Firm Performance and CEO Compensation:

CEO Pay Slice vs Pay-Performance Sensitivity

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Dedication

Dedicated to my parents, Md Abdul Halim & Meer Nilufa Akter, and my wife, Sanjida Chowdhury; the three superheroes of my life who make everything possible for me with their love, self-sacrifice and prayers.

Abstract

I study the relationship between CEO incentive compensation and firm performance in the presence of CEO dominance to examine how incentive compensation improves firm performance by reducing agency conflicts between shareholders and managers. I estimate pay-performance sensitivity (PPS) as a measure of CEO incentive compensation and the CEO pay slice (CPS) as a measure of CEO dominance. Controlling for standard control variables, I conduct multiple OLS regressions and find that at the high level of CPS, PPS improves firm performance, but at the low level of CPS, impact of PPS diminishes. This shows that determining stand-alone associations of PPS or CPS to firm value—a popular practice in the literature—might not be adequate because of an unexplored interaction effect between executive incentive and executive dominance. To address the potential endogeneity issues, I conduct robustness check by employing instrumental variables with a two-stage least square (2SLS) estimation procedure. As an additional robustness check, I account for the year effect and confirm that the results still stand to the same level of significance.

Keywords: CEO compensation, Pay-performance sensitivity, CEO pay slice, Firm performance, Executive dominance

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Table of Contents

List of Figures

List of Tables

1 Introduction

Executive compensation is one of the most debated and continuing topics in the corporate finance literature. In the last few decades, researchers have explored numerous ways to alleviate the agency conflict—the difference in motives between the shareholders/owners (principals) and the managers/executives (agents)—that exists in companies, and subsequently offered various solutions such as offering equity-based compensation (EBC), long term incentive plans in the form of option contracts, restricted stock grants etc. to CEOs in order to cement their ownership and enhance their long-term commitment. However, analyses of such propositions have found mixed results on the efficacy of high compensation packages on firm performance and generally, two viewpoints exist. First, the optimal contracting theory suggests executive incentive contracts to maximize shareholders' value. Second, the rent seeking theory or the managerial power view of compensation argues that agency conflicts could inherently be present in lucrative compensation packages, leading to shareholders' value destruction (Bebchuk & Fried, 2006).

A popular measure of executive incentive is the pay-performance sensitivity (PPS)—defined as the marginal increase in CEO pay given an incremental effect on firm value—which is positively associated with firm performance (Jensen & Murphy, 1990). A recent body of literature that focuses on executive power or, relative importance of CEOs to support the rent seeking theory considers CEO pay slice (CPS)—the proportion of salary captured by CEO from aggregate compensation of the top-five executives—as a measure of pay-heterogeneity and executive dominance, and finds that it is negatively associated with firm value (Bebchuk et al., 2011). However, above associations met disagreements from researchers who have found conflicting results based on these instruments. For instance, while studying the association of CEO power to firm value using CEO pay slice as a proxy, some researchers found non-monotonic relations to various agency conflict issues (Chintrakarn et al., 2015; Jiraporn & Chintrakarn, 2013; Lee et al., 2015). In addition, some authors support CEO power in favor of firm riskiness as it improves firm value (Larcker & Tayan, 2012). Mixed results in the literature motivate this study to pursue reasons behind these potential inconsistency with a perspective different from previous studies.

It is important to note that executive power might vary across firms since it connects to the idiosyncratic characteristics of firm factors such as the team structure, compensation practices etc. Incentive compensation seems to be linked with the CEO power as well. In a recent article published in Bloomberg, Melin and Sam (2020) rank top-paid CEOs and segregate their compensation components which shows incentive compensation packages such as option contracts hold a major portion in the CEO compensation contracts. When I study these CEOs to understand their dominance level, I observe that they have a very high level of CPS.[1] The link between powerfulness and incentive payment becomes more prominent when I examine the calculation of the proxies i.e., CPS and PPS. While CPS indicates the pay heterogeneity among top executives, the calculation involves the Black & Scholes value of options granted in a given year. On the other hand, Coles et al. (2006) follow Core and Guay (2002) for PPS calculation and consider the sensitivity of option portfolio that consists of all the vested and unvested tranches of options. Based on (1) the mixed results between CEO dominance and firm performance documented in prior literature, (2) the current industry practice of incentive compensation packages for powerful CEOs, and (3) the nature of the CEO compensation components and their proxies, I posit that PPS being a measure of executive incentives is not separable from CPS, a measure of executive dominance, and thus, argue that their stand-alone associations with firm performance might be inadequate in drawing implications on agency conflicts.

To capture the compensation component, this study simultaneously considers the incentive component measured by PPS and the dominance or the pay-heterogeneity component measured by CPS instead of focusing only on incentives or cash compensation. Ozkan (2011) argues that studies that do not consider the equity-based component of compensation could be criticized and shows that performance-sensitive component of compensation is vital in assessing the association of pay with performance. However, in contrast to my analysis, the author only focuses on UK CEOs and does not consider the executive dominance component that is naturally

[1] For instance, Tim Cook of Apple Inc. and Tom Rutledge of Charter Communications Inc. have a CPS of 72% as of 2019.

prevalent in companies. Finally, I also examine the interaction effect between PPS and CPS, which, to the best of my knowledge, has not been considered in prior studies.

Analysis of the interaction effect seems crucially important since it proposes answers to questions such as: (1) Is PPS always positively associated with firm performance? (2) Does the negative association of CPS with firm performance always hold? (3) Is it better to have non-dominant CEOs? etc. To understand the effect, I have analyzed CEO compensation from the Execucomp database for the 1992-2019 time period. Firm specific data and stock related information are obtained from Compustat and CRSP respectively for the same period. The analysis of this study is comprised of two parts each of which examines six OLS models. While Tobin's *q* as a measure of firm value is taken as the dependent variable in the first part, the second part considers annual stock return. Stand-alone associations are assessed first and then further analyses are conducted for the interaction effect. Figure 1 portrays how this study analyzes the interaction effect by considering each quadrant. Estimates from the stand-alone cases indicate that PPS shows a positive association to firm performance and CPS shows a negative association to firm performance, both of which are aligned with the literature. However, findings from the interaction effect show that while high level of CPS is present, changing PPS level from low to high increases firm value (measured by annual stock return) but at low level of CPS, influence of PPS on firm performance declines. This indicates that stand-alone association of either executive incentives (PPS) or executive dominance (CPS) to firm performance could be inadequate in understanding the firm value associations—a contribution of this study to the existing literature. This finding rather contradicts Lee et al. (2015) where they estimate an optimal level of power and find that power has a nonmonotonic relation to the firm value i.e., non-optimal power such as excess or deficient power of CEO is negatively related to firm performance. This study indicates that while inadequate power (or, importance) of CEO might not lead to any strong performance for the firm, excess executive dominance can be managed for better firm performance by having more pay performance sensitivity. The high caliber CEOs who have gained importance indicated by their high CPS levels[2] might not be that bad for the firm even though their heterogeneous pay structure appears to be linked to firm's value destruction as shown by Bebchuk et al. (2011). Such dominant CEOs might still improve firm performance if provided with an optimal bundle of vested and unvested option contracts (which would increase their PPS levels)—especially, may be for extended vesting periods—along with the existing compensation contract. Agreeing on the optimal contracting theory, this study contributes to the existing body of literature that circulates around agency conflict issues by adding new perspectives based on the interaction effect, and opening opportunities for further investigations on the optimal contracts.

The remainder of this study is organized as follows. Section 2 reviews prior literature and progresses through hypotheses development. Data and methodology are described in section 3 followed by results in section 4. Section 5 discusses the robustness checks and finally, section 6 concludes.

2 Literature review and hypotheses development

2.1 Measures to minimize agency conflict

Managers are hired to work for the best interest of shareholders: maximizing firm value or shareholders' wealth regardless of demographic factors of firms such as size, location, industry and timeline. However, Jensen and Meckling (1976) argue that these managers do not always follow their mission, but rather seek their own interest by extracting undeserved personal benefits. Deep-rooted in agency conflict, several inefficiencies do not let firms acquire the maximum value that it could potentially achieve. Jensen and Meckling (1976) categorize these inefficiencies into three types of expenditure - bonding costs towards the agents, monitoring expenditure by the principals, and opportunity costs or the residual loss due to the divergence in decision making between the principal and the agent. To establish an efficient management, shareholders incentivize managers through lucrative contracts with high compensation and

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[2] For example, Sundar Pichai, chief executive officer (CEO) of Alphabet Inc. and its subsidiary Google LLC, has a CPS of 71% (quite high) as of 2019.

numerous benefits. These high CEO pays are set on purpose as a motivation to improve firm performance (Edmans & Gabaix, 2009). Dow and Raposo (2005) further show that incentive-based CEO compensation is an essential key to align the interest of managers with that of shareholders. Although it appears that lucrative compensation packages are a solution to the agency problem, in the last few decades researchers have found mixed results on the impacts of such higher compensation policies for better firm performance.

Earlier work on compensation effects focused only on salary and bonus to understand the impact of pay on performance.[3] However, since CEOs did not have strong obligation (may be due to lack of ownership) to the firm and would take value destroying decisions (by taking pet projects, building empires through personally preferred merger and acquisitions etc.) to protect own interest, EBC has evolved to ensure CEOs' incentives in the firm (Hölmstrom, 1979; Rajgopal & Shevlin, 2002). Frydman and Jenter (2010) show dramatic increase in compensation that is highly driven by EBCs during the 1970s. Several studies (Bulan et al., 2010; Demsetz, 1983; Fama & Jensen, 1983; Smith & Stulz, 1985) however suggest that even CEO ownership or, shares owned by CEOs have mixed influences over firm performance. In the early 1990s, stock options became popular in industry practice as an instrument of incentive-based CEO pay (Langsam et al., 1997). However, due to several corporate scandals (e.g., backdating), major reforms in the executive compensation were done in the mid-2000s (Bulan et al., 2010). In addition, restricted stock grants to encourage long-term performance accompanied other instruments in the compensation contracts. Studies based on these several industry practices during this timeline have taken two main directions – the optimal contracting theory and the rent seeking theory.

According to the optimal contracting theory, equity-based compensations are optimal in incentivizing managers (Fama, 1980; Jensen & Murphy, 1990; Lee et al., 2008; Murphy, 1985). On the other hand, the rent seeking theory suggests that when CEOs get entrenched i.e., become

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[3] Murphy (1985) criticizes this practice and propose more components of executive compensation such as base salaries, bonuses, total compensation, and deferred compensation.

individually powerful due to major stock holding in the firm, they become overprotective of their own interest (Bebchuk & Fried, 2006). At their own discretion, these CEOs avail luxurious perquisites and look for opportunities to enlarge their empires by building their pet projects and might avoid risky yet value-enhancing projects which ultimately leads to shareholders' value destruction. Researchers have explained that overconfidence, powerfulness, dominance, high pay dispersion among top executives, poor corporate governance might be some of the reasons behind such set-backs (Bebchuk et al., 2011; Cooper et al., 2016; Hayward & Hambrick, 1997).

2.2 Pay-performance sensitivity in reducing agency conflict

Pay-performance sensitivity (PPS) is the dollar change in CEO's wealth associated with a 1 percent change in the firm's stock price, termed as the compensation delta (Murphy, 2012). Murphy (1985) shows that firm performance measured by shareholders' realized returns has a positive relationship with managerial remuneration. Moreover, considering PPS as a compensation metric and shareholders' return as a measure of firm performance, Jensen and Murphy (1990) shows that a CEO's wealth changes $3.25 for every $1000 change in shareholders' wealth, revealing a small, yet positive association between them. Following this finding, literature shows a high raise in PPS during 1990s in the form of CEO's option holdings (Frydman & Jenter, 2010). The positive association between PPS and firm performance is further supported by several other studies (Pyo & Abedin, 2017; Kaplan, 2012).

Some contradictory views regarding PPS also exist. For instance, Brick et al. (2012) suggest that incentive compensation components such as option grants make CEOs entrenched and risk averse. Hence, they might put their own interest ahead of shareholders', leading to poor firm performance. Aiming to untangle such contradiction, this study first considers Tobin's *q*, and then annual stock return to measure firm performance and analyzes the effect of PPS at the presence of different executive dominance levels. One inherent component of the first two hypotheses is the anticipated influence of dominance level in the association of PPS to firm value.

H1a: The CEO dominance measured by CPS affect the positive relationship between PPS and firm performance measured by Tobin's *q*.

H1b: The CEO dominance measured by CPS affect the positive relationship between PPS and firm performance measured by annual stock return.

2.3 CEO pay slice in aggravating agency problem

A recent pool of literature that supports the rent seeking theory focuses on executive power or, relative importance of CEOs. CEO pay slice (CPS), a popular measure of pay-heterogeneity and executive dominance, is the proportion of salary captured by CEO from aggregate compensation of the top-five executives (Bebchuk et al., 2011). CPS has been found to have important effects on firm value controlling for standard control variables.[4] For instance - high level of CPS leads to a lower firm value (measured by Tobin's *q*), poorer accounting profitability and higher rent extraction (Bebchuk et al., 2011). However, dominance or power might differ for each firm and CEO because of the dependency on the idiosyncratic characteristics of factors such as the compensation contract, top management team structure, CEO ownership etc. Hence, this study speculates that this linear negative impact of CPS to firm performance might not hold always. For instance, when performance is recognized and awarded with more long-term incentives (may be bundled with vested and unvested option contracts), a dominant CEO—who had previously perceived to be a value destructor—might lead a firm with more confidence/motivation (by taking initiatives to boast stock price as he/she has options that are going to vest) and increase its value which would align high executive dominance with strong firm performance. An extension to the first hypothesis, this is a more discrete approach to

[4] Zagonov and Salganik-Shoshan (2018) argue that CPS is inefficient to discern the diverse variations in payment structure of top executives across various organizations. However, in several studies, researchers use similar metrics compared to CPS in order to capture the varied payment structure. Hayward and Hambrick (1997) introduce CEO relative compensation (CRC) to segregate weak CEOs from strong CEOs (where, CRC ≤ 1 being weak). Furthermore, Chang et al. (2010) study the impact of managerial departure announcements on abnormal stock returns by considering relative total pay (RTP) for compensation measure which is calculated by dividing the CEO pay by the next four manager's pay. Overall, I recognize that higher pay-heterogeneity among the top executives is positively associated with agency problems and thus, note that CPS might be a useful tool to study firm value associations.

assess the interaction effect and examine the impact of higher executive dominance on the assessment of incentives to firm performance, which leads to the second hypothesis.

H2: CEO dominance positively interacts with PPS for strong firm performance.

2.4 Mixed reviews on the impact of executive pay

The literature also reveals some mixed results on the association of executive pay to firm performance. Gregg et al. (2005) show that there exists a rather weak link between pay and performance of the CEOs in the UK, especially when stock returns are relatively high. Such arguments are further supported by Girma et al. (2007). In addition, Cooper et al. (2016) show that incentives offered as excess compensation are negatively related to firm performance. However, it is important to note some vital factors while associating executive pay with firm performance. For instance, researchers have considered the compensation component in various ways in the past. While some researchers focus on the incentive portions (Cooper et al., 2016; Dow & Raposo, 2005; Rajan & Wulf, 2006), others study the impact of cash, or whole compensation (Chintrakarn et al., 2015; Girma et al., 2007; Gregg et al., 2005). Ozkan (2011) shows a positive association between pay and performance, and emphasizes on the importance of including performance sensitive components of compensation such as stock options, stock awards etc. Furthermore, various metrics are used to compute firm performance. For instance, some authors have considered Tobin's *q* (Bebchuk et al., 2011), while others have preferred stock return or return on assets (Bulan et al., 2010). Finally, the timeline of the sample firms could be related to the conflicting results while associating compensation with performance. Literature shows that the practice of remunerating higher incentive compensation packages to top executives started in the 1950s and escalated during 1990s (Langsam et al., 1997). The instruments of incentive compensation have also changed after the 1950s for various reasons (e.g., stock market volatility, corporate scandals etc.) (Bulan et al., 2010). This study offers to simplify these issues by: (1) controlling for PPS and CPS simultaneously along with product terms to account for the individual effect and the interaction effect, (2) taking both Tobin's *q* and stock return to measure firm performance. Additionally, the 1992-2019 time period of this study covers the 90s introduction of high incentive payment practice as well as the financial crisis of 2008.[5]

3 Data and methodology

3.1 Data

Compensation data have been collected from the Execucomp database for the 1992-2019 time period. Execucomp provides ranked compensation data of the top-level executives. I retain the top five executives' data by eliminating companies (9.5% of the total) which have information on less than five executives. When more than five executives' data are provided, only top five observations are taken for consistency. One integral part of CPS computation is the compensation component. For that, this study considers the TDC1 item from the Execucomp database which includes salary, bonus, other annual pay, total value of restricted stock grant that year, Black & Scholes value of stock options granted that year, long-term incentive pay-out, all other total compensation following Bebchuk et al. (2011). Post-2006, Execucomp data format was changed to put up with accounting changes and expanded compensation disclosure requirements imposed by Financial Accounting Standards Board (FASB), and Securities and Exchanges Commission (SEC). I address this issue by applying different methods for PPS calculation for the 1992-2006 and 2006-2019 time period following Coles et al. (2006). In addition, Execucomp stopped providing volatility and dividend yield information as of 2006 which are needed in the Black-Scholes formula for option valuation. Hence, I calculate the 60-month rolling volatility, and estimate the dividend yield as suggested by Coles et al. (2006).

[5] Relevant studies, such as Ozkan (2011) only focuses on UK CEOs for the 1999-2005 time period and does not consider the executive dominance that is prevalent in companies. Coles et al. (2006) study the riskiness in firms' decision making for the 1992-2002 time period and do not examine executive dominance. Bebchuk et al. (2011) study the association of CEO dominance—proxied by CEO pay slice—to firm performance for the 1993-2004 time period, however, do not consider the interaction effect between pay-performance sensitivity and CEO dominance.

Risk-free rates are obtained from historical data provided by the Federal Reserve on their website for 'treasury constant maturities' using the 'annual' series.[6]

Firm specific data and stock related information are obtained from Compustat and CRSP respectively for the same time period as mentioned above. Final sample size stands at 32,042 CEO-year observations representing 3,518 unique firms (identified by GVKEY in Execucomp) having 7,265 unique CEOs (identified by CO_PER_ROL in Execucomp) after satisfying the data requirements. However, the number of observations in some regressions varies due to data limitation. For instance, lagged values are missing for the year 1992 (the beginning year of the sample).[7]

3.2 Variables

Tobin's *q*—defined as the market value of equity plus the book value of assets minus the book value of equity, all divided by the book value of assets—as a measure of firm value is used as the dependent variable in the first part of the analysis. I also consider annual stock return to account for firm performance in the second part of the study.

Pay-performance sensitivity (PPS) or, Delta is the dollar change in the executive's wealth for a 1% change in stock price. To estimate PPS, I first calculate option values following the method proposed by Core & Guay (2002), which is based on the Black & Scholes (1973) model for European call options modified by Merton (1973) to adjust for the dividend yield. Equation 1 reports the model.

$$\text{Option value} = \left[Se^{-dt}N(Z) - Xe^{-rT}N(Z - \sigma\sqrt{T})\right] \quad (1)$$

[6] In the annual series, data for 1, 2, 3, 5, 7, and 10 year treasury securities are available. I interpolate the rates to obtain the risk-free rates for 4, 6, 8, and 9 years. If the option maturity is more than 10 years, I use the 10-year rate.

[7] Since the data range of the Execucomp database is Jan 1, 1992 – Present

where, $Z = \left[\left\{Ln\left(\frac{S}{X}\right) + T\left(r - d + \frac{\sigma^2}{2}\right)\right\} / \sigma\sqrt{T}\right]$, N = cumulative probability function for the normal distribution, S = price of the underlying stock, X = exercise price of the option, σ = expected stock return volatility over the life of the option, r = natural logarithm of risk-free interest rate, T = time to maturity of the option in years, d = natural logarithm of expected dividend yield over the life of the option.

For the aggregate PPS, I compute the delta for each CEO-year incorporating all the vested and unvested tranches of options as well as shares owned following Coles et al. (2006) which is based on the "one-year approximation" (OA) method by Core & Guay (2002). The estimation of PPS is in equation 2.

$$\left[\frac{\delta(\text{Option value})}{\delta(\text{Stock price})}\right] * \left(\frac{\text{Stock price}}{100}\right) = \left[e^{-dT}N(Z) * \left(\#\text{Option}_{\text{Holding}} + \#\text{Shares}_{\text{owned}}\right)\right] * \left(\frac{\text{Stock price}}{100}\right) \quad (2)$$

where, $Z = \left[\left\{Ln\left(\frac{S}{X}\right) + T\left(r - d + \frac{\sigma^2}{2}\right)\right\} / \sigma\sqrt{T}\right]$, N = cumulative probability function for the normal distribution, T = time to maturity of the option in years, d = natural logarithm of expected dividend yield over the life of the option.

CEO pay slice (CPS) is measured as the fraction of the total compensation (Execucomp item TDC1) of top-five executives that is received by the chief executive officer (CEO) (see, Bebchuk et al., 2011). While PPS and CPS are my primary explanatory variables, I include other control variables following prior literature (Bebchuk et al., 2011; Coles et al., 2006; Core & Guay, 2002; Graefe-Anderson et al., 2018). For instance, market-to-book is defined as the market value of assets divided by their book value. Book leverage is the total debt divided by the book value of assets.[8] ROA is the return on assets computed as operating income divided by

[8] Book leverage (rather than market leverage) is used since market leverage might change passively simply because of changes in stock price performance and may not be an active managerial choice (Coles et al., 2006).

book value of assets. R&D is research and development expenditure scaled by assets. Capex is capital expenditure net of sales of property, plant, and equipment, also scaled by assets.

Table 1 reports the summary statistics. Overall, the firms in my sample are quite large with a mean (median) market capitalization of $6,197 ($1,919) million. The mean (median) values of Tobin's *q* and annual stock returns are 1.94 (1.46) and 17% (12%), respectively. Mean (median) value of delta is $1,086,400 ($208,024), i.e., average CEO wealth changes by $1,086,000 per 1% change in their firm's stock price. Coles et al. (2006) study pay-performance sensitivity from 1992 to 2002 and find that mean (median) value of delta is $600,000 ($206,000). Since 2002, CEOs have been granted very high levels of incentive-based compensation, which explains the difference. Mean (median) value of CPS is 0.38 (0.38), which is in accordance with the prior literature.[9] To avoid scale difference among the variables in the regressions, natural log of delta (i.e., PPS), market capitalization, and sales is taken. All of the variables are winsorized at 1^{st} and 99^{th} percentile levels to minimize the effects of outliers.

Table 2 reports the sample correlations of key variables used in the analyses. Most of the correlations are significant at 1% level. 'Sales' and 'Market capitalization' have a correlation coefficient of 0.780, quite strongly positive (which is not surprising). The correlation between 'PPS' and 'Market capitalization', 'Sales' and 'PPS' are 0.537 and 0.362 respectively, indicating a moderate degree of correlation. Other correlation values are smaller than 0.362.

3.3 Methodology

Association of executive incentives to firm value is analyzed in two parts, each of which examines six models. In the first part, Tobin's *q* as a measure of firm performance is regressed

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[9] Bebchuk et al. (2011) studies 12,011 firm-year observations from 1993 to 2004 and finds mean (standard deviation) CPS of 35% (11.4%). When I replicate, I get mean (standard deviation) CPS of 36% (12.4%) by studying 18,053 firm-year observations for the same time period. The reason behind the difference in the number of firm-year observations for the same sample period might be the addition of data by Execucomp after 2011.

on PPS, and CPS along with other standard control variables. The second part considers annual stock returns as a measure of firm performance and conducts similar analyses.

3.3.1 Firm value measured by Tobin's q

This is the first part of the analyses and comprises six OLS models, where Tobin's *q* as a measure of firm performance is the dependent variable. Other control variables such as market to book ratio, market capitalization, sales, CEO age, leverage, return on asset, research and development, capital expenditure, product term of PPS and CPS, and lagged values of the product term are included along with the two primary explanatory variables: PPS and CPS.

Initially I try to analyze if the prior findings in the literature hold within my framework. Hence, I assess the association of PPS to firm performance. Subsequently, I analyze the two primary explanatory variables together and test if prior findings still stand. Equation 3 reports the model.

$$\begin{aligned} \text{Tobin's } Q_{i,t} = {} & \beta_0 + \beta_1 \text{PPS}_{i,t} + \beta_2 \text{CPS}_{i,t} + \beta_3 \text{Market to Book}_{i,t} + \beta_4 \text{Market Cap}_{i,t} \\ & + \beta_5 \text{Sale}_{i,t} + \beta_6 \text{CEOAge}_{i,t} + \beta_7 \text{Leverage}_{i,t} + \beta_8 \text{ROA}_{i,t} \\ & + \beta_9 \text{R\&D}_{i,t} + \beta_{10} \text{CAPEX}_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where, $\text{PPS}_{i,t}$ and $\text{CPS}_{i,t}$ is the natural log of pay-performance sensitivity and CEO pay slice of the CEO of firm i in year t respectively; $\text{Market to Book}_{i,t}$ is the ratio of market value to book value, $\text{Market Cap}_{i,t}$ is the natural log of market capitalization, $\text{Sale}_{i,t}$ is the natural log of sales, $\text{CEOAge}_{i,t}$ is the age of CEO (in years), $\text{Leverage}_{i,t}$ is the book leverage, $\text{ROA}_{i,t}$ is the return on asset, $\text{R\&D}_{i,t}$ is the research and development expenditure, $\text{CAPEX}_{i,t}$ is the capital expenditure net of sales of property, plant, and equipment of the firm i in year t; $\epsilon_{i,t}$ is the error term.

As I add more control variables, I explore further firm value associations. I speculate if there is any interaction effect between PPS and CPS, and thus, take the product terms (current and lagged) along with prior control variables. Equation 4 denotes the model.

$$\begin{aligned}\text{Tobin's Q}_{i,t} = \beta_0 &+ \beta_1 \text{PPS}_{i,t} + \beta_2 \text{CPS}_{i,t} + \beta_3 (\text{PPS} * \text{CPS})_{i,t} + \beta_4 \text{PPS}_{i,t-1} \\ &+ \beta_5 \text{CPS}_{i,t-1} + \beta_6 (\text{PPS} * \text{CPS})_{i,t-1} + \beta_7 \text{Market to Book}_{i,t} \\ &+ \beta_8 \text{Market Cap}_{i,t} + \beta_9 \text{Sale}_{i,t} + \beta_{10} \text{CEOAge}_{i,t} + \beta_{11} \text{Leverage}_{i,t} \\ &+ \beta_{12} \text{ROA}_{i,t} + \beta_{13} \text{R\&D}_{i,t} + \beta_{14} \text{CAPEX}_{i,t} + \epsilon_{i,t}, \qquad (4)\end{aligned}$$

where, $(\text{PPS} * \text{CPS})_{i,t}$ and $(\text{PPS} * \text{CPS})_{i,t-1}$ are the current and lagged values of the product term of natural log of pay-performance sensitivity and CEO pay slice of the CEO of firm i in year t. Other variables have the same definitions as above.

3.3.2 Firm value measured by annual stock return

In this part, I run six OLS regressions to examine the association of firm value considering annual stock return as the dependent variable. I initially test if prior findings hold and next, to examine the potential interaction effect between PPS and CPS, I take their product terms along with other control variables. I expect that γ_1 and γ_2 would be statistically significant, and their signs would be positive and negative respectively. I do not expect any particular sign regarding γ_3; however, I expect the product term to be statistically significant so that I can carry out experiment on how they interact with each other. Equation 5 shows the model.

$$\begin{aligned}\text{Stock Return}_{i,t} = \gamma_0 &+ \gamma_1 \text{PPS}_{i,t} + \gamma_2 \text{CPS}_{i,t} + \gamma_3 (\text{PPS} * \text{CPS})_{i,t} + \gamma_4 \text{PPS}_{i,t-1} \\ &+ \gamma_5 \text{CPS}_{i,t-1} + \gamma_6 (\text{PPS} * \text{CPS})_{i,t-1} + \gamma_7 \text{Market to Book}_{i,t} \\ &+ \gamma_8 \text{Market Cap}_{i,t} + \gamma_9 \text{Sale}_{i,t} + \gamma_{10} \text{CEOAge}_{i,t} + \gamma_{11} \text{Leverage}_{i,t} \\ &+ \gamma_{12} \text{ROA}_{i,t} + \gamma_{13} \text{R\&D}_{i,t} + \gamma_{14} \text{CAPEX}_{i,t} + \epsilon_{i,t}, \qquad (5)\end{aligned}$$

where, the subscript i, t denotes the firm i in year t. All the variables have the same definitions as above.

3.3.3 Main effects vs Interaction effects

Six of the twelve regressions from the two parts of the analyses (column 1, 2, 4 in both Table 3 and 4) analyze the stand-alone association of PPS and CPS to firm performance measured by Tobin's *q* and annual stock return. As for the interaction effect, it is important to have both statistically significant product term (i.e., PPS × CPS, in my study) and individual terms (i.e., PPS and CPS) as documented by Balli and Sørensen (2013).

Initially I ask what happens to the association of PPS to firm performance in the presence of CPS when PPS and CPS are controlled for the previous year. Hence, I conduct the analysis on equation 5—since the estimates (in column 6 of Table 4) satisfy the conditions for the interaction effect suggested by Balli and Sørensen (2013)—by fixing the lag terms of PPS, CPS at four different situations: (1) high lagged PPS and high lagged CPS, (2) high lagged PPS and low lagged CPS, (3) low lagged PPS and high lagged CPS, (4) low lagged PPS and low lagged CPS. Calculation is shown in Figure 2. High PPS and CPS (both current and lagged) levels are defined as one standard deviation higher than their median terms while low levels mean one standard deviation lower than their median terms. This assessment evaluates if the relationship of PPS to firm performance remains the same in the presence of different current year CPS levels when controlling for the fixed lagged values of PPS and CPS levels. If the association of PPS to firm performance is not affected by the different current year CPS levels, it would be an indication for the interaction effect (since lagged values are controlled at all possible scenarios).

It remains a question as to what happens to the association of PPS to firm performance in the presence of CEO dominance when I do not control for fixed levels (high or, low) of lagged values of PPS and CPS, and let it remain same as to the current levels (high or, low) of PPS, CPS. That is, I try to understand what happens to the association of PPS to firm performance in the presence of different current year CPS levels (high and low) when the PPS and the CPS is high/low/high-low/low-high for two consecutive years. I start by taking high and low levels of PPS and CPS (and their lagged values) that are one standard deviation away from their median terms to plug them into equation 5 along with the mean values of statistically significant control variables to find four different stock returns. Calculation is shown in Figure 3. To check the marginal change, I further increase the boundary of PPS and CPS (and lagged PPS and CPS) levels by taking them two (also, three) standard deviation away from their median terms, and conduct similar analyses.

4 Results

Table 3 reports parameter estimates of the six OLS models (column 1-6) that comprise the first part of the analyses. Estimates from the first row in column 1-6 show that PPS is positively associated with firm performance at the 1% level of significance, being consistent with the literature. In addition, I note that there is no significant relationship between Tobin's *q* and the lagged values of PPS. I find statistically significant (at 1%) estimates of CPS in column 2 and 4, which shows a negative association to firm value, being consistent with the literature. In addition, estimates from column 4 and 5 (significant at 1%) indicate that lagged value of CPS also has a negative relation to firm value. Overall, from the first part, I note that PPS holds positive association with Tobin's *q*, while CPS has an inverse relationship, showing great congruence with prior literature.

Regarding the interaction effect, Table 3 shows that the product terms are statistically significant at the 1% level in column 3 and 5, and at the 10% level in column 6. However, CPS is statistically insignificant in these cases. Hence, I do not find any significant result to support the first hypothesis (*H1a*) at this point.

Estimates from the second part of the analyses are reported in Table 4. Except for CPS in second column, I find that while PPS is positively related to stock return performance, CPS is negatively related to it in all cases. The findings are consistent with those in the literature that formulates such stand-alone associations (e.g., Bebchuk et al., 2011; Graefe-Anderson et al., 2018; Pyo & Abedin, 2017).

Estimates from Table 4 also show that the product terms are statistically significant at the 5%, 1%, and 10% levels in columns 3, 5, and 6, respectively. Confirming an indication for the interaction effect, individual components i.e., PPS and CPS also show significant associations (positive and negative respectively) in column 5 and 6. Analysis of column 6 (that satisfies the conditions for the interaction effect) is performed to review the association of PPS levels to firm performance in the presence of different current year CPS levels by fixing the lag terms of high and low PPS, CPS at four different scenarios. The analysis shows that the association of PPS to firm performance in the presence of CPS levels (high and low) remains the same (positive, in particular), portrayed by the four panels in Figure 2, which is a strong indication and support for the interaction effect.

Further assessment of column 6 reveals significant interaction effect when keeping the lagged values of (high or, low) PPS, CPS similar (i.e., uncontrolled) as to their current levels (high or, low). Left panel of Figure 3 shows how different current year CPS levels affect the association of PPS to firm performance, supporting the second part of the first hypothesis (*H1b*). The graph shows that when CPS is 1 standard deviation (0.11) higher than its median term (0.38), annual stock return improves from -10.70% to -3.60%, indicating a 66.56% increase because of a rise in PPS (log) from 3.73 to 6.95. However, the graph also indicates that when CPS is 1 standard deviation lower than its median, annual return changes from -6.60% to -3.30%, a 50.62% increase for the same change in PPS levels, confirming the impact of CPS levels and supporting *H1b*.

Additional investigations on column 6 by increasing the boundary of PPS and CPS (and lagged PPS and CPS) levels i.e., by taking them two (also, three for extreme cases) standard deviation away from their median terms expose the interaction effect to be more acute. Center panel of Figure 3 portrays that while high level of CPS is present, changing PPS level from low to high increases stock return performance—supporting the second hypothesis (*H2*)—and at low level of CPS, effect of PPS to firm performance diminishes (and opposite in extreme cases). More specifically, for a same upgrade in PPS (log) from 2.12 to 8.56 I observe two different cases. First, when CPS is two standard deviation higher than its median term (defined as high CPS) annual return changes from -17.3% to 0.80%, revealing a 104.45% increase. Second, when CPS is two standard deviation lower than the median (defined as low CPS), stock return changes from -5.30% to -2.40%, indicating a 54.94% increase. Influenced by CPS levels, this variation in firm performance for the same changes in PPS levels indicates a strong interaction effect. For a more extreme case, when I look into high and low PPS, CPS that are 3 standard deviation away from the medians (right panel of Figure 3), I find that for the same changes in PPS levels, stock return rather decreases by 65.61% when CPS is low compared to an increase by 127.25% when CPS is high, revealing a strong and opposite impact of CPS levels. However, when PPS, CPS are taken 3 standard deviation away from medians to be defined as high (low) PPS, CPS levels, their values stand at 10.16 (0.51) and 0.72 (0.05) respectively while their maximum (minimum) values are 13.47 (-11.40) and 0.71 (0.08) respectively in my sample (summary statistics in Table 1). I consider this case to be extreme as the ‘low CPS’ (0.05) is lower than the minimum CPS (0.08) from my sample, and hence, do not theorize that the extreme CPS levels have opposite effect on the association of PPS to firm performance.

In summary, estimates from the stand-alone cases (i.e., without considering the product terms for the interaction effect) from columns 1, 2, 4 in both Table 3 and 4 indicate that PPS shows a positive and CPS shows a negative association to firm performance, both of which are aligned with the literature. However, considering the interaction effect, the above statement cannot be given confidently.

To obtain economic implications from coefficients above, I compute the impact of incentive compensation in dollar terms on firm performance for two groups: more dominant CEOs and less dominant CEOs. More precisely, an increase of $966,558 (one-tenth of standard deviation) in PPS for a CEO whose CPS is 0.49 (more dominant CEO), would likely to be reflected in 9.50% increase in annual stock returns whereas an identical increase in incentive amount for a CEO whose CPS is 0.27 (less dominant CEO) would likely to be reflected in only 6.56% increase in annual stock returns. As the study finds positive impact of incentives on firm performance, it agrees on the optimal contracting theory, which advocates executive incentive contracts to maximize shareholders’ value. However, it illustrates that stand-alone associations of either pay-performance sensitivity or CEO pay slice to firm performance might be inadequate in understanding their impacts on firm performance.

5 Robustness

I conduct robustness checks by addressing the potential endogeneity issues in equation 5 that unveils the interaction effect. These endogeneity issues could be present due to several factors. First, when studying firm value associations by exploring CPS, it is important to understand that CPS itself could be determined by factors that are also related to firm value

(Bebchuk et al., 2011). Second, several studies (Gomes & Schmid, 2010; Hu & Gong, 2018) suggest links between leverage and stock returns. Stock market also reacts when companies undertake new projects (Bajo et al., 1998; Burton et al., 1999). Jensen and Meckling (1976) exhibit how managers could forego positive NPV projects provided a limited or no ownership in the firm, and multiple studies (Jensen & Murphy, 1990; Lee et al., 2008; Murphy, 1985) argue that this problem is attenuated when equity-based compensation; i.e., ownership is offered to these managers. While positive NPV projects promise to enhance firm performance (indicated by positive stock returns, the dependent variable in this study), they also increase the leverage of firms (Graefe-Anderson et al., 2018). These issues raise potential concerns on the correlation between leverage, an explanatory variable, and the error term.

Following the method of Wooldridge (2002), I control for the above endogeneity concerns by employing instrumental variables (IV) with a two-stage least square (2SLS) estimation procedure. In the first stage, I introduce IVs which are related to the potential endogenous variables: CPS and leverage, but unrelated to the stock returns, the dependent variable.

Equation 6 and 7 display the first stage of the estimation where CPS and leverage are the dependent variables in two separate OLS models. To account for the endogeneity of CPS, I add industry median CPS (InMedCPS) i.e., median CPS in the four-digit standard industrial classification group (SIC) as an IV following Bebchuk et al. (2011). To address the endogeneity of leverage, I add Marginal tax rate before interest deductions (MTBI) as an IV following Givoly et al. (1992) as mentioned in Graefe-Anderson et al. (2018). Other control variables follow equation 5.

$$\begin{aligned}\mathrm{CPS}_{i,t} = \gamma_0 + \gamma_1 \mathrm{PPS}_{i,t} + \gamma_2 (\mathrm{PPS} * \mathrm{CPS})_{i,t} + \gamma_3 \mathrm{PPS}_{i,t-1} + \gamma_4 \mathrm{CPS}_{i,t-1} \\ + \gamma_5 (\mathrm{PPS} * \mathrm{CPS})_{i,t-1} + \gamma_6 \text{Market to Book}_{i,t} + \gamma_7 \text{Market Cap}_{i,t} \\ + \gamma_8 \mathrm{Sale}_{i,t} + \gamma_9 \mathrm{CEOAge}_{i,t} + \gamma_{10} \mathrm{ROA}_{i,t} + \gamma_{11} \mathrm{R\&D}_{i,t} \\ + \gamma_{12} \mathrm{CAPEX}_{i,t} + \gamma_{13} \mathrm{InMedCPS}_{t} + \gamma_{14} \mathrm{MTBI}_{i,t} + \epsilon_{i,t},\end{aligned} \quad (6)$$

$$
\begin{aligned}
\text{Leverage}_{i,t} = {} & \gamma_0 + \gamma_1 \text{PPS}_{i,t} + \gamma_2 (\text{PPS} * \text{CPS})_{i,t} + \gamma_3 \text{PPS}_{i,t-1} + \gamma_4 \text{CPS}_{i,t-1} \\
& + \gamma_5 (\text{PPS} * \text{CPS})_{i,t-1} + \gamma_6 \text{Market to Book}_{i,t} + \gamma_7 \text{Market Cap}_{i,t} \\
& + \gamma_8 \text{Sale}_{i,t} + \gamma_9 \text{CEOAge}_{i,t} + \gamma_{10} \text{ROA}_{i,t} + \gamma_{11} \text{R\&D}_{i,t} \\
& + \gamma_{12} \text{CAPEX}_{i,t} + \gamma_{13} \text{InMedCPS}_t + \gamma_{14} \text{MTBI}_{i,t} + \epsilon_{i,t},
\end{aligned} \tag{7}
$$

where, InMedCPS_t is the industry median CPS in the four-digit SIC group in time t; $\text{MTBI}_{i,t}$ is the marginal tax rate before interest expense of firm i in time t. Other variables have the same definitions as before.

In the second stage, I regress annual stock return on the fitted value of CPS and leverage derived in the first stage. Equation 8 shows the model.

$$
\begin{aligned}
\text{Stock Return}_{i,t} = {} & \gamma_0 + \gamma_1 \text{PPS}_{i,t} + \gamma_2 \widehat{\text{CPS}}_{i,t} + \gamma_3 (\text{PPS} * \text{CPS})_{i,t} + \gamma_4 \text{PPS}_{i,t-1} \\
& + \gamma_5 \text{CPS}_{i,t-1} + \gamma_6 (\text{PPS} * \text{CPS})_{i,t-1} + \gamma_7 \text{Market to Book}_{i,t} \\
& + \gamma_8 \text{Market Cap}_{i,t} + \gamma_9 \text{Sale}_{i,t} + \gamma_{10} \text{CEOAge}_{i,t} + \gamma_{11} \widehat{\text{Leverage}}_{i,t} \\
& + \gamma_{12} \text{ROA}_{i,t} + \gamma_{13} \text{R\&D}_{i,t} + \gamma_{14} \text{CAPEX}_{i,t} + \epsilon_{i,t},
\end{aligned} \tag{8}
$$

where, $\widehat{\text{CPS}}_{i,t}$ is the fitted value of CEO pay slice of the CEO of firm i in time t; $\widehat{\text{Leverage}}_{i,t}$ is the fitted value of leverage of firm i in year t. Other variables are defined similarly as before.

Table 5 reports parameter estimates from the first stage of the 2SLS estimation of stock return performance. Statistical significance and the signs of the estimates of the IVs confirm that they are indeed strong instruments. For instance, coefficient of InMedCPS is positive and statistically significant at 1% level in both OLS models. Although MTBI is statistically insignificant when CPS is the dependent variable, it is significant at 1% level (and negatively associated) while leverage is the dependent variable; which is not unexpected since the purpose of introducing MTBI is to account for leverage, not for CPS.

Estimates from the second stage in Table 6 indicate that prior findings in Table 3 and 4 hold with strong statistical significance. The results show that PPS is positively associated with firm performance while the association of CPS is negative. Both the associations are statistically significant at the 1% level. Most importantly, the product term i.e., the interaction effect is also significant at the 1% level. Hence, this study suggests that stand-alone associations of either pay-performance sensitivity or, executive dominance to firm performance is inadequate in understanding the firm value associations. As an additional robustness check, I account for the year effect and find that these results hold to the same level of significance.

6 Conclusion

Prior literature suggests that pay-performance sensitivity (PPS) as a measure of executive incentive is positively associated with firm performance while CEO pay slice (CPS) as a measure of executive dominance is negatively linked to firm value. This study conducts an empirical investigation on executive pay for performance in the presence of executive dominance, and shows that determining such stand-alone associations might be insufficient in optimizing firm values because of an unexplored interaction effect between executive incentive and executive dominance.

This study considers multiple factors from a different perspective compared to prior studies. Firstly, to capture the compensation component it simultaneously considers the incentive component measured by PPS and the dominance or the pay-heterogeneity component measured by CPS instead of focusing only on incentives or cash compensation. Secondly, the timeline 1992-2019 is selected for this study to include the accelerated CEO pay in the early 1990s and to assess firm performance in terms of stock returns during the 2008 financial crisis. Thirdly and most importantly, this study considers the product term of PPS and CPS to look into the interaction effect which has not been considered in prior studies.

Collecting compensation and firm related data from Execucomp and Compustat, and stock price information from CRSP, this study conducts the analysis in two parts. First, Tobin's q as a measure of firm performance is regressed on PPS, and CPS along with other standard control variables. Second, annual stock return as a measure of firm performance is considered and similar analyses are performed. Analysis from multiple OLS models suggests while high level of CPS is present, changing PPS level from low to high increases firm value but at low level of CPS, impact of PPS declines. To address the potential endogeneity issues, I conduct robustness check by employing instrumental variables (IV) with a two-stage least square (2SLS) estimation procedure. Estimates indicate that original findings hold with strong statistical significance. As an additional robustness check, I account for the year effect and find that the results still stand to the same level of significance. Agreeing on the optimal contracting theory, these results add new perspectives to the literature based on the interaction effect between CEO incentives measured by pay-performance sensitivity and CEO dominance measured by CEO pay slice, and opens opportunity for further investigations on the optimal contracts.

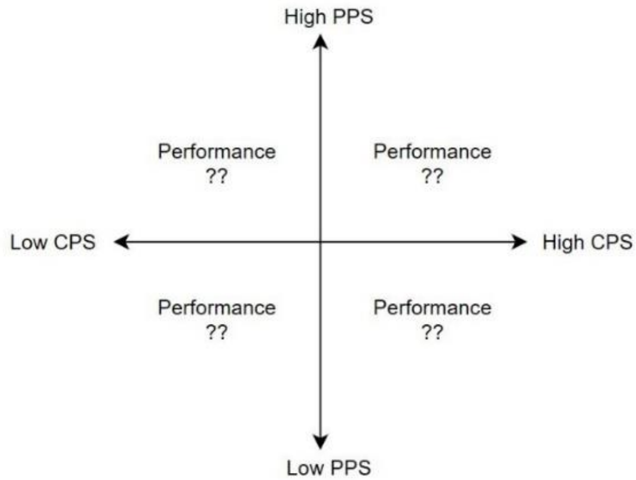

Figure 1*: Prospective interaction between PPS and CPS.*

The figure portrays how this study analyzes the interaction effect by considering each quadrant.

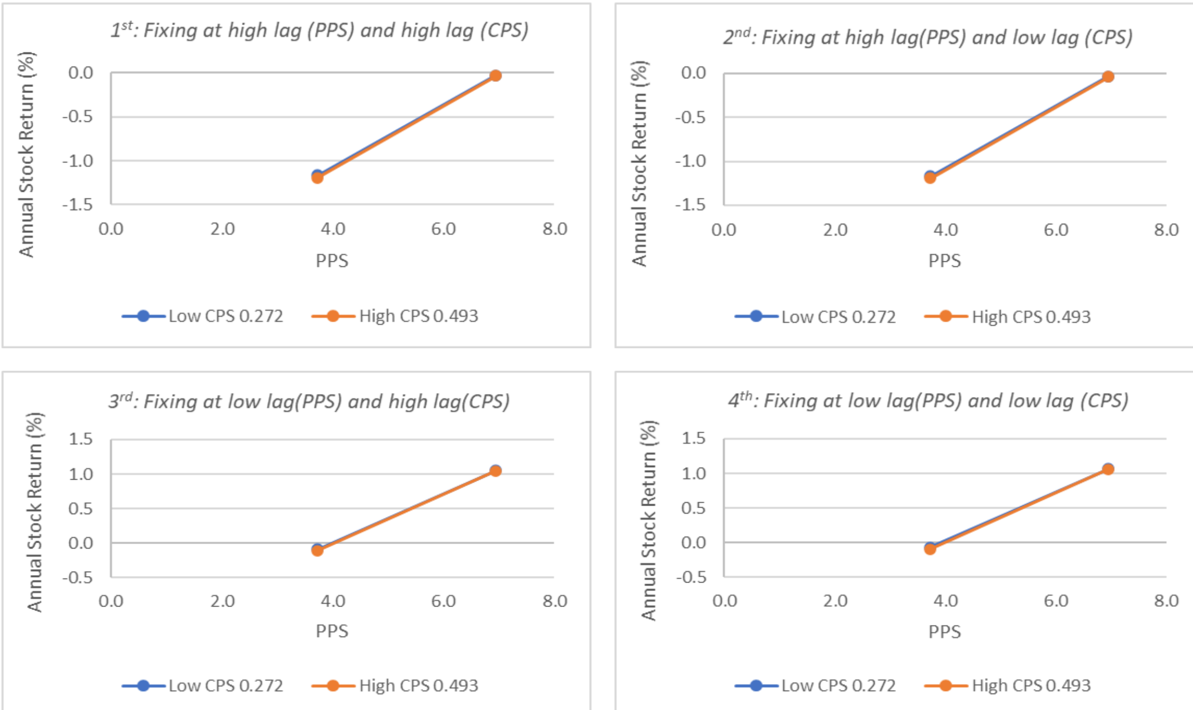

Figure 2*: Analyzing the association of PPS with Firm performance.*

Portrayed by the four panels in the figure above, the analysis on equation 5 (estimates in column 6 of Table 4) shows that the association of PPS to firm performance in the presence of different current year CPS levels (high and low) remains the same when controlling for certain lagged values of PPS and CPS. X-axis represents PPS which is the natural log of pay-performance sensitivity, and Y-axis represents annual stock returns (in %). Calculation is shown in the table below. This table calculates four different stock returns by fixing the lag terms of high and low PPS, CPS at four different scenarios: (1) high lagged PPS and high lagged CPS, (2) high lagged PPS and low lagged CPS, (3) low lagged PPS and high lagged CPS, (4) low lagged PPS and low lagged CPS. High PPS and CPS (also, lagged PPS, CPS) levels are defined as one standard deviation higher than their median terms while low levels mean one standard deviation lower than their median terms.

		Annual Stock Returns (%)							
		1st		2nd		3rd		4th	
		Low CPS (0.272)	High CPS (0.493)	Low CPS (0.272)	High CPS (0.493)	Low CPS (0.272)	High CPS (0.493)	Low CPS (0.272)	High CPS (0.493)
Low PPS	(3.729)	-1.166	-1.190	-1.168	-1.192	-0.083	-0.107	-0.066	-0.090
High PPS	(6.947)	-0.030	-0.036	-0.033	-0.038	1.053	1.047	1.069	1.064

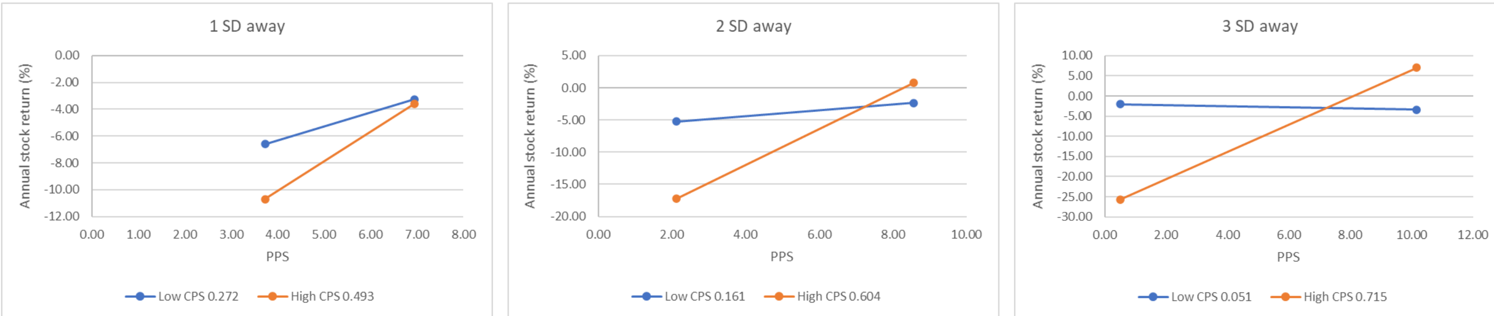

***Figure 3**: Observation of the interaction effect.*

X-axis represents PPS which is the natural log of pay-performance sensitivity, and Y-axis represents annual stock returns (in %). Calculation is shown in the table below. High PPS and CPS (also true for lagged PPS and CPS) levels are defined as one standard deviation higher than their median terms while low levels mean one standard deviation lower than their median terms. To check the marginal effect, I further increase the boundary of PPS and CPS (and lagged PPS and CPS) levels by taking them two (and three) standard deviation away from their median terms. Mean values of other control variables (which are statistically significant) are considered to examine the effect.

Annual Stock Returns (%)			
		Low CPS (0.161)	High CPS (0.604)
Low PPS	(2.120)	-5.265	-17.265
High PPS	(8.556)	-2.373	0.769

Putting those values in equation 5 (estimates in column 6 of Table 4), this table calculates stock returns at high and low PPS, CPS levels (which are 2SD away from their median terms). Center panel of Figure 3 portrays that while high level of CPS is present, changing PPS level from low to high improves stock return performance, and at low level of CPS, stock return performance rather starts to decline (declines in the right panel) for the same changes in PPS levels.

Table 1: Summary statistics

This table provides descriptive statistics on CEO and firm characteristics for the 1992–2019 sample period. Data on executive compensation, firm specific information and stock prices are obtained from Execucomp, Compustat and CRSP databases respectively. Risk-free rates are collected from the Federal Reserve. The sample contain data of 32,042 CEO year observations (representing 3,518 unique firms having 7,265 unique CEOs). CEO pay slice (CPS) is the fraction of the total compensation (Execucomp item TDC1) of the group of top-five executives that is received by the Chief executive officer (CEO). Delta (pay-performance sensitivity) is the dollar change in the executive's wealth for a 1% change in stock price. Tobin's *q* is defined as the market value of equity plus the book value of assets minus the book value of equity, all divided by the book value of assets. MtB or, market-to-book is the market value of assets divided by their book value. Annual return is the annual stock return. Leverage is total debt divided by book value of assets. ROA is the return on assets computed as operating income divided by book value of assets. R&D is research and development expenditure scaled by assets. Capex is capital expenditure net of sales of property, plant, and equipment, also scaled by assets. The variables have been winsorized at 1st and 99th percentile levels.

Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**Q1**	**Median**	**Q3**	**Maximum**
Tobin's *q*	32,042	1.94	1.50	0.42	1.11	1.46	2.15	17.30
Annual Return	32,042	0.17	0.45	-0.89	-0.09	0.12	0.35	2.74
CPS	32,042	0.38	0.11	0.08	0.31	0.38	0.45	0.71
Delta (PPS) ($000s)	32,042	1,086	9,666	0.000011	78	208	572	709,830
MtB	32,042	3.27	4.48	0.16	1.36	2.12	3.52	52.40
Market cap ($M)	32,042	6,197	10,173	3	700	1,919	6,047	41,486
Sales ($M)	32,042	4,889	9,033	28	539	1,464	4,492	47,142
CEO age (years)	32,042	56.12	7.22	28.00	51.00	56.00	61.00	91.00
Leverage	32,042	0.13	0.17	0.00	0.00	0.00	0.25	0.87
ROA	32,042	0.11	0.10	-0.40	0.06	0.12	0.17	0.43
R&D	32,042	0.03	0.06	0.00	0.00	0.00	0.03	1.15
Capex	32,042	0.05	0.05	-0.04	0.01	0.03	0.06	0.44

Table 2: Sample correlations of key variables

This table reports the sample correlations of key variables used in the analysis of the impact and association of executive incentives and executive dominance on firm performance. PPS is the natural log of pay-performance sensitivity; Market Cap is the natural log of market capitalization; Sales is the natural log of annual sales. MtB or, market-to-book is the market value of assets divided by their book value. Leverage is total debt divided by book value of assets. ROA is the return on assets computed as operating income divided by book value of assets. R&D is research and development expenditure scaled by assets. Capex is capital expenditure net of sales of property, plant, and equipment, also scaled by assets. The sample contain data of 32,042 CEO year observations (representing 3,518 unique firms having 7,265 unique CEOs) for the 1992-2019 time period. Italic numbers indicate 1% level of significance.

Variables	**PPS**	**CPS**	**MtB**	**Market Cap**	**Sales**	**CEO age**	**Leverage**	**ROA**	**R&D**	**Capex**
PPS	1									
CPS	*0.075*	1								
MtB	*0.223*	0.012	1							
Market Cap	*0.537*	*0.129*	*0.199*	1						
Sales	*0.362*	*0.131*	-0.004	*0.780*	1					
CEO age	*0.141*	0.008	*-0.051*	*0.070*	*0.112*	1				
Leverage	*0.035*	*0.120*	*0.130*	*0.087*	*0.195*	-0.002	1			
ROA	*0.173*	*0.036*	*0.202*	*0.134*	*0.149*	-0.005	*0.095*	1		
R&D	0.003	*-0.052*	*0.212*	*-0.108*	*-0.282*	*-0.108*	*-0.075*	*-0.149*	1	
Capex	-0.002	*-0.043*	*0.036*	*-0.062*	*-0.057*	*-0.038*	*0.042*	*0.352*	*-0.016*	1

Table 3: Dependent variable: Tobin's *q*

This table provides parameter estimates from regressing Tobin's *q* on the explanatory variables for the six OLS models. Presented in parentheses are the *t*-statistics. Intercepts are not reported. PPS is the natural log of pay-performance sensitivity; Market Cap is the natural log of market capitalization; Sales is the natural log of annual sales. Control variables are explained in data section and summary statistics has been provided in Table 1. Number of observations in the regressions varies due to data limitation. For instance, data are missing for the lagged values of the variables for the year 1992 (the beginning year of the sample). ***, **, * indicate 1%, 5%, 10% level of significance respectively.

	Tobin's *q*					
	(1)	(2)	(3)	(4)	(5)	(6)
PPS	0.1291***	0.1161***	0.1471***	0.13063***	0.1582***	0.1521***
	(13.40)	*(30.35)*	*(14.75)*	*(13.39)*	*(10.55)*	*(9.52)*
CPS		-0.4149***	0.0905	-0.3161***	0.1393	0.0529
		(-8.97)	*(0.58)*	*(-5.31)*	*(0.71)*	*(0.25)*
PPS X CPS			-0.0879***		-0.0765***	-0.0607*
			(-3.37)		*(-2.42)*	*(-1.75)*
Lag (PPS)	-0.0093			-0.0117	-0.0116	0.0023
	(-1.03)			*(-1.27)*	*(-1.27)*	*(0.15)*
Lag (CPS)				-0.2843***	-0.2754***	-0.0664
				(-4.87)	*(-4.71)*	*(-0.34)*
Lag (PPS) X Lag (CPS)						-0.0373
						(-1.12)
MtB	0.1532***	0.1553***	0.1554***	0.1509***	0.1511***	0.1509***
	(106.45)	*(122.77)*	*(122.83)*	*(104.26)*	*(104.30)*	*(104.29)*
Market Cap	0.3345***	0.3492***	0.3495***	0.3393***	0.3392***	0.3393***
	(49.18)	*(57.44)*	*(57.49)*	*(49.55)*	*(49.54)*	*(49.54)*
Sales	-0.4047***	-0.4205***	-0.4203***	-0.4017***	-0.4014***	-0.4014***
	(-61.89)	*(-72.14)*	*(-72.09)*	*(-61.00)*	*(-60.96)*	*(-60.95)*
CEO Age	-0.0058***	-0.0073***	-0.0073***	-0.0061***	-0.0061***	-0.0061***
	(-7.17)	*(-10.31)*	*(-10.27)*	*(-7.56)*	*(-7.55)*	*(-7.55)*
Leverage	-0.8578***	-0.8485***	-0.8484***	-0.8082***	-0.8091***	-0.8092***
	(-25.40)	*(-27.60)*	*(-27.60)*	*(-23.63)*	*(-23.65)*	*(-23.65)*
ROA	4.3267***	4.0641***	4.0631***	4.3587***	4.3566***	4.3566***
	(66.70)	*(70.90)*	*(70.89)*	*(66.62)*	*(66.59)*	*(66.59)*
R&D	5.0349***	4.8328***	4.8371***	4.9915***	4.9943***	4.9948***
	(49.62)	*(53.02)*	*(53.07)*	*(48.20)*	*(48.23)*	*(48.24)*
Capex	-0.5118***	-0.3536***	-0.3548***	-0.5585***	-0.5584***	-0.5592***
	(-4.38)	*(-3.42)*	*(-3.44)*	*(-4.71)*	*(-4.71)*	*(-4.72)*
Observations	24,441	32,042	32,042	23,975	23,975	23,975
R^2	64%	63%	63%	64%	64%	64%

Table 4: Dependent variable: Annual stock return

This table reports parameter estimates from regressing annual stock return on the explanatory variables for the six OLS models. Presented in parentheses are the *t*-statistics. Intercepts are not reported. PPS is the natural log of pay-performance sensitivity; Market Cap is the natural log of market capitalization; Sales is the natural log of annual sales. Control variables are explained in data section and summary statistics has been provided in Table 1. Number of observations in the regressions varies due to data limitation. For instance, data is missing for the lagged values of the variables for the year 1992 (the beginning year of the sample). ***, **, * indicate 1%, 5%, 10% level of significance respectively.

	Annual Return					
	(1)	(2)	(3)	(4)	(5)	(6)
PPS	0.3532***	0.0304***	0.0217***	0.3548***	0.3411***	0.3456***
	(91.77)	*(16.93)*	*(4.64)*	*(90.81)*	*(56.80)*	*(54.04)*
CPS		0.0973***	-0.0437	-0.0448**	-0.2722***	-0.2077**
		(4.48)	*(-0.59)*	*(-1.88)*	*(-3.45)*	*(-2.45)*
PPS X CPS			0.0245**		0.0382***	0.0264*
			(2.00)		*(3.02)*	*(1.90)*
Lag (PPS)	-0.3429***			-0.3449***	-0.3449***	-0.3554***
	(-94.76)			*(-93.49)*	*(-93.51)*	*(-57.08)*
Lag (CPS)				-0.0224	-0.0268	-0.1828**
				(-0.96)	*(-1.15)*	*(-2.33)*
Lag (PPS) X Lag (CPS)						0.0277**
						(2.08)
MtB	0.0120***	0.0152***	0.0152***	0.0119***	0.0118***	0.0119***
	(20.92)	*(25.63)*	*(25.60)*	*(20.52)*	*(20.43)*	*(20.44)*
Market Cap	0.0535***	0.0759***	0.0758***	0.0532***	0.0532***	0.0532***
	(19.69)	*(26.58)*	*(26.56)*	*(19.39)*	*(19.41)*	*(19.40)*
Sales	-0.0603***	-0.0901***	-0.0902***	-0.0595***	-0.0596***	-0.0596***
	(-23.08)	*(-32.93)*	*(-32.96)*	*(-22.55)*	*(-22.60)*	*(-22.61)*
CEO Age	0.0005	-0.0019***	-0.0019***	0.0005*	0.0005*	0.0005*
	(1.49)	*(-5.77)*	*(-5.80)*	*(1.66)*	*(1.65)*	*(1.66)*
Leverage	-0.0705***	-0.1344***	-0.1344***	-0.0656***	-0.0652***	-0.0651***
	(-5.23)	*(-9.31)*	*(-9.31)*	*(-4.79)*	*(-4.76)*	*(-4.75)*
ROA	0.2196***	0.3797***	0.3799***	0.2148***	0.2158***	0.2159***
	(8.47)	*(14.11)*	*(14.12)*	*(8.20)*	*(8.24)*	*(8.24)*
R&D	-0.1329***	-0.3804***	-0.3816***	-0.1279***	-0.1294**	-0.1297***
	(-3.28)	*(-8.89)*	*(-8.92)*	*(-3.09)*	*(-3.12)*	*(-3.13)*
Capex	-0.2780***	-0.5751***	-0.5748***	-0.2793***	-0.2793***	-0.2787***
	(-5.96)	*(-11.86)*	*(-11.86)*	*(-5.88)*	*(-5.88)*	*(-5.87)*
Observations	24,441	32,042	32,042	23,975	23,975	23,975
R^2	34%	11%	11%	34%	34%	34%

Table 5: Two-stage least square estimation: First stage

This table reports parameter estimates from the first stage of the two-stage least square estimation of stock return performance. Industry median CPS (InMedCPS) i.e., median CPS in the four-digit standard industrial classification group (SIC) and marginal tax rate before interest deductions (MTBI) are used as the instrumental variables (IV) to account for the two potential endogenous variables: CPS and leverage. Presented in parentheses are the *t*-statistics. Intercepts are not reported. PPS is the natural log of pay-performance sensitivity; Market Cap is the natural log of market capitalization; Sales is the natural log of annual sales. Control variables are explained in data section and summary statistics has been provided in Table 1. ***, **, * indicate 1%, 5%, 10% level of significance respectively.

	CPS	**Leverage**
PPS	-0.0550***	-0.0192***
	(-141.81)	*(-8.15)*
PPS X CPS	0.1551***	0.0157***
	(453.59)	*(7.56)*
Lag (PPS)	0.0194***	0.0189***
	(36.84)	*(5.94)*
Lag (CPS)	0.3256***	0.1385***
	(50.63)	*(3.55)*
Lag (PPS) X Lag (CPS)	-0.0550***	-0.0074
	(-50.88)	*(-1.13)*
MtB	-0.0002***	0.0067***
	(-3.88)	*(21.54)*
Market Cap	0.0004*	-0.0201***
	(1.66)	*(-13.04)*
Sales	-0.0001	0.0294***
	(-0.42)	*(19.96)*
CEO Age	-0.0001***	-0.0004**
	(-2.81)	*(-2.43)*
ROA	0.0091***	-0.0711***
	(3.55)	*(-4.55)*
R&D	-0.0055	-0.3336***
	(-1.42)	*(-14.29)*
Capex	-0.0051	-0.0412*
	(-1.28)	*(-1.69)*
InMedCPS	0.0520***	0.4327***
	(8.52)	*(11.69)*
MTBI	-0.0063	-0.2975***
	(-1.30)	*(-10.09)*
Observations	17,901	17,901
R^2	93%	91%

Table 6: Two-stage least square estimation: Second stage

This table reports parameter estimates from the second stage of the two-stage least square estimation of stock return performance. CPS and leverage have been instrumented by industry median CPS (InMedCPS) i.e., median CPS in the four-digit standard industrial classification group (SIC) and marginal tax rate before interest deductions (MTBI). That is, fitted values of CPS and leverage derived in the first stage are plugged into the second stage along with other control variables. Presented in parentheses are the *t*-statistics. Intercepts are not reported. PPS is the natural log of pay-performance sensitivity; Market Cap is the natural log of market capitalization; Sales is the natural log of annual sales. Control variables are explained in data section and summary statistics has been provided in Table 1. Number of observations in the regression (compared to equation 5 i.e., column 6 of Table 4) varies due to data limitation (missing values of instrumental variables). ***, **, * indicate 1%, 5%, 10% level of significance respectively.

	Annual Return
PPS	0.4036***
	(59.92)
CPS	-5.5913***
	(-2.90)
PPS X CPS	0.7362***
	(2.85)
Lag (PPS)	-0.5588***
	(-10.32)
Lag (CPS)	1.2694**
	(2.42)
Lag (PPS) X Lag (CPS)	-0.1886***
	(-2.48)
MtB	-0.0008
	(-0.19)
Market Cap	0.0454***
	(4.61)
Sales	-0.0816***
	(-11.40)
CEO Age	0.0005
	(0.94)
Leverage	1.2751***
	(3.47)
ROA	0.2507***
	(4.78)
R&D	0.1751**
	(1.27)
Capex	-0.1599*
	(-1.90)
Observations	17,901
R^2	26%

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Appendix

Table 7: Description of variables

This table defines the variables used in my analysis.

Variable name	Description
Tobin's *q*	As a measure of firm value, Tobin's *q* is defined as the market value of equity plus the book value of assets minus the book value of equity, all divided by the book value of assets
Annual return	Annualized stock return is also used as a measure of firm performance
CPS	The fraction of the total compensation (Execucomp item TDC1) of top-five executives that is received by the chief executive officer (CEO)
PPS	PPS is the dollar change in the executive's wealth for a 1% change in stock price, also known as compensation Delta. Natural log is taken in regressions to avoid scale difference
Market-to-book (MtB)	Market value of assets divided by their book value
Market capitalization	Year-end market value of outstanding shares of a company, calculated by stock price multiplied by the number of shares outstanding. Natural log is taken in regressions to avoid scale difference
Sales	Annual sales, in millions. Natural log is taken in regressions to avoid scale difference
CEO age	CEO's age in years
Book leverage	Total debt divided by the book value of assets
ROA	Return on assets computed as operating income divided by book value of assets
R&D	Research and development expenditure scaled by assets
Capex	Capital expenditure net of sales of property, plant, and equipment scaled by assets