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To my amazing daughter

To my beloved husband

To my wonderful parents

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TABLE OF CONTENTS

LIST OF TABLES

Table Page

Chapter

I. COMPENSATION GAPS AMONG TOP EXECUTIVES: EVIDENCE OF TOURNAMENT INCENTIVES OR PRODUCTIVITY DIFFERENTIALS?

II. PAY GAP AMONG EXECUTIVES AND FIRM VALUE

III. INSTITUTIONS AND DEBT FINANCING

LIST OF FIGURES

Figure Page

Chapter

CHAPTER I

COMPENSATION GAPS AMONG TOP EXECUTIVES: EVIDENCE OF TOURNAMENT INCENTIVES OR PRODUCTIVITY DIFFERENTIALS?

Introduction

Virtually every corporate decision requires the mutual efforts of the senior executive team to successfully implement it, rather than simply the efforts of the CEO. The fact that executives work in a team and their actions affect each other suggests that the compensation level of one executive is likely to alter the incentives of other top executives as well. Tournament theory is a good example of where this perspective is modeled. A majority of the current studies on executive compensation focus rather narrowly on CEO compensation and its impact on the incentives of the CEO alone. One important, but under-explored question is how CEO compensation relative to the compensation of other senior executives affects the incentives of these other executives. The compensation gaps between the CEO and the other top executives vary substantially across firms. In some firms, the CEO is paid about 10 times more than other top corporate executives, while in other firms senior executives are paid more equally, so that the compensation gaps between CEOs and their direct subordinates are much less extreme. By exploring the determinants of these compensation gaps, we shed new light on the important question of how this major financial incentive mechanism is structured in large public firms.

Based on classical marginal productivity theory of labor, differences in the compensation levels of CEOs and other senior executives can simply reflect differences in their marginal contributions to firm performance. Executives differ significantly from each other in their abilities, managerial skills, and position specific experience, which can all affect their overall productivity. An executive's productivity is also strongly affected by their job responsibilities. Models of multiplicative productivity effects (e.g. Rosen 1981, Rosen 1982, Gabaix and Landier 2008) suggest that higher level managers can have much higher productivity than lower level managers, even if their inherent abilities do not differ much. The reason is that a CEO affects the productivity of all levels of the organization and has indirect effects on the productivity of lower level executives. Thus, more talented CEOs (or other senior executives) are placed in charge of more resources and larger firms. Such talented executives are paid substantially more because their ability has a greater impact on their subordinates' productivity.

An alternative view of the compensation gap is that it represents a trophy awarded to the winning executive who gets promoted to the CEO position. This application of tournament theory was first developed by Lazear and Rosen 1981, Green and Stokey 1983, Rosen 1986, among others. Tournament theory emphasizes that job hierarchy provides incentives to employees and firms use promotions as a mechanism of rewarding strong employee performance. Large pay increases induce employees to work hard to increase their chance of getting promoted. The key inference from tournament theory is that it is efficient to pay the winner considerably more than the losers in this internal

labor market competition, even if the winner is only marginally better than the losers.[1] A few supportive empirical studies include Main, O'Reilly, and Wade (1993), Eriksson (1999), and Bognanno (2001), who find that the compensation gaps between a CEO and lower level executives increase with the number of potential competitors for the CEO position. Kale et al (2009) document that events lowering non-CEO executives' promotion probabilities are associated with larger compensation gaps.

Nevertheless, the few studies that empirically support the predictions of tournament theory in explaining compensation policies have come under strong criticism. Scholars in economics, law and management have pointed out that other plausible theories emphasizing relative productivity yield observationally equivalent predictions (Finkelstein and Hambrick 1988, Gibbs 1995, Prendergast 1999, Anabtawi 2005). For example, the widely documented positive association between the number of competitors and the promotion prize in the above mentioned empirical studies can be explained by a productivity model with multiplicative effect: CEOs in charge of more subordinates should be paid substantially more, because their productivity affects the productivity of a larger number of lower level executives. Some evidence in Kale et al (2009), while consistent with tournament theory predictions, can also be explained by productivity theories of compensation. For instance, they interpret evidence that hiring an outside CEO leads to a larger compensation gap as consistent with tournament theory. Their rationale is that the appointment of a new CEO reduces the subsequent promotion probabilities of non-CEO executives and consequently, a larger compensation gap is

[1] The most controversial implication of tournament theory is that high CEO compensation does not necessarily reflect CEO performance, but rather it is chosen to motivate other senior executives in the corporation.

needed to keep the incentives of non-CEO top executives from weakening. Yet, this piece of evidence is also consistent with the predictions of productivity theory since a new CEO hired from outside tends to occur when a firm is performing poorly, so we should expect the new CEO to have better performance than the departing CEO, leading to an expected increase in the compensation gap as the CEO compensation rises. Thus, we are currently left without a clear understanding of whether tournament theory really has any empirical validity.

In this study, we address this limitation in the existing literature by developing stronger tests of tournament theory where we differentiate its predictions from those of productivity theory in explaining the compensation gap. In the first test, we examine compensation gaps prior to a CEO turnover and test the predictions of the two theories. Tournament theory relies on the incentives provided by promotion opportunities and hence, its effect should be most pronounced when a "tournament is on". If firms follow compensation schemes based on tournament theory, then we should expect the winning prize, measured by the compensation gap between the CEO and executives competing for the prize of CEO succession (hereafter we refer to Qualified Internal Candidates, or QICs), to be more sensitive to factors that markedly alter the odds of being promoted, i.e. the number of qualified candidates. Taking this implication one step further, this effect should be even stronger if CEO turnover is largely anticipated, such as planned or mandatory CEO retirement. Alternatively, if the compensation gap reflects superior CEO productivity and a multiplicative productivity effect on subordinates, then we should expect to find that the number of candidates, which also serves as a measure of a CEO's span of control, has a weaker impact on the compensation gap around the time a CEO is

expected to step down. The reason is that a CEO's influence over subordinates is likely to weaken in the CEO transition period, so the CEO productivity effect on subordinates is likely to weaken, even if CEO ability and effort are unchanged.

The second test involves selecting a group of firms most (least) likely to foster a CEO succession contest, and then testing the predictions of tournament pay arrangements for these particular firms. The rationale for this approach is that a firm's incentive mechanisms are heavily rooted in its contracting environment.[2] Thus, one would expect that some firms would consider it more advantageous to implement a tournament incentive scheme and structure their promotion strategies and compensation arrangements in a framework consistent with tournament theory. For instance, Cichello et al (2009) finds that in firms with well-defined organizational structures and two large and similar size divisions, executive promotions appear to be based on a contest between the two senior executives. Galanter and Palay (1991) document that tournament type competition is prevalent among lawyers in promotions to partner. We expect tournament pay arrangements to be most relevant in firms likely to use a succession contest to promote executives. Tournament pay arrangements are also more likely in large, multi-segment firms that have a "deep bench" of high-capable senior executives. Finding significantly stronger effects of the tournament variables in explaining the compensation gap for the subsample of firms most likely to run succession contests (termed tournament-oriented firms) would then support the theory having empirical content. It could also explain why tests based on a broader sample of firms yield only weak support for tournament theory.

[2] This is known as the selection effect of compensation contracts in the labor economics literature.

We find similar evidence to prior studies when tournament theory is tested alone. However, the evidence supporting tournament theory is largely lost once we control for the confounding effects of productivity theory in our analysis. Our findings that tournament theory predictions are not strengthened when we narrow our analysis either to periods prior to the departure of incumbent CEOs, or to firms most prone to succession contests, raise serious questions about the empirical validity of tournament theory. To be specific, we find that the effects of the variables capturing tournament intensity are actually weaker over the three years before CEO turnovers. The results are similar when we restrict CEO turnovers to planned retirements. Among the firms most likely to sponsor succession contests, we find the coefficients of the tournament intensity variables are insignificantly different from the coefficients estimated using the remaining firms. Furthermore, the overall explanatory power of those variables is much lower than that of variables measuring executive productivity in both tournament-oriented and non-tournament-oriented firms.

In contrast to these negative findings, our investigation finds that the cross-sectional variation in the compensation gaps of top executives can largely be explained by optimal contracting based on the varying productivity of individual executives, which indicates that firms attempt to link executive compensation to an individual's productivity. Using a set of variables that capture several dimensions of executive productivity, we find that the compensation gap between a CEO and QICs is lower as the average productivity of these QICs rises relative to that of the CEO.

The measurement of executive productivity is perhaps the biggest challenge to an empirical examination of compensation arrangements implied by productivity theory: the

outputs of individual employees are largely unobservable, especially for those in senior managerial positions. Nevertheless, we can observe signals that capture different aspects of an agent's productivity, including experience, past performance, job responsibilities, and external labor market certification. Mincer (1974) observes that employees voluntarily invest in increasing their human capital through on-the-job training[3] as a means of enhancing the future rates of return to their employment. The theory predicts that productivity increases with greater work experience. Based on symmetric learning models (i.e. Jovanovic 1979), employers periodically update their beliefs about individual worker abilities based on their recent performance in their jobs or on specific assignments. Hence, individual worker's past performance and achievements are positively related to productivity. Lastly, executives whose managerial ability is recognized by the external labor market are expected to exhibit higher productivity than executives whose abilities go unrecognized. Of course, the multiplicative effect of manager productivity can mean that higher level managers inherently have higher productivity given their positions of greater responsibilities.

We construct four measures of individual non-CEO executive productivity based on the above perspective[4] and find that they explain a significant portion of the cross sectional variation in the compensation gaps. More importantly, we find that prior to a CEO turnover senior executive productivity measures have a stronger ability to explain the observed reduction in the compensation gap. This is consistent with compensation being determined by executive productivity levels. In addition, we find clear evidence for

[3] Education is another means to improve human capital, although it is less relevant for seasoned employees, especially senior executives.

[4] We do not use firm performance measures such as ROA or stock returns as proxies for an individual executive's productivity because these firm level measures are the results of group efforts, and it is unclear how much each individual executive contributes to firm performance.

a productivity based explanation of the compensation gap, even among the tournament-oriented firms. More specifically, all four of the managerial productivity measures are significantly correlated with the compensation gap in the directions predicted by theory. Productivity variables also have larger impacts on the model's overall goodness of fit than do tournament variables: when we drop the productivity variables from the regression, the R-squared falls by 39 percent, whereas when we drop the tournament variables from the regression, the R-squared falls by only 5 percent.

The absence of a significant tournament effect in determining the compensation gap is perhaps not that surprising. First of all, the various benefits of being a CEO, including the power, prestige, and the enormous private perks, already provide strong incentives to non-CEOs to compete for promotion to CEO. Thus, it is unclear why firms would find it necessary to structure executive compensation in such a costly way as modeled by tournament theory, i.e. to overpay the CEO to heighten the incentives of the lower level employees. Second, Lazear (1989) argues that a tournament compensation arrangement may actually be harmful to the firm when close collaboration among executives is critical. Aggressive competition among senior executives could lead to sabotage of a competitor's initiatives or projects and could result in inefficient team coordination, which is detrimental to overall firm performance. This is likely to be especially detrimental in technology intensive firms (i.e. Siegel and Hambrick 2005). Lastly, several studies (i.e. Parrino 1997, Frydman and Jenter 2010, Murphy and Zabojnik 2007) document a rising trend toward hiring CEOs from outside the firm, suggesting that the managerial labor market is gradually shifting its preferences to general managerial skills, which are transferable across companies. This increased

mobility of top executives can attenuate the tournament incentives associated with internal promotions, potentially weakening the importance of tournament incentives in recent years.

This study contributes to the literature in three ways. First, this paper adds to a growing body of literature on the pay distribution among top executives, i.e. Anabtawi (2005), Kale et al (2009), Aggarwal et al (2010), Bebchuk et al (2011), Chen et al (2011), Burns et al (2012), Kini et al (2012), and Coles et al (2012). Unlike these earlier studies, we simultaneously examine two major economic theories predicted to shape the hierarchical pay structure of top corporate executives, namely tournament theory and productivity theory.[5]

Second, existing empirical tests of tournament theory are subject to the confounding effects of productivity differences among senior executives, which go uncontrolled for. Not surprisingly, they report mixed results. To address this weakness, we construct two new tests that enable us to distinguish between the predictions of these two important theories. By examining economic environments where the two theories have different implications, we find little evidence to support tournament theory, suggesting that prior studies reporting a tournament effect are capturing the effect of productivity differentials between a CEO and the other top executives.

Third, this study adds to the literature that examines performance-based compensation of corporate executives, often associated with Jensen and Murphy (1990). In their study, Jensen and Murphy examine whether CEO compensation reflects changes

[5] Kale et al (2009) simultaneously consider the effects of tournament incentive and performance based incentives on firm performance. However, when examining the determinants of the compensation gap, they only test the tournament effect and ignore other performance incentives.

in firm performance, a crude measure of CEO productivity. We use four more refined measures of individual executive productivity, which allows us to control for productivity differences across top executives within the same firm.[6] We find the compensation gap is linked to the differential productivity of senior executives and provide evidence which supports performance based explanation for executive compensation arrangements.

The paper proceeds as follows. Section 2 outlines the empirical design to differentiate the two theories and testable predictions. Section 3 describes the sample and variable construction. Section 4 reports the empirical results in terms of relative importance of tournament and productivity theories. Robustness analysis is presented in Section 5 and section 6 presents our conclusions.

Empirical Strategy and Testable Hypothesis

Prendergast (1999) points out a potentially serious identification problem faced by empirical studies of incentive contracts. The predictions of one specific model are often equally consistent with other plausible theories. Thus, many observed phenomena can be explained empirically by multiple theories. In this section, we propose two experiments which clearly differentiate and test the relative importance of two major theories of compensation, namely tournament theory and productivity theory that can both explain the hierarchical compensation gap in top management teams. We first briefly explain the

[6] To be specific, we evaluate executives productivity based on: 1) their past performance inferred from their past compensation growth; 2) tenure at their current positions; 3) their estimated probability of being promoted to CEO, based on observable characteristics; and 4) external labor market certification represented by holding one or more outside directorships in unaffiliated firms. Further elaboration of the four measures is presented in section 3.3.

basic predictions of the two theories, and then sketch out two experiments where the two theories have potentially different empirical implications.

Basic Predictions of Tournament Theory and Productivity Theory

Tournament theory has two major empirical implications. First, when the promotion probability is low, a higher compensation gap is needed to provide sufficient incentives to lower level managers. Moreover, when the promotion probability is too small, the competing candidates have an incentive to "give up" and hence, an even larger pay increase is required to overcome this negative incentive. Therefore, the theory predicts a convex relationship between the compensation gap and the number of QICs competing for promotion. Second, the compensation gap is predicted to be larger when the firm's operating environment is noisy and the random component of manager productivity is large. A noisy environment makes it more difficult to observe manager effort and effectiveness and hence, a larger incentive is needed to effectively reduce potential shirking behavior by managers.

H1 a: Under tournament theory, the compensation gap is increasing in the number of QICs and its squared term. The compensation gap is also increasing in the volatility of stock returns.

The fundamental prediction of productivity theory is that employees are paid according to their contribution to firm output. Hence, better performing QICs should lower the observed compensation gap, everything else being equal. The large skewness observed in the distribution of compensation relative to the distribution of employee abilities can be explained by productivity theory with multiplicative effect (Rosen 1982).

This variant of productivity theory can also explain the phenomenon that compensation within a firm increases with positions of greater authority and control, although an individual executive's ability cannot change overnight with a promotion. Higher level manager productivity can have indirect impacts on employee productivity at all lower levels, and hence more talented people can make larger contributions to firm performance if they are placed in higher positions with responsibilities over more resources. Therefore, this theory generates the same prediction as tournament theory, namely that the number of QICs underneath a CEO is positively associated with the compensation gap, because CEO productivity increases with his or her span of control. However, different from tournament theory, this productivity model with multiplicative effect predicts a concave relation between CEO productivity and a CEO's span of control, due to the limited time a CEO can spend supervising subordinates. Therefore, the quadratic term on the number of QICs is negative under this theory.

H1 b: Under productivity theory, the compensation gap is decreasing in a QIC's productivity. Moreover, under the assumption of a multiplicative effect, the compensation gap is increasing in the number of QICs, but at a decreasing rate.

Compensation Gap Prior to CEO Turnovers

The first experiment we carry out to differentiate tournament and productivity effects is to test these two theories when there are promotion opportunities for QICs. The fundamental assumption of tournament theory is that employees are strongly motivated by promotion opportunities, and larger expected compensation gains on promotion induce greater effort on the part of employees. Intuitively, the tournament incentive

should be stronger and succession contests should be more common in firms that emphasize internal promotions. Therefore, an increasing occurrence of internal CEO appointments would suggest stronger tournament incentives. However, the CEO turnover literature documents an increasing rate of external CEO appointments in the US: Specifically, in 1970 only about 13% of CEOs are hired from outside the firm, while this rate increases to 34% in the 90s (Parrino 1997).

More rigorously, we expect employees to be most motivated by tournament incentive when a promotion opportunity is near. If QICs anticipate that the current CEO will remain in office for many years, then the incentives provided by the internal tournament are greatly reduced, simply because QIC efforts are almost irrelevant to their chance of being promoted. A potentially stronger experiment is to look for a tournament effect on the compensation gaps shortly before CEO turnover events, when QICs have the greatest incentives to compete with each other for promotion and their chance of winning largely depends on their own efforts.[7] Under tournament theory, we expect a much stronger impact of the succession contest on the compensation gap prior to CEO turnovers than in the other time periods. Specifically, the compensation gap should be more sensitive to the number of QICs and stock return volatility during this transition period.

The tournament effect is likely to be more pronounced in shaping executive compensation when a CEO replacement is expected due to a planned retirement. Companies are most likely to have a well-planned CEO succession strategy and run a

[7] In our main tests, we look at the compensation gaps within three years prior to a CEO turnover event, and we check the compensation gaps within five years prior to CEO turnover for robustness.

contest among potential candidates when the incumbent CEO is approaching mandatory retirement age. In situations where CEOs are forced to resign due to extremely bad performance, the hiring of new CEOs is less likely to depend on the result of such succession contest for two reasons. First, given the urgency associated with extremely bad firm performance, a board of directors has little time to select a new CEO. Thus, a non-CEO officer director or even the chair of the board may step in as an interim person. Second, bad firm performance is an indicator of a poorly performing management team, which means a board of directors would be more likely to seek an outsider as the CEO to turn around the current negative performance. Thus, we expect a stronger tournament effect on the compensation gap prior to a planned retirement than a forced CEO turnover due to bad performance.

H2 a: Under tournament theory, the effect of the number of QICs and the volatility of stock returns should be stronger prior to CEO turnovers, especially for planned CEO retirements.

Alternatively, productivity theory predicts that executive compensation differences between two adjacent levels of the managerial hierarchy reflect differences in average executive productivity. Prior to turnovers, CEO productivity is generally lower because of either declining incentives as a CEO retirement nears or other causes that lead to bad firm performance. Furthermore, the positive externality of CEO productivity on subordinates' productivity is also likely to decline as a CEO's influence over subordinates weakens near these major transition periods. Thus, productivity theory with multiplicative effect predicts that the impact of a CEO's span of control, captured by the number of QICs, should decline prior to CEO turnovers. On the other hand, QIC

productivity is likely to rise prior to CEO turnovers, because QICs have greater incentives to reveal their true capabilities and to send stronger signals of their ability to the board of directors. As a consequence, before a CEO turnover, the variables measuring QIC productivity should have greater effects on reducing compensation gaps for two reasons. First, observed performance measures are likely to underestimate changes in QIC productivity, since the extra effort QICs exert to win a promotion is unlikely to reflect itself immediately in changes in observable performance measures. Second, a board of directors is likely to rely on observable and objective signals to evaluate QICs when choosing the next CEO, because these measures are easier to compare across candidates than more qualitative measures, which are particularly difficult for outside directors to observe.

H2 b: Under productivity theory, the effect of the number of QICs on the compensation gap should be weaker prior to CEO turnovers. In contrast, QIC productivity effects on reducing the compensation gap should be stronger before CEO turnovers.

Tournament-Oriented Firms

Executive compensation policy can have a selection effect in that it is designed partly to attract the type of managers that firms prefer based on their contracting environment. It is not surprising that some firms would find it more advantageous to choose tournament incentive plans over other alternative incentive structures. Thus, our second empirical approach involves identifying firms most likely to foster succession

contests, and test if tournament theory is more relevant in explaining the compensation policies across the top executive ranks of those firms.

Although we can sometimes infer from news stories that firms have a list of candidates whom they are considering as a CEO's successor, more generally succession plans are largely unobservable. This makes it difficult to clearly identify which firms are pursuing succession contest strategy (termed tournament-oriented firms hereafter). Studies of CEO succession plans suggest that one reasonable strategy for identifying tournament-oriented firms is to look for firms where the number of qualified internal candidates is greater than one, since a succession contest requires at least two inside QICs.[8] The validity of this approach relies first, on whether the algorithm is effective at identifying inside candidates and second, on whether the succession contests are correctly timed. One challenge to identifying succession contests is that it is possible for a firm to currently have a single QIC because the succession contest occurred in a prior period and one candidate decisively won.[9] In this study, we employ a new empirical strategy to identify tournament-oriented firms using publicly available data that overcomes the above mentioned challenge.

Our approach to identify firms using succession contests relies on the characteristics of firm turnover decisions. The strategy behind our identification algorithm is to argue that appointing an insider as CEO suggests that some sort of competition among inside candidates was taking place before the CEO turnover date. In

[8] Mobbs and Raheja (2010).

[9] One alternative approach to identifying tournament-oriented firms is to send out survey questionnaires on a firm's current and past succession processes. However, given the large amount of time needed to obtain a relatively large sample, this approach is not easily pursued. Furthermore, a large portion of the sample would be lost due to non-responses, or we would then be forced to use a similar approach to the one for categorizing unresponsive firms.

cases where the CEO is replaced by an outsider, there are two possibilities. First, the recruiting plan may heavily favor an outsider so that the board of directors focuses its search on outside candidates, and not surprisingly, a qualified outsider is appointed to the position. Second, outside candidates are introduced into the competition together with inside candidates, and the outsider wins. In the first scenario, although a succession contest may take place among several outside candidates, it does not influence the compensation structure of the executives inside the firm. Hence, these firms are not classified as tournament-oriented for the purpose of testing the tournament effect on senior manager compensation. In the second scenario, insiders also compete for the CEO position, and tournament incentives do motivate inside candidates to seek the CEO prize. Therefore, we treat these firms as tournament-oriented. In examining firms where an outsider defeats the inside candidates (the second scenario), we look for appointments of external CEOs where at least one existing non-CEO officer is on the board. This approach relies on prior evidence that internal CEO candidates are likely to be inside directors. Realizing that succession contests can take place well before an actual CEO replacement, we look back as far as three years[10] before the actual CEO turnover for each tournament-oriented firm in order to correctly time the occurrence of the succession contest.

After identifying tournament-oriented firms based on the algorithm sketched above, we estimate a logit model to determine the factors that influence firms to self-select into the tournament-oriented category. The relative importance of tournament and productivity theories in explaining the compensation gap is then examined for the

[10] We look back as far as five years in robustness test.

predicted tournament-oriented firms, where we explicitly control for the private information associated with the succession contest choice by adding the inverse Mill's ratio obtained from the logit estimation.[11] If tournament theory has a first order effect in determining the compensation gap in tournament-oriented firms, we should expect to find the tournament variables to be more important statistically in these firms than in the remaining firms. Alternatively, if productivity theory has a first order effect in determining the compensation gap, we should observe a strong productivity effect in both groups.

H3 a: Under tournament theory, the effects of tournament variables (i.e. the number of QICs and its squared term, and the volatility of stock returns) on the compensation gap should be larger in the subsample of predicted tournament-oriented firms than in the remaining subsample of firms.

H3 b: Under productivity theory, the effects of tournament variables should at best have equally weak effects in both subsamples of firms. Moreover we should observe that QIC productivity has a strong effect on the compensation gap in both subsamples.

[11] We use predicted tournament-oriented firms based on the probability estimated from the logit model using 0.5 as the cutoff point. The reason to use predicted tournament-oriented firms instead of the identified tournament-oriented firms is to partly address the potential misspecification in our identification algorithm.

Data Source, Variable Construction and Sample Description

Data Source

We obtain top executive officers and their compensation data from Compustat's Execucomp for the period from 1993 to 2005. Observations in year 1992 are excluded due to the database's very incomplete coverage in that year. Since FAS123R significantly changed the reporting rule on equity based compensation starting in year 2006,[12] our sample ends in 2005 so that equity-based compensation is estimated on a consistent basis. Identification of the CEO is primarily based on the Chief Executive Officer code (CEOANN=CEO). The sample only includes firms with a clearly identified CEO and at least three non-CEO senior executives reported in Execucomp. Firm accounting information and stock return information are taken from Compustat and CRSP respectively. Boards of directors and other corporate governance characteristics are obtained from RiskMetrics. Because RiskMetrics begins reporting board of director information in year 1996, our major tests are based on the 10-year period from 1996 to 2005.

Definition of Qualified Internal Candidates in the Tournament

Although firms report at least top five executive in their proxy statements, not all of them are equally important. Hierarchical levels exist even among top management teams. For example, immediately below the CEO, there are usually one to four senior

[12] Specifically, the FASB began requiring that the public entities report the cost of all employee stock options and other equity based compensation based on their current fair value.

executives, followed by other executives further down the hierarchy. Only executives immediately below the CEO are treated as potential candidates for CEO succession. We define these executives as qualified internal candidates (QICs), where they must meet the following two criteria in order to be considered serious CEO candidates: (1) they must be younger than 65 years old;[13] (2) they must either be an officer-director or have total compensation within 10 percent of the highest paid non-CEO executive. In robustness, the definition of QICs is relaxed to include non-CEO executives whose total compensation is within 20 percent of the highest paid non-CEO senior executive. Officer-directors generally have greater abilities and knowledge of a firm's overall operations. Hence, they are more likely to be considered potential successors to the CEO. Also, the higher paid executives are likely to have greater responsibilities and report directly to the CEO.

Former CEOs are eliminated from the pool of QICs, since they are less likely to be competing for the CEO position a second time. Other less qualified senior executives, who are one level lower in the hierarchy than the QICs, are termed level three managers. The three management levels in the executive team provide a rich setting to test tournament incentives. Table 1 Panel A summarizes the typical titles of the QICs. We find 11 percent of QICs are divisional heads. The remaining QICs are executives with major oversight responsibilities, including presidents and vice presidents (84.50 percent), COOs (21.66 percent), CFOs (18.61 percent), Vice Chairmen (11.24 percent), and others (3 percent).[14] In terms of predictive power, this algorithm successfully identifies most new CEOs promoted internally: among the inside CEO appointments over the sample

[13] In robustness, I use 62 years old as the cutoff point.
[14] The sum of these percentages exceeds 100 because many executives hold more than one title.

period, 80 percent are identified as QICs in the prior year, of which 63 percent were inside directors. Moreover, a logistic regression of the probability of promotion to the CEO position suggests that QICs are 3.24 times more likely to be promoted than non-QIC level three executives.[15]

Table 1 Descriptive Statistics of QICs

Panel A

Total number of QICs		35518	
QIC titles		Number	Percentage
Divisional managers		3862	10.87%
Oversight managers		31656	89.13%
	President and Vice President	26748	84.50%
	Vice Chair	3567	11.24%
	COO	6857	21.66%
	CFO	5909	18.67%
	Other Chief Executives	953	3%

Panel B

	Number of firm-year observations			
Number of QICs	Definition 1		Robust Definition	
	Freq	Percentage	Freq	Percentage
1	6998	52.18%	5298	39.51%
2	4172	31.11%	4241	31.63%
3	1678	12.51%	2514	18.75%
4	514	3.83%	1229	9.16%

Table 1 Panel B shows the distribution of the number of QICs in the sample under two alternative definitions. One notices that a large portion of sample firms (over 52%)

[15] The left-hand side of the logistic regression is a dummy indicating whether this executive is promoted to the CEO position in the future (within three years). The explanatory variables include an indicator variable that denotes whether this executive qualifies as QIC, executive age, and executive gender.

have only one QIC. In these single candidate firms, a contest for the CEO succession is less likely to occur. However, it is also possible that a succession contest took place at an earlier stage, and the winner becomes the designated successor. This designated successor usually has a much higher probability of being promoted and receives higher compensation than other non-CEO executives.[16] In robustness test, we exclude firms with designated successors from the multiple QICs tests of tournament theory. More than 44 percent of sample firms have two or three QICs, while firms having four or more QICs are very rare. This is consistent with anecdotal evidence on the size of CEO contests. [17]

Measure of the Compensation Gap

The compensation gap between executives in adjacent hierarchical levels is based on each executive's total compensation, including salary, bonus, other annual pay, the total value of current restricted stock grants, the Black-Scholes value of any current stock option grants, long-term incentive payouts, and all other compensation (as reported in Execucomp item TDC1). We further separate total compensation into short term (salary, bonus, and other annual pay) and long term compensation (all other components). The compensation gap between the CEO and the qualified QICs is measured by the logarithm of the ratio of CEO compensation to the median compensation of QICs. By using the ratio rather than dollar difference to measure the compensation gap, we control for the average compensation level of all the senior executives, a measure that is usually highly

[16] Studies of firm succession plans and potential candidate pools include Naveen (2006), Mobbs and Raheja (2010).
[17] In GlaxoSmithKline's 2007 CEO race, they announce three candidates. The incumbent CEO at that time commented that the number of candidates is larger than usual.

correlated with firm size.[18] Moreover, taking logarithms of the ratios reduces the skewness of the dependent variable.[19] It also helps to address the concern that the relationship between the compensation gap and some key explanatory variables might be non-linear.[20] To summarize, we examine three measures of the compensation gap formally defined in the following equations.[21]

[18] Nevertheless, we also use the log of dollar difference in compensation for robustness. To be specific, the compensation gap is defined alternatively as:
Total Gap= Log(total CEO compensation – median total compensation of QIC)
Short-term Gap = Log (short-term CEO compensation – median short-term compensation of QIC)
Long-term Gap = Log (long-term CEO compensation – median long-term compensation of QIC)
[19] The skewness of the distributions of the three compensation gap measures is -0.7, -0.6 and -1.7 respectively.
[20] For example, in Gabaix and Landier (2008) the CEO compensation is a power function of firm size.
[21] The compensation gaps between level 2 and level 3 managers are calculated in a similar manner.

Table 2 Descriptive Statistics of the Compensation Gap Measures

	Mean	Median	N
Compensation variables			
CEO total compensation ($ 000)	4426.29	2301.62	13410
CEO short-term compensation ($ 000)	1337.38	958.98	13410
CEO long-term compensation ($ 000)	3100.36	1193.01	13410
Median QIC total compensation ($ 000)	2371.47	1342.18	13410
Median QIC short- term compensation ($ 000)	725.81	538.3	13410
Median QIC long- term compensation ($ 000)	1622.15	718.37	13410
Annual CEO total compensation growth	0.57	0.06	10916
CEO alignment	3.42	1.8	10548
Median QIC alignment	1	0.55	11430
Compensation gap between CEO and QICs			
Total gap (dollar term, $ 000)	1989.33	834.74	13410
Total gap (ratio)	2.18	1.79	13410
Short-term gap(dollar term,$ 000)	599.27	385	13410
Short- term gap (ratio)	2.01	1.77	13410
Long -term gap (dollar term,$ 000)	1406.3	386.12	13410
Long -term gap (ratio)	3.78	1.84	13410
Compensation gap between QICs and level 3 managers			
Total gap (dollar term, $ 000)	1067.51	446.63	13410
Total gap (ratio)	2.1	1.03	13410
Short- term gap(dollar term,$ 000)	229.05	139.37	13410
Short- term gap (ratio)	1.45	1.34	13410
Long- term gap (dollar term,$ 000)	817.29	259.64	13410
Long- term gap (ratio)	5.95	1.87	13410

Total Gap = Log (total CEO compensation / median total compensation of QICs)

Short-term Gap = Log (short-term CEO compensation / median short-term compensation of QICs)

Long-term Gap = Log (long-term CEO compensation / median long-term compensation of QICs)

Table 2 shows that non-CEO executives are generally paid less than CEOs. On average, a CEO's total compensation is more than twice that of the median QIC. The long-term compensation gap ratio is even larger, which is on average 3.78, with a median value of 1.84. In terms of dollar amount, the average total compensation difference between the CEO and the median QIC is $1.989 million, and about two thirds of the difference comes from differences in long-term compensation. Our compensation gap is generally lower than that reported in Kale et al (2009). The reason appears to be that Kale et al (2009) treat all non-CEO executives reported in proxy statements as CEO candidates, while we only include those who have more important roles and are better paid and qualified to be CEO succession candidates. Figures 1 and 2 highlight the trends in CEO compensation, QIC compensation, and their compensation gap over the 1993-2005 period. Although the compensation of both CEO and non-CEO senior executives shows a significant rise over the 13-year period, CEO compensation exhibits a faster rise. Hence, the compensation gap also rises noticeably, where the average total compensation gap in dollars doubles, and the average long-term compensation gap triples in size.

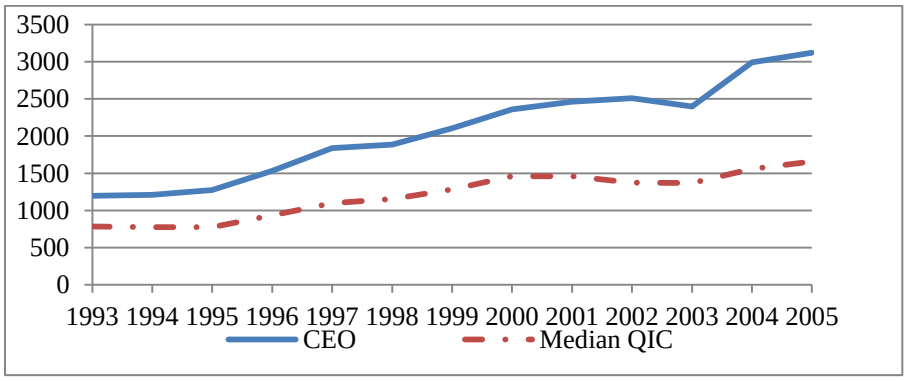

Figure 1a Median Total Compensation Year By Year ($000)

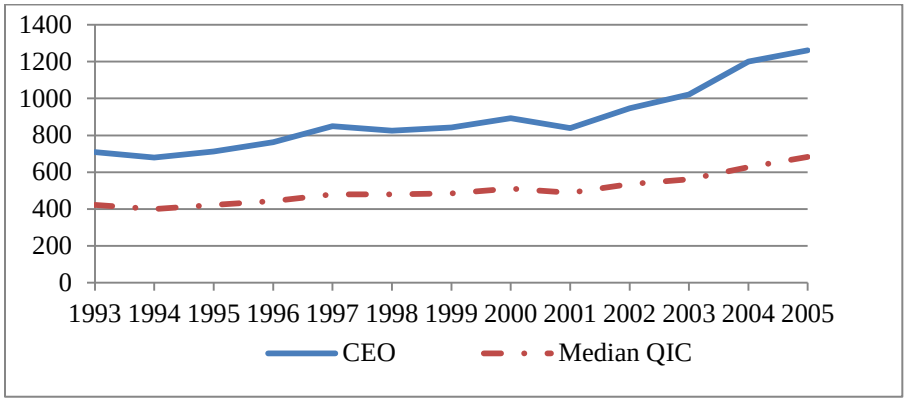

Figure 1b Median Short-Term Compensation Year By Year ($000)

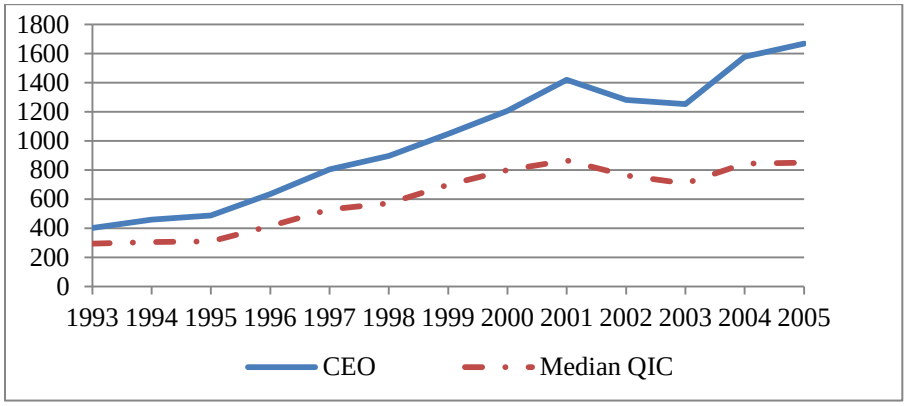

Figure 1c Median Long-Term Compensation Year By Year ($000)

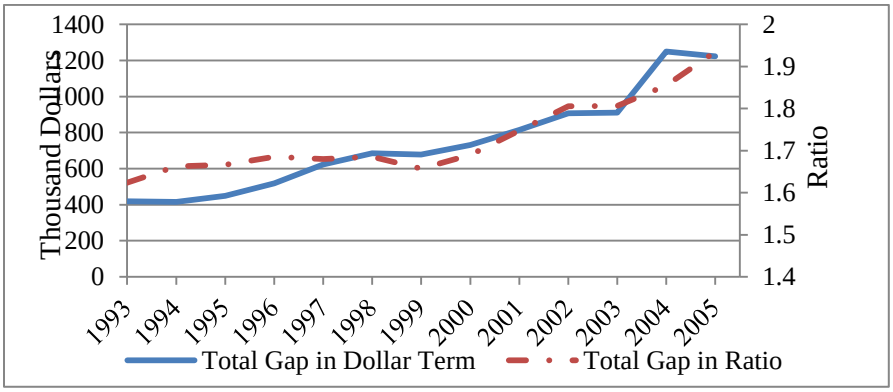

Figure 2a Median Total Gap Measured In Dollar Term and In Ratio

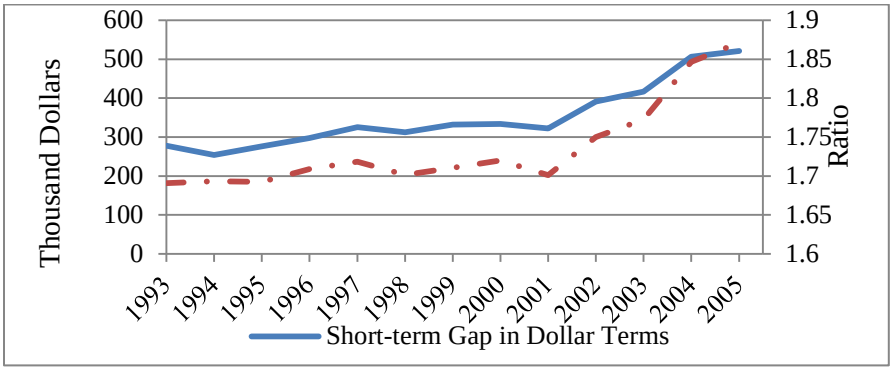

Figure 2b Median Short-Term Gap Measured In Dollar Term and In Ratio

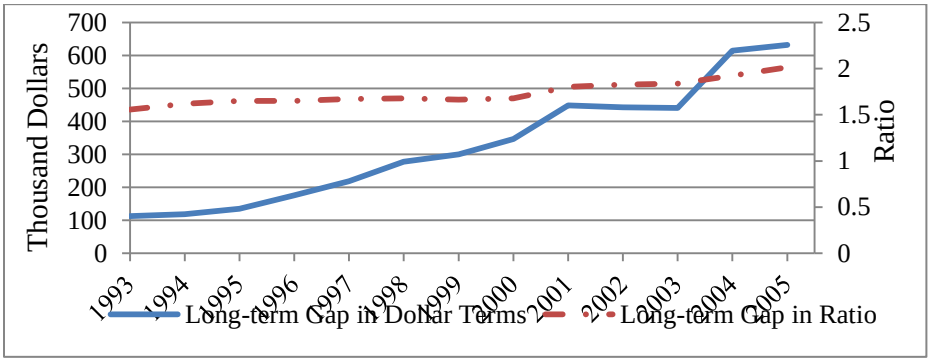

Figure 2c Median Long-Term Gap Measured In Dollar Term and In Ratio

Productivity Variables

The critical issue in testing productivity theory is that executive productivity is unobserved. What can be observed is a set of measures correlated with executive productivity. Based on prior theories and empirical evidence, we use four measures of executive productivity. First, human capital theories argue that worker productivity increases with work experience, but at a decreasing rate. Using personnel data within a firm, Gibbs (1995) shows that employee performance first increases, then decreases with

tenure. Therefore, we use an executive's position tenure, measured by the number of years he or she spends in the current position as our first measure of productivity. To capture concavity in the relationship, we also include the position tenure variable squared. This is likely to be a conservative measure of QIC productivity, because we cannot observe how long the QIC stays in the position beyond our sample period.

Baker et al (1994) document that employees with faster rates of growth in compensation are more likely to be promoted and receive promotions more rapidly, which is consistent with symmetric learning theory that employers primarily learn about worker productivity from their past performance (Jovanovic 1979). Thus, we use the average raise in compensation over the past three years as a second proxy for an executive's short-term past performance.[22] As a third proxy for a QIC's expected productivity, we estimate the propensity to be promoted to CEO of this firm or another S&P 1500 firm over the next three years. The promotion propensity is estimated from a logit model, where the dependent variable is an indicator of whether a QIC is promoted within three years and the explanatory variables include a COO indicator, a CFO indicator, a president indicator, a vice-president indicator, a vice-chairman indicator, an inside director indicator, QIC's current position tenure, and the log of QIC age. Our fourth measure is the number of independent directorships held by the QIC.[23] Masulis and Mobbs (2011) document that non-CEO executives recognized by the external labor market for their managerial talent by outside board appointments at unaffiliated firms are more likely to become a CEO at their own or another firm than other non-CEO

[22] If the executive has less than three years of annual compensation, we use all the available observations in Execucomp to compute his or her compensation growth rate. If the executives has only one year of compensation, then we use the average compensation growth of other top executives in the same firm to proxy his or her compensation growth.

[23] An independent directorship refers to an outside directorship in an unaffiliated firm.

executives. Table 3 reports summary statistics for these four productivity measures. QICs hold their current positions for an average of under 4 years. The median annual compensation growth of QICs is 16%. The mean and median promotion propensities are 8% and 7% respectively. About 9% of firms have at least one QIC serving as an independent director of another firm.

Table 3 Descriptive Statistics of QIC Productivity Measures

Productivity measures of QICs	Mean	Median	N
Tenure as QIC	3.83	3.5	13410
Compensation growth	0.64	0.16	13410
Promotion propensity	0.08	0.07	13410
Outside independent directorships	0.09	0	13410

Identify CEO Turnovers

CEO turnover is identified by a CEO name change from the prior year. Whether the new CEO is promoted from inside or outside the firm is determined by comparing the time this person joins the firm and the time that he or she is appointed as CEO. If he or she is a firm employee for more than one year prior to becoming CEO, then the CEO appointment is defined as an inside promotion, otherwise it is defined as an outside appointment. For new CEOs where we lack information on their prior tenure at the firm, we use the Forbes business profile and Marquis Who's Who on the Web to determine if a new CEO is an inside or outside appointment.

Sample Description

We report the descriptive statistics of our sample in Table 4 Panel A and B. The definition of each variable is given in Appendix A. All continuous variables are winsorized at 99 and one percent levels.

Firms in our sample are relative large and complex, with average total assets of $4.714 billion and more than two business segments. The mean and median ROA is 3 percent and 5 percent respectively. The average firm has 9 directors on its board and more than 60% are classified as independent directors. About 8% of CEOs are firm founders and another 3% of CEOs belong to founding families. The average CEO in our sample is 55 years old and has held the position for 7 years. Lastly, 63% of CEOs also serve as the board's chairperson. We find that executive pay-for-performance sensitivity of our sample is similar in magnitude to prior work.[24] A hundred dollars increase in shareholder value leads to $3.42 and $1 increases in a CEO's and QIC's personal wealth respectively. This is comparable to Aggarwal and Samwick (2003), who find that pay-for-performance sensitivity is higher for CEOs than non-CEO executives.

[24] The calculation of pay-for- performance sensitivity is explained in Appendix B.

Table 4 Summary Statistics of the Sample Firms

Panel A			
Firm characteristics	Mean	Median	N
Total assets ($ million)	4714	1022	13406
Firm age	21.04	15	12975
Number of business segments	2.41	2	12472
Leverage	0.16	0.12	12180
ROA	0.03	0.05	13007
Market to book ratio	3.17	2.23	13312
Stock returns	0.016	0.014	12735
Volatility of stock returns	0.139	0.12	12774

Panel B			
Governance variables	Mean	Median	N
Board size	9.14	9	10503
Pct of independent directors	0.64	0.66	10503
Pct of busy independent directors	0.10	0	10473
IDB dummy	0.13		10503
Non-CEO officers ownership	1.76%	0.27%	12933
CEO age	55.38	55	12649
CEO tenure	7.1	5	12545
CEO chairman duality	0.63	1	13410
CEO ownership	3.07%	0.34%	11246
CEO is the founder	0.08		13410
CEO belongs to founder family	0.03		13410

Table 5 Trend of Compensation Gap Prior to CEO Turnovers

	No CEO Turnover		Forced CEO Turnover		CEO Retirement	
	(1)	(2)	(3)	(4)	(5)	(6)
	Mean	Median	Mean	Median	Mean	Median
Change of Dollar Term Total Compensation Gap ($000)	303.69	92.46	-239.96	-90.16	-276.89	-59.56
Change of Total Compensation Gap Ratio	0.07	0.02	-0.1	-0.07	-0.17	-0.09
Change of CEO Total Compensation($000)	378.11	145.04	-59.09	0	134.27	46.57
Change of Median QIC Total Compensation ($000)	81.5	57.62	176.1	26.07	411.49	132.29
Percentage of QICs as Officer Director	39.62%		55.04%		68.58%	

Horse Race between Tournament Theory and Productivity Theory: Empirical Results

Testing Competing Contracting Theories Prior to CEO Turnovers

When no CEO turnover is foreseen in the near term, we observe an upward trend in the compensation gap between the CEO and QICs as reported in Table 5: the compensation gap increases on average by $303,696 every year, with a median value of $92,467; the ratio of CEO total compensation over median QIC compensation on average also increases by 35% with a median of 1.2%. The growth in compensation gap is a result of relatively faster growth in CEO compensation compared to that of the QICs. The compensation gap starts to fall three years prior to CEO turnover, especially when a firm experiences a string of poor performance. For the median firm, the total annual compensation gap falls by $90,159. This largely reflects negative growth in CEO compensation.[25] In contrast, although the compensation gap also narrows three years prior to CEO retirements, it is mainly because QICs' annual compensation increases much more than CEO compensation does. The average (median) yearly compensation increase is $411,000 ($132,000) for the QICs and $134,276 ($46,572) for the CEO. The faster rise in QIC compensation prior to CEO retirements can partly be explained by the fact that QICs start to take on more responsibilities in this transition period. For example, about 48 percent of QICs that are not officer-director are appointed to the board within three years prior to CEO retirements. The ratio is 25 percent when the CEO is forced out

[25] CEO annual compensation falls by $59,090 annually on average three years prior to forced turnover due to bad performance. The annual compensation growth of QIC, although not negative, is much slower than in other time periods ($26,069 increase prior to forced turnovers versus an average increase of $57,627 when there is no near term forced CEO turnover).

due to bad performance. This result is consistent with productivity based compensation policies where QICs get paid more when they take on more job responsibilities.

Testing Tournament Predictions

Table 6 presents multivariate tests of the ability of tournament theory to explain the total compensation gap, short-term compensation gap and long-term compensation gap.[26] We then examine the explanatory power of tournament theory prior to a CEO turnover by interacting the tournament variables with an indicator variable for firms that experience CEO replacements in the following three years.[27] As discussed earlier, tournament theory (H1a) predicts a convex relationship between the number of QICs and the compensation gap. Empirically, we find that the number of QICs has a significant positive association with all three forms of the compensation gaps, consistent with the findings in prior work.[28] But, the negative coefficient on the quadratic term of the number of QICs suggests that its effect on the compensation gap diminishes and may even reverse when the number of QICs is large. We find similar results even when we limit our analysis to firms that have more than one QIC as reported in regression 4 of Table 6. Bognanno (2001) also finds a similar result. This evidence clearly contradicts the tournament prediction, but is in line with the predictions of productivity theory with multiplicative effect. The diminishing return on CEO time and energy in supervising their subordinates creates a concave relation between CEOs productivity and the number of subordinates they supervise. Firm performance volatility measured by the stock return

[26] We use OLS regression with year and industry fixed effects. The standard errors are cluster at firm level.
[27] We also look at CEO turnovers in the next five years for robustness.
[28] In unreported regressions, we find that the number of candidates increases the compensation gap by lowering the median pay of QICs rather than inflating CEO compensation.

Table 6 Tournament Effect on the Compensation Gap

	Total Gap		Short-Term Gap		Long-Term Gap		Total Gap	
Number of QICs	0.26	***	0.11	***	0.28	***	0.31	***
	(0.04)		(0.03)		(0.08)		(0.09)	
(Number of QICs)^2	-0.03	***	-0.01	*	-0.02		-0.04	***
	(0.01)		(0.01)		(0.02)		(0.014)	
Volatility of stock returns	-0.68	***	-0.50	***	-0.50		-0.47	*
	(0.21)		(0.16)		(0.41)		(0.28)	
Log (board size)	0.12	**	-0.01		0.40	***	0.12	*
	(0.05)		(0.04)		(0.11)		(0.07)	
Board independence	-0.002		0.002		0.013		0.01	
	(0.02)		(0.02)		(0.05)		(0.027)	
Pct of busy ind. Directors	-0.01		-0.04		-0.07		0.03	
	(0.07)		(0.06)		(0.18)		(0.27)	
IDB indicator	-0.09	***	-0.02		-0.20	***	-0.10	***
	(0.03)		(0.02)		(0.06)		(0.03)	
CEO ownership	-0.03	***	-0.02	***	-0.04	***	-0.03	***
	(0.00)		(0.00)		(0.01)		(0.005)	
E index	0.02	**	0.005		0.03		0.02	***
	(0.01)		(0.01)		(0.02)		(0.01)	
CEO Chairman	0.00		-0.01		0.05		0.03	
	(0.02)		(0.02)		(0.05)		(0.03)	
CEO is the only officer director	0.16	***	0.14	***	0.17	***	0.28	***
	(0.02)		(0.02)		(0.05)		(0.03)	
CEO is the founder	-0.04		-0.07	*	0.01		-0.11	**
	(0.04)		(0.04)		(0.11)		(0.05)	
CEO belongs to founder family	-0.15	***	-0.15	***	-0.21	*	-0.15	**
	(0.04)		(0.04)		(0.12)		(0.07)	
CEO alignment	0.03	***	0.01		0.04	***	0.02	**
	(0.01)		(0.01)		(0.01)		(0.008)	
QIC alignment	-0.05	*	-0.03		0.09		-0.07	*
	(0.03)		(0.03)		(0.08)		(0.038)	
Probability of VP resigning	-0.10	**	-0.02		-0.28	**	0.10	
	(0.05)		(0.04)		(0.12)		(0.09)	
Log (CEO tenure)	-0.04	***	-0.02		-0.13	***	0.03	
	(0.01)		(0.01)		(0.03)		(0.016)	
Log(industry median gap)	0.36	***	0.13	***	0.64	***	0.35	***
	(0.02)		(0.02)		(0.06)		(0.028)	
Herfindahl index	-0.09		0.36		0.99		1.19	
	(0.72)		(0.67)		(1.77)		(1.09)	
Industry homogeneity	-0.58	***	-0.07		-0.97	**	-0.16	
	(0.18)		(0.15)		(0.39)		(0.26)	
Log (lag total assets)	0.02	**	0.02	**	0.03		0.01	
	(0.01)		(0.01)		(0.03)		(0.015)	
Lag (MTB)	0.001		-0.007		0.015		-0.01	
	(0.01)		(0.01)		(0.02)		(0.01)	
R&D Intensive Indicator	-0.07	***	-0.006		-0.06		-0.03	
	(0.027)		(0.02)		(0.06)		(0.03)	
Number of business segments	0.000		0.005		-0.006		0.00	
	(0.01)		(0.00)		(0.01)		(0.007)	
Industry and year fixed effects	Yes		Yes		Yes		Yes	
Number of Observations	9366		9366		9366		4155	
R-squared	0.21		0.19		0.15		0.31	

standard deviation is negative and significantly associated with the total compensation gap (both in full sample and in the firms having more than one QIC) and the short-term compensation gap, again contradicting the tournament theory prediction in H1a.[29] This observed association could alternatively be explained by a firm lowering pay disparity in an effort to retain talented managers by maintaining a lower pay disparity, especially when a firm is operating in a more volatile economic environment.[30] However, this argument is not part of tournament theory. In summary, the results in Table 6 are inconsistent with hypothesis H1a of tournament theory.

We next examine the tournament effect on the compensation gap of firms prior to CEO turnovers, reported in the Table 7 regressions estimates. In contrast to hypothesis H2a, we do not find that the effects of tournament variables become stronger in the CEO transition period when a succession contest is most likely to take place. The interaction term of the turnover indicator and the number of QICs is significantly negative, suggesting that the total compensation gap is less sensitive to the intensity of the succession contest. Moreover, the coefficient of squared number of QICs remains negative and significant prior to a CEO turnover, failing to support the tournament prediction that the compensation gap increases at an increasing rate with the size of the tournament. On the other hand, the finding that the curvature between the compensation gap and the number of QICs flattens prior to CEO turnovers can be interpreted as consistent with productivity theory with multiplicative effect as predicted by hypothesis

[29] Stock return volatility is measured from monthly returns over the prior 5 years. Similar results are obtained using abnormal returns based on either 1) a one-factor market model or 2) a two-factor market model where the second factor is the industry return.

[30] Indeed, Bloom and Michel (2002) find that large compensation gap is associated with higher manager turnover and shorter manager tenure, and this impact can be exaggerated under more volatile operating conditions.

H2b: the positive externality of CEO productivity on subordinates' productivity declines as a CEO approaches replacement. Additionally, the negative impact of stock return volatility on the compensation gap becomes stronger prior to CEO turnover, indicating that firms put more emphasis on retaining talented VP executives by lowering the compensation gap in CEO transition periods. This evidence again strongly contradicts the tournament theory prediction of hypothesis H2a.

Table 7 Tournament Effect Prior to CEO Turnovers

	Dependent Variable: Total Compensation Gap			
	(1)	(2)	(3)	(4)
Number of QICs	0.23 ***	0.23 ***	0.19 ***	0.22 ***
	(0.04)	(0.036)	(0.04)	(0.04)
(Number of QICs)^2	-0.024 ***	-0.024 ***	-0.07 ***	-0.024 ***
	(0.008)	(0.007)	(0.02)	(0.008)
Volatility of stock returns	-0.45 **	-0.60 ***	-0.50 **	-0.45 **
	(0.19)	(0.2)	(0.21)	(0.22)
CEO Turnover Indicator	-0.35 ***		-0.28 ***	
	(0.09)		(0.11)	
CEO Retirement Indicator		-0.37 ***		-0.43 **
		(0.12)		(0.18)
Interactions of CEO Turnover Indicator				
with Number of QICs	-0.17 **		-0.14 *	
	(0.081)		(0.076)	
with (Number of QICs)^2	0.018 ***		0.019 **	
	(0.003)		(0.01)	
with Volatility of stock returns	-0.75 **		0.58	
	(0.36)		(0.40)	
Interactions of CEO Retirement Indicator				
with Number of QICs		-0.15 *		-0.16 *
		(0.09)		(0.09)
with (Number of QICs)^2		-0.02		0.01
		(0.02)		(0.03)
with Volatility of stock returns		-1.71 ***		-0.97
		(0.6)		(0.84)

Table 7, continued

	(1)		(2)		(3)		(4)	
Log (board size)	0.10	**	0.11	**	0.12	**	0.12	**
	(0.05)		(0.05)		(0.06)		(0.06)	
Board independence	0.00		0.00		-0.01		-0.01	
	(0.02)		(0.02)		(0.03)		(0.03)	
Pct of busy ind. Directors	0.01		-0.01		-0.11		-0.11	
	(0.07)		(0.07)		(0.08)		(0.08)	
IDB indicator	-0.08	***	-0.09	***	-0.05	*	-0.05	*
	(0.03)		(0.03)		(0.03)		(0.03)	
CEO ownership	-0.03	***	-0.03	***	-0.02	***	-0.02	***
	(0.00)		(0.00)		(0.00)		(0.00)	
E index	0.02	***	0.02	**	0.01	*	0.01	*
	(0.01)		(0.01)		(0.01)		(0.01)	
CEO Chairman	0.01		0.00		0.00		0.00	
	(0.02)		(0.02)		(0.03)		(0.03)	
CEO is the only officer director	0.13	***	0.15	***	0.16	***	0.16	***
	(0.02)		(0.02)		(0.02)		(0.02)	
CEO is the founder	-0.05		-0.04		-0.02		-0.02	
	(0.04)		(0.04)		(0.05)		(0.05)	
CEO belongs to founder family	-0.16	***	-0.15	***	-0.13	***	-0.13	***
	(0.05)		(0.04)		(0.05)		(0.05)	
CEO alignment	0.02	***	0.02	***	0.02	***	0.02	***
	(0.01)		(0.01)		(0.01)		(0.01)	
QIC alignment	-0.07	**	-0.06	*	-0.11	***	-0.11	***
	(0.03)		(0.03)		(0.04)		(0.04)	
Probability of VP resigning	-0.10	**	-0.10	**	-0.15	***	-0.15	***
	(0.05)		(0.05)		(0.06)		(0.06)	
Log (CEO tenure)	-0.03	**	-0.04	***	-0.04	**	-0.04	***
	(0.01)		(0.01)		(0.02)		(0.02)	
Log(industry median gap)	0.35	***	0.36	***	0.23	***	0.23	***
	(0.02)		(0.02)		(0.03)		(0.03)	
Herfindahl index	-0.13		-0.05		-1.09		-1.10	
	(0.73)		(0.73)		(0.88)		(0.88)	
Industry homogeneity	-0.53	***	-0.56	***	-0.42	*	-0.44	**
	(0.18)		(0.18)		(0.22)		(0.22)	
Log (lag total assets)	0.03	**	0.02	**	0.02		0.02	
	(0.01)		(0.01)		(0.01)		(0.01)	
Lag (MTB)	0.00		0.00		0.01		0.01	
	(0.01)		(0.01)		(0.01)		(0.01)	
R&D Intensive Indicator	-0.06	*	-0.07	***	-0.06	**	-0.06	**
	(0.038)		(0.027)		(0.03)		(0.031)	
Number of business segments	-0.003		-0.001		-0.03		-0.03	
	(0.01)		(0.01)		(0.01)		(0.01)	
Number of Observations	9366		9366		9366		9366	
R-squared	0.22		0.21		0.15		0.15	

We draw similar conclusions when we focus only on periods prior to planned CEO retirements, when a board of directors is most likely to evaluate QICs for promotion by running a competition.[31] Yet, there is no evidence that tournament effects become more important prior to CEO retirements. Rather, the results are more in line with productivity theory, where firms endeavor to retain QICs by raising their compensation and thus, lowering the compensation gap. In untabulated regressions, we undertake the same analysis for only firms that have more than one QIC. We continue to uncover no significant evidence consistent with tournament theory.

One concern with this experiment is that the compensation gap generally falls prior to CEO turnovers, which would bias us against finding a strong tournament theory effect. To address this potential bias, we use the compensation of the new replacement CEO to calculate the compensation gap for firms which experience a CEO replacement over the next three years. The motivation for using a future compensation gap is that the compensation of a new CEO provides a better approximation of what the QIC can earn should he or she win the succession contest. Therefore, the compensation gap between QIC's current compensation and the future new CEO's compensation is a better measure of the CEO prize. Regression 3 and 4 in Table 7 test the tournament effect using this alternative compensation gap measure. However, we again find that the effect of tournament variables falls both prior to all CEO turnovers and planned CEO retirements, which is again inconsistent with the tournament theory prediction in hypothesis H2a. The

[31] A turnover is defined as CEO retirement when the CEO is over 62 years old three years prior to the turnover and the firm is not in the bottom quartile among its industry peers (based on 2-digit SIC code) based on two-year ROA and ROE.

results are qualitatively the same, even if we restrict our analysis to firms that have multiple QICs.

Testing Productivity Theory

Table 8 shows the effects of QIC productivity on our three compensation gap measures.[32] The results are consistent with the prediction of hypothesis H1b that more productive QICs lower the compensation gap. Our four measures of QIC productivity are all significantly correlated with the three compensation gap measures and have the predicted signs, except that QIC compensation growth does not significantly affect the short-term gap and QIC outside independent directorships do not significantly affect the long-term gap. Considering the possibility that the four proxies of productivity can be correlated with each other, we test the four measures individually and obtain similar results in unreported regressions. Additionally, we use principle component analysis to create two orthogonal factors based on the four productivity measures in order to address a potential multicollinearity problem. Both factors have significant negative relations to the total compensation gap, the short-term compensation gap and the long-term compensation gap.

We further test the impact of QIC productivity on the compensation gap prior to a CEO turnover by interacting the turnover indicator with the four productivity measures. The results reported in Table 9 suggest that the QIC productivity effect is particularly strong in reducing the compensation gap over the three years prior to a CEO turnover event, supporting the productivity prediction of hypothesis H2b. Furthermore, the

[32] The standard errors of the regressions are adjusted based on Murphy and Topel (1985), because the QIC promotion probability is a generated regressor.

Table 8 Productivity Effect on the Compensation Gap

	Total Gap		Short Term Gap		Long Term Gap	
QIC compensation growth rate	-0.08	***	-0.001		-0.16	***
	(0.01)		(0.003)		(0.01)	
QIC promotion propensity	-2.69	***	-1.81	***	-2.74	***
	(0.18)		(0.14)		(0.4)	
QIC outside independent directorship	-0.04	**	-0.05	***	-0.03	
	(0.02)		(0.02)		(0.04)	
Log (QIC tenure)	-0.36	***	-0.12	**	-0.71	***
	(0.07)		(0.05)		(0.16)	
(Log QIC tenure)^2	0.11	***	0.03	*	0.25	***
	(0.02)		(0.02)		(0.06)	
Log (board size)	0.12	**	0.04		0.35	***
	(0.05)		(0.04)		(0.1)	
Board independence	-0.02		-0.02		-0.03	
	(0.02)		(0.02)		(0.05)	
Pct of busy ind. directors	0.03		-0.01		0.10	
	(0.06)		(0.05)		(0.16)	
IDB indicator	-0.07	***	-0.01		-0.14	**
	(0.02)		(0.02)		(0.06)	
CEO ownership	-0.03	***	-0.01	***	-0.04	***
	(0.00)		(0.00)		(0.01)	
E index	0.02	***	0.01		0.04	***
	(0.01)		(0.01)		(0.01)	
CEO Chairman	0.06	***	0.04	**	0.13	***
	(0.02)		(0.02)		(0.05)	
CEO is the only officer director	0.02		0.04	**	0.07	
	(0.02)		(0.02)		(0.05)	
CEO is the founder	-0.10	**	-0.11	***	-0.14	
	(0.04)		(0.03)		(0.1)	
CEO belongs to founder family	-0.12	**	-0.12	***	-0.16	
	(0.05)		(0.04)		(0.11)	
CEO compensation growth	0.03	***	0.00		0.06	***
	(0.01)		(0.00)		(0.02)	
Log (CEO tenure)	0.01		0.05	***	-0.06	**
	(0.01)		(0.01)		(0.02)	
CEO alignment	0.02	***	0.01		0.03	**
	(0.01)		(0.00)		(0.01)	
QIC alignment	-0.03		0.00		0.11	
	(0.03)		(0.03)		(0.07)	
Probability of VP resigning	-0.07		-0.03		-0.16	
	(0.05)		(0.04)		(0.11)	
Log(industry median gap)	0.36	***	0.12	***	0.66	***
	(0.03)		(0.02)		(0.07)	
Herfindahl index	-0.49		0.24		0.15	
	(0.66)		(0.6)		(1.66)	
Industry homogeneity	-0.26		0.00		-0.41	
	(0.17)		(0.14)		(0.39)	
Log (lag total assets)	0.04	***	0.04	***	0.02	
	(0.01)		(0.01)		(0.02)	
Number of business segments	0.00		0.00		0.00	
	(0.01)		(0)		(0.01)	
Lag (MTB)	0.00		-0.01		0.00	
	(0.01)		(0.01)		(0.02)	
R&D Intensive Indicator	-0.06	**	-0.028		-0.04	
	(0.026)		(0.019)		(0.05)	
Number of Observations	8802		8802		8671	
R-squared	0.31		0.24		0.21	

productivity effect is stronger when the CEO is near retirement, suggesting that even in the scenarios where the board of directors is most likely to foster a succession contest to select the next CEO, they still set compensation policy to be closely tied to executive productivity levels.

Alternatively, we use the estimated CEO turnover probability[33] within three years and then interact it with the tournament variables and productivity variables. We obtain qualitatively similar results.

Testing Competing Contracting Theories in Tournament-Oriented Firms

Firm Selection of Its Executive Compensation Regime

Tournament theory predicts that executive competition is particularly beneficial when it is very costly to monitor and evaluate employee efforts. For example, in firms with volatile stock returns, individual executive performance is more difficult to isolate from random exogenous factors. Hence, a compensation scheme that is based on relative performance, modeled in tournament theory, becomes more attractive to the boards of these firms. Similarly, firms are more likely to use tournament incentives when it is difficult to construct a peer group of comparable firms to benchmark executive performance against, such as those in highly heterogeneous industries. Finally, the likelihood of running a tournament contest may also be higher when the firm is large and

[33] The CEO turnover probability within three years is estimated using a logit model. The dependent variable equals one if a firm experience CEO turnover in the next three years. The independent variables include log (total assets), log(firm age), volatility of stock returns, market to book ratio, R&D to total assets ratio, a poor performance indicator, log(CEO tenure), a CEO above 62 indicator and year fixed effects. In the second step regression, we interact this estimated CEO turnover probability with tournament variables and productivity variables, and the standard errors are adjusted using the methodology in Murphy and Topel (1985).

Table 9 Productivity Effect Prior to CEO Turnovers

Panel A

	QIC Productivity = Compensation Growth				QIC Productivity = Promotion Propensity			
	(1)		(2)		(3)		(4)	
QIC Productivity	-0.02	***	-0.025	***	-2.19	***	-2.46	***
	(0.003)		(0.004)		(0.23)		(0.21)	
QIC Productivity * Turnover Indicator	-0.05	***			-0.84	***		
	(0.007)				(0.32)			
QIC Productivity * CEO Retirement Indicator			-0.06	***			-0.47	**
			(0.01)				(0.19)	
Turnover Indicator	-0.15	***			-0.13	***		
	(0.02)				(0.04)			
CEO Retirement Indicator			-0.09	***			-0.09	*
			(0.028)				(0.05)	
Control variables	Yes		Yes		Yes		Yes	
Number of observations	9374		9374		9360		9360	
R-Squared	0.24		0.23		0.24		0.24	

Panel B

	QIC Productivity = Ind. Outside Directorship				QIC Productivity = Log - (Tenure)			
	(5)		(6)		(7)		(8)	
QIC Productivity	-0.06	***	-0.06	***	-0.32	***	-0.36	***
	(0.021)		(0.021)		(0.04)		(0.067)	
QIC Productivity * Turnover Indicator	0.04				-0.25	***		
	(0.05)				(0.09)			
QIC Productivity * CEO Retirement Indicator			-0.04				-0.35	**
			(0.05)				(0.14)	
(Log QIC Tenure) ^{2}					0.09	***	0.09	***
					(0.019)		(0.02)	
(Log QIC Tenure) ^{2} * Turnover Indicator					0.07	**		
					(0.03)			
(Log QIC Tenure) ^{2} * CEO Retirement Indicator							0.10	*
							(0.059)	
Turnover Indicator	-0.24	***			-0.41	***		
	(0.02)				(0.06)			
CEO Retirement Indicator			-0.16	***			-0.41	***
			(0.29)				(0.09)	
Control variables	Yes		Yes		Yes		Yes	
Number of observations	8802		8802		9360		9360	
R-Squared	0.22		0.21		0.21		0.22	

has multiple segments and hence employs a larger number of high-quality senior executives.

Logit model estimates are reported in Table 10, Panel A on the factors that influence firm decisions to self-select into tournament-oriented group. The dependent variable equals one if the firm is classified as tournament-oriented based on the criteria outlined section 2.3, and zero otherwise. Consistent with the prior predictions, we find that stock return volatility has a significant positive association with the probability of being tournament-oriented, while industry homogeneity has a significant negative association. Moreover, we find that a firm is more likely to use a succession contest in industries that tend to appoint internal candidates as CEOs. This is consistent with the evidence in Cremers and Grinstein (2011), where they document a weak tendency of CEO compensation to benchmarking industry peers in such industries. Large and complex firms are more likely to run a succession contest among inside candidates.[34] A succession contest is more likely to take place when there are several qualified internal candidates, and a long serving CEO near retirement age. CEO power significantly alters firm succession strategies. When CEOs have stronger power relative to their board of directors, they are harder to replace in the first place and hence, these firms are less likely to have any meaningful succession plan. Consistent with this prediction, we find that CEO-Chairman duality, founder-CEOs, and less independent boards are all associated with a low probability of a firm sponsoring a succession contest.

[34] Cichello et al (2009) also find evidence that multi-segments firms promote executives using tournament style competition.

Table 10 Panel A Selection Model Predicting Tournament-Oriented Firms

Constant	-1.06	***
	(0.15)	
Number of QICs	0.15	***
	(0.05)	
Volatility of stock returns	0.53	**
	(0.23)	
CEO above 62	0.42	***
	(0.04)	
CEO Chairman	-0.30	***
	(0.03)	
CEO is the founder	-0.30	***
	(0.05)	
CEO belongs to founder family	0.16	**
	(0.07)	
CEO ownership	-0.01	***
	(0.00)	
Log (CEO tenure)	-0.04	***
	(0.00)	
E index	0.09	***
	(0.01)	
IDB indicator	0.01	
	(0.04)	
Log(board size)	0.22	***
	(0.06)	
Board independence	-0.04	
	(0.03)	
Log (total asset)	0.09	***
	(0.01)	
Number of business segments	0.02	*
	(0.01)	
Poor performance indicator	0.05	
	(0.04)	
Industry Homogeneity	-0.54	
	(0.18)	***
Number of industry inside turnovers	0.02	***
	(0.00)	
Number of observations	9443	
Pseudo R-squared	0.11	

Determinants of the Compensation Gaps in Tournament-Oriented Firms

With the selection equation estimated in the first step, we can test the effects of tournament and productivity theories on the compensation gap, while explicitly controlling for the private information embedded in a firm's decision to implement a specific compensation scheme. Recognizing that true tournament firms are not directly observable and the identification mechanism we use is imperfect, we test hypotheses H3a and H3b on the subsample of firms predicted to be tournament-oriented. As shown in Table 10 Panel B, the total compensation gap, short-term compensation gap, and long-term compensation gap are larger for predicted tournament firms than non-tournament firms, both in dollar terms and in ratios. The predicted tournament-oriented firms also have more QICs.

Table 10 Panel B Tournament-Oriented Firms vs. Non-Tournament Firms

	Predicted tournament firms (N=4851)		Predicted non-tournament firms (N=4592)	
	Mean	Median	Mean	Median
Number of QICs	1.7	1	1.6	1
Total gap (dollar term, $ 000)	2565.79	1290.59	1733.73	730.53
Short-term gap (dollar term, $ 000)	768.24	514.89	574.41	373.69
Long-term gap (dollar term, $ 000)	1825.78	699.68	1191.57	289.17
Total gap (ratio)	2.19	1.93	2.05	1.7
Short- term gap (ratio)	2.02	1.85	1.95	1.74
Long- term gap (ratio)	9.75	1.99	4.19	1.66

To the extent that the compensation gap is shaped by tournament theory, we expect to find a stronger relation between the compensation gap and the tournament variables in the subsample of predicted tournament-oriented firms. Regressions 1 and 2 of Table 11 test the tournament theory predictions after estimating which firms are tournament oriented. The coefficient estimates of the squared number of QICs and stock return volatility remain negative and significant, contradicting the tournament predictions. This result even holds in the subsample of tournament-oriented firms. More importantly, the marginal impacts of the tournament variables on the compensation gap are slightly lower in the predicted tournament-oriented firms than they are for the remaining firms, although the differences are for the most part statistically insignificant.[35] Finding that the tournament effect is not significantly stronger in firms that are more likely to utilize a succession contest raises serious questions about the empirical validity of tournament theory in explaining the hierarchical compensation gaps among top executives.

On the other hand, the variables capturing the productivity effects are significantly associated with the compensation gap in both subsamples of firms. Furthermore, the incremental explanatory power of the productivity variables is much larger than that of the tournament variables: specifically if we exclude the productivity variables from the regression model, it reduces the R-squared by 39 percent (from 0.36 to 0.22) in the predicted tournament-oriented firms, while if we exclude the tournament variables from the regression model, it only lowers the R-squared by 5 percent (from 0.36 to 0.34). The results in Table 11 again suggest that tournament theory is less important

[35] We test the statistically significance of coefficient difference across two regressions using the Z-statistics proposed in Clogg et al (1995) and Paternoster et al (1998).

empirically than productivity theory, even in firms most likely to employ a succession contest.

Other Control Variables

In terms of control variables, we find that the potential threat of being fired provides another effective incentive mechanism, and works as a substitute for promotion incentives: the probability that QIC will leave the firm in the next five years is negatively associated with the compensation gap when we only consider the tournament effect. However, the effect of dismissal becomes insignificant once we control for QIC productivity, probably because the chance of being dismissed is highly correlated with productivity. Moreover, we find that firms in highly homogenous industries tend to have lower compensation gaps, consistent with the idea that the promotion effect becomes weaker when the QICs have more outside job opportunities. In addition, we find that large firms have higher compensation gaps. Firms with high growth opportunities, measured by their market-to-book ratio, on average have higher compensation gaps. On the other hand, R&D intensive firms on average have lower compensation gaps. The industry median compensation gap is also positive and significant, indicating that firms tend to benchmark to their industry peers when setting executive compensation. In unreported regressions, we find CEO tenure is positively associated with both CEO and QIC compensation levels. However, CEO tenure is negatively associated with the three measures of compensation gaps in most cases, suggesting that CEOs who remain in their positions longer tend to pay subordinates more, which results in a lower compensation gap.

Table 11 Tournament Effect and Productivity Effect in Tournament-Oriented and Non-Tournament Groups

	Tournament Effects		Productivity Effects		All Together	
	Tournament-Oriented Group (1)	Non-Tournament Group (2)	Tournament-Oriented Group (3)	Non-Tournament Group (4)	Tournament-Oriented Group (5)	Non-Tournament Group (6)
Tournament Variables						
Number of QICs	0.23 ***	0.35 ***			0.21 ***	0.26 ***
	(0.05)	(0.06)			(0.04)	(0.05)
(Number of QICs)^2	-0.02 **	-0.05 ***			-0.03 ***	-0.04 ***
	(0.01)	(0.01)			(0.01)	(0.01)
Volatility of stock returns	-0.61 *	-0.81 **			-0.29	-0.93 ***
	(0.35)	(0.37)			(0.25)	(0.33)
QIC Productivity Variables						
QIC compensation growth rate			-0.07 ***	-0.09 ***	-0.06 ***	-0.09 ***
			(0.01)	(0.01)	(0.01)	(0.01)
QIC promotion propensity			-3.83 ***	-1.96 ***	-3.13 ***	-1.41 ***
			-0.30	(0.26)	-0.32	(0.29)
QIC outside independent directorship			-0.05 *	-0.01	-0.05 *	0.01
			(0.03)	(0.03)	(0.03)	(0.03)
Log (QIC tenure)			-0.37 ***	-0.37 ***	-0.37 ***	-0.45 ***
			(0.09)	(0.1)	(0.09)	(0.1)
(Log QIC tenure)2			0.10 ***	0.15 ***	0.11 ***	0.16 ***
			(0.03)	(0.03)	(0.03)	(0.04)
Inverse Mill's Ratio	0.35 **	0.22 **	-0.01	0.12	0.12	0.14
	(0.14)	(0.11)	(0.12)	(0.10)	(0.12)	(0.11)
Control Variables and Governance Variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	3916	3951	3613	3745	3610	3743
R-Squared	0.22	0.27	0.34	0.36	0.36	0.37
Z-statistics testing the difference of coefficients across two regressions						
Number of QICs	-1.54					
(Number of QICs)^2	2.12 **					
Volatility of stock return	0.39					

Additional Tests and Robustness

The Economic Impact of Productivity and Tournament

The economic impacts of QIC productivity measures on the total compensation gap are larger than that of the tournament incentive measures. We calculate the percentage change in the compensation gap (i.e. the ratio of CEO total compensation to median QIC total compensation) by increasing the executive productivity variables by one standard deviation from their means while holding the other variables at their mean values. The QIC productivity measures exhibit stronger economic impacts on the total compensation gap: a one standard deviation increase in QIC compensation growth, promotion probability and tenure all lower the total compensation gap by substantial amounts, namely 17 percent, 11 percent and 4 percent, respectively. The economic impacts of tournament variables are smaller: the net impact of adding one more QIC to the tournament is 4.6 percent; the economic influence of stock return volatility is -4.5 percent, but the sign is opposite the tournament theory prediction.

Tests for Convexity in Pay Structure

Rosen (1986)'s tournament model predicts that pay grows in a "convex" manner with hierarchical levels, and greater weight is required on the final top-ranking prize to motivate lower level executives to put in greater effort, independent of past achievements.[36] Due to the lack of detailed compensation records for most corporate

[36] Rosen (1986) argues that employees are motivated by not only the pay increase associated with the current promotion possibility, but also the option value of future promotions. As the employee "climbs" up

positions, we cannot test the convexity prediction within a firm. Nevertheless, we are able to explore if convexity exists among top executives using the top three levels of managers identified in section 3.2. To be specific, we expect the compensation increase on being promoted from a level three manager to a level two manager to be less than the compensation increase on being promoted from a level two manager position to the CEO position.

We find little evidence supporting Rosen (1986)'s tournament theory prediction that pay grows in a "convex" manner with the hierarchical levels of senior managers. As shown in Table 1 Panel C, an executive's total compensation on average increases by 2.10 times on being promoted from level three to level two (the median is 1.03 times). While the total compensation increases by 2.18 times on average if a level two senior manager is promoted to the CEO position (the median is 1.79 times). Although the latter compensation increase is larger, it is not statistically different from the former. In terms of short-term compensation, the mean increase is 145% on being promoted to level two, and the mean increase is 201% on becoming CEO. Considering long-term compensation, the mean and median increases on being promoted to a level two management position are both larger than those observed on being promoted from a level two manager to CEO, which runs counter to the tournament prediction.

Table 12 tests the convexity of pay growth in multivariate regressions. After controlling for firm and CEO characteristics, the "L1L2" indicator (which equals one for the compensation gap between the CEO and the level two QICs and zero for the

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the corporate ladder, the promotion option become less valuable and therefore, a higher compensation gap is required to keep the incentive constant.

compensation gap between the level two and level three managers) is negative and significant, suggesting that the total compensation gap between the CEO and level two managers is lower than the total compensation gap between level two and level three managers. We find similar result for the long-term compensation gap. These results are again inconsistent with the convexity prediction of tournament theory. However, we find some supportive evidence for this prediction when evaluating the short-term compensation gap: this gap is larger between the CEO and level two managers after controlling for other factors that may affect the compensation gap. We realize that the results in this section only hold when we focus on top executives and cannot be generalized to the whole organization.

Compensation Gaps in Firms with Different Characteristics

Lazear and Rosen (1981) argue that when both the level of effort and output of employees are hard to monitor, it is optimal to use rank ordering, as in tournament based compensation schemes. Therefore, we expect tournament variables to have a stronger impact on the compensation gap in large and complex firms if tournament theory is empirically valid.

On the other hand, Lazear (1989) argues that aggressive competition and large compensation gaps between hierarchical levels also have potential negative effects, because they discourage cooperation among competing managers and in the extreme can lead to outright sabotage. Therefore, Lazear argues that firms that require close teamwork and cooperation may find tournament pay arrangements less beneficial. Siegel and Hambrick (2005) argue that firms that are technological intensive generally need

Table 12 Convexity of Hierarchical Pay Structure among Top Executives

	Total Gap		Short Term Gap		Long Term Gap	
L1L2 indicator	-0.025	*	0.277	***	-0.205	***
	(0.013)		(0.01)		(0.04)	
Log (board size)	-0.039		-0.039		0.038	
	(0.03)		(0.02)		(0.07)	
Board independence	0.014		0.016		0.087	***
	(0.01)		(0.01)		(0.03)	
Pct of busy ind. Directors	0.026		-0.020		-0.017	
	(0.04)		(0.03)		(0.1)	
IDB indicator	-0.019		-0.011		-0.043	
	(0.01)		(0.01)		(0.04)	
CEO ownership	-0.019	***	-0.010	***	-0.031	***
	(0.001)		(0.001)		(0.01)	
E index	0.010	***	0.005	*	0.008	
	(0.001)		(0.001)		(0.01)	
CEO Chairman	0.045	***	0.036	***	0.056	*
	(0.01)		(0.01)		(0.03)	
CEO is the only officer director	0.037	***	0.033	***	0.031	
	(0.01)		(0.01)		(0.03)	
CEO is the founder	-0.068	***	-0.071	***	-0.118	*
	(0.02)		(0.02)		(0.06)	
CEO belongs to founder family	-0.051	**	-0.031		-0.052	
	(0.02)		(0.02)		(0.07)	
CEO alignment	0.021	***	0.009	***	0.032	***
	(0.001)		(0.001)		(0.01)	
QIC alignment	-0.068	***	-0.064	***	-0.146	***
	(0.02)		(0.02)		(0.05)	
Probability of VP resigning	-0.006		-0.010		0.016	
	(0.02)		(0.02)		(0.06)	
Log (CEO tenure)	0.001		0.028	***	-0.050	***
	(0.01)		(0.01)		(0.02)	
Log(industry median gap)	0.035	***	0.012	***	0.063	***
	(0.01)		(0.001)		(0.02)	
Herfindahl index	0.216		0.110		1.496	
	(0.35)		(0.36)		(1.23)	
Industry homogeneity	0.027		0.002		0.133	
	(0.09)		(0.08)		(0.29)	
Log (lag total assets)	0.031	***	0.016	***	0.025	
	(0.01)		(0.01)		(0.02)	
Lag (MTB)	0.007		-0.002		-0.023	*
	(0.001)		(0.001)		(0.01)	
R&D Intensive Indicator	-0.02	*	-0.006		-0.023	*
	(0.013)		(0.01)		(0.01)	
Volatility of stock returns	0.044		-0.108		-0.103	
	(0.09)		(0.11)		(0.22)	
Number of business segments	0.000		0.000		0.001	
	(0.001)		(0.001)		(0.01)	
Number of Observations	15174		15174		15174	
R-squared	0.15		0.16		0.14	

considerable cooperation among executives, as part of their efforts to manage the design, production, and selling of their high-tech products. Hence, we expect tournament theory to be less relevant in explaining compensation gaps in high-tech firms.

We find little evidence that the tournament effect varies across firms with different characteristics as reported in Table 13. The interaction terms of tournament variables with the number of business segments and firm size are not significant. Similarly, the tournament effect on the compensation gap is also indistinguishable across high tech and non-high tech firms. These pieces of evidence fail to support tournament theory.

Executive Productivity and the Size of Tournament Competition

In this section, we examine if the effect of executive productivity on compensation gap changes with the number of potential non-CEOs competing for the CEO position. We expect that when there are several capable candidates to be the CEO's successor that the board of directors is more likely to evaluate QICs productivity in making its selection. Hence, we may observe a stronger productivity effect when the size of succession contest is large. To test this hypothesis, we interact the four productivity measures with the size of competition, measured by the number of QICs. Our results in Table 14 are largely consistent with this prediction. The interaction terms of number of QICs with QIC promotion propensity and QIC compensation growth rate are both negative and significant. The effect of QIC tenure on the compensation gap also becomes stronger if there are more QICs in the firm. However, the interaction of the indictor for a QIC with an outside independent directorship and the number of QICs is positive,

contradicting our prediction. Overall, the results using three of the four productivity measures suggest that high QIC productivity lowers the compensation gap even further when there are more QICs in competition to be promoted to CEO.

Table 13 Tournament Effect on the Compensation Gap Conditional on Firm Characteristics

	(1)		(2)		(3)		(4)	
Number of QICs	0.26	***	0.37	**	0.35	***	0.28	***
	(0.04)		(0.15)		(0.08)		(0.04)	
(Number of QICs)^2	-0.03	***	-0.03		-0.05	***	-0.03	***
	(0.01)		(0.03)		(0.02)		(0.01)	
Volatility of stock returns	-0.57	***	0.06		-0.89	**	-0.45	**
	(0.22)		(0.77)		(0.42)		(0.22)	
Interaction of Multi-Segment Indicator								
with Number of QICs	0.04							
	(0.04)							
with (Number of QICs)^2	-0.01							
	(0.01)							
with Volatility of stock returns	-0.31							
	(0.24)							
Interaction of Firm Size								
with Number of QICs			-0.01					
			(0.02)					
with (Number of QICs)^2			0.001					
			(0)					
with Volatility of stock returns			-0.12					
			(0.11)					
Interaction of Industry Homogeneity								
with Number of QICs					-0.32			
					(0.36)			
with (Number of QICs)^2					0.08			
					(0.07)			
with Volatility of stock returns					1.21			
					(1.84)			
Interaction of Hi-Tech Indicator								
with Number of QICs							0.02	
							(0.07)	
with (Number of QICs)^2							0.00	
							(0.02)	
int with Volatility of stock returns							-0.49	
							(0.34)	
Governance variables	Yes		Yes		Yes		Yes	
Control variables	Yes		Yes		Yes		Yes	
Number of observations	9366		9366		9366		9366	
R-Squared	0.21		0.21		0.21		0.21	

Table 14 Interaction of QIC productivity and the Size of CEO Contest

	Total Gap		Total Gap		Total Gap		Total Gap	
QIC Productivity Variables								
QIC compensation growth rate	-0.01							
	(0.008)							
QIC promotion propensity			-1.27	***				
			(0.35)					
QIC outside independent directorship					-0.02			
					(0.02)			
Log (QIC tenure)							-0.49	***
							(0.08)	
(Log QIC tenure)^2							0.11	***
							(0.03)	
Interactions of Number of QICs with								
QIC compensation growth rate	-0.01	***						
	(0.005)							
QIC promotion propensity			-0.50	***				
			(0.21)					
QIC outside independent directorship					0.19	***		
					(0.07)			
Log (QIC tenure)							-0.14	***
							(0.05)	
(Log QIC tenure)^2							0.04	*
							(0.02)	
Size of Contest								
Number of QICs	0.13	***	0.14	***	0.16	***	0.25	***
	(0.01)		(0.016)		(0.01)		(0.03)	
Governance variables	Yes		Yes		Yes		Yes	
Control variables	Yes		Yes		Yes		Yes	
Number of observations	8913		8347		8899		8913	
R-Squared	0.23		0.26		0.24		0.25	

Compensation Gaps in Firms with Strong Corporate Governance

One potential reason that we do not find evidence supporting tournament theory is that the agency problems at these firms are so severe that they undercut the effectiveness of tournament incentives. A number of influential scholars have argued that agency conflicts between shareholders and managers can significantly influence executive compensation arrangement.[37] We test this proposition by adding controls for major internal governance mechanisms. Empirically, we find that the presence of independent director blockholders (IDB)[38] significantly lowers the total compensation gap and the long term compensation gap, probably due to the reason that IDBs have a strong incentive to closely monitor a CEO. CEO ownership has significant negative associations with all three forms of the compensation gap, which is consistent with the hypothesis that higher CEO ownership improves CEO alignment with shareholders and strengthens overall firm governance. We find that firms with a high E-index,[39] which reduces the threat from the market for corporate control, have higher compensation gaps. CEOs who chair the board, or who are the board's only officer-director, are associated with higher compensation gaps. These two results suggest that more entrenched CEOs have higher pay gaps. On the other hand, founder-CEOs and CEOs belonging to the founding family decrease the compensation gap, which is consistent with there being less agency problems in these firms. A large board is associated with higher gap, though board

[37] Studies in this vein include, but not limit to , Bebchuk and Fried (2003, 2004), Borokhovich, Brunarski and Parrino (1997), Core, Holthausen and Lacker (1999), Cyert, Kang and Kumar (2002), Chhaochharia and Grinstein (2009).
[38] Independent Director Blockholder is defined following Agrawal and Nasser (2010). They find that these independent director blockholders help to improve firm governance and lower CEO entrenchment since they have strong financial incentives to monitor CEO and firm performance.
[39] Entrenchment Index is proposed by Bebchuk, Cohen and Farrell (2009).

independence and the percentage of busy independent directors, surprisingly, often do not have significant impacts on the compensation gap measures.

Furthermore, given the evidence of agency problems on firms' compensation policy in both earlier studies and this study, we do not expect the primary economic factors to have homogeneous effects on the compensation gaps of firms facing varying degrees of agency problems. Rather, compensation policies are more likely to be shaped by economic theories of incentives when firms are reasonably well governed. We expect that the effectiveness of the two optimal contracting mechanisms should be stronger in a strong corporate governance environment and weaker in a poor corporate governance environment.

Table 15 Indirect Effect of Agency Problems on the Compensation Gap

	Dual Class Firms	Single Class Firms	Z-statistics of difference
QIC Productivity Measures			
QIC compensation growth rate	-0.02 **	-0.04 **	-1.85 *
QIC promotion propensity	-1.69 ***	-2.81 ***	-2.00 **
QIC outside independent directorship	0.014	-0.06 ***	-1.37
QIC tenure	0.19	-0.48 ***	-3.40 ***
(QIC tenure)2	-0.05	0.14 ***	3.00 ***
Tournament Variables			
Number of QICs	0.23 *	0.31 ***	-0.63
(Number of QICs) 2	-0.02	-0.04 ***	-0.915
Volatility of stock returns	-1.3 **	-0.63 **	1.24

We further test the robustness of our results by controlling for one clear measure of weak governance, which is CEO entrenchment facilitated by having dual class shares (i.e. Masulis, Wang and Xie 2009). We find in Table 15 that the relationship between QIC productivity and the compensation gap is stronger in single-class share firms than in dual-class firms. This is consistent with better governed firm having their compensation gaps that are better explain by productivity differentials between the CEO and QICs. However, we still do not find evidence supporting tournament theory, even when agency problems are relatively less severe. Specifically, we continue to find that the compensation gap is not related to the number of QICs in a convex manner, and that the compensation gap is negatively, rather than positively associated with the volatility of firms' stock returns, contracting the two major tournament theory predictions.

Alternative Compensation Gap Measures

Main, O'Reilly and Wade (1993) argues that "for the typical VP, the result of winning the tournament and becoming CEO is to enjoy an increased salary for as long as he subsequently remains CEO". The compensation gap we use in prior sections only captures part of the prize of winning the tournament and becoming CEO, since it measures compensation differences only over a single year. Hence, in robustness analysis, we replace the earlier compensation gaps with expected cumulative compensation gaps approximated by the product of the one-year compensation gap and the expected number of years a winning QIC remains CEO. The expected CEO tenure is estimated based on the industry's median length of CEO tenure and the tenure of the prior CEO in the firm.[40]

[40]An OLS model is estimated with the CEO tenure as the left –hand side variable. For CEOs that stay beyond the end of our sample period (2005), we track their career path using post-2005 data to determine

Another potential concern with using the compensation gap between the CEO and the median QIC as the winning prize is that it may partially reflect the job title and job responsibility of the median QIC. To address this issue, we use the compensation gap between the CEO and the COO as a proxy for the size of the winning prize. There are two reasons for using this measure: first, the COO is usually the second most important corporate officer and has the highest probability of succeeding to the CEO position (Mobbs and Raheja 2010); second, by requiring an executive to have only the title of COO and no other titles, we are able to minimize the impact of heterogeneous QIC work responsibilities across firms with different organizational structures and thereby obtain a cleaner measure of the compensation gaps across firms.

We conduct all our experiments using these two alternative measures of the compensation gap. Reassuringly, we find that our conclusions remain unchanged. We find no strong evidence in favor of a tournament effect, while the productivity differentials remain the most important factors in explaining the compensation gap.

Other Robustness Tests

Timing the occurrence of a succession contest for the CEO's position can be difficult for very long-tenured CEOs. Some long tenured CEOs are apt to have their succession carefully planned before they leave. One famous case is Jack Welch who started to select his successor 7 years before his retirement from GE. The possibility that succession competition can occur long before CEO replacement should bias the estimates

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their tenure. For CEOs who stay in their positions beyond 2010 (the latest year in Execucomp with complete data that we have access to), we use 2010 as their last year in office, and we acknowledge that there is a downward bias in measuring CEO tenure for that group of CEOs. The explanatory variables are the tenure of the previous CEO and the median tenure of CEOs in the same 2-digit SIC industry

against finding evidence supportive of tournament theory. To address this potential bias, we analyze two experiments that exclude firms whose CEO tenure is longer than 16 years (the 90 percentile of the sample), and we use an alternative cut-off of 10 years (the 75 percentile of the sample). Our main results continue to hold and more importantly, we still fail to uncover any supportive evidence for tournament theory.

We also employ the following battery of sensitivity tests: 1) relax the second restriction in the definition of QICs, and allow executives whose compensation is within 20 percent of the highest paid non-CEO executive to be classified as a QIC; 2) require the QICs to be younger than 62 years old rather than 65; 3) redefine the compensation gap to be the logarithm of dollar compensation difference between the CEO and the median QIC; 4) delete firm-year observations where the CEO only serves in the position for less than one year; 5) delete firm-year observations where the CEO is also a founder or is a member of the founder's family; 6) use median regressions to eliminate the potential impact of extreme outliers. Under all of these alternative specifications, the earlier results continue to hold.

Conclusion

One serious drawback of much of the existing empirical work on the compensation of top executives is a failure to test against plausible alternative models. For example, studies that examine performance based pay arrangements are silent when it comes to the relevance of promotion incentives, while studies that test tournament theory and promotion incentives fail to explicitly recognize that their evidence is frequently

consistent with productivity theory models. Unfortunately, single theory tests tend to be less powerful. In contrast to much of the extant literature, we compare and differentiate two types of compensation incentives, namely output-based productivity theories and promotion-based tournament theory to provide new insights into the determinants of the compensation gaps among top corporate executives.

We find that productivity theory is more relevant than tournament theory in explaining compensation gaps among top executives in the US. Qualified internal non-CEO candidates (QICs) with better performance, such as candidates with track records of rapid compensation growth, high promotion probabilities, extensive managerial skills and experience developed from their tenure in their existing positions and outstanding managerial talent recognized by outside directorship appointments, all tend to exhibit lower compensation gaps. In contrast, we find little evidence to support tournament theory predictions that the compensation gap increases at an increasing rate with the size of a succession contest, and that the compensation gap increases with the noisiness of the operating environment.

Further investigation of the situations where tournament theory should be most relevant also fails to provide supportive evidence of the importance of tournament theory. We find the compensation gap is less sensitive to tournament factors prior to CEO departures and retirements. We also fail to find strong evidence for a tournament effect in explaining the compensation gap, even in firms that are most likely to foster a succession contest. Both results go against the tournament predictions. On the other hand, productivity theory predictions are confirmed for firms in various circumstances. For example, QICs are promoted to the board and their compensation grows faster than the

CEO when the CEO is about to retire. Moreover, QIC productivity has a more pronounced effect on reducing the compensation gap prior to CEO turnovers, consistent with the prediction of productivity theory. Lastly, we find the productivity theory is more important in explaining compensation than tournament theory, even among tournament-oriented firms. The above evidence suggests that despite the fact that some firms appear to have characteristics that encourage the use of a succession contest for executive promotion decisions (Cichello et al 2009, Mobbs and Raheja 2010), these firms appear to only infrequently determine executive compensation based on a tournament "winner takes all" regime. Rather, the compensation of senior executives is closely tied to their productivity or performance level.

Empirical studies of executive compensation theories generally take two approaches. The first approach is to examine whether the observed compensation arrangements are consistent with the basic properties of the posited theory and that they consistent with the key predictions derived from the theory. The second approach is to test whether the agents respond to a specific compensation arrangement by examining the impact of a compensation arrangement on subsequent firm performance. We take the first approach in this study and explore the question of how firms distribute compensation among top executives. In a separate study, we take this second approach and ask the question of how executive compensation arrangements and compensation gaps alter manager incentives and in turn, affect managerial decisions, firm policies and shareholder value. Answers to these questions are likely to provide further insights into the consequences of alternative executive compensation choices.

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APPENDIX A Variable Definition

Compensation Variables:	
Total gap	Log (total CEO compensation/ the median total compensation of QICs)
Short- term gap	Log (short term CEO compensation / the median short term compensation of QICs)
Long- term gap	Log (long term CEO compensation / the median long term compensation of QICs)
Tournament Variables:	
QIC	"Qualified internal candidates", refers to non-CEO senior executives who serve on the board or have total compensation within 10 % (20%) of highest paid non-CEO senior executive
Number of QICs	The number of non-CEOs that are qualified as internal CEO successor candidates
Volatility of stock returns	The standard deviation of monthly stock returns five year prior to the sample year
Tournament-oriented firms	Firms are classified as tournament-oriented, if we observe they hire a CEO internally, or in the situations where an outsider is hired as the CEO but we observe several internal candidates before the CEO succession.
Productivity Variables:	
QIC tenure	The number of years the executive has been stayed on the current position
QIC compensation growth	The average compensation growth over the past three years
QIC promotion propensity	The probability of being promoted to the CEO position in the next three years. The probability is estimated by running a logit regression, and the explanatory variables are a COO indicator, a CFO indicator, a president indicator, a vice-president indicator, a vice-chairman indicator, an inside director indicator, QIC's current position tenure, and the log of QIC age
Number of independent boards held by QIC	Number of outside independent directorships held by this executive in an unaffiliated firm
Other Incentive Variables	
Probability of VP resigning	Estimated probability that the VP will resign in the next five years. The probability is estimated using a logit model, and the explanatory variables are: board of director indicator, executive's age, and a poor performance indicator

CEO alignment	(Number of CEO shares+ option's delta * number of CEO held options)/total number of shares outstanding *100
QIC alignment	(Number of shares held by the QIC+ option's delta * number of options held by the QIC)/total number of shares outstanding * 100
Industry median gap	The median total gap of firms in the same industry (exclude the own firm). Industry is defined using 4-digit SIC code if it has more than five companies; if 4-digit SIC industry has less than five companies, I use 3-digit SIC to define industry; if 3-digit SIC industry has less than five companies, I use 2-digit SIC to define industry
Accounting Variables	
Log (lag total assets)	Logarithm of lag total assets
Log (firm age)	Logarithm of the number of years the firm is being listed
Lag ROA	ROA= Income before extraordinary items/lag total assets
Lag MTB	MTB =(Total assets-book equity + market value of equity)/Total assets
R&D Intensive Indicator	A dummy variable equals one if a firm's R&D/total assets ratio is above 0.04, the 75 percentile of the sample
Lag stock returns	The average monthly stock returns of the last 12 months
Poor performance dummy	A dummy variable equals one if either the firm's industry adjusted ROA or industry adjusted ROE is in the bottom quartile in the industry
Governance and CEO Power Variables	
Entrenchment index (E index)	Entrenchment Index constructed in Bebchuk, Cohen and Farrell 2009
Board independence dummy	Equals one if more than 60 percent of directors are independent, and equals zero otherwise
Percentage of busy independent directors	The number of independent directors holding more than three directorships as a percentage of the total number of independent directors
CEO-Chairman	Equals one if the CEO is also the chairman of the board, and equals zero otherwise
CEO ownership	The percentage of stocks held by the CEO
Officer ownership	The percentage of stocks held by all non-CEO executives
CEO is the founder	Dummy variable which equals one if the CEO is also the founder
CEO belongs to founder family	Dummy variable which equals one if the CEO is a member of the founder family
Independent director blockholder (IDB) indicator	Equals one if one or more independent directors hold more than one percent of shares or voting power, and equals zero otherwise
Log (CEO tenure)	Logarithm of the number of years he or she has been served as the CEO

Log (CEO age)	Logarithm of the age of the CEO
Industry Homogeneity	Mean partial correlation between firm's returns and an equally weighted industry index, for all firms in the same two-digit industry code, holding market return constant (see Parrino 1997). Estimated based on 60 monthly returns prior to sample year

APPENDIX B the Construction of CEO and QIC Alignment

The portion of executive compensation that improves alignment with shareholder interests is measured by pay-for-performance sensitivity: the sum of stock and option sensitivities to a $100 change in shareholder wealth. Following Kale, Reis and Venkateswaran (2009), I construct the shareholder alignment incentives as follows:

CEO alignment = 100 * (Number of CEO held shares + option's delta * number of CEO held options) / total number of shares outstanding

QIC alignment = 100 * (Number of QIC held shares + option's delta * number of QIC held options) / total number of shares outstanding

Following Kale, Reis and Venkateswaran (2009), we use the percentage of stock ownership at the beginning of the year for each executive to obtain the stock-based sensitivity of an executive's equity portfolio. For option holding, we use the number of options held by each executive at the beginning of the year. An option's delta is calculated following Murphy (1999): all options held at the beginning of the year are treated as a single grant with a five-year time to maturity; the average exercise price is determined based on the year end intrinsic value and year end stock price; the interest rate is the five-year constant-maturity Treasury bill from Federal Reserve; the annualized dividend yield is obtained from Execucomp; stock return volatility is calculated as the annualized standard deviation of the most recent 60 monthly total stock returns to shareholders prior to the sample year. Delta is calculated based on the above information

using a modified Black-Scholes formula modified to incorporate continuous dividend payments:

$$\text{Option Value} = \text{Pe}^{\{-\ln(1+\text{d})\text{T}\}}\text{N}(\text{z}) - \text{Xe}^{\{-\ln(1+\text{r})\text{T}\}}\text{N}(\text{z} - \sigma\sqrt{\text{T}})$$

$$\text{Delta} = \frac{\partial \text{Option Value}}{\partial \text{P}} = \text{e}^{\{-\ln(1+\text{d})\text{T}\}}\text{N}(\text{z})$$

Where:

P = Grant-date stock price

X = Exercise price

T = Expiration term (years)

d = Annualized dividend yield

s = Annual stock-price volatility

r = Risk-free interest rate

$$z = \frac{\ln\left(\frac{P}{X}\right) + \left[\ln(1+\text{r}) - \ln(1+\text{d}) + \frac{\sigma^2}{2}\right]\text{T}}{\sigma\sqrt{T}}$$

N ( ) = Cumulative normal distribution function

CHAPTER II

PAY GAP AMONG EXECUTIVES AND FIRM VALUE

Introduction

The compensation of corporate CEOs has been studied extensively in the past two decades, but few studies have explored the compensation arrangements of other top executives or the pay distribution of the corporation's top executive team.[41] Bebchuk, Cremers and Peyer (2011) study the pay gap from corporate governance perspective, and they view the slice of CEO pay over the aggregate compensation of the top five executives as a manifestation of CEO power and document a negative relation between pay gap and firm performance. Aggarwal, Fu and Pan (2010) empirically test the bottom-up incentives (referred as internal governance) modeled in Acharya, Myers and Rajan (2010), and they find a hump-shape relation between pay gap and firm investment.[42] Kale, Reis, and Venkateswaran (2009) view the pay gap as an incentive mechanism to solve the moral hazard problem as modeled in Lazear and Rosen (1981): large pay gap motivates non-CEO executives to work hard for promotion and reduces managerial shirking. They

[41] Such studies include but not limit to Aggarwal and Samwick (2003), Kale, Reis, and Venkateswaran (2009), Bebchuk, Cremers and Peyer (forthcoming), Aggarwal, Fu, and Pan (2010), Chen, Huang, and Wei (2011), Kini and Williams (2012).

[42] The intuition is that when the CEO is paid less than managers, managers have little incentive to learn or exert effort and CEO has little incentive to invest for the long-run. On the other hand, when the CEO is paid quite high relative to the managers and the CEO is dominant, then CEO then again has little incentive to invest for the long-term. They measure the pay gap as the difference in abnormal compensation between the CEO and non-CEO executives.

find that firm value increases in pay gap. Thus, the effects of pay gap on firm value are currently in dispute.

In this study, we consider a neglected perspective in empirical studies— the collaboration among executives and the efficiency of management team production. Lazear (1989) points out that large pay gaps potentially undermine collaboration among senior executives and lead to value-destroying office politics and even conscious sabotage. More specifically, non-CEO executives may have incentives to devote effort in damaging their competitors' performance in order to inflate their own chances of being promoted to the CEO position, when the pay increase upon promotion is relatively high. Given the fact that the executive responsibilities are invariably shared and firm decisions embody the mutual agreement of the senior executive group, a properly designed incentive mechanism should minimize managerial moral hazard, while maximizing executive cooperation, so as to attain high overall management team productivity.

We examine the pay gap through the lens of a simple principal-agent framework. Modifying the Lazear (1989) model, we add governance mechanisms that mitigate the moral hazard problem, i.e. equity-based executive compensation. The principal in the corporate context is its shareholders and the agents are the CEO and two senior executives who are competing to be the next CEO. The pay gap derived from the model is jointly determined by the expected marginal benefit of improving managerial incentives by linking their chances of promotion to the effort they put in and the expected marginal cost of inducing counterproductive rivalries (sabotage) among senior executives. Rivalries or sabotage refers to the general behavior that reduces co-worker productivity while not improving one's own productivity. This stylized model also predicts that the

pay gap level depends negatively on agents' equity deltas: the marginal benefit of having a large pay gap to lower moral hazard problems (including shirking) is reduced when other governance mechanisms exist to align manager and shareholder interests. In other words, equity-based incentives and corporate governance work as substitutes for a large pay gap. We then examine the relationship between pay gap and firm value. Our model clearly indicates that the effect of pay gap on firm output is a function of the parameters that capture key firm and executive characteristics. More specifically, the effect of pay gap on firm output is larger when the marginal benefit of reducing manager moral hazard problems is large, such as when managers have higher marginal productivity of effort. On the other hand, the effect of pay gap on firm output is reduced by the damage caused by counter-productive executive rivalries. The effect of pay gap on firm output is also found to fall when a firm's equity returns are riskier.

Using data on executive compensation for US public firms from 1996 to 2005,[43] we find strong support for the predictions derived from our model. The pay gap is larger when managerial moral hazard problems are more severe, and the pay gap is smaller when the expected cost of counter-productive executive rivalries is more serious. Examining the relationship between pay gap and firm performance, we find that the effect of pay gap on firm performance is significantly positive when the firm has greater manager-shareholder agency conflicts, creating a large managerial moral hazard problem. On the other hand, the effect of pay gap on firm performance is greatly diminished and can even be negative, when managerial shirking concerns are small, while improving collaboration and management team productivity is a first order of magnitude issue.

[43] The public firms in our data are S&P 500 large cap firms, S&P 400 mid cap firms, and S&P 600 small cap firms, that are reported in the Execucomp database.

These relationships provide evidence that the pay gap's impact on firm performance is not uniform across all firms. Instead, this relationship is largely conditional on firm characteristics.

We measure the pay gaps among top executives as the logarithm of dollar difference between CEO's total compensation and the median total compensation of non-CEO executives that are reported in a firm's proxy statement. We evaluate firm value by looking at its industry-adjusted Q, both in the immediate future (a year ahead) and longer term (three years ahead). Examining the univariate statistics on the pay gap, we document several noteworthy findings. First, substantial cross-sectional heterogeneity exists in firm pay gaps, which is highlighted by a bottom quartile pay gap of $542,423, compare to that in the top quartile of $3,427,720.[44] The pay gap rises over our sample period, with the median pay gap rising from $935,530 in 1996 to $1,948,430 in 2005. Alternatively, we use the CPS (CEO pay slice constructed by Bebchuk et al 2011) to measure pay gap. It is measured by the ratio of the CEO total compensation over the aggregate compensation of the top five executives. We also find an upward trend over time using this measure.

Second, pay gap is highly firm specific, with firm fixed effects explaining more than half of the cross-sectional variation. Pay gap is also strongly correlated with firm level characteristics. Large firms have significantly larger pay gap than otherwise similar firms. This is consistent with several model predictions. Large firms tend to be more difficult to monitor and can have more severe moral hazard problems, which calls for a higher pay gap to provide additional incentives. Moreover, marginal productivity of

[44] Our pay gap distribution is similar, though slightly higher than that reported in Kale et al (2009), probably because our sample period is several years later than theirs. Our pay gap distribution appears to be same as Kale et al (2009) if we use their sample period.

executive effort increases with firm size and complexity (i.e. Rosen 1981, Rosen 1982, Gabaix and Landier 2008), and our model predicts a positive relation between marginal productivity of executive effort and pay gap. We also find that pay gap rises as firms become risker, which is consistent with the idea that high risk firms are more difficult to monitor and hence face larger managerial moral hazard problems. On the other hand, pay gap declines as managerial moral hazard becomes less of a concern. For example, the pay gap is lower, when either firm corporate governance is strong or non-CEO top executive financial interests are better aligned with shareholders through a higher equity delta.

One of our hypotheses is that pay gap should be smaller when team production is critical to firm performance and when reducing counter-productive sabotage is a top priority. Siegel and Hambrick (2005) argue that top management collaboration is particularly important in technology-intensive firms, because of the substantial amount of information processing required and the need for frequent reassessments and adjustments in corporate strategies in the face of a rapid changing marketplace.[45] We find that pay gap decreases with R&D expenditures only when overall firm corporate governance is strong. When both managerial moral hazard and expected costs of competing manager sabotage are of major concern, a higher pay gap can be expected.

[45] There is a long stream of research and field studies in the management literature that looks at the environmental uncertainty and the degree of task interdependence, i.e. Thompson (1967), Galbraith (1973), Eisenhardt and Bourgeois (1988) , Hambrick (1994) and etc. Siegel and Hambrick (2005) argue that among various forms of environmental uncertainty, R&D intensity has the most pronounced effect on top management interdependence and collaboration , because first high R&D intensive firms have large information processing requirements and second, innovations requires frequent negotiations and mutual adjustments.

The third set of findings uncovers a relationship between pay gap and firm performance. The effect of pay gap on industry adjusted Tobin's Q averaged over the full sample is negative, but it is not statistically significant. In contrast to Aggarwal et al (2010), we do not find a hump-shape relation using our pay gap measure. Neither does the effect of the pay gap-firm performance relationship depend on whether the large pay gap is due to high CEO compensation or low non-CEO executive compensation. In fact, we find that the pay gap-firm performance relationship is conditional on firm characteristics. The effect of pay gap on firm performance is positive and significant when monitoring costs are higher and managerial moral hazard is potentially more serious. For instance, the pay gap increases industry-adjusted Q significantly in large, complex firms, suggesting that such firms benefit more from having a larger pay gap. On the other hand, the marginal effect of pay gap on industry-adjusted Q declines and even becomes negative, as the level of managerial moral hazard falls. We find that pay gap has a significant negative correlation with firm performance in firms with strong corporate governance and a higher median non-CEO executive equity delta.

The relation between pay gap and firm performance also depends on how harmful employee sabotage is likely to be for firm performance. Our model predicts a low pay gap level and a low pay gap-firm performance relationship when team production is important and the expected cost of employee sabotage is large. We find that the coefficient on pay gap significantly falls with firm technology-intensity, measured by R&D expenses over total assets. We also find that the marginal effect of pay gap on industry-adjusted Q declines with firm risk, measured by volatility of stock returns, with an effect that is statistically significant at 1 percent level. This result complements the

findings in Bloom and Michel (2002), who document that a large pay gap is associated with higher management turnover and shorter manager tenure and that this impact is exacerbated under more volatile operating conditions.

We use a quasi-natural experiment as our first approach to testing causality between pay gap and firm performance. The exogenous event we use as a quasi-natural experiment is the Bush Administration's 2003 Dividend Tax Cut. Chetty and Saez (2010) and Chetty and Saez (2005) theoretically and empirically show that dividend tax cut increases managers' after-tax wealth obtained from their equity holdings and hence effectively increases the sensitivity of managerial wealth to firm value. This exogenous tax reform legislation results in improved alignment of manager interests with shareholders and reduces the managerial moral hazard problem. Consequently, the benefit of having a large pay gap in order to reduce the managerial moral hazard problem becomes less attractive. Therefore, we expect firms to reduce their pay gaps following the dividend tax cut in 2003, and the effect of pay gap level on firm value should also decrease after the tax cut. Indeed, we find that on average the pay gap declines significantly after the tax reform, controlling for other firm characteristics and a time trend. The magnitude of the pay gap drop is especially large for firms having high managerial ownership and paying out dividends regularly. Furthermore, we find the pay gap effect on firm value also falls after 2003 and the reduction is especially large for riskier and high R&D intensive firms.

We also use a conventional IV-GMM approach to address potential endogeneity to further establish the causality of the pay gap-firm performance relationship. The exogenous instrumental variables for the pay gap are the industry's median pay gap level

and the number of internal CEO successions by industry firms over the prior year. A firm's pay gap is highly correlated with industry pay gap since many firms tend to benchmark to industry peers in setting executive compensation. Furthermore, industry trends concerning hiring internal CEO candidates can significantly influence CEO succession decisions of firms within the industry, and hence affect a firm's pay gap level. However, economically, there is no clear reason to expect these two industry specific variables to be directly related to an individual firm's industry-adjusted Q. Formal statistical tests, including Hansen's J statistic and the Cragg-Donald Wald test, indicate that the two instrumental variables both meet the exclusion and relevance requirements for statistically valid IVs. Importantly, we find that our main findings regarding the relationship between pay gap and firm value continue to hold under the IV-GMM specifications.

Our paper is organized as follows. We present a simple model in Section 2 to motivate our empirical analysis. The data and sample construction are presented in section 3. We report our primary empirical evidence in section 4. The quasi-natural experiment using 2003 tax cut is presented in section 5. We report our robustness tests in section 6 and conclude in section 7.

Model

We adopt a simple model to illustrate how the choice of pay gap level reflects a tradeoff between the benefit of reducing managerial moral hazard and the expected cost of inducing lower level employee sabotage. Our model is similar to the framework in

Lazear (1989), with our primary innovation being the inclusion of other incentive mechanisms to help align manager interests with those of shareholders. We emphasize the purpose of this model is purely to illustrate the relationship that inspires the later empirical tests, rather than to identify a specific structural equation system.

Consider two agents j and k who are competing to become the next CEO. The agent's productivity $q(\mu,\theta)$ is a positive function of his/her own effort μ, and is a negative function of the rival's sabotage activity θ. The agent also bears a cost $c(\mu,\theta)$, which is a positive function of the agent's individual effort to improve productivity and to sabotage the rival. The firm's output Q depends on the collective effort and sabotage levels of the two agents:

$$Q = q_j + q_k \tag{1}$$
$$q_j = \alpha\mu_j - \beta\theta_k + \varepsilon_j \tag{1a}$$
$$q_k = \alpha\mu_k - \beta\theta_j + \varepsilon_k \tag{1b}$$
$$c_j = A\mu_j^2 + B\theta_j^2 \tag{2a}$$
$$c_k = A\mu_k^2 + B\theta_k^2 \tag{2b}$$

The parameter α reflects the agent's marginal productivity of effort, which may be a function of firm risk σ^2, as well as other sources of heterogeneity in firm and agent characteristics. The parameter β represents the marginal reduction in productivity from a competitor's sabotage activities. Effort is unobservable by the principal, but all other parameters are common knowledge. Denote a linear sharing rule between the principal and the agents, which aligns the interests of the agents and principal, $S = \eta + sQ$. The agent receives a pay package of w_1 if he/ she wins promotion, otherwise the agent

receives a pay package of w_2 if he/she loses the competition and stays on the current position or is forced to leave the firm and search for another position. The agent cares about his/ her total pay less the costs involved, and has exponential utility with constant absolute risk aversion γ. The agent j then maximizes

$$\max_{\mu,\theta} \{ w_1 p(\mu_{j,}\theta_j;\mu_{k,}\theta_k) + w_2[1-p(\mu_{j,}\theta_j;\mu_{k,}\theta_k)] - c_j(\mu_{j,}\theta_j) + S_j(\mu_{j,}\theta_j;\mu_{k,}\theta_k) - \frac{\gamma}{2}s^2\sigma^2\} \tag{3}$$

The promotion probability p depends not only on an agent's own productivity, but also on that of its rival and it indirectly depends on the two agents' sabotage activities. This is formally stated as

$$\begin{aligned} p(\mu_{j,}\theta_j;\mu_{k,}\theta_k) &= prob(q_j > q_k) \\ &= prob[(\alpha\mu_j - \beta\theta_k) - (\alpha\mu_k - \beta\theta_k) > \varepsilon_k - \varepsilon_j] \\ &= G \end{aligned} \tag{4}$$

where G is the distribution function of the random variable $\varepsilon_k - \varepsilon_j$, the random shocks on firm production and the agents' idiosyncratic production.

Solving the first order condition, we obtain the levels of productive effort and sabotage of agent j given w_1, w_2, and s :

$$\mu_j = \frac{\alpha}{2A}[(w_1 - w_2)g(.) + s] \tag{5a}$$

$$\theta_j = \frac{\beta}{2B}[(w_1 - w_2)g(.) - s] \tag{5b}$$

Because the two agents are symmetric, the level of productive effort and sabotage chosen by agent *k* are determined in the same way. We can clearly see that both effort and

sabotage increase as the pay gap gets larger. Moreover, the alignment of an agent's interests with that of the principal, s, helps to constrain the two agents' sabotage behavior. Hence, a better way to induce effort and lower the level of sabotage is to maintain a relatively low pay gap ($w_1 - w_2$) and a better alignment of manager and shareholder interests through equity-based manager compensation.

The competitive firm must maximize the two agents' expected rents subject to a zero-profit constraint by choosing w_1, w_2, s. Solving the first order condition, we get the following equilibrium pay gap $\Delta = w_1 - w_2$ and the sharing rule s:

$$\Delta = \frac{1}{g(.)} \frac{(\frac{\alpha^2}{A} - \frac{\beta^2}{B})}{(\frac{\alpha^2}{A} + \frac{\beta^2}{B})}(1-s) \tag{6}$$

$$s = \frac{1}{2\gamma\sigma^2 + \frac{\alpha^2}{A} + \frac{\beta^2}{B}}[(\frac{\alpha^2}{A} + \frac{\beta^2}{B}) - (\frac{\alpha^2}{A} - \frac{\beta^2}{B})\Delta g(.)] \tag{7}$$

Substituting (5a) and (5b) back into (1), we obtain the relationship between firm output Q and the pay gap level Δ

$$Q = (\frac{\alpha^2}{A} - \frac{\beta^2}{B})g(.)\Delta + (\frac{\alpha^2}{A} - \frac{\beta^2}{B})s \tag{8}$$

Several implications emerge by examining equation (6). The pay gap is determined by the tradeoff between the marginal benefit of improving manager incentives and thereby reducing moral hazard (α^2 / A) and the marginal cost of encouraging strong rival competition, which induces potential sabotage behavior

(β^2 / B). Notice that marginal benefits and marginal costs are highly related to the firm's environment that influences managers' marginal productivity of effort α, the costs of undertaking sabotage *B*, and the damage brought about by agents' sabotage β. Moreover, when managerial interests are better align with those of principals through other governance arrangements, the moral hazard problem is less severe, and the benefit of the pay gap is lower. Hence, the optimal pay gap decreases with the quality of the firm's corporate governance and the managers' equity delta. Thus, the optimal pay gap is highly firm specific. Given this analysis, we form the following hypotheses:

1. $\partial\Delta / \partial\alpha > 0$. Pay gap increases in a manager's marginal productivity of effort. Hence, pay gap should be larger in large and more complex firms, because a manager's marginal productivity of effort is high in such firms (i.e. Rosen 1982, Gabaix and Landier 2008).

2. $\partial\Delta / \partial\beta < 0$. Pay gap decreases in the damage associated with agent sabotage. Hence, given that Siegel and Hambrick (2005) find that team production is more important in high-tech firms, we expect pay gap to be lower in technology-intensive firms.

3. $\partial\Delta / \partial s < 0$. Pay gap should be lower when managers have better incentives due to their equity holdings and other firm governance mechanisms that align their interests with those of the principals.

4. $\partial\Delta / \partial\sigma = \frac{\partial\Delta}{\partial g}\frac{\partial g}{\partial\sigma} > 0$. Pay gap increases in the variance of the random production shocks, which is our measure of firm risk.

The relationship between pay gap and firm output is also largely conditional on firm characteristics as indicated by equation (8). The coefficient of pay gap is increasing in the marginal benefit of improving manager incentives and reducing moral hazard (α^2 / A) and the marginal cost of encouraging greater manager competition, which can lead to agent sabotage (β^2 / B). In light of the model predictions, we form the following testable hypotheses with regard to the relationship between pay gap and firm value:

5. $\partial Q / \partial \Delta \partial \alpha > 0$ The effect of pay gap on firm value increases in marginal productivity of managerial effort. Hence, we expect a greater effect of pay gap on firm value in large and complex firms.

6. $\partial Q / \partial \Delta \partial \beta < 0$ The effect of pay gap on firm value decreases in the expected damage associated with agent sabotage. Therefore, we expect the effect of pay gap on firm value to fall with the level of R&D intensity, which requires greater agent cooperation.

7. $\partial Q / \partial \Delta \partial \sigma < 0$ The effect of pay gap on firm value also falls with rising firm risk.

Data and Sample Description

Data Source

We obtain top executive officer names and compensation data from Compustat's Execucomp. Since FAS123R substantially changed the reporting rule on equity based compensation starting in year 2006,[46] our sample ends in 2005 to allow equity-based compensation to be estimated on a consistent basis. Identification of the CEO is primarily based on the Chief Executive Officer code (CEOANN=CEO). The sample only includes firms with a clearly identified CEO and at least three non-CEO senior executives reported in Execucomp. Firm accounting information and stock return information are taken from Compustat and CRSP respectively. Boards of directors and other corporate governance characteristics are obtained from RiskMetrics. Because RiskMetrics begins reporting board of director information in year 1996, our sample begins in that year. Thus, our major tests are based on the 10-year sample period from 1996 to 2005.

[46] Specifically, the FASB began requiring that the public entities report the cost of all employee stock options and other equity based compensation based on their current fair value.

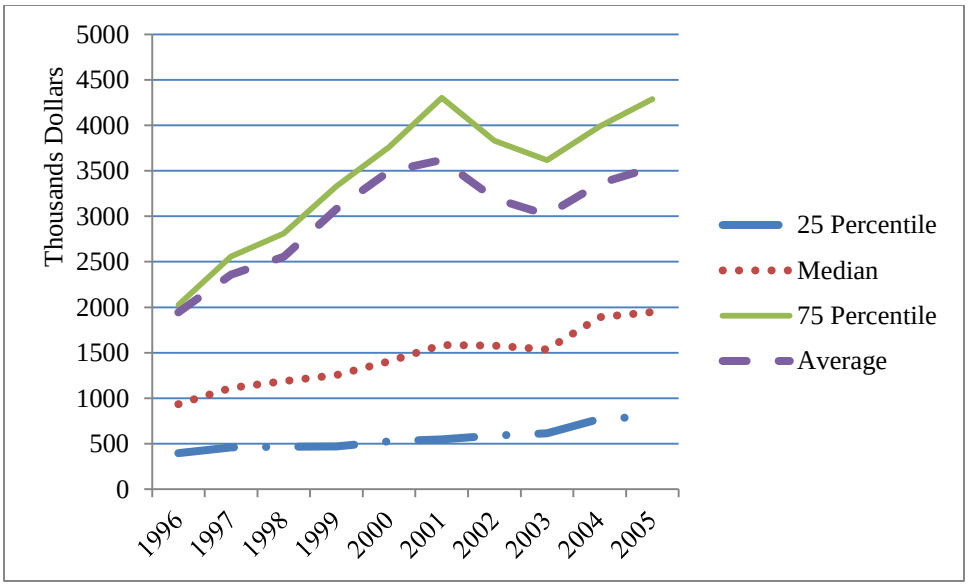


Figure 1 Time Series Trend of Pay Gap

Variable Definition

The pay gap is measured as the difference in total compensation between the CEO and median total compensation of the other top executives who are reported in the proxy statements. We then scale the difference by taking the natural logarithm. Following Kale et al (2009), due to the existence of cases where a CEO's total compensation is less than the median non-CEO executive's total compensation, which results in a negative pay gap, we monotonically transform all observations by adding a constant equal to the absolute value of the minimum gap to each observation. The pay gap measure is based on the total compensation of each top executive, including salary, bonus, other annual pay, the market value of restricted stock granted that year, the Black-Scholes value of stock options granted that year, long-term incentive payouts, and all other compensation elements (as reported in Execucomp item TDC1). The sample mean and median of pay

gap is $3,023,210 and $1,380,640, respectively, and we observe a large cross-sectional variation. The bottom quartile of pay gap is $542,424 and the top quartile is $3,427,720. Meanwhile, there is a significant upward trend over time as shown in Figure 1. The median pay gap is $935,530 in 1996 and it increases to $1,948,430. We also use several alternative pay gap measures, including the CPS (CEO pay slice) studied by Bebchuk et al (2011), the coefficient of variation of the total compensation for the top executives and the Gini coefficient of total compensation among the top executives. We find a similar upward trend over our sample period when we use these alternative measures, reported in Table 1.[47] These alternative pay gap measures have significant positive correlations, although they are far from perfectly correlated.

Table 1 Time Series Trend of Pay Gap (000$)

Panel A: Pay Gap ($000) = CEO total compensation –median non-CEO executive total compensation

Year	Mean	Lower Quartile	Median	Upper Quartile
1996	1943.71	394.82	935.53	2026.07
1997	2358.5	458.56	1113.94	2557.25
1998	2555.9	468.077	1186.52	2809.53
1999	3079.04	470.06	1253.38	3333.16
2000	3493.99	528.07	1407.66	3761.61
2001	3618.82	547.75	1586.83	4302.45
2002	3196.96	590.91	1578.23	3829.78
2003	3015.95	612.86	1536.24	3616.8
2004	3359.86	774.19	1890.7	3988.75
2005	3538.75	800.2	1948.43	4288.38

[47] CPS is the ratio of CEO total compensation over the aggregate total compensation of all top 5 executives. Coefficient of variation is the standard deviation of total compensation for all top executives divided by the mean value of total compensation for all top executives. The equation to calculate Gini coefficient is:

$$Gini = \frac{N+1}{N-1} - \frac{2}{N(N-1)\mu}\left(\sum_{i=1}^{n} P_i X_i\right),$$

where P is the rank of total compensation and X is the amount of total compensation for person i.

Panel B: Alternative Measures

Sample Median Year by Year			
Year	CPS	Coefficient of Variation	Gini Coefficient
1996	0.35	0.56	0.31
1997	0.36	0.576	0.326
1998	0.362	0.582	0.329
1999	0.365	0.604	0.335
2000	0.368	0.611	0.342
2001	0.375	0.618	0.345
2002	0.378	0.62	0.345
2003	0.38	0.612	0.338
2004	0.385	0.614	0.337
2005	0.39	0.634	0.345

Table 2 Descriptive Statistics

Variable Name	Mean	Lower Quartile	Median	Upper Quartile
Key Variables				
Adjusted Q	0.59	-0.14	0.15	0.79
Pay gap (thousand $)	3023.21	542.42	1380.64	3427.72
Log (Pay gap)	7.82	7.31	7.76	8.38
Total Assets (million $)	5427.17	434.40	1157.72	3633.65
Number of Business Segments	2.22	1	2	3
Governance Index Score	0.10	-1.63	-0.07	1.70
RD/Total Assets	0.03	0	0	0.04
Firm Risk	0.13	0.08	0.11	0.16
Log (CEO Equity Delta)	12.64	11.60	12.45	13.45
Log (Median Non-CEO Equity Delta)	10.20	9.11	10.21	11.25
Firm Characteristics				
CEO Tenure	6.31	2	4	9
CEO Chairman Dummy	0.63	N/A	N/A	N/A
Board Size	9	7	9	11
Board Independence	0.65	0.55	0.66	0.79
Percentage of Busy Independent Director	0.1	0	0	0.20
Presence of IDB	0.10	N/A	N/A	N/A
Entrenchment Index	1.75	1	3	4
Market Leverage	0.22	0.04	0.17	0.35
Capx/Total Assets	0.04	0.02	0.03	0.05
Alternative Measures of Pay Gap				
CPS	0.37	0.29	0.37	0.44
Coefficient of Variation	0.65	0.45	0.61	0.79
Gini Coefficient	0.35	0.25	0.33	0.43

Correlation among Alternative Pay Gap Measures

	Pay Gap	CPS	Coefficient of Variation	Gini Coefficient
Pay Gap	1	0.53***	0.48***	0.47***
CPS		1	0.58***	0.54***
Coefficient of Variation			1	0.97***
Gini Coefficient				1

We measure firm value using Tobin's Q, approximated by book value of assets minus book value of equity plus market value of equity, all divided by book value of assets. Each firm's Tobin's Q measure is industry adjusted by subtracting the industry median Q, where the industry is defined by FF 49 industries using the Compustat Universe (excluding the firm in question). We examine both industry adjusted Q at year (t+1) (termed the one-year adjusted Q) and the average industry adjusted Q over the next three years (termed the three-year adjusted Q). The median one-year adjusted Q and three-year adjusted Q are 0.128 and 0.125, respectively.

We evaluate the overall strength of corporate governance based on five dimensions: (1) board composition and board monitoring; (2) blockholder monitoring; (3) anti-takeover provisions that measure the strength of the market for corporate control; (4) a CEO's formal positions and power inside the firm; (5) industry competition. To be specific, (1) includes board size (median=9), percentage of independent directors (median=0.66), percentage of busy independent directors who serve on more than three boards (mean=0.1, median=0). For (2), we use an indicator for the presence of independent blockholder (IDB) on the board (frequency=0.10). [48] For (3), we use the entrenchment index (E index) of Bebchuk, Cohen and Farrell (2009) (median=2). For (4), we use an indicator for CEO-chair duality (frequency=0.65), while for (5) industry competition is measured by a Herfindahl index for the firm's main 4 digit SIC (median=0.03). Due to the correlation among those governance mechanisms and the potential substitution (Fahlenbrach 2009) and complementarity effects (Hartzell and Starks 2003) among them, we construct a single governance index score to capture the

[48] Following Agrawal and Nasser(2010), I define independent director blockholders (IDB) as independent directors holding more than one percent of total shareholdings or of total votes.

overall strength of a firm's governance. To be specific, each of the above variables is standardized by demeaning it and scaling it to have a unit standard deviation. Variables negatively associated with governance quality, i.e. percentage of busy independent directors, the E index, CEO-chair duality indicator and the Herfindahl index, are multiplied by -1. The governance index score is then calculated as the linear combination of those transformed variables, where a high score indicates a firm with better overall level of governance. The mean and median values of the governance index score are 0.06 and -0.05, respectively. Firms whose score falls below the 25 percentile level (score=-1.63) are considered to have extremely weak corporate governance (captured by a weak governance indicator). On the other hand, firms whose score is above the 75 percentile level (score=1.70) are considered well governed, which is represented by a strong corporate governance indicator.

The median firm in our sample has total assets of $1157 million dollars and operates in two business segments. Firms operating in multiple business segments and with above-median size are regarded as complex in the nature of its business and organizational structure, in contrast to small firms operating in single segment, which is similar to the definition used in Coles et al (2008). Technology-intensity is captured by a firm's investment in R&D activities. We define firms that have R&D to total assets ratio greater than or equal to the 75 percentile level (R&D/ total assets=0.04) to be technology-intensive. Note that the R&D intensity of the sample firms is highly right skewed. We assess firm risk by looking at its stock return volatility, measured as the standard

deviation of its 60-month stock returns over the past five years.[49] The sample mean and median of stock return volatility is 0.13 and 0.11, respectively. We measure an executive's alignment of interest with shareholders using the executive's equity delta, which is defined as the dollar change in his or her accumulated stock and option portfolios for a 1% change in stock price, following the approach of Core and Guay (2002). Haubrich (1994), Hall and Liebman (1998), and Core and Guay (1999) argue that a wealth-constrained and risk-averse manager can obtain powerful incentives from a large dollar equity portfolio. Our sample of CEOs has an median equity delta of $256,199, while the median non-CEO executive's equity delta is substantially lower with a median of $25,233. We report the sample statistics in Table 2 and all continuous variables are winsorized at 1 and 99 percentile levels.

Negative Pay Gap

Sometimes, the CEO is paid less than the median level of the non-CEO top executives and this leads to a negative pay gap. About 5.34% of our firm-year observations (892 out of 16699) have a negative pay gaps. Some firms only have negative pay gaps occasionally, while some firms persistently have CEO paid less than other top executives, i.e. Franklin Resources, Southwest Airlines, Safeguard Scientifics, Biomet, and etc. Table 3 compares negative-pay-gap firms with positive-pay-gap firms. Firms having negative pay gaps are smaller, invest significantly more in R&D expenses, and have more volatile stock returns. Their overall corporate governance mechanisms are also much stronger. A higher portion of such firms have CEOs who are founders or

[49] For firms that have less than 5 years of public history, we use the monthly observations of stock returns that are available. However, we require a minimum of 12 consecutive months observations.

founding family members. In terms of industry representation, about half of the firms with negative pay gaps are in business services (FF industry 34), chips and electronic equipment (FF industry 36), Retail (FF industry 42), and Transportation (FF industry 40). The descriptive statistics is largely consistent with our predictions (1)-(3).[50]

Table 3 Negative Pay Gap Firms vs. Positive Pay Gap Firms

	Firms with Positive Pay Gap		*Firms with Negative Pay Gap*	
	Mean	Median	Mean	Median
Total Assets (million dollars)	5430.63	1186.29	5367.8	758.37
Number of Business Segments	2.23	1	2.06	1
RD/Total Assets	0.03	0	0.06	0
Firm Risk	0.13	0.11	0.17	0.15
Log (CEO Equity Delta)	12.63	12.45	12.88	12.45
Log (Median Non-CEO Equity Delta)	10.21	10.21	10.12	10.08
Governance Index Score	0.08	-0.11	0.78	0.54
CEO is the Founder	6%		17%	
CEO is Founder Family Member	3%		4%	

[50] Prior studies generally do not treat firms with negative pay gaps separately. The descriptive statistics in this section shows .that firms with negative pay gaps could have different characteristics from those with positive pay gaps. Therefore we exclude them from our sample in robustness tests to make sure our main results are not purely driven by this subgroup of firms, though negative gaps are always possible under some bonus schemes.

Empirical Results

Pay Gap Level and Firm Characteristics

We first examine the relationship of pay gap and firm characteristics. We find that pay gap is highly firm-specific and it is significantly correlated with factors reflecting the marginal benefit of managerial effort and the marginal costs of rival manager sabotage. The results in column one of Table 4 show that firm size has a significant positive correlation with pay gap, consistent with the prediction that pay gap should increase with a manager's marginal productivity of effort. The pay gap is negatively correlated with other top executives' median equity delta and the coefficient is statistically significant at 1 percent level, suggesting that when non-CEO top executive incentives are better aligned with shareholder interests, a lower pay gap is optimal. Similarly, we find pay gap decreases with the firm's corporate governance score, suggesting that when the overall corporate governance is strong enough to substantially lower manager-shareholder agency problems, the benefit of having large pay gaps is also reduced. This result is also in line with argument in Acharya, Myers and Rajan (2010) that internal incentives can substitute for other corporate governance mechanisms. Consistent with our prediction (4), we find that pay gap increases with firm risk. Surprisingly, we find no evidence that pay gap is related to firm R&D level in any significant way, which stands in contrast with the prediction that high technology-intensive firms that bear large costs of productivity-reducing competing manager sabotage should have low pay gaps. One possible reason is that although high-tech firms generally suffer greatly from uncooperative rival

competition, they are also generally hard to monitor due to their high technology-intensity, which requires larger pay gap to control for a potential manager moral hazard problem. Therefore, we further examine whether high-tech firms significantly reduce pay gap when the overall corporate governance mechanisms are strong enough to control managerial moral hazard. As predicted, this is indeed what we find: pay gap is negatively related to R&D intensity when moral hazard is kept low by strong corporate governance, thus causing managerial collaboration to be a priority for these firms.

Table 4 Determinants of Pay Gap

	(1)		(2)		(3)	
Log (Firm Size)	0.15	***			0.15	***
	(0.03)				(0.03)	
R&D/Total Assets	0.35		0.4			
	(0.31)		(0.31)			
R&D/Total Assets* Governance Index Score						
Volatility of Stock Returns	0.85	**	0.65	**	0.85	***
	(0.34)		(0.3)		(0.3)	
Log (Median Non-CEO Equity)	-0.03	**	-0.02	**	-0.03	***
	(0.01)		(0.012)		(0.010)	
Governance Index Score	-0.03	***	-0.02	***	-0.03	***
	(0.006)		(0.006)		(0.006)	
Number of Business Segments	-0.006				-0.006	
	(0.008)				(0.008)	
Complex Firm Indicator			0.017	***		
			(0.003)			
High-Tech Indicator					0.06	
					(0.06)	
Market Leverage	-0.25	**	-0.19	*	-0.24	**
	(0.11)		(0.10)		(0.11)	
Tobin Q	0.03	**	0.015		0.03	**
	(0.012)		(0.012)		(0.012)	
CEO Above 62 Dummy	-0.004		-0.007		-0.005	
	(0.03)		(0.03)		(0.03)	
Log (CEO Tenure)	-0.09	***	-0.09	***	-0.09	***
	(0.015)		(0.016)		(0.015)	
Log (CEO Equity Delta)	0.35	***	0.37	***	0.35	***
	(0.02)		(0.016)		(0.016)	
Firm Fixed Effects	Yes		Yes		Yes	
Year Fixed Effects	Yes		Yes		Yes	
Number of Observations	10142		10142		10142	
R-Squared	0.5		0.49		0.49	

Table 4, continued

	Model 4		Model 5		Model 6	
Log (Firm Size)	0.15	***	0.14	***	0.14	***
	(0.03)		(0.03)		(0.03)	
R&D/Total Assets	0.35		0.33		0.22	
	(0.3)		(0.31)		(0.32)	
R&D/Total Assets* Governance Index Score					-0.61	**
					(0.30)	
Volatility of Stock Returns	0.87	***			0.86	***
	(0.34)				(0.33)	
Log (Median Non-CEO Equity)			-0.03	***	-0.03	***
			(0.012)		(0.012)	
Governance Index Score	-0.03	***	-0.03	***	-0.03	***
	(0.006)		(0.006)		(0.006)	
Number of Business Segments	-0.006		-0.006		-0.006	
	(0.008)		(0.008)		(0.008)	
High Non-CEO Equity Delta Indicator	-0.068	**				
	(0.029)					
High Risk Firm Indicator			0.014	***		
			(0.003)			
Market Leverage	-0.23	**	-0.23	**	-0.25	**
	(0.11)		(0.11)		(0.11)	
Tobin Q	0.028	**	0.028	**	0.028	**
	(0.012)		(0.012)		(0.012)	
CEO Above 62 Dummy	-0.005		-0.004		-0.004	
	(0.04)		(0.036)		(0.036)	
Log (CEO Tenure)	-0.09	***	-0.095	***	-0.095	***
	(0.015)		(0.015)		(0.015)	
Log (CEO Equity Delta)	0.35	***	0.35	***	0.35	***
	(0.016)		(0.016)		(0.016)	
Firm Fixed Effects	Yes		Yes		Yes	
Year Fixed Effects	Yes		Yes		Yes	
Number of Observations	10142		10142		10142	
R-Squared	0.49		0.49		0.49	

Our results from using indicator variables in place of continuous variables are similar to the regression results in column one. We find that large and complex firms have larger pay gaps than small and single segment firms. High risk firms also have significantly larger pay gaps than low risk firms. Firms with above-median equity deltas for non-CEO executives have an average 6 percent lower pay gap than firms with non-CEO executive equity deltas below the sample median. Firms with strong corporate governance have an average pay gap that is 12 percent lowers than firms with weak governance.

Pay Gap Level and Firm Value

We next test the effect of pay gaps on firm value measured by one-year and three-year industry-adjusted Tobin's Qs. Table 5 reports the regression results of one-year and three-year industry-adjusted Q on pay gap, controlling for other factors that earlier studies document to affect firm performance. Although we find pay gap is negatively correlated with firm performance, it is statistically insignificant once we include firm fixed effects. This result is in line with equation (8) in our model: the effect of pay gap on firm value is conditional on firm specific parameters, and both the sign and magnitude of the coefficient are determined by the marginal benefit of reducing managerial moral hazard and the marginal costs of non-CEO manager sabotage. We also include a quadratic term on pay gap to test if there is an invert-U relationship. We find that neither pay gap, nor its squared value, are significantly related to firm performance (measured by short term or long term performance), contradicting the findings reported by Aggarwal et al (2011).

Table 5 Effect of Pay Gap on Firm Value: Full Sample

	One-Year Adjusted Tobin's Q (t+1)			
	(1)	(2)	(3)	(4)
Log (Pay Dispersion)	-0.018 **	-0.009	-0.002	-0.013
	(0.007)	(0.008)	(0.02)	(0.01)
Log (Pay Dispersion)^2			-0.0001	
			(0.002)	
Log (Pay Gap)* Positive CEO Abnormal Pay				-0.001
				(0.02)
Log (Pay Gap)*Negative non-CEO Abnormal Pay				0.002
				(0.017)
Positive CEO Abnormal Pay				0.02
				(0.17)
Negative non-CEO Abnormal Pay				-0.03
				(0.13)
Log (Total Assets)	-0.03 ***	-0.62 ***	-0.63 ***	-0.62 ***
	(0.008)	(0.03)	(0.03)	(0.03)
Adjusted Q	0.71 ***	0.33 ***	0.33 ***	0.33 ***
	(0.007)	(0.01)	(0.01)	(0.01)
Leverage	-0.17 ***	0.14 *	0.14 *	0.15 *
	(0.05)	(0.08)	(0.08)	(0.08)
Volatility of Stock Returns	-0.29 *	-0.41	-0.4	-0.4
	(0.15)	(0.26)	(0.26)	(0.26)
RD/Total Assets	0.83 ***	0.74 ***	0.74 ***	0.74 ***
	(0.15)	(0.25)	(0.24)	(0.24)
CAPX/Total Assets	-0.43 ***	-0.11	-0.11	-0.11
	(0.14)	(0.19)	(0.19)	(0.19)
Diversified	-0.03	0.01	0.01	0.01
	(0.016)	(0.025)	(0.02)	(0.02)
Log (CEO Tenure)	-0.014	0.012	0.01	0.01
	(0.01)	(0.012)	(0.01)	(0.01)
Log (CEO Equity Delta)	0.022 **	0.01	0.014	0.011
	(0.01)	(0.01)	(0.013)	(0.013)
Log (Median Non-CEO Equity)	0.03 ***	0.006	0.003	0.007
	(0.007)	(0.01)	(0.009)	(0.009)
Governance Index Score	0.001	0.01 ***	0.013 ***	0.013 ***
	(0.003)	(0.004)	(0.004)	(0.004)
Firm Fixed Effects	No	Yes	Yes	Yes
Industry Fixed Effects	Yes	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	9643	9643	9643	9643
R-Squared	0.64	0.76	0.77	0.77

Table 5, continued

	Three-Year Adjusted Tobin's Q (t+1, t+3)							
	(5)		(6)		(7)		(8)	
Log (Pay Dispersion)	-0.02	***	-0.004		-0.005		-0.008	
	(0.007)		(0.006)		(0.02)		(0.007)	
Log (Pay Dispersion)^2					0.0001			
					(0.001)			
Log (Pay Gap)* Positive CEO Abnormal Pay							0.006	
							(0.01)	
Log (Pay Gap)*Negative non-CEO Abnormal Pay							-0.004	
							(0.01)	
Positive CEO Abnormal Pay							-0.02	
							(0.12)	
Negative non-CEO Abnormal Pay							0.03	
							(0.09)	
Log (Total Assets)	-0.03	***	-0.63	***	-0.64	***	-0.63	***
	(0.007)		(0.02)		(0.02)		(0.02)	
Adjusted Q	0.57	***	0.13	***	0.13	***	0.13	***
	(0.006)		(0.007)		(0.007)		(0.007)	
Leverage	-0.18	***	0.33	***	0.33	***	0.33	***
	(0.05)		(0.06)		(0.06)		(0.06)	
Volatility of Stock Returns	-0.23	*	-0.12		-0.13		-0.13	
	(0.14)		(0.19)		(0.19)		(0.19)	
RD/Total Assets	1.05	***	0.33	*	0.32	*	0.32	*
	(0.14)		(0.17)		(0.17)		(0.17)	
CAPX/Total Assets	-0.4	***	0.09		0.09		0.09	
	(0.13)		(0.13)		(0.13)		(0.13)	
Diversified	-0.03	**	0.016		0.016		0.016	
	(0.015)		(0.018)		(0.018)		(0.018)	
Log (CEO Tenure)	-0.013		0.01		0.01		0.01	
	(0.09)		(0.01)		(0.008)		(0.008)	
Log (CEO Equity Delta)	0.03	***	0.02	**	0.02	**	0.02	**
	(0.008)		(0.009)		(0.009)		(0.009)	
Log (Median Non-CEO Equity)	0.03	***	-0.001		-0.002		-0.002	
	(0.007)		(0.006)		(0.006)		(0.006)	
Governance Index Score	-0.002		0.009	***	0.009	***	0.009	***
	(0.003)		(0.003)		(0.003)		(0.003)	
Firm Fixed Effects	No		Yes		Yes		Yes	
Industry Fixed Effects	Yes		No		No		No	
Year Fixed Effects	Yes		Yes		Yes		Yes	
Number of Observations	9643		9643		9643		9643	
R-Squared	0.59		0.84		0.77		0.77	

Since firms could have large pay gaps either because CEO pay is very high or non-CEO manager pay is relatively low, we test if the pay gap-firm performance relationship depends on the source of the large pay gap. We first estimate the abnormal CEO pay using the residual from regressing total CEO compensation on firm size, market to book ratio, year and industry fixed effects. The abnormal compensation for median non-CEOs is calculated in the same way. We observe that 42.35% of firm-year observations have positive abnormal CEO compensation, while 59.22% of firm-year observations have negative abnormal median non-CEO compensation. We then interact the pay gap with an indicator for positive CEO abnormal pay and an indicator for negative non-CEO abnormal pay in model 4 and model 8 of Table 5. Once again, we find statistically insignificant relationship between pay gap and firm performance. Furthermore, the relationship is not related to whether CEO pay is too high or non-CEO pay is too low.

Our hypotheses in section 2 suggest that the relationship between pay gap and firm value relies on the marginal benefit of reducing managerial moral hazard, which is closely related to manager marginal productivity. Following this logic, we test the effect of pay gap on firm performance conditional on firm complexity. As modeled in Rosen (1982) and Gabaix and Landier (2008), marginal productivity of manager effort increases with firm size and complexity. We test prediction (5) by interacting pay gap with a complex-firm indicator, with the results reported in Table 6. Consistent with our hypothesis, we find a significant positive coefficient on the interaction term in both the one-year and three-year industry-adjusted Q regressions, suggesting that complex firms reap greater benefits from having larger pay gaps. The effect of pay gap on firm

Table 6 Effect of Pay Gap on Firm Value Conditional on Firm Type

	1	2	3	4	5	6
	1 Y Adj. Q	3 Y Adj.Q	1 Y Adj. Q	3 Y Adj.Q	1 Y Adj. Q	3 Y Adj.Q
Log (Pay gap)	-0.04	-0.04	0.007	0.002	0.04	0.098 ***
	(0.08)	(0.08)	(0.008)	(0.007)	(0.05)	(0.038)
Log (Pay gap)* Complex Firm	0.044 ***	0.06 ***				
	(0.01)	(0.01)				
Log (Pay gap)* Corporate Governance Index			-0.002 **	-0.005 ***		
			(0.0025)	(0.002)		
Log (Pay gap)* Non-CEO Equity Delta					-0.005 \	-0.01 ***
					(0.004)	(0.003)
Complex Firm Dummy	-0.42 ***	-0.58 ***				
	(0.12)	(0.10)				
Corporate Governance Index			0.033 *	0.05 ***		
			(0.02)	(0.014)		
Non-CEO Equity Delta					0.046	0.07 ***
					(0.04)	(0.02)
Firm Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	9709	9709	9709	9709	9713	9713
R-Squared	0.75	0.82	0.77	0.84	0.78	0.87

performance also depends on the severity of a firm's moral hazard problem. In firms where strong corporate governance tightly limits the moral hazard problem, the marginal benefit of reducing CEO moral hazard is lower and so is the benefit of raising pay gap on firm value. Consistent with this prediction, we find that the marginal effect of pay gap on firm value significantly falls with the overall strength of a firm's corporate governance. The magnitude is economically large: the marginal effect of pay gap on one-year industry adjusted Q falls by 70% if the firm's corporate governance moves from the bottom quartile to the top quartile, while the marginal effect of pay gap on three-year industry adjusted Q becomes negative when a firm's corporate governance index score is in the top quartile. Similarly, we find that the marginal benefit of having a large pay gap to improve managerial incentives and hence raise firm value is greatly reduced when non-CEO executives have high equity deltas. The marginal effect of pay gap on three-year industry adjusted Q falls from a significantly positive to a significantly negative coefficient, if non-CEO executive equity deltas move from the bottom quartile to the top quartile for our sample.

We test hypothesis (6) by interacting pay gap with R&D intensity. Consistent with the hypothesis that the effect of pay gap on firm value decreases with the potential cost of competing manager rivalry, we find that the coefficient on the interaction of pay gap and R&D intensity is negative and significant. The marginal effect of pay gap on one-year adjusted Q is 84 percent lower for high R&D-intensity firms than for firms without significant R&D expenditures. The coefficient of pay gap in the firm value regressions also depends on firm riskiness. Specifically, the estimates in the last two columns of Table 6 indicate that the marginal effect of pay gap on firm value

significantly falls as firm risk increases. The coefficient of pay gap is 0.038 for firms in the bottom quartile of stock return volatility, compared to -0.014 for firms in the top quartile. This is strongly consistent with prediction (7) that riskier firms suffer more from large pay gaps. Our result complements the findings in Bloom and Michel (2002), which documents that large pay gaps are associated with higher manager turnover and shorter manager tenure, and this impact can be intensified under more volatile operating conditions.

Predicted Pay Gap and Firm Value

We test the relation between pay gap and firm value in Table 7 using the fitted value for pay gap. The reason for using predicted pay gap instead of the actual level is that the actual pay gap can be affected by random shocks from time to time and hence, the relationship we document in Table 6 could be spuriously driven by those random shocks. Using fitted values helps to control for the effects from these random shocks.

Our results remain the same under this specification. Predicted pay gap significantly reduces firm value in small and single segment firms, while it significantly increases firm value in large, multi-segment firms (conglomerates). The positive effect of predicted pay gap on firm value significantly falls if overall corporate governance is strong or if non-CEO top executives have high equity deltas. The effect of predicted pay gap on firm value even becomes negative if the firm has a corporate governance score above 0.5 or the median non-CEO top executive has an equity delta that is high enough (above the 95 percentile of the sample). The effect of predicted pay gap on industry-adjusted Q also falls with R&D intensity, and its effect is reduced by almost 70% if a

Table 7 Pay Gap and Firm Value: Using Predicted Pay Gap

	(1)	(2)	(3)	(4)	(5)	(6)
	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q
Log (Predicted Pay gap)	2.71 ***	-4.05 ***	0.05 **	0.34 ***	0.13 ***	0.23 ***
	(0.74)	(0.13)	(0.025)	(0.06)	(0.025)	(0.03)
Log (Predicted Pay gap)* Complex Firm		0.1 ***				
		(0.02)				
Log (Predicted Pay gap)* Corporate Governance Index			-0.1 **			
			(0.04)			
Log (Predicted Pay gap)* Non-CEO Equity Delta				-0.026 ***		
				(0.005)		
Log (Predicted Pay gap)* R&D/TA					-2.24 ***	
					(0.18)	
Log (Predicted Pay gap)* Volatility of Stock Return						-1.42 ***
						(0.19)
Complex Firm Dummy		-0.79 ***				
		(0.16)				
Corporate Governance Index			0.074 ***			
			(0.02)			
Non-CEO Equity Delta				0.2 ***		
				(0.045)		
R&D/TA					0.19 ***	
					(0.014)	
Volatility of Stock Return						1.92 ***
						(0.154)
Firm Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	9709	9709	9709	9713	9713	9700
R-Squared	0.84	0.84	0.84	0.84	0.84	0.84

firm with no material R&D expenditures begins to invest heavily in R&D and moves its R&D intensity level to the top quartile of the sample (R&D/total assets= 0.04). Similarly, the positive effect of predicted pay gap on firm value also falls significantly as a firm's risk level rises.

2003 Tax Reform as a Quasi-Natural Experiment

The Impact of Dividend Tax Cut

The Jobs and Growth Tax Relief Reconciliation Act of 2003 drastically cut the dividend tax to a flat rate of 5 or 15 percent[51] from the previous progressive tax schedule with a top rate of 35 percent. The agency model of dividend tax in Chetty and Saez (2010) shows that a dividend cut leads to lower agency problems, because it increases manager after-tax wealth obtained from their equity holdings and thus, results in a better alignment of interest between managers and shareholders. We term this as an increase in *effective ownership*, because its effect is equivalent to an increase in manager share ownership. Empirical evidence has shown that corporate behavior changes around the 2003 dividend tax cut. For instance, Chetty and Saez (2005) find that regular dividends rose sharply right after the 2003 tax cut. Cheng, Hong and Shue (2012) find that after this dividend cut, managers are less likely to push pet projects such as "corporate goodness".

[51] More precisely, taxpayers in the bottom two income tax brackets face a new dividend tax rate of 5 percent, while taxpayers in the top four brackets face a new dividend tax rate of 15 percent.

In addition to dividend tax cut, the Jobs and Growth Tax Relief Reconciliation of 2003 also cuts the capital gains tax significantly. The capital gains tax decreased from rates of 8%, 10%, and 20% to 5% and 15%. The drop in capital gains tax shifts executive preferences towards more stock based compensation, which can also result in increased managerial ownership. We use the 2003 tax reform as a largely exogenous event, which increases managers' alignment of interest with shareholders and hence, reduces managerial moral hazard incentives. We then study the corresponding changes in pay gaps and the effect of pay gaps on firm performance.

The intuition behind the Chetty and Saez (2005) model is straightforward. The manager can do three things with a firm's cash *X*: pay out dividends *D*, invest *I* in a productive project that generates net profits *f(I)* for shareholders, or invest J in a pet project that gives the manager private benefits of g(J). Assuming the manager holds α percent of the firm's total shares outstanding, the manger's payoff has the following structure:

$$V = \alpha(1-t_d)[D + \frac{f(I)+X-D}{1+\gamma}] + \frac{g(J)}{1+\gamma} \tag{9}$$

The manager's effective ownership stake $\alpha(1-t_d)$ increases with a drop in the dividend tax rate, t_d. Meanwhile, the marginal cost of pet projects $\partial g / \partial I = \alpha(1-t_d)\partial f / \partial I$ increases as the dividend tax rate t_d is lowered. Hence, after the tax reform, we expect a decrease in manager's investment in pet projects, and an increase in real investment *I* or dividend payment *D*, depending on whether the initial investment I is at the first-best level. Moreover, large shareholders also effectively have larger shareholdings after the

dividend tax cut that encourage them to monitor managers more closely, which reduces the agency problems further.

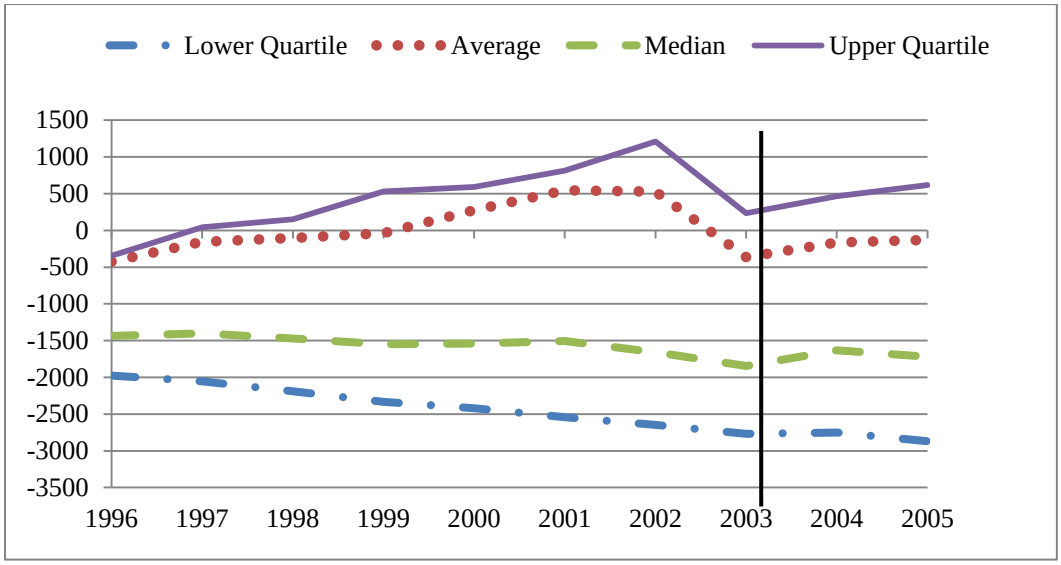


Figure 2a De-trended Pay Gap ($000) Before and After 2003 Tax Reform

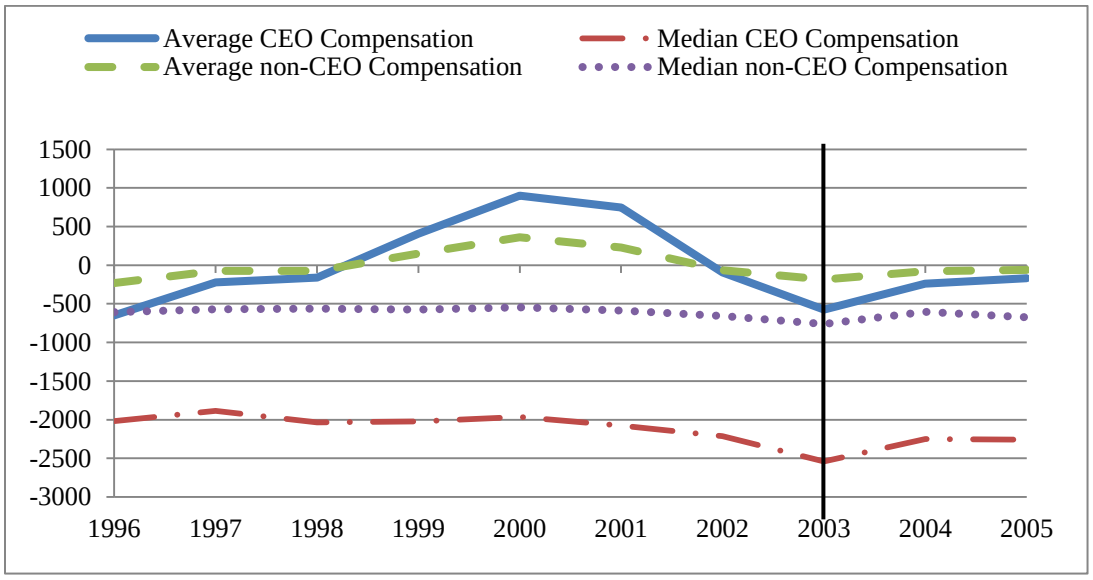
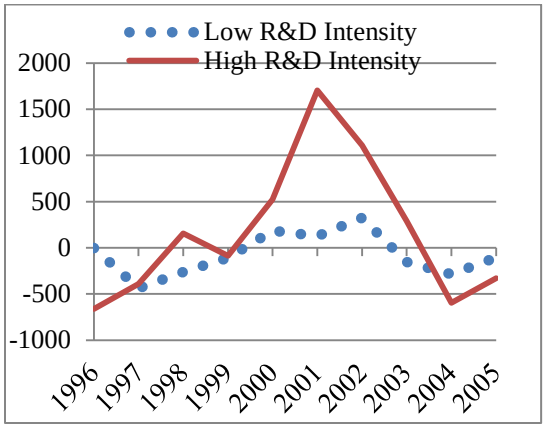


Figure 2b CEO Total Compensation (De-trended) vs. Total Compensation (De-Trended) for Median Non-CEOs

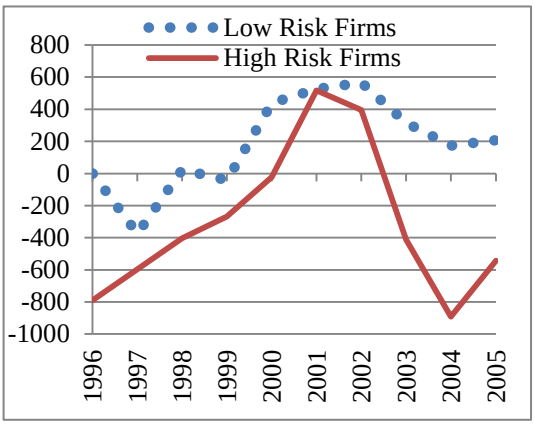
The Change of the Pay Gap Level

We expect a decrease in pay gap following the 2003 tax cut, because the marginal benefit of having a large pay gap is reduced due to the increase in effective managerial ownership. Figure 2 (a) shows the change in the pay gap around 2003, after taking out the time trend. Consistent with our expectation, there is a clear drop in the de-trended pay gap in year 2003, and the drop is across the whole distribution of individual firm pay gaps. The drop is most pronounced for firms whose pay gaps are in the top quartile. Figure 2 (b) further shows that both CEO total compensation and median non-CEOs' total compensation drops following the 2003 dividend tax cut, and the CEO total compensation falls significantly more than non-CEO managers' total compensation. We then investigate whether different firms respond to this tax cut differently. Figure 3 plots the changes in the de-trended pay gap over time, conditional separately for firms with different characteristics. Simple firms (i.e. small and single segment firms) cut their pay gaps more aggressively than complex (large and conglomerate) firms. High R&D firms also reduce their pay gaps more dramatically than firms with little investment in R&D. In addition, high risk firms cut their pay gaps more aggressively than low risk firms. We then examine the changes in pay gaps based on a firms' dividend payout status. We investigate firms that do not pay a dividend over the whole sample period, firms that pay out dividends over the entire sample period, and firms that start to pay dividends after 2003. We find that firms that initiated dividend payouts after 2003 cut their pay gaps most significantly, suggesting that these firms' behavior was affected most by the tax cut.

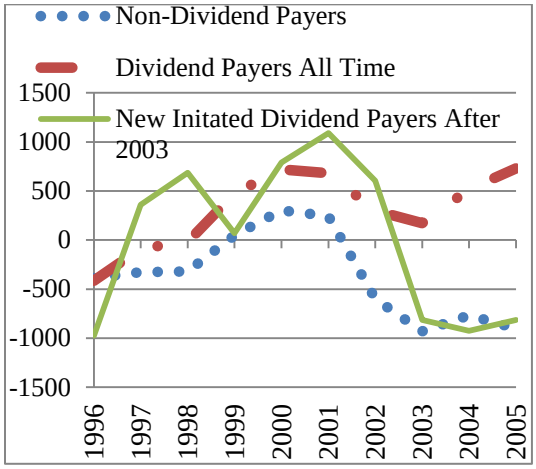
a. Low R&D vs. High R&D Firms



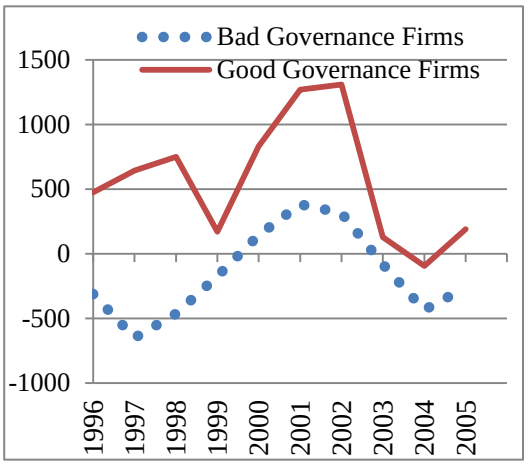
b. Low Risk vs. High Risk Firms



c. Dividend Paying Status



d. Bad vs. Good Governance Firms



e. Simple vs. Complex Firms

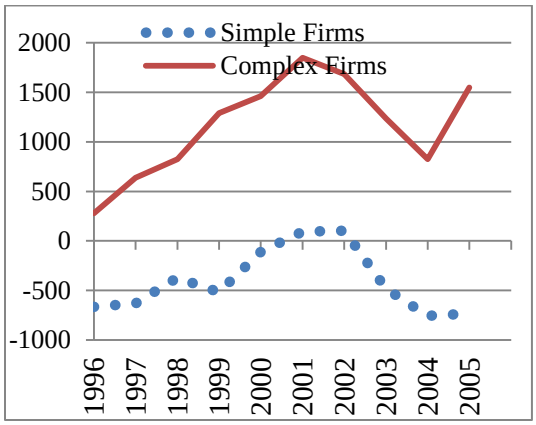


Figure 3 De-trended Pay Gap ($000) Before and After 2003 Conditional on Firm Types

We next formally test whether the pay gaps change on average after the 2003 dividend tax cut using the following specification:

$$\log(pay\ gap)_{it} = \alpha + \beta_1 post_{it} + \beta_2 (t-2003)_{it} + \beta_3 post_{it} \times (t-2003)_{it} + X_{it}\gamma + \mu_{it} \quad (10)$$

where post is defined as an indicator variable for the post-tax-cut 2003-2005 period, *t-2003* captures the time-series trend, and X_{it} is a vector of firm level controls. We also include firm fixed effects to control for unobservable time-invariant firm level factors.

Table 8 column 1 displays the result of this regression. Although the pay gap has an overall upward trend ($\beta_2 > 0$), it decreases significantly after the 2003 dividend tax cut, controlling for the time series trend. The coefficient β_1 is significantly negative at the one percent level. In terms of economic magnitude, the pay gap declines by 10 percent for the average firm ($302,321 dollars) in the post-tax-cut period (2003-20050, relative to the pre-tax-cut period (1996-2002). Column 2 and column 3 of Table 8 show that both the level of CEO compensation and median non-CEO executive compensation decline after 2003 tax cut, but the level of CEO compensation appears to decline more than the level of median non-CEO compensation. The model of Chetty and Saez (2005) in equation (9) further suggests that firms most affected by the tax reform are those having higher managerial stock ownership (α) and paying out dividends (*D*>0). Hence, we test whether these firms tend to cut their pay gaps more than other firms. The three-way interaction term of the post-tax reform indicator, CEO's aggregate shareholding as a percentage of total shares outstanding (CEO ownership) and a firm's dividend payout status prior to the tax reform in column 4 of Table 8 is negative and significant at the one

Table 8 Change of Pay Gap Before and After 2003 Tax Cut

	Y= Log (Pay Gap)	Y= Log (CEO Pay)	Y= Log (Median non-CEO Pay)	Y= Log (Pay Gap)	Y= Log (Pay Gap)	Y= Log (Pay Gap)
Post Indicator	-0.1 ***	-0.13 ***	-0.12 ***	-0.14 ***	-0.11 ***	-0.14 ***
	(0.036)	(0.028)	(0.019)	(0.037)	(0.037)	(0.04)
Post * CEO Ownership* Dividend Payer Indicator				-0.024 ***		
				(0.008)		
Post * Median Non-CEO Ownership* Dividend Payer Indicator					0.005	
					(0.12)	
Post* Ownership Difference* Dividend Payer Indicator						-0.023 ***
						(0.008)
Post* CEO ownership				0.015 ***		
				(0.005)		
CEO Ownership* Dividend Payer Indicator				0.028 ***		
				(0.008) ***		
Post* Median Non-CEO ownership					-0.089	
					(0.08)	
Median Non-CEO Ownership* Dividend Payer Indicator					-0.03	
					(0.07)	
Post * Ownership Difference						0.016 ***
						(0.005)
Ownership Difference * Dividend Payer Indicator						0.03 ***
						(0.008)
Trend	0.046 ***	0.08 ***	0.06 ***	0.07 ***	0.07 ***	0.07 ***
	(0.01)	(0.004)	(0.003)	(0.007)	(0.007)	(0.007)
Firm Level Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	10184	10184	10184	10202	10064	10064
R-Squared	0.49	0.78	0.84	0.46	0.46	0.46

percent level. This is consistent with the prediction that firms that pay out dividend and have CEOs with large ownership positions respond to the tax reform more strongly than other firms and cut their pay gaps more aggressively. In unreported regressions, we find that such firms reduce their pay gaps by cutting CEO compensation more aggressively than cutting median non-CEO compensation, relative to the remaining firms. In column 5, we replace CEO ownership with median non-CEO executive ownership, and the three-way interaction term is also negative, suggesting that when non-CEO top executives have larger ownership positions in dividend-paying firms, these firms also cut their pay gaps more aggressively, but the effect is not statistically significant. Finally, we look at the ownership difference between the CEO and median non-CEO top executive and interact it with an indicator for a firm's dividend payout status in column 6. We find that firms having a large ownership differences between the CEO and other top executives and regularly paying cash dividends prior to the tax reform reduce their pay gap significantly more than other firms.

We next examine whether the magnitude of the pay gap reduction is conditional on firm characteristics by estimating the following regression model:

$$\begin{aligned}\log(pay\ gap)_{it} = {} & \alpha + \beta_1 post_{it} + \beta_2 post_{it} \times firm\ type_{it} + \beta_4 firm\ type_{it} \\ & + \beta_5 (t-2003)_{it} + \beta_6 post_{it} \times (t-2003)_{it} + X_{it}\gamma + \mu_{it}\end{aligned} \tag{11}$$

Table 9 Change of Pay Gap Before and After Tax Cut Conditional on Firm Type

	Model 1		Model 2		Model 3		Model 4		Model 5	
Post Indicator	-0.08	**	-0.1	***	-0.11	***	-0.05		-0.04	
	(0.038)		(0.04)		(0.04)		(0.03)		(0.03)	
Post* Complex	0.02	**								
	(0.008)									
Post * High-Tech			-0.004							
			(0.04)							
Post * High-Risk Firm					0.007					
					(0.04)					
Post* Dividend Payer							0.04			
							(0.08)			
Post * Strong Governance Indicator									-0.03	
									(0.04)	
Complex Indicator	0.01									
	(0.03)									
High-Tech Indicator			0.06							
			(0.07)							
High-Risk Firm Indicator					-0.019					
					(0.04)					
Dividend Payer Indicator							0.39			
							(1.02)			
Strong Governance Indicator									-0.1	
									(0.03)	
Trend	0.041	***	0.046	***	0.046	***	0.041	***	0.05	***
	(0.008)		(0.01)		(0.01)		(0.007)		(0.006)	
Post*Trend	-0.003		-0.004		-0.003		-0.003		0.002	
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
Firm Level Controls	Yes		Yes		Yes		Yes		Yes	
Firm Fixed Effects	Yes		Yes		Yes		Yes		Yes	
Number of Observations	10184		10184		10184		10184		10184	
R-Squared	0.47		0.47		0.47		0.47		0.47	

The results are reported in Table 9. Consistent with the diagram in figure 3 (b), we find a smaller decrease in the pay gaps of complex firms compared with simple firms,

after controlling for a time trend and other firm characteristics, and the difference in pay gap reductions is statistically significant at 5 percent level. High R&D firms and high risk firms reduce their pay gaps more than other firms, although the difference is not statistically significant. Similarly, the difference in pay gap reductions by firms with good and bad corporate governance is not statistically significant. We also look at the average change of pay gaps based on firm dividend payout status. Without taking into account the level of managerial ownership, we find no significant difference in the pay gap changes of dividend and non-dividend paying firms. When we use the predicted probability of paying a cash dividend, instead of the firm's actual dividend payout status,[52] we find no evidence suggesting that changes of pay gaps around the 2003 tax reform is related to the dividend payout propensity.

The Relation between Pay Gap and Firm Value Before and After Tax Cut

In this section, we examine whether the effect of pay gaps on firm performance changes after an exogenous rise in effective managerial ownership caused by the 2003 dividend tax cut. Managers have greater incentives to put in more effort after the dividend tax reform act because their wealth is more closely tied to firm value after the exogenous increase in their effective ownership. Meanwhile, for the same reason, managers are less willing to sabotage their colleagues, everything else being equal. Thus, we expect firm value to increase after the tax cut. Moreover, the marginal effect of the pay gap on motivating executives to put in more effort and thereby reducing moral hazard declines, because the marginal productivity of effort falls with the level of effort, but the

[52] The probability of paying out dividends is estimated using a logistic model following Denis and Osobov (2008). Specifically, the independent variables are firm size measured by logarithm of total assets, market to book ratio, percentage change of total assets, retained earnings/book value of equity and EBIT/total assets. The independent variables are measured at one year before the dividends are paid out.

marginal cost of effort increases with the level of effort. Therefore, we expect the marginal effect of pay gap on firm value to decline after the 2003 tax reform act, relative to the pre-tax-cut period. We formally test this prediction by estimating the following regression:

$$\begin{aligned} industry\ adjusted Q_{it} = {} & \alpha_0 + \alpha_1 \log(pay\ gap)_{it} + \alpha_2 post + \alpha_3 (t - 2003)_{it} \\ & + [\beta_1 \log(pay\ gap)_{it} + \beta_2 (t - 2003)_{it}] \times post_{it} \\ & + X_{it}\gamma + \mu_{it} \end{aligned} \tag{12}$$

The results are reported in Table 10. We find that α_1 is positive and statistically insignificant, consistent with our findings in Table 5 that on average pay gap does not have a significant impact on firm value. β_1 is negative and statistically significant and $\alpha_1 + \beta_1 < 0$, suggesting that a larger pay gap reduces firm value after the 2003 tax reform, and the impact is statistically significant. This is consistent with our prediction that the marginal effect of pay gap declines after an exogenous increase in managerial ownership. α_2 is significantly positively, consistent with our prediction that firm value on average increases after the dividend tax cut.

We next use a difference-in-difference approach and compare the changes in pay gap coefficients across firms with different characteristics. Specifically, we compare complex versus simple firms, high versus low R&D intensity firms, high versus low risk firms, and good versus bad governance firms. Formally, the regression specification is as follows:

$$\begin{aligned} industry\ adjusted\ Q_{it} = {} & \alpha_0 + \alpha_1 \log(pay\ gap)_{it} + \alpha_2 \log(pay\ gap)_{it} \times firm\ type_{it} + \alpha_3 post + \alpha_4 (t - 2003)_{it} \\ & + [\beta_1 \log(pay\ gap)_{it} + \beta_2 \log(pay\ gap)_{it} \times firm\ type_{it} + \beta_3 (t - 2003)_{it}] \times post_{it} \\ & + X_{it}\gamma + \mu_{it} \end{aligned} \tag{13}$$

The coefficient β_2 shows us the average change in the pay gap effects for high minus low-type firms. The results are reported in the Table 9. While the effect of pay gap on firm value generally falls after the tax reform ($\beta_1 < 0$), there is significant cross-group heterogeneity. Complex firms experience a much smaller decline in the marginal effect of pay gap relative to simple firms ($\beta_2 > 0$). On the other hand, high-risk firms and high-tech firms have a much larger decline in the pay gap effect on firm value, compared to low-risk firms and low R&D intensity firms respectively ($\beta_2 < 0$). Similarly, the decline in the marginal effect of the pay gap after the tax reform is also larger for well-governed firms compared to weakly-governed firms ($\beta_2 < 0$). These cross-group comparisons are all statistically significant.

The unexpected dividend tax cut provides us with a quasi-natural experiment which gives us new insights into how firms adjust senior manager financial incentives in the face of an exogenous change in the contracting environment. We find that firms appear to respond to such changes by adjusting their executive compensation arrangements to take into account the changing incentives due to taxes. Moreover, the effect of one incentive mechanism on improving firm value becomes weaker if other incentive mechanisms are reinforced by changes in government regulatory or tax policies.

Table 10 Pay Gap and Firm Value Before and After Tax Cut

	1	2	3	4	5	6
	1 Y Adj. Q	3 Y Adj.Q	1 Y Adj. Q	3 Y Adj.Q	1 Y Adj. Q	3 Y Adj.Q
Log (Pay gap)	0.004	0.009	-0.006	-0.005	0.034 ***	0.033 ***
	(0.009)	(0.006)	(0.01)	(0.008)	(0.011)	(0.008)
Log (Pay gap)*Post	-0.03 **	-0.026 ***	-0.03 **	-0.033 ***	-0.022 *	-0.016 *
	(0.013)	(0.01)	(0.014)	(0.01)	(0.013)	(0.009)
Log (Pay Gap)*Complex Firm			0.03 **	0.05 ***		
			(0.014)	(0.01)		
Log (Pay Gap)*Complex Firm *Post			0.003	0.01 ***		
			(0.004)	(0.002)		
Log (Pay gap)* High-Tech Firm					-0.06 ***	-0.05 ***
					(0.015)	(0.01)
Log (Pay gap)* High-Tech Firm*Post					-0.03 ***	-0.03 ***
					(0.004)	(0.003)
Firm Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	9709	9707	9707	9707	9707	9707
R-Squared	0.76	0.84	0.76	0.84	0.77	0.84

Table 10, continued

	7	8	9	10
	1 Y Adj. Q	3 Y Adj.Q	1 Y Adj. Q	3 Y Adj.Q
Log (Pay gap)	0.03 **	0.02 **	0.001	-0.001
	(0.014)	(0.01)	(0.01)	(0.01)
Log (Pay gap)*Post	-0.03 **	-0.026 ***	-0.005	-0.002
	(0.013)	(0.01)	(0.01)	(0.01)
Log (Pay gap)* High-Risk Firm	-0.035 **	-0.02 *		
	(0.016)	(0.011)		
Log (Pay gap)* High-Risk Firm*Post	-0.001	-0.01 ***		
	(0.004)	(0.002)		
Log (Pay Gap)*Good Governance Firm			0.017	0.004
			(0.014)	(0.01)
Log (Pay Gap)*Good Governance Firm*Post			-0.01 **	-0.013 ***
			(0.005)	(0.003)
Firm Level Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	9700	9700	9700	9700
R-Squared	0.77	0.84	0.73	0.82

Table 11 IV-GMM Estimation of the Effect of Pay Gap on Firm Value

	Model 1	Model 2	Model 3	Model 4	Model 5
Endogenous Variables					
Log (Pay Gap)	-0.03 **	-0.001	0.09	0.05	0.09
	(0.09)	(0.55)	(0.58)	(0.52)	(1.13)
Log (Pay Gap)* Complex Firm Dummy	0.07 ***				
	(0.02)				
Log (Pay Gap)* Corporate Governance Index		-0.003 ***			
		（0.001）			
Log (Pay gap)* Non-CEO Equity Delta			-0.02 ***		
			(0.003)		
Log (Pay gap)* R&D/TA				-0.95 ***	
				(0.11)	
Log (Pay gap)* Volatility of Stock Return					-0.33 ***
					(0.12)
Control Variables	Yes	Yes	Yes	Yes	Yes
Statistical Tests for the Validity and Relevance of Instrumental Variables					
First Stage F-Statistics	29.95 ***	27.23 ***	29.83 ***	27.44 ***	31.56 ***
	1489.73 ***	1383.9 ***	715.64 ***	657.19 ***	2569.16 ***
Cragg-Donald Wald test for weak instruments	31.51	29.11	31.26	28.69	32.84
Hansen J statistics	1.11	1.67	0.78	1.68	3.6
P-value of J statistics	0.57	0.43	0.59	0.4	0.16

Robustness

Instrumental Variable Regressions Using GMM

Our quasi-natural experiment presented in section 5 is one approach to controlling for endogeneity in our results. We next use a conventional approach for taking endogeneity into account, namely using instrumental variable regressions. To implement this approach, we use annual industry median pay gap level and industry number of internal CEO successions to instrument for a firm's pay gap level. The interactions of pay gap with indicators for various classes of firms are instrumented by interactions of the two exogenous instruments with these firm class indicators. For instance, the interaction of pay gap with the complex firm indicator is instrumented by two exogenous instruments: the interactions of industry median pay gap and the industry number of internal CEO successions with the complex firm indicator.

The instrumental variable regression model is estimated with GMM. The IV-GMM estimator is more efficient than the 2SLS estimator when the number of exogenous instrumental variables is more than the number of endogenous variables and thus, the model is overidentified. Table 11 reports the main results of estimating this model. The findings are qualitatively the same as those found in Tables 5. The Hansen's J statistics for testing the overidentifying restriction has insignificant P-value, indicating that the null hypothesis that the exogenous variables are appropriately independent of the error process cannot be rejected, which is to say the exclusion requirement is met. Both the F-

statistics and the Cragg-Donald Wald test used to detect a weak instruments problem indicate that the instruments are sufficiently correlated with the endogenous regressors.

Other Examinations for Robustness

Finally, alternative measures of pay gap are used to check the robustness of the main results. Three alternative measures of pay gap we explore are: 1) CPS, defined as the slice of CEO total compensation as a percentage of the aggregate total compensation of the top five executives, which is used in Bebchuk et al (2011); 2) the Gini-coefficient of total compensation among the top five executives, which is used in Kale et al (2009), Aggarwal et al (2011), and Bebchuk et al (2011); 3) the coefficient of variation of the total compensation among the top five executives. The major findings of the study continue to hold under these alternative specifications.

As further robustness analysis, we delete financial and utility firms, due to their heavy regulatory burden and distinctly different structures of their balance sheets. We also delete firms whose CEO is also a founder, because their incentives may be very different from those of professional managers. Lastly, we exclude firms with negative pay gaps. Again, our results remain qualitatively unchanged.

Horizontal Pay Gap

We also look at pay gaps among non-CEO executives. The reason for this procedure is that executives are more likely to compare themselves to other executives with similar positions and status. Hence, non-CEO top executive incentives are more likely to be affected by the compensation of other non-CEO executives. Moreover, a hierarchical structure could well exist among non-CEO executives. These executives may

first need to be promoted to a core-executive position, for example holding the COO position, before they can compete for the CEO position. We define the pay gap among non-CEO executives as the horizontal pay gap, and it is calculated as the dollar difference between the 75th percentile and the 25th percentile of total compensation of all non-CEO executives. The distribution of the horizontal pay gaps is reported in the summary statistics of Table 12. The horizontal pay gap is significantly lower than the pay gap between the CEO and the median non-CEO executive.

Our results using the horizontal pay gap are largely similar to our earlier results using our primary pay gap measure. On average, large horizontal pay gaps significantly increase firm value based on an analysis of the full sample. This effect is significantly reduced as firm R&D intensity and stock return volatility rise, which is largely consistent with our prior findings. The effect of the horizontal pay gap on firm value is greater for large and complex firms, relative to small and single segment firms, but the difference is not statistically significant. The effect of the horizontal pay gap on firm value also falls with the quality of the firm's corporate governance and the median non-CEO executive's equity delta, but again the difference is not statistically significant. This result also holds even if we include the pay gap between the CEO and the median non-CEO executive as an additional control variable.[53]

[53] The results are available upon request.

Table 12 Horizontal Pay Gap and Firm Value

Panel A

	Mean	Lower Quartile	Median	Upper Quartile
Horizontal Pay Gap (000$)	872.27	166.14	392.96	944.71
Log (Horizontal Pay Gap)	5.96	5.11	5.97	6.85

Panel B

	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q	3 Y Adj.Q
Log (Horizontal Pay Dispersion)	0.02 ***	-0.001	0.021 ***	0.06 **	0.03 ***	0.075 ***
	(0.005)	(0.007)	(0.005)	(0.03)	(0.006)	(0.012)
Log (Horizontal Pay Dispersion)* Complex Firm		0.0015				
		(0.01)				
Log (Horizontal Pay Dispersion)* Corporate Governance Index			-0.001			
			(0.001)			
Log (Horizontal Pay Dispersion)* Non-CEO Equity Delta				-0.004	-0.27 ***	
				(0.003)	(0.07)	
Log (Horizontal Pay Dispersion)* R&D/TA						
Log (Horizontal Pay Dispersion)* Volatility of Stock Return						-0.39 ***
						(0.07)
Firm Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	9709	9709	9709	9713	9713	9700
R-Squared	0.84	0.84	0.84	0.84	0.84	0.84

Conclusion

We use the often-neglected importance of team production in our empirical study to shed new light on the relationship between pay gap and firm performance. Given that large pay gaps can unintentionally invite value-reducing office politics and non-cooperative behavior by competing managers, we posit a simple principal-agent model that predicts that the pay gap level is determined by the tradeoff between reducing managerial shirking and improving team production incentives. Moreover, the relationship between pay gap and firm value also largely depends on a firm's marginal benefit of reducing managerial moral hazard and the marginal cost of inducing non-cooperative manager behavior.

In particular, our analysis highlights that the pay gap decision should be highly firm specific. It is more beneficial in larger, more complex firms and conglomerates, where the marginal productivity of manager effort is higher and hence, a board's main goal is to find ways to induce more managerial effort. The pay gap is lower, when other firm governance mechanisms in place are strong enough to ensure that managerial efforts are close to the first-best level and consequently making a large pay gap unnecessary. The pay gap level is also related to the likelihood of competing manager sabotage of each other and the potential loss of firm value from sabotage. We find pay gaps to be lower when increasing team production and eliminating non-cooperative managerial behavior is a firm's major concern, such as for high R&D intensity firms with strong corporate governance.

We then test the relationship between firm value and pay gap. This relationship is clearly conditional on firm specific characteristics. We find that the effect of pay gap on improving firm performance is significantly positive when a firm has potentially more manager-shareholder agency problems and the moral hazard problem associated with shirking or excessive perquisite consumption is large. On the other hand, the effect of pay gap on firm performance is largely reduced and can even become negative, when managerial shirking is not a major concern, while improving team collaboration and productivity is a first order of magnitude issue. To be specific, large pay gaps significantly increases firm value in complex firms. Its effect significantly falls and can even become negative when a firm has large R&D investment, or when a firm has high risk, or when senior manager incentives are better aligned with shareholders through either large equity deltas or well-constructed corporate governance systems.

Our primary finding is further reinforced by using the 2003 tax reform as a quasi-natural experiment, an event which increases manager after-tax wealth obtained from their equity holdings and lowers the managerial moral hazard problem. We find firms on average reduce their pay gap following this exogenous tax code change. Moreover, the size of the pay gap reduction is heterogeneous across different classes of firms. Also, the marginal effect of pay gap on firm value significantly falls after the tax reform act, suggesting that managerial compensation arrangements that improve firm value are weakened when existing financial incentive mechanisms are reinforced by exogenous external shocks.

Our empirical results help explain the apparently contradictory findings in the existing research that report significant positive and negative relationships between pay

gap and firm value. We find that there is no simple relationship between pay gap and firm value across the full sample of publicly listed firms. Instead, we find that the level of pay gap and its effects on firm value depend on firm characteristics and these effects can change over time with major changes in a firm's contracting environment. Thus, no simple rule of thumb exists to determine whether a large or small pay gap is value enhancing for all firms. It follows that pushing pay gap in one direction is likely to benefit some firms, while at the same time harming others.

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APPENDIX A Variable Definitions

Compensation Variables	
Pay Gap	CEO total compensation (TDC1) –median total compensation of non-CEO executives
Equity Delta	Dollar change in executive's stock and option portfolios for a 1% change in stock price. Calculated follow Core and Guay (2002)
Positive CEO Abnormal Pay Indicator	CEO Abnormal Pay is the residual from regressing total CEO compensation on firm size, market to book, year and industry fixed effects. Positive CEO abnormal Pay indicator equals one if CEO abnormal pay is greater than zero.
Negative non-CEO Abnormal Pay Indicator	Non-CEO Abnormal Pay is the residual from regressing total compensation of median non-CEO on firm size, market to book, year and industry fixed effects. Negative non-CEO abnormal Pay indicator equals one if CEO abnormal pay is less than zero.
Horizontal Pay Gap	75th percentile of total compensation for all non-CEO executives – 25th percentile of total compensation for all non-CEO executives
CEO Ownership	The aggregate shares held by CEO over the total shares outstanding
Non-CEO Ownership	The median number of shares held by all non-CEO executives over the total shares outstanding
Firm Characteristic Variables	
One-year Adjusted Q	Industry adjusted Tobin's Q measured at the end of year t+1
Three-year Adjusted Q	Industry adjusted Tobin's Q averaged over year t+1 to t+3
Firm risk	The standard deviation of monthly stock returns over the prior five years
Governance index score	A linear combination of a set of transformed variables that capture the corporate governance mechanisms
Diversified	A indicator variable which equals one if the firm has more than on business segments
Leverage	Market Leverage = (debt in current liability + long term debt)/(debt in current liability + long term debt+ market value of equity)
Complex Firm Dummy	Equals one if the firm's total assets are above sample median and has more than one business segments

High-Tech Firm Dummy	Equals one if the firm's R&D/ total assets ratio is above 0.04, and zero otherwise
High Risk Firm Dummy	Equals one if the firm's stock return volatility over the prior five years is above the sample median
Strong governance dummy	Equals one if the firm's governance index score is above 1.71
Dividend Payer Indicator	Equals one if the firm pays out dividend prior to the tax reform in 2003

CHAPTER III

INSTITUTIONS AND DEBT FINANCING

Introduction

Debt is a major source of capital for firms worldwide. The extant literature has studied firm debt financing patterns, such as debt placement choice (i.e. public vs. private debt) and debt financing costs (i.e. measured by debt yield). These studies find debt financing decisions are related to characteristics that reflect a firm's credit quality, the conflicts of interest between debtholders and equityholders, the firm's level of information asymmetry, and issue flotation costs (Krishnaswami, Spindt, and Subramaniam 1999, Hadlock and James 2002, Denis and Mihov 2003). The implicit assumption of these studies is that capital markets are competitive and perfectly elastic, and hence, debt financing decisions reflect the outcomes of a firm solving an optimization problem based on its fundamentals (Baker 2009).

To the extent that external capital markets are not fully efficient and perfectly competitive, firm debt financing patterns are likely to be affected by supply side constraints. Using a novel cross-country dataset, we are able to identify the effects of outside institutional constrains on firm debt financing decisions, above and beyond the effects of firm fundamentals. Specifically, we examine whether and how institutional arrangements systematically influence a firm's debt financing choice between public and

private debt, and its financing costs, measured by the yield on the issue date of a specific debt instrument. Our sample includes 26 countries, both developed and developing countries, and spans a 14-year period from 1995-2008.[54] The major institutional features we focus on are: the level of development of the economy and various capital markets, the extent and strength of creditor legal protections, and the availability and transparency of financial information. We expect these institutional features to affect firm debt financing decisions by altering the relative advantages or disadvantages of public and private debt. Three mechanisms can be at work, which help explain these relationships. First, institutional arrangements can have a significant impact on the size and development of debt markets (La Porta et al 1997), which is correlated with the liquidity and systematic risk of public debt. Second, creditor legal protections and their enforcement can alter investor preference between privately negotiated and public debt contracts. Lastly, the transparency and comprehensiveness of financial information available to outside investors is an important factor that directly affects the informational efficiency of the public debt market.

We first look at a firm's debt financing choice between public and private placement bonds, and show that the country level institutional environment in which a firm operates is at least as important as the firm's own characteristics in determining its debt financing decisions. Using a logit regression framework, major firm characteristics in combination explain 20 percent of the variation in firm debt placement choices. In contrast, country fixed effects alone have a pseudo R-squared of 22 percent and explain more of these debt issue choices than firm characteristics do. Regardless of firm level

[54] The sample countries are listed in in Table 1.

heterogeneity, a firm that resides in a developed country is much more likely to issue public debt than a firm that resides in a developing country, and a firm that resides in a common law country is much less likely to issue public debt than a firm that resides in a civil law country.[55]

Our analysis continues by investigating several possible channels through which country level institutional arrangements can measurably influence individual firm debt placement choice. Private lending by financial institutions is the primary source of capital for firms that have no access to public financing. Firms that bear substantial costs because of high debt agency and information asymmetry problems would find it optimal to borrow privately, either by selling private placement bonds to financial institutions or by obtaining bank loans.[56] From this perspective, bank loans and private placement bonds can act as potential substitutes. Consistent with this prediction, we find that the volume of credit provided by the banking sector is positively associated with the probability of issuing public bonds and is negatively associated with the probability of issuing privately placed bonds. Similarly, equity and publicly issued bonds are the two primary sources of public financing. It follows that a well-developed equity market could lower a corporation's likelihood of issuing public bonds. Firms that do not find it prohibitively costly to issue public bonds can nevertheless find it attractive to issue equity when the domestic equity market is well developed. Indeed, we find that a large domestic equity market is associated with a low likelihood of public debt issuance.

[55] In a related paper, Ellis et al (2011) explores the effects of global factors and a country's governance on firm investment decisions.

[56] Severe debt agency problems and information asymmetry dramatically increase the cost of issuing public debt, as argued in Galai and Masulis (1976), Jensen and Meckling (1976), Myers (1977), Leland and Pyle (1977), Diamond (1984, 1991), and Ramakrishnan and Thakor (1984), among others.

Both the strength of a country's legal protection of creditors and the quality of its law enforcement has important impacts on firm financing decisions. In countries with weak legal protection and enforcement, financial instruments that allow investors to actively monitor managers, limit manager discretion and are contractually easier to interpret, have a higher likelihood of being issued. Sufficient legal protection of debtholders is associated with less managerial self-dealing and more efficient debt renegotiation and bankruptcy procedures (La Porta et al 1997, Djankov et al 2008). This lowers the risk of investing in public debt. Thus, we expect the probability of issuing public debt to increase with the strength of a country's creditor rights protection laws and the level of their enforcement. Our empirical findings are largely supportive of this prediction. Lastly, a more transparent financial reporting system and the existence of reliable sources of credit information on individual firms play critical roles in mitigating the information asymmetry between firms and outside investors, especially for firms that borrow in international debt markets. From this perspective, we expect that greater scope, accessibility and quality of credit information to raise the likelihood of a firm issuing public debt. However, the evidence we uncover only partially supports this prediction.

We also find results that institutional arrangements in the local economy can affect firm debt financing indirectly by lowering the sensitivity of the debt issuance choice to debt agency problems exacerbated by firm idiosyncratic risk, information asymmetry, and its ex-ante bankruptcy probability. We find a firm's choice between issuing public or private bonds is less sensitive to its asset tangibility, technological intensity, and current leverage ratio if it is located in a country with strong creditor legal protections and better access to credit information.

Issuing debt in international capital markets has become a more common practice in the last decade, especially after the creation of euro and the rapid development of Eurobond market. In fact, almost 30 percent of debt issuance in our sample is placed internationally. Our evidence indicates that a firm's ability to access to international debt markets is significantly affected by an issuer's nationality as well. Firms from countries with more developed economies, better creditor protections, and investor access to higher quality creditor financial information are more likely to borrow in international debt markets. In contrast, firms from developing countries generally issue domestic debt. Investors in international debt markets are more concerned about country level institutional factors, such as the level of managerial self-dealing and systematic corruption in the society. We find that the debt issuance choices of firms from countries where such problems are more serious are more strongly affected and these firms are less likely to issue public debt in international capital markets. Instead, they tend to rely on private borrowing where investors can more closely monitor issuer managers to minimize their self-dealing behavior. Moreover, we find evidence that better access to credit information and comprehensive accounting information significantly increases a firm's probability of issuing public debt in international bond markets.

We next explore the impact of major institutional factors in the domestic economy on the cost of debt financing measured by bond yield. We find that economy-wide institutional factors not only affect overall debt financing costs for both public and private bonds, they also affect the yield spread between public and private bonds. Adding institutional factors into the yield spread regressions increases the R-squared by about 1.5 to 2 times. Higher GDP per capita, larger banking sector and equity market are

all related to lower bond yields. Better creditor rights protection and more transparent credit information also reduce debt financing costs. Moreover, we find that the yield spread between public and private bonds is significantly lower in developed countries, and it also falls with stronger creditor legal protections and better investor access to reliable credit information. Moreover, the decrease in yield spread is mainly due to the reduction in public bond yield. Possible ways for major institutional factors to affect yield spreads are by improving overall financial development and the condition of the public debt market, which is generally correlated with higher market liquidity and lower market risk.

This study is directly related to an emerging literature that explores the supply side effects of corporate financing and capital structure decisions. Schaller (2008), Greenwood et al (2008), Graham, Leary, and Roberts (2012) analyze the effect of monetary and fiscal policies on corporate capital structure through the channels of bank lending, credit conditions, and government deficit. Stohs and Mauer (1996), Baker and Wurgler (2002), Leary and Roberts (2005) test the effect of interest rate on firm capital structure decisions.

This study is also closely related to a large literature that explorers the effect of legal origins and institutional factors on economics and finance. King and Levine (1993) document the relationship between the level of financial development and economic growth. La Porta et al (1997,1998), and Djankov et al (2008) find that legal origins, legal rules and level of enforcement that protect investors and constrain managerial self-dealing, are associated with the size, breadth and depth of financial markets. Booth et al (2001) find that these institutional factors can also affect firm capital structure decisions.

Doidge et al (2007) find that laws and institutions strongly affect corporate governance. We find evidence that these domestic institutional factors affect individual firm debt financing decisions. There are three potential channels for these major institutional factors to affect corporate financing. First, the stage of development of various financial markets determines the availability of capital and accessibility of different capital markets, which is a supply-side effect that strongly influences a firm's debt financing choice and cost of financing in equilibrium. Secondly, the quality and strength of creditor legal protections determine how effectively debt contracts can be enforced when a debt covenant violation occurs. It also significantly affects the efficiency of the bankruptcy process, which directly affects investor recovery rates. These two institutional features can alter an investor's assessment of a firm's bankruptcy risk. The third channel affects the financial transparency of borrowers. The accounting standards used in reporting corporate financial information defines the level of financial transparency of domestic firms, which directly affects the level of information asymmetry and a lender's expected risk of loss.

This study contributes to the literature on corporate borrowing as well. It tests theories of firm debt financing in an international setting. Studies using US data find evidence supporting flotation cost explanations for debt financing choice (i.e. Blackwell and Kidwell 1988), debt agency cost theories developed by Galai and Masulis (1976) and Jensen and Meckling (1976), firm information asymmetry effects modeled in Leland and Pyle (1977) and Diamond (1984, 1991), and the ease of debt renegotiation explanation proposed by Chemmanur and Fulghieri (1994). We find that firm attributes capturing the various costs mentioned above significantly influence both the choice of public versus

privately placed bond issuance and the bond yield for firms outside the United States. Interestingly, firms in both developing and developed countries show largely similar patterns. The only notable difference is that debt financing choices in developing countries are more heavily influenced by firm size and its credit rating, while in developed countries debt issuance size and maturity are more important factors.

The remainder of the study is organized as follows. Section 2 describes the dataset and properties of the sample, and then reviews the main institutional features in these countries. In Section 3, we review the existing theories explaining the choice between public and private debt issuance, and hypothesized effects of major country level institutional arrangements on such choices. In section 4, we empirically examine the effects of institutional factors on the choice between public and private debt, while in Section 5 we focus on the effect of institutional factors on bond yields. In section 6, we examine the effects of market conditions (i.e. hot vs. cold issuance market) on debt placement choice and bond yields. Conclusions and implications are discussed in Section 7.

Data and Sample

Public Bonds vs. Private Placement Bonds

The two debt instruments we analyze are publicly issued and privately placed corporate bonds. Corporate bonds consist of a non-negligible share of a typical firm's

outstanding debt and provide an important source of debt financing.[57] Publicly issued and privately placed bonds are similar in terms of their basic contract structure, though they differ in the sense that privately placed bonds are offered to a limited number of sophisticated institutional investors through private negotiations, which makes contract renegotiation easier. These bonds are also subject to stricter debt covenants and direct monitoring by these sophisticated investors. This feature of private placement bonds allows us to test theories predicting a firm's debt financing choice between private and public debt, while at the same time avoiding the need to control for major differences in debt structure, due to the comparability in contract structure to public bonds.

Bank loans are another major source of capital for the majority of firms which is not explicitly examined in this study. This is due to several concerns. First, bank loans have very different debt structure and banks have much better access to information on firm financial conditions. This makes bank loans difficult to be compared to corporate bonds. Second, bank lending usually takes place between firms and banks that are geographically nearby, and rarely goes beyond national borders. Hence, the decisions to borrow and lend are less related to country level institutional arrangements than they are to firm specific factors. Corporate bonds, on the other hand, are often placed nationwide or even internationally, especially for corporations that are constrained by the small size of a domestic bond market or when large amounts of foreign capital are needed.

Data Source and Sample Construction

Information on newly issued private placements and public bonds is obtained

[57] According to the statistics published by Bank For International Settlements (BIS), at the end of 2009 , the total amounts outstanding of international corporate bond worldwide is about 3.05 trillion US dollars, and the total amounts outstanding of domestic corporate bond worldwide is 6.197 trillion US dollars.

from SDC Global New Issuances database for the years 1995-2008. All variable rate bonds, convertible bonds, and bonds with equity features, such as bonds with warrants or rights are eliminated, leaving only fixed-rate, straight bonds in our sample. All Rule 144A-private placements are also excluded because, unlike traditional private placements, Rule 144A-private placements are structured to facilitate inter-institutional trading in the secondary market and therefore they tend to resemble public offering bonds more than traditional, non-144A private bonds.[58] Bonds issued by financial companies (SIC 6000-6999) are excluded from the sample, because these bonds (such as mortgage-backed and asset-backed bonds) and their issuers tend to have more complicated capital structures with high leverage and use more complicated contract features. Accounting information on bond issuers are primarily obtained from the SDC and WorldScope databases.

A country can be included in the sample only if it has at least three private placements and three public bond offerings during the sample period. We have 26 non-US countries that meet this requirement in our sample, including 8 developing countries and 18 developed countries. Of this sample, 8 countries are common law countries, while the remainder are civil law countries. We have 16 OECD countries, and 6 of the G8 Countries, with the U.S. and Russia being the two exceptions. Geographically, there are 10 Asian countries, 11 European countries, one North American country, two South American countries, and two Oceania countries. A list of the sample countries is given in Table 1.

[58] See Fenn (2000) for a detailed description of the unique characters of 144 A private placement bonds.

Table 1 List of Sample Countries

Nation	Number of Public Bonds	Number of Private Placement	Aggregate Size of Issuer Over Equity Market Cap	Developed Country	OECD	Continent	G8	Legal Origins
Australia	43	36	11%	1	1	Pacific	0	Common
Austria	23	14	9%	1	1	Europe	0	Civil
Brazil	80	14	14%	0	0	South America	0	Civil
Canada	30	51	2%	1	1	North America	1	Common
China	17	44	2%	0	0	Asia	0	Civil
Finland	33	4	14%	1	1	Europe	0	Civil
France	341	37	47%	1	1	Europe	1	Civil
Germany	92	21	35%	1	1	Europe	1	Civil
Hong Kong	30	19	6%	1	0	Asia	0	Common
India	157	144	18%	0	0	Asia	0	Common
Indonesia	54	17	10%	0	0	Asia	0	Civil
Italy	58	5	34%	1	1	Europe	1	Civil
Japan	3825	229	37%	1	1	Asia	1	Civil
Luxembourg	19	12	8%	1	1	Europe	0	Civil
Malaysia	9	196	11%	0	0	Asia	0	Common
Netherlands	144	35	18%	1	1	Europe	0	Civil
New Zealand	5	6	7%	1	1	Pacific	0	Common
Peru	117	3	62%	0	0	South America	0	Civil
Philippines	3	28	20%	0	0	Asia	0	Civil
Singapore	46	80	6%	1	0	Asia	0	Common
South Korea	67	35	87%	1	1(After 1996)	Asia	0	Civil
Spain	27	3	14%	1	1	Europe	0	Civil
Sweden	63	14	22%	1	1	Europe	0	Civil
Switzerland	111	11	7%	1	1	Europe	0	Civil
Thailand	149	67	50%	0	0	Asia	0	Civil
United Kingdom	441	36	23%	1	1	Europe	1	Common

Table 1, continued

Nation	GDP Per Capita ($)	Domestic credit provided by bank/GDP	Market Cap/GDP	Depth of Credit Info	Accounting Standard Index
Australia	30037.22	108.47%	99.42%	5	75
Austria	32291.77	125.59%	25.06%	6	54
Brazil	8311.75	75.67%	40.74%	5	54
Canada	33481.88	183.23%	109.38%	6	74
China	5059.26	131.10%	127.56%	2	n/a
Finland	27247.8	65.06%	123.06%	5	77
France	29412.63	109.29%	75.01%	4	69
Germany	31024.78	137.50%	46.90%	6	62
Hong Kong	31911.95	140%	348.68%	4	69
India	2230.78	61.80%	51.33%	2	57
Indonesia	3127.24	50.06%	26.64%	2	n/a
Italy	28023.41	105.24%	47.31%	6	62
Japan	28982.32	297.92%	73.66%	6	65
Luxembourg	49083.33	101.04%	153.20%	n/a	n/a
Malaysia	11442.21	149.33%	149.17%	6	76
Netherlands	33242.61	152.21%	111.67%	5	64
New Zealand	23930.24	122.15%	33.93%	5	70
Peru	5932.25	20.66%	28.44%	6	38
Philippines	2873.87	60.99%	41.80%	3	65
Singapore	42174.62	81.81%	176.82%	4	78
South Korea	19540.20	89.69%	49.14%	5	62
Spain	26105.55	143.28%	88.36%	5	64
Sweden	28857.47	105.77%	109.41%	4	83
Switzerland	34610.07	176.45%	239.97%	5	68
Thailand	6679.90	134.26%	59.66%	4	64
United Kingdom	29497.33	142.52%	149.26%	6	78

Table 1, continued

Nation	Credit Rights Protection Index	Tax Evasion	Anti-Self Dealing Index	Control of Corruption	Depth of Credit Info
Australia	3	5.78	0.76	1.99	5
Austria	3	5.69	0.21	1.83	6
Brazil	1	2.89	0.27	0.0067	5
Canada	1	6.93	0.64	2.27	6
China	2	3.81	0.76	-0.183	2
Finland	1	7.38	0.45	2.39	5
France	0	4.54	0.38	1.5	4
Germany	3	4.6	0.28	1.85	6
Hong Kong	4	6	0.96	1.5	4
India	2	2.21	0.58	-0.22	2
Indonesia	3	2.73	0.65	-0.84	2
Italy	2	3.13	0.42	0.77	6
Japan	3	6.36	0.5	1.28	6
Luxembourg	n/a	7.63	0.28	1.96	n/a
Malaysia	3	6.09	0.95	0.47	6
Netherlands	3	5.84	0.21	2.27	5
New Zealand	4	7.29	0.95	2.32	5
Peru	0	n/a	0.45	-0.12	6
Philippines	1	2.03	0.21	-0.4	3
Singapore	3	8.54	1	2	4
South Korea	3	4.63	0.47	0.38	5
Spain	2	4.82	0.37	1.32	5
Sweden	1	3.97	0.33	2.35	4
Switzerland	1	6.84	0.26	2.25	5
Thailand	3	3.74	0.81	-0.25	4
United Kingdom	4	6.69	0.95	2.09	6

As reported in Table 2, there are 5984 new public bond issues in the sample, and 5398 of these issues are by firms in developed countries, while 586 of these public bond issues are by firms in developing countries. The total number of new private placement bond issues in the sample is 1158, and 645 of these bond issues are by firms from developed countries and 513 of them are by firms from developing countries. This statistics suggests that issuers from developed countries are much more likely to issue bonds publicly. Moreover, the majority of public bonds are issued by firms in civil law countries (5223 out of 5984). The number of private placement bonds is split more evenly between common law countries and civil law countries. Of course, the bond issues can differ substantially in other dimensions, which we take into account in our later multivariate analysis.

Table 2 Cross-Country Difference of Institutional Arrangements

	Full Sample	Developed Countries	Developing Countries	Common Law Countries	Civil Law Countries
Total Number of Public Issuances	6171	5562.00	609.00	827.00	5344.00
Total Number of Private Placements	1166	651.00	515.00	572.00	594.00
Average GDP Per Capita ($)	21812.45	29465.49	5549.73	25137.81	20247.57
Average Domestic credit provided by bank/GDP	1.18	1.33	0.85	1.24	1.16
Average Market Capitalization/GDP	0.99	1.14	0.66	1.40	0.82
Average Credit Rights Protection Index	2.24	2.41	1.88	3.00	1.88
Average Tax Evasion	5.21	5.93	3.36	6.19	4.74
Average Anti-Self-Dealing Index	0.54	0.52	0.59	0.85	0.41
Average Control of Corruption	1.18	1.80	-0.19	1.55	1.02
Average Depth of Credit Information	4.68	5.12	3.75	4.75	4.65
Average Accounting Standard Index	66.43	69.06	59.00	72.13	63.40

Institutional Arrangements

The size and development of a country's banking sector is measured by the ratio of domestic credit provided by the banking sector divided by GDP. Annual measures of this ratio are obtained from the WDI database. The average of the annual ratios for each country in our sample is reported in Table 1. Among the countries in our sample, Japan has the largest banking sector, with domestic bank credit representing almost three times GDP. Peru has the smallest banking sector with domestic bank credit representing only about 20% of GDP. The statistics in Table 2 shows that the banking sector is more important in developed countries than it is in developing countries (the ratio is 132.62% vs. 85.48%). It is also on average slightly larger in common law countries than in civil law countries. Hong Kong has the largest stock market, measured by total equity market capitalization over GDP (obtained from WDI database annually), and Austria has the smallest stock market capitalization. The equity market is clearly larger and more important in developed countries and in common law countries than it is in developing countries and civil law countries. Annual GDP and GDP per capita (both measured in year 2000 US dollars) are obtained from the WDI database as well.

The extent to which creditors have legal protection is measured by the Creditor Rights Index constructed by La Porta et al (1998). This index summarizes the legal rules that "cover the respect for the security of a loan contract, the ability of a lender to take possession of assets in a loan default, and the ability of management to seek protection from creditors unilaterally".[59] The index ranges from zero (weak protection) to four (strong protection), and is constructed in year 1995. In robust regressions, we also use the same index constructed in year 2000. Common law countries have better creditor rights

[59] Refer to La Porta et al (1998)

protection, with an average index score of 3, while civil law countries have relatively weak creditor rights protection, reflected in an average score of 1.88.

We measure the strength of law enforcement by looking at control over managerial self-dealing, control of corruption, and prevalence of tax evasion. The anti-self-dealing index (Djankov et al 2008) is a numerical measure of the intensity of public and private enforcement of regulations on managerial self-dealing. Higher scores indicate stronger enforcement. Common law countries in the sample on average have significantly higher scores than civil law countries. The extent to which public power is exercised to gain private benefit (corruption) is negatively associated with a country's legal enforcement. A country with better enforcement of its laws and regulations generally has a better control of corruption. We obtain the control of corruption index from Worldwide Governance Indicators. This index ranges from -0.84 to 2.39 in our sample, where a larger score represents stronger legal enforcement. This index is constructed biannually before 2002 and annually after 2002. On average, developed countries and common law countries have better control over corruption, based on the statistics in Table 2. The frequency of tax evasion is a measure of the enforcement of tax laws, which is correlated with corporate self-dealing. We include the tax evasion index of the World Economic Forum as the third measure of a country's legal enforcement level. This index ranges from 2.03 to 8.54 in our sample, and a higher score indicates higher tax evasion and weaker tax law enforcement. Based on this index, tax evasion seems to be more prevalent in developed countries.

The World Bank Development Indicator (WDI) provides an index which measures the rules affecting the scope, accessibility, and the quality of credit information

available through public and private credit registries. Based on this index, Peru, Malaysia, Italy, Japan, Austria, Germany, UK, and Canada have good quality credit information, while the accessibility and quality of credit information is low in Indonesia, India and China. We also use the Accounting Standard Index of La Porta et al (1998) to measure the quality and comprehensiveness of financial information for each sample country. This index is created by examining and rating companies' 1990 annual reports on their inclusion or omission of 90 financial items. A high score indicates a high accounting standard.

Bond and Issuer Characteristics

Table 3 exhibits the major characteristics of public and private placement bonds. Public bonds differ significantly from private placement bonds in that they generally have larger total proceeds, longer term to maturity, and lower yield to maturity. The average issue size is $265.59 million and $104.28 million for public and private bonds respectively, all measured in $US dollars. Average term to maturity is 85.47 months for public bonds, and 60.94 months for private placements. The yield to maturity at issuance averages 3.34% for public bonds and 5.22% for private bonds. In terms of bond seniority, most of public and private placement bonds are classified as senior debt claims. In contrast to the typical U.S. corporate bond issues, we find that bonds issued in our sample countries rarely have call provisions.

Issuers vary substantially across the two types of bonds. Public bonds issuers are much larger than private bond issuers: the average (median) firm total assets value is $22,694 ($10,816) million for public bond issuers, compared to $8,791 ($1,033) million

for private bond issuers, all measured in 2002 US dollars. In terms of credit ratings, almost all the bonds included in our sample have investment grade ratings.13% of public issuers are classified as high-tech firms, compared to 10% of private issuers on average. Public bond issuers also have a higher level of tangible assets. The leverage ratio is similar across the two groups. The univariate statistics in Table 3 indicate that large issuances are more likely to be placed publicly, and that larger firms and firms with debt having lower default risk tend to issue public debt more frequently.

Table 3 Summary Statistics of Bond Issuances and Firm Characteristics

Panel A Full Sample

	Public Bond			Private Placement Bonds		
	Mean	Median	N	Mean	Median	N
Proceeds($ millions)	265.59	127.5	5981	104.28	31.6	1158
Maturity (months)	85.47	72	5984	60.94	60	1158
Yield to Maturity at Issuance Date	3.34%	2.36%	5882	5.22%	4.80%	1117
% of Callable Bonds	0.23%		5984	0.00%		1158
% of Senior Bonds	99.80%		5984	99.91%		1158
Firm Total Assets($ millions)	22649.34	10816.9	5515	8791.66	1033.9	939
Firm Leverage	0.45	0.44	4910	0.46	0.43	723
% of Issuers with Investment Rating	99%		5984	98%		1158
% of High Tech Firms	13%		5984	10%		1158
Industry Tangibility	0.48	0.42	5510	0.44	0.42	963

Panel B Developed Countries

	Public Bond			Private Placement Bonds		
	Mean	Median	N	Mean	Median	N
Proceeds($ millions)	282.6	140.7	5395	108.9	26.6	645
Maturity (months)	88.4	73	5398	58.7	60	645
Yield to Maturity at Issuance Date	2.84%	2.2	5367	3.46%	3.11%	616
Firm Total Assets($ millions)	24569.34	12114.4	5019	14096.86	3663.9	489
Firm Leverage	0.46	0.44	4549	0.43	0.42	392
% of Issuers with Investment Rating	99%		5398	97%		645
% of High Tech Firms	13%		5398	12%		645
Industry Tangibility	0.47	0.41	5043	0.41	0.36	510

Panel C Developing Countries

	Public Bond			Private Placement Bonds		
	Mean	Median	N	Mean	Median	N
Proceeds($ millions)	109	43.8	586	98.54	39	513
Maturity (months)	58.4	60	586	63.67	60	513
Yield to Maturity at Issuance Date	8.37%	8%	515	7.38%	6.80%	501
Firm Total Assets($ millions)	3221.04	1044.25	496	3026.67	551.8	450
Firm Leverage	0.43	0.42	361	0.49	0.45	331
% of Issuers with Investment Rating	97%		586	99%		513
% of High Tech Firms	13%		586	8%		513
Industry Tangibility	0.51	0.54	467	0.47	0.47	453

Panel D Common Law Countries

	Public Bond			Private Placement Bonds		
	Mean	Median	N	Mean	Median	N
Proceeds($ millions)	408.25	198.5	761	74.31	27.6	565
Maturity (months)	96.72	72	761	58.74	60	565
Yield to Maturity at Issuance Date	6.24%	6.1	743	5.99%	5.92%	547
Firm Total Assets($ millions)	17195.24	5864.65	540	3299.16	594.4	476
Firm Leverage	0.41	0.38	392	0.48	0.44	325
% of Issuers with Investment Rating	97%		761	99%		565
% of High Tech Firms	15%		761	5%		565
Industry Tangibility	0.51	0.53	678	0.48	0.51	463

Panel E Civil Law Countries

	Public Bond			Private Placement Bonds		
	Mean	Median	N	Mean	Median	N
Proceeds($ millions)	244.8	124.4	5220	132.84	41	593
Maturity (months)	83.83	72	5223	63.04	60	593
Yield to Maturity at Issuance Date	2.91%	2%	5140	4.48%	3.60%	571
Firm Total Assets($ millions)	23241.35	11263.8	4975	14438.37	3594	463
Firm Leverage	0.46	0.45	4518	0.44	0.42	398
% of Issuers with Investment Rating	99%		5223	96%		593
% of High Tech Firms	13%		5223	15%		593
Industry Tangibility	0.47	0.41	4832	0.39	0.35	500

Hypothesis Development and Brief Literature Review

Firm Characteristics and the Choice between Public and Private Debt

Theoretical literature on firm financing decisions predicts that several factors can influence a firm's choice between public and private debt issuance. Public issuance of debt securities typically involves higher flotation costs, which include investment banking fees, attorney fees, SEC filing fees, and other transaction costs. Private placement debt is generally free of securities filing fees. Blackwell and Kidwell (1988) provide evidence that public debt issues have a larger fixed cost than private issues and that private issues are relatively more cost effective for small firms and firms undertaking small debt offerings.

The prevalence of debt agency problems also heavily influences a firm's debt financing choice. Galai and Masulis (1976) and Jensen and Meckling (1976) point out that managers whose interests are aligned with shareholders have greater incentives to take on riskier projects and substitute riskier assets for existing lower risk assets, often termed an asset substitution problem. Galai and Masulis (1976) and Myers (1977) explore a second type of debt agency problem regarding manager incentives to forgo some low risk, positive NPV projects, leading to an underinvestment problem. Firms suffering from high contracting costs associated with these two debt agency problems are more likely to issue debt privately, because private debtholders can lower these agency costs by imposing strict debt covenants and are better able to closely monitor their enforcement.

Leland and Pyle (1977), Diamond (1984, 1991), and Ramakrishnan and Thakor (1984) emphasize information production by private lenders. These theories argue that lenders in private debt markets have information advantages over public lenders: first, because they typically have periodic access to proprietary firm information when the debt is up for renewal; and second, they also have superior skills over public debtholders in terms of evaluating firm specific information. Firms facing larger manager-investor information asymmetry tend to have poor access to public debt markets when the costs of information asymmetry are high. Hence, these firms tend to borrow privately. The last benefit of private debt is its flexibility in renegotiating contract terms. Chemmanur and Fulghieri (1994) predict that access to debt financing is a function of both a borrower's probability of default and a lender's ability to efficiently renegotiate or else force a speedy liquidation. It follows that it is optimal for borrowers with a higher ex-ante probability of financial distress to borrow privately.

Prior empirical research tests the above theoretical predictions primarily using US data, and finds the evidence is largely supportive of the theories. Krishnaswami, Spindt, and Subramaniam (1999) find firm size and average debt issue size are negatively correlated with the ratio of private debt over total debt outstanding. Both Krishnaswami et al. (1999) and Houston and James (1996) find evidence consistent with the debt agency problems and information asymmetry hypotheses: specifically, they find that firms with high growth opportunities are more likely to issue private debt. Hadlock and James (2002) and Denis and Mihov (2003) find that risky firms and firms with low credit ratings tend to borrow privately.

An important and as yet unanswered question is whether these theories have support using international data and whether the identified factors have similar explanatory power in predicting financing choice for firms headquartered outside the US. To the extent that a similar set of fundamental economic factors drives firm decisions, we expect to find that firm level characteristics, which affect debt financing choices of US firms also play significant roles in non-US firms. The second important questions is whether the factors affect firm decisions in a similar way across countries with fundamentally different institutional features, such as countries in different development stage and countries with different legal origins. By including a large number of countries in our sample, we are able to investigate these questions.

Institutional Arrangements and the Choice between Public And Private Debt

Economic agents, such as firms, investors, and financial institutions, are shaped by the institutional environment they face. This section discusses the potential impacts of institutional differences across countries on how firms are financed. In particular, we focus on institutional variables that reflect (1) the development of key financial markets, (2) the legal protection of creditors and the ability of creditors to enforce legal contracts, and (3) the transparency and comprehensiveness of firm financial statements and credit information.

Firm debt financing choice reflects the interplay of a firm's demand for capital and outside investors' security preferences. Holding firms demand constant, the supply side factors can significantly alter a firm's choice between different financing instruments. For example, in countries where the banking sector is dominant, the market for private

placement bonds may be very undeveloped or even non-existent. In this situation, bank loans may be the first choice of firms seeking private financing. To some extent, bank loans and private placement bonds can represent substitutes. Thus, the amount of banking credit available to the private sector could lower a firm's likelihood of issuing private placement bonds. Similarly, when the stock market is highly developed, more firms are likely to have access to the public capital markets, potentially at relatively low costs, which can raise their likelihood of issuing equity rather than bonds. Therefore, firms in general are less likely to issue public bonds in countries with large domestic equity markets.

Jensen and Meckling (1976) argue that firm can be viewed as a nexus of a set of contracting relationships among firm stakeholders. To mitigate the inherent conflicts of interests among these different stakeholders, explicit and implicit contracts are used. As argued by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) and a large literature hereafter, the effectiveness of these contracts in controlling stakeholder conflicts of interests largely depends on the external quality and strength of the legal system. Fan, Titman, and Twite (2012) report that firms tend to rely on financial instruments that limit managerial discretion in countries with weak laws and enforcement of creditor rights. When there are strong laws and enforcement, monitoring by private lenders becomes less common. Therefore, the external legal protection of creditors acts as a substitute for close monitoring of a firm by private lenders.

When the legal protection of creditors is strong and can be credibly enforced, bankruptcy proceedings triggered by covenant violations tend to be more efficient and creditors expect a higher recovery rate, which substantially lowers the risks associated

with lending. Consequently, close monitoring and flexible renegotiation available in a private lending relationship is less attractive in these countries compared to countries with weak creditor protection. Everything else equal, this suggests a higher probability of issuing public bonds when firms operating in countries with stronger legal protections of creditors. Beyond the formal legal protection for creditors, the integrity and enforceability of these laws is also critical. Firms are more likely to issue bond publicly when the legal protections of creditors are strongly enforced.

The last dimension of the institutional arrangements affecting creditors that we examine is the availability of transparent firm financial information and credit information. Such information helps to resolve the information asymmetry problem between a firm and its outside investors, which lowers the costs of adverse selection and moral hazard that are made more serious as information asymmetry rises. Therefore, we expect to see firms issue public bonds more frequently when their financial reporting standards are high and the quality of credit information available to investors is good.

Regression Analysis

The Effects of Firm Characteristics

The first question we explore is whether the determinants of debt financing choice documented in US studies are also relevant in explaining this choice outside the US, and if they are relevant, whether they affect non-US firms in the same way they affect US

firms. We estimate a firm's choice between public and private placement bonds using a logit model.

The results of the logit estimation are reported in Table 4. Columns 1 and 2 report regression estimates using the full sample. Column 1 includes only firm and issuance characteristics, while column 2 also takes into account the effect of global business cycles by including year fixed effects. Large bond issues[60] and those with longer maturities are more likely to be placed publicly. Large firms are generally regarded as having fewer debt agency problems (Smith and Warner 1979), and they also have less information asymmetry due to extensively public scrutiny. Consistent with this argument, we find firm size has a significant positive association with a firm's probability of issuing public bonds. High tech firms tend to have greater growth opportunities than other manufacturing firms and we find they are less likely to issue public bonds, supporting the debt agency problem hypothesis.[61] Firms with investment grade ratings are more likely to issue public bonds than non-investment grade firms. Firm leverage is negatively associated with the probability of issuing public bonds. Industry tangibility does not affect debt placement decisions in any significant way.[62] Bonds issued internationally are more likely to be privately placed than domestic issues, as shown in column 9. The full-sample regressions suggest that the theories that explain firms financing decisions also apply internationally and that the key firm specific factors affecting US firm financing choices also drive firm financing choices outside the US.

[60] As a robustness check, we include the squared term of log (proceeds) in column 9. It does not have a statistically significant effect on the choice between public and private bond issuance.
[61] In robustness test, I use market to book ratio as another proxy for a firm's growth opportunities. This variable is missing fairly frequently, which reduces my sample size.
[62] Due to data limitation, we use industry median tangibility ratio rather than individual firm's tangibility ratio, in order to preserve our sample size.

Table 4 Logit Regression: Firm Characteristics and Choice between Public and Private Bonds

Dependent variable=1 if firm issues a public bond								
	Model 1		Model 2		Model 3		Model 4	
	All Countries		All Countries		Developing Countries		Developed Countries	
Log (Proceeds)	0.72	***	0.85	***	-0.06		1.74	***
	(0.05)		(0.057)		(0.10)		(0.08)	
(Log Proceeds)^2								
Log (Term to Maturity)	0.22	*	0.16	*	-0.26	*	0.28	**
	(0.09)		(0.09)		(0.14)		(0.13)	
Investment Grade Rating	1.62	***	1.66	***	0.47	**	4.43	***
	(0.41)		(0.44)		(0.20)		(0.56)	
High Tech Indicator	-0.37	***	-0.51	***	0.21		-1.11	***
	(0.14)		(0.14)		(0.27)		(0.21)	
Log (Book Assets)	0.34	***	0.31	***	0.28	***	-0.09	*
	(0.04)		(0.03)		(0.08)		(0.05)	
Firm Leverage	-0.42	*	-0.7	***	-1.07	**	-0.09	
	(0.24)		(0.25)		(0.47)		(0.41)	
Industry Tangibility	-0.12		0.16		0.52		0.18	
	(0.23)		(0.24)		(0.43)		(0.37)	
International Issue Indicator								
Constant	-6.3	***	-6.29	***	-1.06		-9.53	***
	(0.57)		(0.61)		(20.87)		(0.87)	
Year Fixed Effects	No		Yes		Yes		Yes`	
Number of Observations	5333		5333		624		4709	
Pseudo R-Squared	0.17		0.2		0.15		0.2	

Table 4, continued

Dependent variable=1 if firm issues a public bond										
	Model 5		Model 6		Model 7		Model 8		Model 9	
	Common Law Countries		Civil Law Countries		All Countries w/o Japan		Japan		All Countries	
Log (Proceeds)	0.55	***	1.18	***	0.41	***	3.44	***	0.94	***
	(0.11)		(0.07)		(0.06)		(0.22)		(0.20)	
(Log Proceeds)^2									-0.01	
									(0.02)	
Log (Term to Maturity)	0.09		0.16		0.06		0.1		0.21	**
	(0.15)		(0.13)		(0.10)		(0.34)		(0.09)	
Investment Grade Rating	-0.53		3	***	0.88	***	-5.21		1.6	***
	(0.74)		(0.56)		(0.14)		(10.75)		(0.41)	
High Tech Indicator	-0.53		-0.73	***	-0.23		-0.57		-0.49	***
	(0.32)		(0.17)		(0.18)		(0.42)		(0.15)	
Log (Book Assets)	0.49	***	0.04		0.23	***	-0.36	***	0.49	***
	(0.08)		(0.04)		(0.05)		(0.10)		(0.03)	
Firm Leverage	0.34		-1.07	***	-0.71	**	-1.58	*	-0.87	***
	(0.50)		(0.34)		(0.31)		(0.90)		(0.26)	
Industry Tangibility	-0.41		0.73	**	-0.35		2.89	***	-0.09	
	(0.49)		(0.30)		(0.29)		(0.89)		(0.24)	
International Issue Indicator									-2.46	***
									(0.14)	
Constant	-5.82	***	-6.32	***	-2.76	***	-2.55	***	-5.32	***
	(1.14)		(0.79)		(0.60)		(10.75)		(0.74)	
Year Fixed Effects	Yes		Yes		Yes		Yes		Yes	
Number of Observations	691		4643		1594		3739		5333	
Pseudo R-Squared	0.38		0.15		0.22		0.26		0.25	

Columns 3 and 4 of Table 4 report estimates for subsamples of developing and developed countries, respectively. Some interesting patterns are uncovered when comparing the estimates across the two subgroups. First, firm characteristics are more important than bond issue characteristics in developing countries. To be more specific, firm size plays a much more important role. Variables that capture a firm's risk profile, namely its credit rating and current leverage ratio are both significant in column 3, riskier

firms are less likely to issue bond publicly. The issue size does not significantly affect a firm's choice. Term to maturity is negatively related to the likelihood of issuing publicly, although its effect is barely significant. Second, the contracting terms of a bond, such as its size and maturity, are clearly more important factors in developed countries than they are in developing countries, suggesting that flotation costs are a major driver of a firm's debt choice in developed countries. Third, firm size has a much larger effect in developing countries, in that larger firms are much more likely to issue public bonds. Surprisingly, firm size has a marginally significant negative relation with public bond issuance in developed countries. Columns 5 and 6 examine subsamples of common law and civil law countries, respectively. We find that firm size lowers a firm's likelihood of issuing public bonds primarily in civil law countries.

Japanese firms account for a large part of our sample. To insure that our results are not heavily influence by a single country, we re-estimate the logit model using the full sample, excluding Japanese firms. The results are shown in Column 7 of Table 4 and they are qualitatively the same as the full sample regression in Column 2. A regression using only Japanese firms suggest that the negative effect of firm size in developed countries and civil law countries reported in prior regressions may be due to the effect of bonds issued by Japanese firms. In column 8, we find that firm size significantly reduces Japanese firms' probability of issuing public bonds. After dropping Japan from the sample, the negative coefficients of firm size in columns 4 and 6 become positive. However, the cause for why firm size is negatively correlated with public bond issuance in Japan remains a puzzle.

Table 5 Logit Regression: Institutions and Choice between Public and Private Bonds

Dependent variable=1 if firm issues a public bond				
	Model 1	Model 2	Model 3	Model 4
Developed Country Indicator			1.87 ***	
			(0.07)	
Common Law Indicator				-1.81 ***
				(0.07)
Log (GDP Per Capita)				
Development of Banking Sector				
Development of Stock Market				
Creditor Rights Protection				
Anti-Self-Dealing Index				
Control of Corruption				
Tax Evasion				
Depth of Credit Information				
Accounting Standard				
Constant			0.29 ***	2.22 ***
			(0.06)	(0.04)
Country Fixed Effects	Yes	Yes	No	No
Year Fixed Effects	No	Yes	Yes	Yes
Number of Observations	7142	7142	7142	7142
Pseudo R-Squared	0.23	0.24	0.11	0.11

Table 5, continued

Dependent variable=1 if firm issues a public bond						
	Model 5		Model 6		Model 7	
Developed Country Indicator						
Common Law Indicator						
Log (GDP Per Capita)	0.56	***	1.05	***	0.89	***
	(0.04)		(0.09)		(0.05)	
Development of Banking Sector	0.27	**	0.59	***	0.21	***
	(0.05)		(0.09)		(0.06)	
Development of Stock Market	-0.89	***	-0.12		-0.35	***
	(0.07)		(0.08)		(0.08)	
Creditor Rights Protection			0.26	***		
			(0.058)			
Anti-Self-Dealing Index			0.04			
			(0.32)			
Control of Corruption			0.36	**		
			(0.12)			
Tax Evasion			-0.91	***		
			(0.08)			
Depth of Credit Information					-0.17	***
					(0.05)	
Accounting Standard					-8.73	***
					(0.65)	
Constant	-3.42	***	-5.54	***	-0.27	
	(0.29)		(0.70)		(0.38)	
Country Fixed Effects	No		No		No	
Year Fixed Effects	Yes		Yes		Yes	
Number of Observations	7067		6947		6935	
Pseudo R-Squared	0.14		0.18		0.16	

The Effects of Institutions

Table 5 shows the effect of country level institutional arrangements on the financing choices of domestic firms. Country level fixed effects alone explain 23% of the variation in firms' bond issuance choices. A logit model based on issue and firm characteristics has a pseudo R-squared of 17%. Comparing columns 1 and 2 of Tables 4

and 5, we conclude that country level factors are at least as important as firm level factors in determining the choice between public and private bond issuance.

The remainder of this section explores the key institutional factors that potentially affect firm financing decisions and how they affect individual firms at the microeconomic level. The stage of economic development in a country certainly affects its firms financing decisions: we find that firms in developed countries are more likely to access the public bond market. Examining regression 3 of Table 5, we see that the developed economy indicator alone explains 11% of the cross-sectional variation in firm debt financing choices. Firms located in countries with high GDP per capita are more likely to issue public bonds. Model 4 tests the effect of legal origins. Given that common law countries have better investor protection than civil law countries (LLSV 1998 and LLSV2002), we expect firms in common law countries to issue public bonds more frequently than firms in civil laws countries, based on the argument in section 3.2. However, we find that the common law origin indicator is negative and statistically significant at one percent level. This result, on the surface, seems to contradict the prediction that better investor protection encourages public financing. However, given that legal origins affect a variety of legal and economic aspects of a country, it is premature to interpret this result as strong evidence against this prediction. To test this prediction more rigorously, we examine the specific legal rules that are directly relevant to creditor protection when we reexamine the relationship between creditor protection and firm financing decisions later in this section.

The development of other financial markets clearly affects the bond issuance behavior of firms. We find that in countries with large and powerful banking sectors,

firms are less likely to tap the private placement bond market.[63] We also find that the larger the size of the stock market, the lower firm's frequency of issuing public bonds. The results are consistent with our predictions that bank loans act as potential substitutes for private placement bonds, while public equity acts as a partial substitute for a public bond issues.

In column 6 of Table 5, we test the effect of creditor protection and legal enforcement on individual firm financing decisions. The result suggests that stronger statutory creditor protection, measured by the creditor rights protection index, significantly increases a firm's likelihood of issuing in the public bond market. Furthermore, if a country has strong public and private enforcement of anti-corporate-self-dealing laws, its firms have a higher likelihood of issuing debt publicly. This prediction follows because the agency cost of debt financing arising from managerial self-serving behavior is likely to be low. Thus, investors in these countries find it less risky to invest in public bonds than investors in countries with a high risk of managerial self-dealing. Therefore, firms have greater access to public bond market because of the relatively low agency costs associated with public bonds. Similarly, firms in countries with better control over corruption issue public bonds more frequently. Lastly, weak legal enforcement, measured by the prevalence of tax evasion, lowers a firm's likelihood of issuing bonds publicly.

The effects of credit information availability and higher quality accounting standards are tested in column 7 of Table 5. Surprisingly, better access to credit

[63] The size of banking sector is measured by the ratio of domestic credits provided by the banking sector divided by GDP, on a 0-1 scale.

information and a more comprehensive financial reporting system tends to lower the frequency of firms issuing public bonds. This result contradicts the prediction that a better information system lowers information asymmetry between the firm and outside investors and hence increases a firm's access to the public bond market.

Table 6 tests the relative importance of firm characteristics and institutional factors in explaining firm debt financing choice by pooling these explanatory variables together. Model 1 of Table 6 is a regression that includes all firm and country level factors and has a pseudo R-squared of 0.32. The results concerning associations of debt financing decisions and firm characteristics still hold. Beyond these firm characteristics, country level institutional arrangements continue to have significant associations with individual firm bond issuance decisions.

Table 6 Logit Regression: Interaction of Institutions and Firm Characteristics

	Dependent variable=1 if firm issues a public bond					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm Characteristics						
Log (Proceeds)	1.59 ***	1.12 ***	1.11 ***	1.09 ***	1.12 ***	1.1 ***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Log (Term to Maturity)	-0.22	-0.07	-0.19	-0.07	-0.11	-0.07
	(0.20)	(0.10)	(0.12)	(0.10)	(0.10)	(0.09)
Investment Grade Rating	1.57 ***	1.18 **	1.34 ***	1.33 ***	1.69 ***	1.33 ***
	(0.49)	(0.50)	(0.50)	(0.50)	(0.51)	(0.50)
High Tech Indicator	-0.78 ***	-0.37 **	-0.41 **	-0.6	-2.07 *	-0.34 **
	(0.19)	(0.16)	(0.16)	(0.43)	(0.46)	(0.16)
Log (Book Assets)	0.19 ***	-0.02	-0.05	-0.02	-0.04	-0.02
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Firm Leverage	-0.58 **	-0.49 *	-0.7 **	-0.51 *	-0.65 **	-1.86 *
	(0.34)	(0.28)	(0.28)	(0.28)	(0.28)	(0.97)
Industry Tangibility	1.11 ***	3.31 ***	3.1 ***	0.9 ***	1.06 ***	0.88 ***
	(0.03)	(0.80)	(0.83)	(0.27)	(0.28)	(0.27)
Institutional Arrangements						
Log (GDP Per Capita)	0.91 ***	0.71 ***	0.61 ***	0.69 ***	0.58 **	0.68 ***
	(0.24)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Development of Banking Sector	1.79 ***	0.38 ***	0.11	0.39 ***	0.08	0.41 ***
	(0.21)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)
Development of Stock Market	-0.14	1.22 ***	-0.89 ***	-1.25 ***	-0.89 ***	-1.23 ***
	(0.17)	(0.13)	(0.14)	(0.13)	(0.13)	(0.13)
Creditor Rights Protection	0.09	-0.03		-0.53 ***		-0.69 ***
	(0.17)	(0.16)		(0.08)		(0.14)
Anti-Self-Dealing Index	2.56 **		-1.44 **		-3.64 ***	
	(1.07)		(0.77)		(0.36)	
Control of Corruption	1.38 ***					
	(0.33)					

Table 6, continued

Tax Evasion	-0.81	***										
	(0.14)											
Depth of Credit Information	-0.92	***										
	(0.14)											
Accounting Standard	-13.35	***										
	(2.77)											
Interaction Terms												
Industry Tangibility*Creditor Rights Protection			-0.87	*								
			(0.27)									
Industry Tangibility* Anti Self-Dealing Index					-3.31	***						
					(1.20)							
High Tech Indicator * Creditor Rights Protection							0.09					
							(0.15)					
High Tech Indicator* Anti Self-Dealing Index									2.87	***		
									(0.79)			
Firm Leverage*Creditor Rights Protection											0.47	
											(0.35)	
Firm Leverage*Depth of Credit Information												
Constant	-0.8		-6.04	***	-7.72	***	-8.79	***	-6.37	***	-8.26	***
	(2.48)		(1.06)		(1.01)		(0.87)		(0.93)		(0.96)	
Year Fixed Effects	Yes		Yes		Yes		Yes		Yes		Yes	
Number of Observations	5131		5299		5299		5299		5299		5299	
Pseudo R-Squared	0.32		0.26		0.27		0.26		0.27		0.27	

Firms that face high costs associated with debt agency problems tend to have poorer access to public bond markets, and they are the firms that appear to benefit most from stronger legal protections of creditor rights. A firm's choice between public and private bond is less sensitive to its proportion of tangible assets versus embedded growth options, when it resides in a country with stronger creditor protection laws and when the law can be effectively enforced. As reported in columns 2 and 3 of Table 6, the interaction terms of industry tangibility with creditor rights protection and the anti-self-dealing index are negative and significant, suggesting that firms with fewer tangible assets are more adversely affected by weaker legal protections of creditor rights in terms of their propensity to issue public debt. In contrast, the interaction of the high-tech indictor with creditor rights protection and the anti-self-dealing index are positive and significant, suggesting that high-tech firms have better access to the public bond market when creditors have better legal protections. This is consistent with the argument that when managerial self-dealing behavior is tightly constrained by law, closer monitoring of firms by creditors is less critical.

International Bond Issues

With increasing integration of global financial markets, more firms are choosing to issue debt internationally, especially after the creation of euro in 1999.[64] The percentage of bonds issued internationally before and after 1999 is 25% and 29%, respectively. Panel A of Table 7 shows the prevalence and distribution of international bonds. Of the 7142 bond issues in the sample, 26.30% of them (N=1878) are issued outside their own country, and the remaining 73.70% are issued domestically. Of the

[64] Most international issued bonds are either US dollar denominated or euro denominated.

international bonds, 76.20% (N=1431) are public bonds, which is a lower proportion than the 86.49% of domestic debt issues that are public bonds. Firms from developed countries issue substantially more international bonds, and they account for 1802 of the 1878 international issuances in the sample. In terms of a firm's choice between international bonds and domestic bonds, firms from developed countries are much more likely to issue international bonds than are firms from developing countries. The ratio of international bond issues to domestic bond issues is 1 over 2.35 for developed countries and 1 over 13.46 for developing countries. Similarly, international bond issues of firms located in common law countries also appear more attractive to investors than bond issues of firms located in civil law countries. The ratio of international bond issues over domestic bond issues is 1 over 3.72 for civil law countries and 1 over 1.05 for common law countries. The ratio of international bond issues over domestic bond issues rises to 3.27 over 1 if we focus on common law countries that have well developed economies.

Table 7 Panel A: Descriptive Statistics of Internationally Issued Bonds

Domestic Bonds N= 5264 73.70%		International Bonds N=1878 26.30%	
Public Bonds	Private Placement	Public Bonds	Private Placement
4553	711	1431	447
86.49%	13.51%	76.20%	23.80%

	Developed Countries	Developing Countries	Common Law Countries	Civil Law Countries
Domestic Bonds	4241	1023	680	4584
	70.18%	93.08%	51.28%	78.82%
International Bonds	1802	76	646	1232
	29.82%	6.92%	48.72%	21.18%

The statistics in last paragraph indicates that a country's institutional characteristics largely affect domestic firm access to the international debt market, and this conclusion is further supported by multivariate regression estimates. A logit model estimating a firm's likelihood of issuing international bonds is reported in Column 1 of Table 7. We find that firms in more developed countries, measured by GDP per capita, are more likely to issue debt internationally. If a country has a large domestic debt market, measured by the size of its banking sector, then its firms are less likely to sell bonds in the international debt market. On the other hand, a well-developed domestic equity market increases a firm's likelihood of borrowing internationally. Furthermore, we find that country level indices of creditor rights protection, anti-self-dealing and control of corruption also have a significant positive association with the probability of a firm issuing bonds internationally. A high prevalence of tax evasion significantly lowers a firm's probability of issuing bonds internationally. Access to reliable credit information has a significant positive association with the probability of international bond issuance.

We test the choice between public issuance and private placement for the subsample of internationally issued bonds in model 2 and model 3 of Table 7. In contrast to the regression estimates in the full sample, we find that a larger banking sector is associated with a lower probability of issuing public bonds internationally. Moreover, the effects of legal constraints on managerial self-dealing and control of corruption are statistically significant in the subsample of international bonds. Consistent with the predicted effect of the quality of financial accounting information, we find that better access to accounting information largely increases a firm's probability of issuing public bonds internationally. Compared with the results in model 7 of Table 5 where the effects

of having reliable firm credit information and financial accounting information are both negative, the evidence in Table 7 suggests that access to reliable financial accounting information is given much more weight by foreign investors than by domestic investors. Our evidence suggests that country level factors are more important in determining firm issuance choice between public and private debt when firms are tapping the international bond market. Because institutional characteristics represent a different set of risk factors, independent of firm level risk factors, investors are more concerned with risks arising from country-specific institutional characteristics when they invest in foreign companies.

Table 7 Panel B Likelihood of Issuing International Bonds

Dependent variable =1 if firm issues an international bond			
	Model 1	Model 2	Model 3
Log (GDP Per Capita)	1.83 ***	0.63 ***	0.53 ***
	(0.15)	(0.18)	(0.14)
Development of Banking Sector	-2.51 ***	-0.96 ***	-1.31 ***
	(0.13)	(0.15)	(0.13)
Development of Stock Market	0.69 ***	-0.01	-0.1
	(0.10)	(0.15)	(-0.12)
Creditor Rights Protection	0.26 ***	0.13 **	
	(0.07)	(0.06)	
Anti-Self-Dealing Index	3.82 ***	2.01 ***	
	(0.61)	(0.38)	
Control of Corruption	2.09 ***	0.72 ***	
	(0.20)	(0.19)	
Tax Evasion	-2.07 ***	-0.66 ***	
	(0.10)	(0.13)	
Depth of Credit Information	1.43 ***		0.04 *
	(0.10)		(0.02)
Accounting Standard	-7.31 ***		4.38 ***
	(2.28)		(1.16)
Constant	-11.11 ***	-2.41 *	-5.08 ***
	(1.73)	(1.48)	(1.23)
Year Fixed Effects	Yes	Yes	Yes
Number of Observations	6418	1761	1757
Pseudo R-Squared	0.47	0.18	0.16

Institutions and Bond Yield

In this section, we explore how key institutional factors can affect bond yields, an implicit channel through which they affect a firm's choice between private debt market and public debt market. In particular, we study the yield spread between public bonds and private placement bonds at the date of issuance, and examine the effect of key institutional factors on the yield spread. Private placement bonds usually have a higher yield than similar public offering bonds, and the differentials capture a liquidity premium and the additional premium private lenders require to compensate them for the costs of closely monitoring borrowers (Carey et al 1994). We expect institutional factors to have a larger impact on public bond yields by affecting bond market conditions, including the size and development of public corporate bond market, the overall market risk, public bond market liquidity and even the existence of an active secondary corporate bond market. The yield on private placement bonds is largely determined by the private negotiation between the lenders and borrowers, and hence, is less likely to be strongly affected by institutional arrangements.

Consistent with the prior studies using US corporate bond data, in Table 3 we find that public bonds on average have lower yields than private bonds (3.34% vs. 5.22%). Next we compare the bond yields in developed and developing countries. In developed countries, both the mean and median yield of public bonds is lower than that of private placement bonds. However, we find the exact opposite results in developing countries. Public bonds are on average more expensive than private placement bonds, in terms of bond yield, and for the median bonds, the yield spread of public bond over private bond can be as large as 1.2%. Moreover, we notice private bond issuers and public bond

issuers are of similar size in developing countries, whereas in developed countries private bond issuers are much smaller than public bond issuers. The term to maturity and issue size of public bonds are comparable to that of private placement bonds in developing countries. These results are starkly different from the earlier findings for US firms that private placement bonds are generally issued by very small firms and with small total proceeds, at higher yields and much shorter maturities. We compare bond characteristics across common law and civil law countries as well. In common law countries, the mean and median yield of public bonds is slightly higher than that for private placement bonds. The maturity of public bonds on average is much longer than private placement bonds. In civil law countries, both mean and median yield is lower for public bonds than for private placement bonds, and public bonds also tend to have longer maturities and larger issuance size.

We test the effects of key institutional arrangements on the yield spread of public bond over private placement bond in multivariate regression framework. Firms are not randomly assigned to issue bonds publicly or privately. Instead, they make this decision based on the particular circumstances they are facing and their own unique characteristics. Thus, the institutional factors that affect their issuance decisions can well affect the yields of their bond issues. Recognizing this, we adjust the OLS regressions on bond yield for firm self-selection. Following Campa and Kedia (2002) and Li and Prabhala (2007) we use a Heckman selection model. We first model a firm's decision of whether to issue public bonds or private placement bonds, and then calculate the inverse Mills ratio, which captures a firm's private information used in making its bond issuance decision. We then

estimate the OLS regression on bond yield, including the inverse Mills ratio estimated from the first step to adjust for self-selection. Our econometric model is the following:

$$D_{it} = 1 \ \ if \ X_{it}\gamma + W_{it}\delta + \eta_{it} > 0$$

$$D_{it} = 0 \ if \ X_{it}\gamma + W_{it}\delta + \eta_{it} \leq 0$$

$$Y_{it} = \ \alpha + \beta_1 X_{it} + \beta_2 W_{it} + \beta_d D_{it} + \beta_\lambda [\lambda_1 D + \lambda_0 (1 - D)] + \varepsilon_{it}$$

where

$$\lambda_1 = \frac{\phi(X\gamma + W\delta)}{\Phi(X\gamma + W\delta)}$$
$$\lambda_0 = \frac{-\phi(X\gamma + W\delta)}{1 - \Phi(X\gamma + W\delta)}$$

D is an indicator variable, which equals to one if the firm chooses to issue a public bond. The coefficient β_d captures the average yield spread of public bonds over private bonds. X is a vector of bond characteristics, W is matrix of country level institutional factors, λ_1 and λ_0 are the inverse Mills ratios calculated from the first step probit regression. The estimation results are reported in Table 8. We find that bond yield increases with its term to maturity. Bond yield decreases with issue size at a decreasing rate: bond yield is negatively related to issue size (i.e. log (total proceeds)) and is positively related to issue size squared. Bonds with call options generally have to pay a higher yield, while bonds with investment grade ratings pay a significantly lower yield than bonds that are below investment grade. High tech firms and highly levered firms on average pay a higher yield, and large firms are able to issue bonds at relatively low costs

(in terms of bond yield). High portions of tangible assets also lowers bond yield. Bonds issued internationally tend to pay a higher yield than those issued domestically. The inverse Mills ratio is always negative and significant in affecting bond yield, suggesting that firms tend to choose an issuance method with a lower yield. Public bonds on average have a much lower yield than private placement bonds, after controlling for key bond contract terms and firm characteristics. The average yield spread of public bond over private placement bond for similar bonds issued by similar firms is -3.65%, based on the β_d estimate. Taking account of the potential heterogeneity among our sample countries by adding in country fixed effects, the yield spread falls to -1.98%.

Table 8 Bond Yield

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Log (Proceeds)	0.54	***	0.86	***	-0.55	***	-0.08	***	-0.03		-0.81	***
	(0.03)		(0.03)		(0.10)		(0.02)		(0.03)		(0.08)	
$(\text{Log Proceeds})^2$					0.09	***					0.07	***
					(0.01)						(0.008)	
Log (Term to Maturity)	0.33	***	0.46	***	0.47	***	0.75	***	0.78	***	0.78	***
	(0.06)		(0.05)		(0.04)		(0.029)		(0.02)		(0.03)	
Callable	1.08		0.41		0.22		-0.87	*	-1.08	**	-1.45	***
	(0.85)		(0.79)		(0.33)		(0.45)		(0.45)		(0.49)	
Investment Grade Rating	-4.44	***	-3.65	***	-4.66	***	-2.27	***	-1.98	***	-1.72	***
	(0.40)		(0.38)		(0.09)		(0.21)		(0.20)		(0.16)	
Public Bond	-5.02	***	-3.95	***	-0.68		-0.47	***	-0.44	***	-0.40	***
	(0.14)		(0.14)		(0.13)		(0.15)		(0.16)		(0.14)	
High Tech Indicator			0.42	***	0.31	***			0.09	***	0.084	*
			(0.08)		(0.06)				(0.04)		(0.045)	
Log (Book Assets)			-0.57	***	-0.35	***			-0.07	***	-0.07	***
			(0.02)		(0.01)				(0.12)		(0.01)	
Firm Leverage			0.06		0.15				0.74	***	0.76	***
			(0.15)		(0.11)				(0.08)		(0.08)	
Industry Tangibility			-0.46	***	0.54	***			-0.38	***	-0.36	***
			(0.13)		(0.10)				(0.07)		(0.07)	
International Issue Indicator					2.23	***					0.43	***
					(0.06)						(0.07)	
Lambda	-2.55	***	-2	***	-0.31	***	-0.26	***	-0.25	***	-0.73	***
	(0.10)		(0.09)		(0.08)		(0.08)		(0.09)		(0.10)	
Country Fixed Effects	No		No		No		Yes		Yes		Yes	
Year Fixed Effects	Yes		Yes		Yes		Yes		Yes		Yes	
Number of Observations	5229		5229		5229		5229		5229		5229	
Adjusted R-squared	0.23		0.33		0.38		0.81		0.81		0.82	

Table 9 Effect of Institutional Factors on Bond Yield

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Controls and Year Fixed Effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Public Bond	-0.7	***	-0.98	***	-0.93	***	-0.18		0.16		1.73	***	-0.4	
	(0.11)		(0.11)		(0.12)		(0.16)		(0.15)		(0.30)		(0.26)	
Lambda	-0.41	***	-0.47	***	-0.43	***	-1.16	***	-0.26	***	-0.35	***	-0.46	***
	(0.07)		(0.07)		(0.07)		(0.09)		(0.08)		(0.07)		(0.07)	
Log (GDP Per Capita)	-0.58	***	-1.93	***					-1.98	***	-1.63	***	-1.94	***
	(0.05)		(0.03)						(0.026)		(0.04)		(0.03)	
Developed Indicator							-2.74	***						
							(0.14)							
Development of Banking Sector	-1.73	***												
	(0.04)													
Development of Stock Market	-0.07													
	(0.05)													
Common Law Indicator									1.04	***				
									(0.12)					
Creditor Rights Protection			-0.2	***									-0.015	
			(0.02)										(0.08)	
Depth of Credit Information					-0.47	***					-0.16	***		
					(0.03)						(0.046)			
Public*Developed Indicator							-2.84	***						
							(0.18)							
Public *Common Law									1.06	***				
									(0.14)					
Public* Depth of Credit Information											-0.49	***		
											(0.05)			
Public*Creditor Rights Protection													-0.21	**
													(0.08)	
Number of Observations	5203		5229		5229		5229		5229		5229		5229	
Adjusted R-squared	0.73		0.61		0.62		0.48		0.66		0.63		0.61	

Table 9 presents the effect of institutional arrangements on bond yield and the yield spread between public and private bonds. The development of the economy, measured by GDP per capita significantly reduces bond yield for both public and private bonds. Moreover, bond yields are also significantly lower in countries with a larger banking sector and a larger stock market. Strong credit rights protection and better access to credit information significantly lower overall corporate bond yields as well. Country level institutional differences have a direct impact on the yield spread of public bonds over private placement bonds. In column 4 of Table 9, we find that the interaction of the public bond indicator and the developed economy indicator is negative and significant at one percent level, and the public bond indicator itself is insignificant. The results suggest that the yield on public bonds is slightly below that on private placement bonds, but the difference is statistically insignificant for developing countries. The difference in yield averaged across all bonds with different contract terms becomes significantly negative for developed countries. Column 5 tests the effect of legal origins on bond yield by interacting the public bond indicator with the common law indicator. We find that bond yield tend to be larger for both public and private bonds in common law countries compare to civil law countries'. In addition, after controlling for bond contract terms, public bonds have significantly higher yields than private placement bonds in common law countries, consistent with the univariate statistics in Table 3. Bond yield spread is statistically insignificant in civil law countries.

Column 6 of Table 9 tests the effect of credit information transparency on yield spread. The interaction of public bond indicator and the depth of credit information is negative and significant, while the public bond indicator itself is positive and significant.

This indicates that when it is difficult to obtain credit information through public available channels, public bonds have a higher yield than similar private placement bonds, suggesting that private debt market is likely to provide cheaper financing and hence has a comparative advantage over the public bond market when assess to creditor financial conditions is poor. The yield of public bond and its yield spread over private bonds are significantly lower when creditor financial information becomes more transparent. The result in column 7 of Table 9 suggests that stronger creditor rights protection also significantly lowers the yield spread, perhaps because stronger legal protections for debtholders is associated with a more developed and informationally efficient debt market, which lowers the overall market risk and improves the liquidity of public corporate bond market.

Cold and Hot Security Markets

Security issuance activity exhibits strong cyclical patterns. For example, Eckbo, Masulis and Norli (2007) show that the aggregate volume of equity issues fluctuates greatly over time and this cyclicality is generally categorized as there being a hot or cold new issue markets. In this section, we examine whether individual firm's debt financing patterns are affected by overall market conditions and whether they are substantially different across hot and cold markets.

Classifying security markets as being hot or cold is commonly determined by examining aggregate total proceeds of net issue activity of domestic securities of a particular category, in our case debt (both public and private) issued by domestic firms. If

the debt market issue activity is in the top quartile of the time series, then we define this as a hot market period. On the other hand, if the debt issue activity is in the lowest quartile of the time series, we define this as a cold market period. We calculate this for the domestic debt market of each sample country for each year of our sample period. We obtain this data from the Bank for International Settlement (BIS).[65] As reported in Table 10, both the average bond proceeds (issue size) and aggregate annual total proceeds are larger in hot markets than in cold markets. This result holds for both publicly and privately issued bonds. The average term to maturity for public bonds issued during hot markets is slightly shorter than for bonds issued in cold markets, and the average yield is slightly higher in cold markets as well. This could reflect the fact that during hot market period, smaller firms and higher risk firms that normally cannot issue public bonds are able to tap the public bond market, taking advantage of overall booming market conditions and investors optimism. On the other hand, we find the opposite patterns for private placement bonds: the private placement bonds issued in hot market have longer terms to maturity and lower yields than those issued in cold market, suggesting that firms are more likely to borrow cheaply from private lenders during hot market period.

[65] We use the table "Domestic debt securities by financial institutions and corporate issuers.

Table 10 Hot Markets vs. Cold Markets

	Hot Markets		Cold Markets	
	Public Bonds	Private Bonds	Public Bonds	Private Bonds
Average Proceeds ($ million)	274.04	124.52	247.92	114.72
Total Annual Volume of Bond Issues ($ million)	30144.39	3330.93	24668.29	2117.98
Average Term to Maturity (Months)	82.33	63.68	85.57	59.5
Average Yield	3.59	5.15	3.12	5.68

We formally test the effect of market conditions on a firm's choice between public and private placement bonds in Table 11 using a logit regression model. We find that the likelihood of issuing public bonds are higher during hot markets and are lower during cold markets, but the effect is not statistically significant. Thus, even after we control for the overall domestic debt market conditions, bond and firm level characteristics as well as country-level institutional arrangements continue to have significant impacts on a firm's placement choice.

We also examine whether the average bond yield is affected by domestic debt market conditions in Table 12. After controlling for other important factors, we find that bond yield is significantly lower in hot markets. The results concerning the effects of institutional arrangements documented in prior sections continue to hold.

Market conditions in the international debt market are likely to affect a firm's decision of borrowing internationally. To examine this question, we categorize international debt market conditions using aggregate total proceeds of net issues of international corporate debt issued worldwide. The data is obtained from the Bank for

International Settlements (BIS) as well.[66] The market is considered as to be hot if the aggregate net issues are in the highest quartile of the annual time series and to be cold if the aggregate net issues are in the lowest quartile of the annual time series. Table 10 column 2 reports the effect of international debt market conditions on a firm's choice of issuing internationally or domestically. We find that the likelihood of tapping international market is significantly higher if the market is hot. Moreover, the likelihood of issuing public bonds in the international debt market is also affected by the overall market conditions of the international debt market. It is significantly lower when the international debt market is cold. More importantly, after controlling for international market conditions, our key results with regard to the effect of institutional arrangements on debt financing choices continue to hold in these regressions.

[66] We use the table "International debt securities by corporate issuers".

Table 11 Market Conditions and Debt Issuance Choice

	Model 1		Model 2		Model 3	
	Full Sample		Full Sample		Subsample of International Issues	
	Public vs. Private		International vs. Domestic		Public vs. Private	
Hot Domestic Debt Market	0.17					
	(0.18)					
Cold Domestic Debt Market	-0.11					
	(0.19)					
Hot International Debt Market			0.56	**	0.065	
			(0.24)		(0.38)	
Cold International Debt Market			-0.25		-0.7	**
			(0.28)		(0.34)	
Firm Characteristics						
Log (Proceeds)	1.58	***				
	(0.07)					
Log (Term to Maturity)	-0.23					
	(0.22)					
Investment Grade Rating	1.58	***				
	(0.49)					
High Tech Indicator	-0.77	***				
	(0.19)					
Log (Book Assets)	0.19	***				
	(0.046)					
Firm Leverage	-0.58	*				
	(0.33)					
Industry Tangibility	1.07	***				
	(0.32)					
Institutional Arrangements						
Log (GDP Per Capital)	0.94	***	2.02	***	0.53	***
	(0.24)		(0.14)		(0.19)	
Development of Banking Sector	1.73	***	-2.46	***	-0.75	***
	(0.21)		(0.11)		(0.15)	

Table 11, continued

Development of Stock Market	-0.18		0.53	***	-0.22	
	(0.16)		(0.10)		(0.17)	
Creditor Rights Protection	0.09		0.37	***	0.07	
	(0.17)		(0.07)		(0.07)	
Anti-Self-Dealing Index	2.66	***	3.25	***	3.37	***
	(0.90)		(0.62)		(0.75)	
Control of Corruption	1.35	***	2.4	***	1.14	***
	(0.34)		(0.19)		(0.23)	
Tax Evasion	-0.8	***	-2.47	***	-0.62	***
	(0.14)		(0.11)		(0.13)	
Depth of Credit Information	-1	***	1.26	***	-0.29	**
	(0.13)		(0.09)		(0.13)	
Accounting Standard	-14.07	***	-0.6		-4.81	*
	(2.81)		(2.49)		(2.73)	
Constant	-0.81		-14.33	***	2.01	
	(2.51)		(1.65)		(2.14)	
Year Fixed Effects	Yes		Yes		Yes	
Number of Observations	5131		6815		1813	
Pseudo R-Squared	0.32		0.48		0.16	

Table 12 Market Conditions and Bond Yield

	Model 1		Model 2	
Hot Domestic Debt Market	-0.03		-0.24	***
	(0.06)		(0.07)	
Cold Domestic Debt Market	0.027		0.006	
	(0.058)		(0.066)	
Log (Proceeds)	-0.02		-0.06	***
	(0.03)		(0.02)	
Log (Term to Maturity)	0.77	***	0.86	***
	(0.03)		(0.038)	
Callable	-1.07	*	0.94	
	(0.60)		(0.62)	
Investment Grade Rating	-2.48	***	-3.51	***
	(0.24)		(0.27)	
Public Bond	-0.41	**	-0.52	***
	(0.19)		(0.12)	
Lambda	-0.27	**	-0.35	***
	(0.11)		(0.07)	
Log (GDP Per Capita)			-1.16	***
			(0.04)	
Developed Indicator				
Development of Banking Sector			-1.63	***
			(0.04)	
Development of Stock Market			-0.06	
			(0.05)	
Common Law Indicator				
Creditor Rights Protection				
Depth of Credit Information			-0.6	***
			(0.03)	
Country Fixed Effects	Yes		No	
Year Fixed Effects	yes		Yes	
Number of Observations	5229		5229	
Adjusted R-squared	0.75		0.68	

Conclusion

Both theoretical and empirical studies have shown that firm level factors drive a firm debt financing patterns, such as the choice between public and private debt and the cost of debt financing. The results in this study indicate that a firm's debt financing decision is also significantly affected by conditions in the country in which it is located. The institutional environment of a country has a profound impact on a firm's debt financing and its effect is at least as important as firm specific characteristics. We find that the development of the overall economy and various capital markets, creditor rights protection and legal enforcement, the transparency of creditor financial information, all significantly alter a firm's choice between private and public bonds, and the corresponding bond yield of the specific debt instrument they choose to issue. The results are robust after controlling for various firm level characteristics that are shown to be correlated with firm debt financing decisions both theoretically and empirically. Moreover, the results also hold even if we consider domestic and international debt market conditions and aggregate issuance activities on the bond market.

Empirically, we find a significant association of domestic banking sector development and a firm's choice between public and private bond issuance. A dominant banking sector appears to make private placement bond issuance less attractive for firms seeking to issue bonds. This could be due to the fact that bank loans are close substitutes for private placement bonds and their contract features are even more flexible than private bonds to some extent. On the other hand, a well-developed equity market reduces a firm's likelihood of issuing public bonds, which is also consistent with the prediction that equity issuance could crowd out public bond issuance.

Furthermore, we find that the public bond market is more accessible when the legal system provides stronger legal protections to creditor rights and these laws are effectively enforced. Such an effect is particularly strong for firms that have potentially severe debt agency and information asymmetry problems. These legal arrangements constrain managerial self-dealing behavior and lead to more efficient bankruptcy proceedings. The result is lower expected default probability and an increase in the recovery rate conditional on a default. The country level institutional arrangements also determine a firm's access to the international bond market. Moreover, their effects on the choice between public and private bonds are more pronounced for firms borrowing in the international debt market.

In terms of debt financing costs, highly developed economies with more developed banking sectors and equity market generally have lower bond yields for both public and private debt. Strong creditor protection and a transparent and reliable financial accounting system also lower debt financing costs. Moreover, we find that institutional factors also affect the bond yield spread of public debt over private debt. Developed countries have much lower yield spreads than underdeveloped countries, and civil law countries on average have lower yield spreads than common law countries. The yield spread also decreases with the strength of creditor legal protections and public availability of creditor financial information.

This study shows that corporate financing decisions are likely to be jointly determined by both a demand side effect, which is the traditional corporate finance approach to focus on lender concerns about firm fundamentals, and the supply side effect, such as the constrains that exist in external capital markets. We document that key

institutional factors have large impact on individual firm's debt financing choices and debt financing costs, perhaps through their impact on shaping the overall efficiency of the domestic capital markets that firms face. The domestic debt market's liquidity, informational efficiency and inherent risks associated with the strength of the legal system, each affects the relative financing costs across different markets, and also alters borrower and lender preferences over selling and buying bonds in different capital markets.

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APPENDIX A Variable Definitions

Date Item	Definition	Data Source
Bond Characteristics		
Issue size	Total bond proceeds	SDC
Maturity	Term to maturity in months	SDC
Call Provision	Equals one if the bond is callable and zero if the bond is not callable	SDC
Investment Grade Rating	Equals one if the firm has an investment grade credit rating before new bond issuance, and zero otherwise	SDC
Senior Bond	Equals one if the bond is senior and zero if the bond is subordinate	SDC
Firm Characteristics		
Firm Size	Natural Logarithm of a firm's total book assets at the end of fiscal year before bond issuance	WorldScope
Firm Leverage	(Long term debt + short term debt)/Total assets	WorldScope
High Tech Firm	Based on AeA's definition of high tech industries	WorldScope and AeA
Industry Tangibility	The median of four-digit industry tangible ratio	WorldScope
Institutional Variables		
Developed Countries	A zero or one dummy variable indicating whether the country is classified as developed according to World Bank classification based on countries' gross national income level	World Bank
GDP per Capita	GDP per capita measured in year 2000 US dollars	WDI
Common Law	A zero or one dummy variable indicating whether a country adopts the common law system	LLSV 1998
Domestic Credit Provided by the Banking Sectors/GDP	Includes all credit to various sectors on a gross basis, with the exception of credit to the central government. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions.	WDI
Market Capitalization/GDP	Market capitalization of domestic listed companies/ GDP	WDI
Creditor Rights Index	Summarizes the legal rules from the bankruptcy and reorganization laws covering the following: (1) The country imposes restrictions, such as creditors' consent or minimum dividends to file for reorganization (2) Secured creditors are able to gain possession of their security once the reorganization petition has been approved (3) Secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm (4) The debtor does not retain the administration of its property pending the resolution of the reorganization	La Porta et al (1998)
Anti-self-dealing	A numerical measure of the intensity of public and private enforcement	Djankov et

Index	on regulating managerial self-dealing	al 2008
Control of Corruption	One dimension of Worldwide Governance Indicator, measures the strength of controlling corruption	WGI of World Bank
Tax Evasion	Assessment of the prevalence of tax evasion. Higher scores indicate higher tax evasion. The data is obtained in year 2002.	World Economic Forum
Depth of credit information	Index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries	WDI
Accounting Standard Index	Index created by examining and rating companies'1990 annual reports on their inclusion or omission of 90 items	LLSV 1998