.322***	-0.201***
	(-1.81)	(-4.30)	(-4.05)
$Persist_t$	-0.003	1.090***	0.673***
	(-0.04)	(8.10)	(7.31)
zConstant	4.748***	2.177***	4.006***
	(49.05)	(7.89)	(25.10)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster by	Firm	Firm	Firm
N	24,429	24,429	24,429
Adjusted R^2	0.499	0.491	0.618

able 8 reports the regression results on the shift toward the past ROA after sales declines by estimating Equation (2). All variables are defined in the Appendix; all continuous variables are winsorized at the 1st and 99th percentiles. Industry/year fixed effects are included in the regression models and the standard errors are clustered by firm. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

국문초록

경영자 성과-보상 민감도에 관한 연구

본 논문은 경영자 성과-보상 민감도에 대한 두 개의 독립적인 논문으로 구성되어 있다. 첫 번째 논문은 경영자 능력과 성과-보상 민감도 간의 관계를 분석한 것이다. 많은 이론연구에서 최적보상계약을 달성하기 위해서 경영자 능력이 높을수록 성과-보상 민감도가 높은 인센티브 계약이 제공되어야 한다고 논증한 바 있으나, 이에 관한 구체적인 실증 분석은 부족하다. 이에 본 연구는 이론연구와 동일하게 경영자 능력이 높을수록 높은 성과-보상 민감도의 보상시스템 즉, 높은 인센티브가 제공되는지 실증 분석하였다. 1994년부터 2015년까지 미국기업을 대상으로 경영자 능력과 성과-보상 민감도 간의 양(+)의 관계가 존재하는지 분석하였는데, 이를 위해 (i) 경영자의 임기가 상당기간 오래되어 경영자 능력에 대한 불확실성 및 정보비대칭이 해소되었다고 볼 수 있는 continuing CEO 표본과 (ii) 경영자 부임 첫 해로 능력에 대한 불확실성과 정보비대칭이 가장 높은 new CEO 표본을 구별하여, 경영자 능력과 성과-보상 민감도 간의 관계를 살펴보았다. 분석 결과에 의하면, continuing CEO 표본과 new CEO 표본에서 모두 경영자 능력과 성과-보상 민감도 간 유의한 양(+)의 관계가 나타났으나, new CEO 표본에서 두 변수간의 관계가 상대적으로 약하게 나타났다. 이는 평균적으로 경영자의 능력이 높을수록 성과-보상 민감도가 높은 보상 구조가 주어지는 반면, 새롭게 부임한 경영자에 대해서는 능력에 대해 불확실성이 존재하여 경영자 능력에 따라 적절한 인센티브가 제공되지 않을 가능성이 높음을 의미한다.

나아가, 본 연구에서는 앞선 결과를 토대로 경영자가 부임한 첫 해에는 경영자 능력에 대한 불확실성과 정보비대칭으로 인해 다양한 능력-보상인센티브 조합이 나타날 수 있다는 전제하에, 어떤 조합이 가장 높은 매칭 품질을 나타내는지를 분석하였다. 분석결과, 능력이 우수한 경영자에게 높은 인센티브가 제공되는 경우, 낮은 인센

티브가 제공되는 경우에 비해 기업가치와 미래 영업성과가 더 높은 것으로 나타났다. 그러나 능력이 높은 경영자에게 낮은 인센티브가 제공되는 경우, 해당 경영자는 자발적으로 기업을 떠날 가능성이 높은 것으로 나타났다. 이러한 결과는 능력이 높은 경영자에게는 높은 인센티브를 제공하는 것이 최적 임을 시사한다. 한편, 능력이 부족한 경영자의 경우, 낮은 인센티브보다 오히려 높은 인센티브를 제공하는 것이 기업가치에 긍정적인 영향을 미치는 것으로 나타났습니다. 능력이 낮은 경영자에게 낮은 인센티브가 주어지는 경우 해당 경영자가 해고될 가능성은 높았다. 능력이 낮은 경영자이라도 이론과 달리, 성과-보상 민감도가 높은 보상 계약을 제공하는 것이 기업가치에 긍정적인 영향을 미침을 알 수 있다. 본 연구는 경영자 능력에 대한 불확실성 및 정보비대칭성이 높은 초기의 보상 계약을 연구한 것으로, 경영자 능력과 최적의 보상 인센티브 간의 관계를 분석한 최초의 실증분석 연구라는 점에서 의미가 있다.

두 번째 논문은 매출 감소 시 측정한 이익이 경영자의 보상구조에 어떠한 영향을 미치는지 분석한 것이다. 매출이 감소하는 경우 측정한 당기 이익은 매출하락을 극복하기 위한 경영자의 노력 및 성과에 대한 완전한 정보를 내포하지 못한다. 이와 같이 당기 이익의 정보력이 감소하는 경우, 당기 이익과 보상 간의 관계가 어떻게 조정되는지 살펴보았다. 1993년부터 2014년까지 미국기업을 대상으로 분석한 결과, 매출이 감소하는 경우, 당기 이익과 보상 간의 관계가 하락함을 발견하였다. 매출 감소 시, 경영자의 다양한 보상(현금보상과 주식기준보상)수준을 결정할 때 당기 이익이 평가지표로서 가지는 가중치가 하락함을 의미한다. 나아가, 매출이 감소하는 경우 당기 이익에 대한 성과-보상 민감도를 낮추는 대신 오히려 과거 년도 이익에 대한 민감도를 높였는데 이러한 행태는 경영자의 다양한 보상 중 주식기준보상에서 나타났다. 종합하면, 이익은 매출이 하락하는 경우 매출이 증가하는 경우에 비해 평가지표로서의 중요도가 감소함을 발견하였고, 이에 따라 경영자의 성과-보상 간의 관계가 변화한다는 것을 발견하였다는데 그 공헌점을 찾을 수 있다.

주요어: 경영자 능력, 경영자 성과-보상 민감도, 델타, 매칭품질, 경영자 교체, 최적 보상계약, 매출변화, 매출감소

학번: 2015-30159