Tournament Incentives and Labor Investment Efficiency

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Abstract

This study examines the impact of promotion-based tournament incentives on corporate labor investment efficiency. We find tournament incentives, measured as the pay gap between the CEO and the next layer of senior executives, lead to inefficient labor investments, measured as the absolute deviation from optimal net hiring warranted by firm fundamentals. Further analysis shows that the positive relationship between tournament incentives and labor investment inefficiency is weakened the firm appoints a new CEO or operates in industries with a high degree of product similarity and market concentration. Our main findings are robust to the alternative explanation, endogeneity concerns, and alternative measures. Overall, our evidence is consistent with the dysfunctional view of tournament incentives and highlights that senior executives play an influential role in labor investments.

EFMA Classification: 110 150 190

Keywords: Labor investment, Tournament incentives, Pay Gap, Investment efficiency

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1. Introduction

Labor input has been perceptive as one of the most crucial determinants of production in economic theory. Research shows that labor costs represent approximately two-thirds of the total costs of producing goods and services (Hamermesh, 1995, Bernanke, 2004). Prior research has shown that firms can obtain competitive advantages by designing efficient labor investment strategies (Becker, 1962, Lazear and Shaw, 2007, Ellul et al., 2018). Optimal labor investment enhances earnings generation and improves firm productivity (Merz and Yashiv, 2007), while divergence from optimal labor investment distorts corporate development and destroys firm value (Khedmati et al., 2019, Stein, 1989). Labor investments, parallel to standard non-labor investments (i.e., capital expenditure, research and development), are corporate decisions made by managers. A fast-growing body of literature has established that stock price informativeness (Ben-Nasr and Alshwer, 2016), CEO-director ties (Khedmati et al., 2019), and CEO equity-based compensation (Sualihu et al., 2021) can influence labor investment efficiency through their effects on managerial behaviors. Although prior studies have generated important insights, they have not directly examined how behaviors of senior executives other than the CEO can directly affect labor investment.

The senior management team, as an integral element, is the decision-making unit that determines firm human resource policy, including the selection procedure and recruitment policy (Boone and Hendriks, 2009, Hambrick, 1994). Other than the CEO, senior executives are heavily involved in labor recruitment decisions.[1] Dale (2003) notes that recruitment decisions are amongst the most crucial decisions top managers need to make. While the CEO responds exclusively to performance-based incentives, non-CEO executives (i.e., VPs) are heavily influenced by promotion-based incentives stemming from the tournament for the CEO

[1] Anecdotal evidence suggests that in a standard hiring process, the recruiter or the human resource managers may provide a shortlist of promising candidates, it is still up to the hiring managers (i.e., the CEO or the relevant top executive) to evaluate the candidate's ability and to make the final recruitment decision.

position (e.g., Kubick and Masli 2016; Haß et al. 2015). Yet, the research to date has not systematically linked tournament incentives and labor investment. In this paper, we seek to fill the void in prior literature by examining the effect of the promotion-based tournament incentives, created by the pay gap between the CEO and non-CEO executives, on corporate labor investment efficiency.

The tournament incentive, first proposed by Lazear and Rosen (1981), argues that rank-based compensation provides employees with an impetus to work harder to move up the corporate ladder for higher compensation. Due to the skewed corporate compensation structure, the largest pay gap occurs between the CEO and non-CEO executives. Since only the best relative performer will be promoted to the CEO position and receive significantly increased pay, the large pay gap serves as the ultimate prize to induce non-CEO executives to initiate greater efforts to enhance their chances of promotion. Given that business is a collective endeavor and almost every major corporate decision requires the combined efforts of the senior executive team (Hambrick, 1994), studies have shown the increased efforts from non-CEO executives have led to enhanced firm value and performance (Burns et al., 2017, Kale et al., 2009, Shen and Zhang, 2018). As over-investment in labor deplete the limited resources, whereas under-investment in labor can result in underutilization of resources and forgoing valuable projects, both of which can result in low productivity and potential punishment for the responsible manager. To increase their chance of winning the promotion-based tournament, non-CEO executives may exert more effort in studying the firm's hiring needs and assisting the CEO in setting the best labor investment strategy. Following this line of reasoning, tournament incentives can lead to more efficient labor investments.

However, the tournament incentive is not without problems and can have unintended consequences (Baker et al., 1988). Previous studies show that the tournament indeed induces more managerial efforts, but not all efforts are beneficial to the firm. For example, Goel and

Thakor (2008) theoretically predict that managers would gamble on the more extreme outcomes from riskier and larger projects to increase their chance of winning the promotion contest. Consistent with this prediction, empirical works show that the option-like payoff structure of tournaments incentives encourage managers to take excessive risk and engage in fraud activities (Kini and Williams, 2012, Haß et al., 2015), which often lead to inefficiencies in firm investments (Hvide, 2002, Gilpatric, 2009). In addition, to increase their own chance of winning, senior executives who participated in the promotion contest become less willing to corporate (Drago and Garvey, 1998, Henderson and Fredrickson, 2001) and even sabotage other competitors' performance (Harbring and Irlenbusch, 2011, Garicano and Palacios-Huerta, 2005, Masulis and Mobbs, 2011, Rajan and Wulf, 2006, Dechenaux et al., 2015). Furthermore, tournament promotion makes it difficult for firms to retain executives. Both talented managers with good outside options and managers who see a low chance of promotion would be more willing to leave the competition and join other firms (Acharya et al., 2011, Mobbs and Raheja, 2012), which disrupt firm investment and operational stability.

The optimal level of labor investment is justified by firm fundamentals (Jung et al., 2014, Ben-Nasr and Alshwer, 2016). Hence, efficient labor investment requires managers to possess an in-depth understanding of firm-specific knowledge and use the information shared by other managers to create a match between the labor input and corporate resources (Dale, 2003). Since trust and team cohesion are critical for managers to communicate information effectively and make collective decisions over corporate strategy (Agarwal et al., 2020), the reduced helping efforts and the increased fraud and sabotage activities encouraged by the tournament impede efficient information sharing and may result in inferior labor investments. In addition, as managers who tend to leave the firm refuse to learn firm-specific skills because they become less useful at another firm (Thomas, 2004, Henderson and Fredrickson, 2001, Kale et al., 2014, Chen et al., 2013), the increased turnover induced by the tournament

destabilize the team, trigger cognitive conflicts, disrupt corporate routines, create further structural inefficiencies in the knowledge sharing and damage a firm's ability to integrate human capital (Grant, 1996, Messersmith et al., 2014, Hannan and Freeman, 1984). To this end, tournament incentives can lead to inefficient labor investments.

In sum, it remains an empirical question whether the tournament incentives can induce more efficient labor investment. To answer this question and complement the previous works, we empirically examine the relation between tournament incentives for non-CEO executives and firm labor investment efficiency. We estimate the firm's optimal level of labor investment using the model developed by Pinnuck and Lillis (2007) that was modified by Khedmati et al. (2019). The absolute value of the deviation from the optimal labor investment is defined as the labor investment inefficiency. Tournament incentives are measured as the total compensation gap between the CEO and the median pay of the next layer of non-CEO executives. Using a sample of 22,426 firm-year observations from 2,372 unique US public firms over the period 1993 to 2018, we find consistent evidence showing that tournament incentives created by the pay gap are positively related to labor investment inefficiency. Controlling for variables that are known to affect labor investment efficiency, year and industry fixed effect, a one-standard-deviation increase in the pay gap centered on its mean results in a 7.9% increase in labor investment inefficiency. The results remain robust after controlling for unobserved time-invariant firm-level variables using the fixed-effect model.

While our baseline results are in line with the prediction that tournament incentives are determinantal to labor investment efficiency, concerns arise as the large pay gap between the CEO and the next layer of executives may attribute to CEO entrenchment (Bebchuk et al., 2011, Chen et al., 2013), and our results can be interpreted as entrenched CEOs make inefficient labor investments. We adopt three approaches to disentangle the influence of CEO entrenchment on the interplay between the pay gap and labor investment inefficiency to rule out this alternative

explanation. First, we explicitly control for variables that represent CEO entrenchment in our baseline analysis. Second, we control for the CEO's pay slice among top executives' total pay to proxy for the overall effect of CEO entrenchment on the pay gap (Coles et al., 2018, Li et al., 2014, Bebchuk et al., 2011). Third, we adopt a two-stage regression approach as in Chen et al. (2013) to extract the residual pay gap that is independent of CEO entrenchment as the proxy for tournament incentives. We continue to find a positive relation between tournament incentives and labor investment inefficiency.

We further confirm that inefficient labor investment is due to the tournament by examining the contextual factors that affect the relationship between tournament incentives and labor investment efficiency. Specifically, we find that the positive effect of tournament incentives is weakened when contestants in the tournament have less eager to compete for the CEO position, such as in firms that recently appointed a new CEO and in firms that operate in industries with a high degree of product similarly and market concentration.

We next decompose inefficient labor investments into over-investment and under-investment components. We show that tournament incentives can lead to both types of labor investment inefficiencies. However, after decomposing the inefficiencies further into over-hiring, under-firing, under-hiring, and over-firing, we find the effect of tournament incentives on labor investment inefficiency is mainly through hiring rather than firing, suggesting managers are reluctant to engage in firing when adjusting labor investment (Cao and Rees, 2020).

The potential endogeneity issues in executive compensation can prevent us from inferring the causality between tournament incentives and labor investment efficiency. We address endogeneity concerns in four ways. First, we employ an instrumental variable (IV) approach, in which we treat the pay gap as an endogenous variable. We use the industry average pay gap and the number of VPs in the firm as the instruments because previous studies suggest

that the optimal compensation structure varies by industry, and the tournament increase with the number of executives with the same titles (Bebchuk et al., 2011). The positive relation between tournament incentives and labor investment inefficiency holds in the IV approach. Second, we perform a propensity score matching (PSM) analysis to address the systematic differences in firm characteristics between firms with high and low tournament incentives. Our main results remain robust to the regression analysis using the matched sample. Third, despite that there lacks a direct exogenous shock in the executive compensation gap, we use the adoption of the 'Say-on-Pay'(SoP) vote from the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank) to construct a Difference-in-Differences (DiD) - continuous design to provide clearer evidence on the causal relationship between tournament incentives and labor investment inefficiency.[2] Last, although the adoption of the firm fixed effects model serves as our first attempt to address the omitted variables concerns, we estimate a long-window change-on-change analysis to maximize the temporal variations in our data and address this concern further. These analyses consistently point to a positive relationship between tournament incentives and labor investment inefficiency, alleviating the endogeneity concerns.

We conduct an additional test to rule out the concern that the link between tournament incentives and labor investment inefficiency is a by-product of inefficient non-labor investment. We follow the procedure outlined in prior work, including Ben-Nasr and Alshwer (2016) and Jung et al. (2014), to test whether contemporaneous non-labor investments in capital expenditure (CAPEX), research and development (R&D), acquisitions, and advertising drive our results. We find that irrespective of the relationship between labor investment and the four types of non-labor investments, tournament incentives remain positively related to labor

[2] We follow Atanasov and Black (2016) to use the term "DiD-continuous" to describe our identification since the SoP vote is a shock that affects all firms but affects some firms more than others.

investment inefficiency, suggesting that the tournament incentives can directly induce executives to make inefficient labor investment decisions independent of others non-labor investments.

To check the robustness of our results, we use alternative variables to proxy for tournament incentives and alternative estimations for the optimal labor investment. In addition, as executives' behavior may also be affected by performance-based incentives, we control for the CEO and average VP's performance-based incentives (Delta) and risk-taking incentives (Vega) in our analysis. Our results continue to survive in this battery of robustness checks.

The contributions of the paper to the literature are threefold. First, this study enhances our understanding of the consequences of tournament incentives. A substantial body of research has examined the association between tournament incentives and non-labor investment, such as capital, R&D, and acquisition investments (Kini and Williams, 2012, Hasan et al., 2020, Shen and Zhang, 2018). To the best of our knowledge, we are the first to bridge the research in tournament incentives and labor investment. Corporate labor investment decisions are different from non-labor investments: First, unlike the adjustment costs of other non-labor investments, which are strategically arranged and infrequently made, labor investment costs can be easily and frequently adjusted through moving, retaining, or replacing the workforce (Hamermesh, 1995), and tend to have a long-standing impact on a firm's costs and earnings (Merz and Yashiv, 2007). Second, labor investment is more challenging to plan and monitor as the firm does not own the labor but rents it from willing individuals who have the option to leave the firm in response to alternative opportunities (Donangelo, 2014). As such, labor investment decisions rely more on executives' subjective opinions and behaviors than other non-labor investments (Mo et al., 2019), and the inference drawn from non-labor investment cannot be meaningfully extrapolated to labor investment (Khedmati et al., 2019). A legacy view on labor investment suggests fewer frictions in the labor market and

insignificant labor adjustment costs (Dixit et al., 1994, Bloom, 2009). This view posits that labor investment only complements other investments and requires little or no monitoring. However, we provide clear evidence that labor investment is not an appendage of other standard non-labor investments, and managerial behaviors induced by tournament incentives can directly influence labor investments. In addition, our results add to the line of research investigating the dysfunctional consequences of the tournament incentive by showing inefficient labor investment is an unintended consequence of promotion tournament.

Second, our paper elaborates on the literature investigating the determinates of labor investment. Recent research has highlighted the importance of maintaining optimal investment in employees and found that financial reporting quality (Jung et al., 2014), stock price informativeness (Ben-Nasr and Alshwer, 2016), institutional investors horizons (Ghaly et al., 2020), employee-friendly treatment (Cao and Rees, 2020), and CEO-director ties (Khedmati et al., 2019) are crucial factors determining firm labor investment efficiency. The work closely related to ours is Sualihu et al. (2021), who show that the absolute level of the CEO's option and stock compensation can affect labor investment efficiency differently. While the prior research focuses on the CEO's influence on labor investments, we extend this line of research by recognizing that executives jointly make labor investment decisions and, thus, the rank-based promotion tournament induced by the pay gap can significantly determine labor investment efficiency.

Third, we also contribute to the evolving literature on inequity aversion, especially concerning the fair pay of employees. Excessive CEO pay has gradually become a social issue subject to growing criticism from shareholders, regulators, and social activists. For example, non-CEO executives only earn approximately 40% of the CEO (Conyon, 2006). The pay gap between the CEO and the average worker is even more significant. According to a report by Economic Policy Institute in 2019, CEO compensation has grown 940% since 1978, while the

compensation for typical workers has risen only 12% during the same period.[3] Research in this genre has shown that large pay disparities discourage employees and result in negative corporate outcomes such as lower productivity (Akerlof and Yellen, 1990), lower employee morale (Green and Zhou, 2019), and higher voluntary turnover (Faleye et al., 2013). As the rank-based tournament incentive can be one of the attributes to excessive CEO compensation, our results are consistent with the argument that inequality impairs firm operation. Hence, this paper offers implications to shareholders and regulators to set a fair and effective compensation structure to avoid harmful compentiton among corporate managers that is detrimental to firm operation and its stakeholders (i.e. employees).

The remainder of this paper proceeds as follows. The following section describes the sample, variables, and empirical strategies. Section 3 present the main empirical results. Section 4 addresses the endogeneity concerns, and Section 5 presents the robustness tests. The last section concludes the paper.

2. Sample Selection, Variable Construction, and Model Specification

2.1 Data Source and Sample

We obtain data on executive compensation between 1993 and 2018 from *ExecuComp*. Firm fundamental data are retrieved from *COMPUSTAT*. We delete financial institutions (SIC 6000 – 6999) and regulated utilities (SIC 4900 – 4999). Information on the board of directors is obtained from *BoardEx*. Stock returns are retrieved from *CRSP*. Industry labor union data is accessed from *UNIONSTATS*. The final data consists of 22,426 firm-year observations from 2,372 unique firms with non-missing data for our main analysis. We adjust all monetary terms to 2018-level using the US Consumer Price Index (CPI) index. All continuous variables are winsorized at the 1% level for both tails to mitigate the influence of outliers.

[3] See more details at https://www.epi.org/publication/ceo-compensation-2018/.

2.2 Measuring Tournament Incentives

Following Kini and Williams (2012), we measure tournament incentives using the difference between CEO pay and the next layer of senior executives. Specifically, the variable, *Ln [Pay Gap]*, is defined as the logarithm transformation of the difference between CEO total compensation and the median total pay of the next highest-paid four executives, as in Haß et al. (2015).[4] As a robustness check, we also use the Gini Index of the compensation to the highest-paid five executives (*Gini Top5*), and the coefficient of variation of executive pay to the top five executives scaled by the mean of top five executives total pay (*CV Top5*) as alternative measures for CEO pay disparity.

2.3 Measuring Inefficient Labor Investment

Labor investment is proxied by net hiring, which is the year-over-year change in the number of employees as in Benmelech et al. (2019), Ellul et al. (2018), and Pinnuck and Lillis (2007). We then follow the standard model adopted in recent labor investment literature, including Ben-Nasr and Alshwer (2016), Cao and Rees (2020), Ghaly et al. (2020), Jung et al. (2014), and Khedmati et al. (2019) to regress firm net hiring over a set of firm fundamental variables and retrieve the residual. The absolute value of the estimated residual from Eq. (1) is adopted as our measure for labor investment inefficiency (*Labor Inefficiency*). Thus, the lower the value of *Labor Inefficiency*, the higher the labor investment efficiency.

[4] To be consistent with the *CEO Pay Slice* from Bebchuk et al. (2011) when addressing the alternative explanation, we use the top five executives reported in *Execucomp* to construct *Pay Gap* as in Haß et al. (2015). However, our results are robust to use the median compensation for all executives in *Execucomp*.

$$
\begin{aligned}
Net\ Hiring_{i,t} = {} & \beta_0 + \beta_1 Sales\ Growth_{i,t-1} + \beta_2 Sales\ Growth_{i,t} + \beta_3 ROA_{i,t} \\
& + \beta_4 \Delta ROA_{i,t-1} + \beta_5 \Delta ROA_{i,t} + \beta_6 Stock\ Return_{i,t} \\
& + \beta_7 Firm\ Size\ Rank_{i,t-1} + \beta_8 Quick\ Ratio_{i,t-1} \\
& + \beta_9 \Delta Quick\ Ratio_{i,t-1} + \beta_{10} \Delta Quick_{i,t} + \beta_{11} Leverage_{i,t-1} \\
& + \beta_{12} Asset\ Turnover_{i,t-1} + \beta_{13} LossBin1_{i,t-1} + \beta_{14} LossBin2_{i,t-1} \\
& + \beta_{15} LossBin3_{i,t-1} + \beta_{16} LossBin4_{i,t-1} + \beta_{17} LossBin5_{i,t-1} + \lambda_j \\
& + \varepsilon_{i,t}
\end{aligned}
\tag{1}
$$

where *Net Hiring* is the percentage change in the total number of employees; *Sales Growth* is the year-over-year change in sales; *ROA* is the return on assets, *Stock Return* is the annualized stock return; *Firm Size Rank* is the percentile rank of the firm market value of equity; *Quick Ratio* is the sum of cash and short-term investments and total receivables to total current liabilities; *Leverage* is the long-term debt and debt in current liabilities to book value of total assets; *Asset Turnover* is the sales to book value of total assets, *LossBin1* to *LossBin5* are dummy variables set to one for every 0.005 intervals of *ROA* from 0 to -0.025. We use the Fama-French 48 industry classification and include industry fixed effects (λ) in the model to control for unobserved industry characteristics affecting net hiring.

2.4 Empirical Strategy and Control Variables

Our empirical model to estimate the effect of tournament incentives on labor investment efficiency is outlined in Eq. (2).

$$
\begin{aligned}
Labor\ Inefficiency_{i,t} \\
&= \beta_0 + \beta_1 Ln\,[Pay\ Gap]_{i,t-1} + \beta_2 Accounting\ Quality_{i,t-1} \\
&+ \beta_3 Market - to - Book_{i,t-1} + \beta_4 Firm\ Size_{i,t-1} \\
&+ \beta_5 Quick\ Ratio_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 Dividend_{i,t-1} \\
&+ \beta_8 Vol\ Cash\ Flow_{i,t-1} + \beta_9 Vol\ Sales_{i,t-1} \\
&+ \beta_{10} Vol\ Net\ Hiring_{i,t-1} + \beta_{11} Tangibility_{i,t-1} + \beta_{12} Loss_{i,t-1} \\
&+ \beta_{13} Labor\ Intensity_{i,t-1} + \beta_{14} Labor\ Union_{i,t-1} \\
&+ \beta_{15} Non - labor\ Inefficiency_{i,t-1} + \lambda_j + \eta_t + \varepsilon_{i,t}
\end{aligned}
\tag{2}
$$

where the dependent variable, *Labor Inefficiency*, is the measure of labor investment inefficiency estimated from Eq. (1). λ and η represent industry and year fixed effects. *i*, *t*, and *j* are firm, year and industry subscripts, respectively. Standard errors are clustered at the firm level to account for the possible within-firm serial correlation. A positive (negative) coefficient (β_1) on $Ln\,[Pay\ Gap]$ suggest tournament incentives lead to inefficient (efficient) labor investment.

The control variables in our model are identical to Khedmati et al. (2019). Accounting quality has a significant impact on labor investment efficiency (Jung et al., 2014). Hence, we estimate accounting quality cross-sectionally by industry-year using the model originated from Dechow and Dichev (2002) and modified by McNichols (2002) and Francis et al. (2005). The variable *Accounting Quality* is the standard deviation of the residual from the estimation model over the previous 5-years times negative one. Therefore, the higher the value, the better the accounting quality. *Market-to-Book* is the ratio of the market value of common equity scaled by the book value of common equity. *Firm Size* is measured at the natural logarithm of the market value of equity. Jung et al. (2014) note that firm short-term liquidity and cash flow shortages can affect corporate hiring; we, therefore, control for *Quick Ratio* in our regression. Financial leverage can influence labor investments as the required interest and principal

payment reduce available funds, resulting in delaying or cost-cutting in hiring (Pinnuck and Lillis, 2007). Hence, we include *Leverage* as a control variable. In a similar vein, dividend payment reduces available capital for future investment (Ryan Jr and Wiggins III, 2002). Therefore, we set a dummy variable (*Dividend*) to indicate firms that pay dividends in a given fiscal year and include it in Eq. (2).

We also control for the standard deviation of cash flow (*Vol Cash Flow*), sales (*Vol Sales*), and net hiring (*Vol Net Hiring*) over the previous five-year period because volatility in these variables may lead to inefficient labor investment decisions (Jung et al., 2014, Ryan Jr and Wiggins III, 2002). Jung et al. (2014) note that firms that control a significant amount of assets are likely to hire more employees. We, therefore, use firm property, plant, and equipment, scaled by the book value of total assets as the measure for firm tangible assets (*Tangibility*). Also, as firms suffering from losses hire fewer employees (Jung et al., 2014), we create an indicator variable (*Loss*) to indicate firms that experience a negative return on assets in a given year. Following Khedmati et al. (2019), we control for *Labor Intensity*, measured as the number of employees to the book value of assets. Jung et al. (2014) point out that a strong labor union monitors the firm to make more efficient labor investments. We, therefore, measure the strength of the labor union of an industry as the percentage of union coverage in the industry's total labor force (*Labor Union*). In addition, we estimate firm capital investment inefficiency (*Non-labor Inefficiency*) as the absolute value of the residual from Biddle et al. (2009) model to control for the influence of other non-labor investment on labor investment (Khedmati et al., 2019, Cao and Rees, 2020, Jung et al., 2014).

2.5 Descriptive Statistics

Descriptive statistics for the full sample are presented in Table 1. The mean (median) value of the natural logarithm pay gap between the CEO and the median level of other top four executives (*Ln [Pay Gap])* is 7.754 (7.829), similar to that reported in Jia (2018). The absolute

value of the abnormal labor investment (*Labor Inefficiency*) has a value of 0.127 for firms with mean characteristics in our sample. The average over-investment (under-investment) in labor is 0.179 (0.107). The values of labor investment inefficiencies and other control variables are comparable to previous studies, including Ben-Nasr and Alshwer (2016), Cao and Rees (2020), Ghaly et al. (2017), Jung et al. (2014), and Khedmati et al. (2019).

[Insert Table 1 Around Here]

3. Tournament Incentives and Labor Investment Efficiency

3.1 Baseline Results

This section establishes the effect of tournament incentives on labor investment inefficiency by answering the empirical question of whether greater tournament incentives created by the pay gap between the CEO and the next layer of executives result in efficient labor investment.

Using the data described in the previous section, we estimate Eq. (2) and present the findings in Table 2. The coefficient of estimate on *Ln [Pay Gap]* is positive (0.009) and statistically significant at the 1% level in Column (1). Since *Labor Inefficiency* is an inverse measure of labor investment efficiency, the positive coefficient on *Ln [Pay Gap]* suggests that greater tournament incentives are associated with more inefficient investments in labor. The increase is also economically significant. A one standard deviation increase in *Pay Gap* centered on its mean increased *Labor Inefficiency* by 0.059 standard deviations, or a 7.9% increase from the mean.[5] Columns (2) adopts firm fixed-effects models to alleviate the

[5] Since *Ln [Pay Gap]* is in natural logarithm, we follow Kini and Williams (2012) to express the economic meaning in terms of the standard deviation of *Labor Inefficiency* for a one standard deviation change in *Pay Gap* itself (not *Ln [Pay Gap]*). Specifically, we compute the level of *Pay Gap* that is 0.5 standard deviation below its mean (low pay gap) and 0.5 standard deviation above its mean (high pay gap). We then take the difference in the natural logarithm of high pay gap (8.715) and the natural logarithm of low pay gap (7.603). The difference (1.112 = 8.715-7.603) is then multiplied by the coefficient 0.009 to compute the change in *Labor Inefficiency* for a one standard deviation increase in *Pay Gap*. Finally, we divide the change (0.010 = 0.009 * 1.112) by the standard deviation of *Labor Inefficiency* to compute the relevant change, which is 0.010/0.169 = 0.059. In addition, as the mean value for *Labor Inefficiency* is 0.127, the 0.010 increase in *Labor Inefficiency* represents approximately a 7.9% (=0.010/0.127) increase from its mean.

concerns that time-invariant firm heterogeneity determines the pay gap.[6] The coefficient on *Ln [Pay Gap]* remains positive and statistically significant at the 1% level, suggesting unobserved time-invariant firm-level factors do not drive the positive relationship between tournament incentives and labor investment inefficiency. These results lend support to the argument that tournament incentives induce managers to make inefficient labor investments. This finding complements the literature examining dysfunctional consequences of the tournament incentive (Haß et al., 2015) by relating an unintended new outcome (inefficient labor investment) to the promotion-based tournament.

[Insert Table 2 Around Here]

The signs on the coefficients of the control variables are consistent with previous studies. Notably, *Accounting Quality* is negatively related to investment inefficiency, confirming better accounting quality mitigates inefficient labor investments (Jung et al., 2014). Moreover, the negative coefficients on *Firm Size* and *Labor Intensity* show that large and labor-intensive firms invest more efficiently (Khedmati et al., 2019, Cao and Rees, 2020). On the contrary, firms with greater liquidity (*Quick Ratio*), larger variations in sales (*Vol Sales*) and net hiring (*Vol Net Hire*), and higher levels of inefficient non-labor investments (*Non-labor Inefficiency*) tend to invest in labor inefficiently (Jung et al., 2014, Sualihu et al., 2021).

3.2 Tournament Versus CEO Entrenchment

Although prior research interprets the pay gap between the CEO and other executives as tournament incentives (Kini and Williams, 2012), the large pay disparity could also suggest the incumbent CEO seize the pay-setting process and require higher pay for himself (Bebchuk et al., 2011, Bebchuk and Fried, 2003). Weak corporate governance is associated with various

[6] In an unreported table, we adopt Fama-MacBeth regressions to address the within-firm variation with the standard errors adjusted for time-series serial correlation by using the Newey and West (1987) method. We continue to find a positive and significant relationship between tournament incentives and labor investment inefficiency.

agency issues that can lead to inefficient investments (Khedmati et al., 2019, Ghaly et al., 2020). Hence, our findings could be driven by CEO entrenchment rather than the promotion tournament among subordinate executives. This section adopts three approaches to disentangle the influence of CEO entrenchment and tournament incentive on labor investment.

We first alleviate the influence of entrenched CEO on labor investment by explicitly controlling for CEO entrenchment in our baseline regression. We follow Bebchuk et al. (2011) to control for whether the CEO also holds the Chairman position (*CEO Duality*), the proportion of company shares owned by the CEO (*CEO Ownership*), the number of years the incumbent CEO holds the position (*CEO Tenure*), and the excessive compensation awarded to the CEO (*CEO Excess Pay*), where *CEO Excess Pay* is estimated as the residual from regressing CEO total compensation on firm size (*Firm Size*), Return-on-Asset (*ROA*), annual stock return (*Stock Return*), market-to-book ratio (*Market-to-Book*) cross-sectionally by year and industry as in Core et al. (1999) and Ferri and Maber (2013). Column (1) of Table 3 presents the results with additional controls. The sample size reduces to 18,640 due to additional data requirements. We show that controlling for CEO entrenchment does not change our finding as the coefficient on *Ln [Pay Gap]* remains positive and highly significant in Column (1).

[Insert Table 3 Around Here]

Next, rather than using individual variables to control for CEO entrenchment, we use a single entrenchment proxy concerning pay disparity in Column (2). It is worth noting that previous studies have adopted various measures of the pay disparity between the CEO and the next layer of executives, and the literature to date does not reach a consensus on the difference between various pay disparity measures. Many studies, including Burns et al. (2017), Chen et al. (2013), and Vo and Canil (2019), treat various pay disparity measures equally. Nevertheless, one strand of the studies argues that the absolute size of the pay gap between the CEO and non-CEO executive directly captures the tournament prize, hence, measures the tournament

incentive (Haß et al., 2015, Kini and Williams, 2012, Coles et al., 2018), while the relative size of the pay disparity between CEO and the next layer of executives captures managerial power and CEO entrenchment (Coles et al., 2018, Li et al., 2014, Bebchuk et al., 2011). Therefore, we follow Bebchuk et al. (2011)to construct CEO Pay Slice as the proportion of total compensation of the highest-paid five executives captured by the CEO to proxy for CEO entrenchment. To the degree that *Ln [Pay Gap]* captures tournament incentives and *CEO Pay Slice* captures CEO entrenchment, we include both variables in Column (2) of Table 3.[7] We continue to find a positive and highly significant coefficient on *Ln [Pay Gap]*. However, the coefficient on *CEO Pay Slice* is positive but statistically insignificant.

In addition, we employ a two-stage method adopted by Chen et al. (2013) to estimate the residual pay gap that is independent of CEO entrenchment. Specifically, we regress *Ln [Pay Gap]* on a range of corporate governance variables, including *E-Index*, *CEO Duality*, *Board Size*, *Board Independence*, *Compensation Committee Size*, *Compensation Committee Independence*, *Audit Committee Size*, *Audit Committee Independence*, *Institutional Ownership*, and *CEO Ownership* in the first stage. Thus, the residual from the first-stage estimation conveys information unrelated to CEO entrenchment and is more likely to reflect the tournament incentive. We re-estimate our baseline model by replacing the observed pay gap with the residual pay gap estimated from the first stage (*Residual Pay Gap*). The sample reduces further to 10,098 firm-year. The results presented in Column (3) show a positive and highly significant coefficient on *Residual Pag Gap*.

Collectively, the results from Table 3 are similar to our baseline findings and confirm that the pay gap captures information beyond CEO entrenchment (Bebchuk et al., 2011, Chen et al., 2013), and it is the tournament incentives created by the pay gap, not the entrenched

[7] The Pearson correlation between *CEO Pay Slice* and *Ln [Pay Gap]* is 0.496. However, the model passes the Variance Inflation Factors (VIF) checking for multicollinearity.

CEO, that lead to more inefficient labor investment. Thus, tournament incentives are counterproductive for labor investment efficiency as the tournament can diminish collaboration, prevent information sharing, and even induce sabotage activities (Garicano and Palacios-Huerta, 2005, Haß et al., 2015).

3.3 VP Incentives

Our results so far have shown that tournament incentives induce more inefficient labor investments. However, the effectiveness of tournament incentives depends on the intensity of the competition, and facilitating a promotion-based tournament would have no value if non-CEO executives decide not to compete for the CEO position. Thus, if the tournament is indeed the driving force behind the positive relationship between the executive pay gap and labor investment inefficiency, the effect should weaken when senior managers are less eager to compete in the promotion tournament. In Table 4, we consider three scenarios where the pay gap between the CEO and subordinate managers is unlikely to induce strong tournament incentives. We expect the positive relationship between the pay gap and labor investment inefficiency to be weakened in these scenarios.

[Insert Table 4 Around Here]

First, we examine the scenario when the firm appoints a new CEO. Since the tournament for the previous CEO position ends when a new CEO is appointed, and the tournament for the new CEO position is still in its early stage, existing non-CEO executives are less concerned about winning the CEO position and have less eager to compete in the tournament (Kale et al., 2009). Given that the average tenure of CEO is approximately seven years in our sample, we define *New CEO* as a dummy variable that equals one in the year and the following year after a CEO turnover, and zero otherwise. According to our definition, approximately 16.5% of firm-year in our sample recently had a new CEO. Columns (1) of Table 4 present the result when we include the interaction term between *Ln [Pay Gap]* and

New CEO in Eq. (2). We continue to find a positive and highly significant coefficient on *Ln [Pay Gap]*. More importantly, the negative coefficient on the interaction term (*Ln [Pay Gap]* × *New CEO*) suggests that the positive effect of tournament incentives on labor investment inefficiency is weaker when the firm recently had a new CEO.

Next, we examine industry products similarity and market concentration as the second and third scenarios in Columns (2) and (3), respectively. Non-CEO managers are unlikely to aggressively compete for the CEO position within their firms if the firm operates in an industry with a high degree of product similarity and market concentration because their knowledge and skills are more transferable; hence, it is easier for senior executives to take opportunities outside their firms and the probability of internal promotion is also likely to be lower in these firms (Hasan et al., 2020). We, therefore, extract firm-level product similarity score and industry concentration index from Hoberg and Phillips (2016) to measure the industry-wide product similarity and market concentration.[8] We then create the dummy variable *High Similarity* (*High Concentration*) that equals one for firms with above (below) median product similarity score (industry concentration Herfindahl-Hirschmann index), and zero otherwise. Results from Columns (2) and (3) show that contradict to the positive and significant coefficients on *Ln [Pay Gap]*, the interaction terms (*Ln [Pay Gap]* × *High Similarity* and *Ln [Pay Gap]* × *High Concentration*) are negative and statistically significant. Thus, the inefficient labor investments induced by tournament incentives are significantly lower if the firm's products are highly similar to its rivals and operates in industries with greater concentration.

Table 4, collectively, shows that the positive effect of the pay gap on labor investment inefficiency is weakened when managers are reluctant to participate in the promotion-based

[8] Product similarity score and industry concentration index are retrieved from Hoberg-Phillips Data Library (http://hobergphillips.tuck.dartmouth.edu/industryconcen.htm).

competition, further confirming tournament incentives created by the pay gap can result in inefficient labor investments.

3.4 Over and Under-Investment in Labor

We then investigate to what extent our results are driven by over-investment or under-investment in labor. A firm is considered over-invest (under-invest) in labor when the actual net hiring is above (below) the level justified by firm fundamentals. Hence, *Over Investment* is measured as the positive residual from Eq. (1), while *Under Investment* is measured as the absolute value of the negative residual from Eq. (1). We further decompose *Over Investment* into *Over-hiring* and *Under-firing*, and *Under Investment* into *Under-hiring* and *Over-firing* as in Jung et al. (2014), Ben-Nasr and Alshwer (2016), and Ghaly et al. (2020).[9]

Table 5 presents the effect of tournament incentives on different types of labor investments. In Column (1), we find that tournament incentives lead to more over-investment in labor as the coefficient on *Ln [Pay Gap]* is positive (0.018) and significant at the 1% level. The coefficient on *Ln [Pay Gap]* is positive and significant in column (2) but statistically insignificant in column (3) suggests that the effect of tournament incentives on over-investment in labor is driven by over-hiring but not under-hiring. The positive (0.004) and significant coefficient on *Ln [Pay Gap]* in Column (4) shows that tournament incentives also result in more under-investment in labor. However, Columns (5) and (6) reveal that the effect is driven by under-hiring rather than over-firing. These results in Table 5 suggest that the effect of tournament incentives on labor investment is through the hiring process rather than the firing process. A potential explanation is that the adoption of wrongful discharge laws in the US has significantly increased the firing costs (Serfling, 2016).[10] These costs include not only

[9] *Over-hiring* (*Under-firing*) is over-investment in labor when the expected level of net hiring is positive (negative). *Under-hiring* (*Over-firing*) is under-investment in labor when the expected level of net hiring is positive (negative).

[10] Serfling (2016) shows that the majority of states adopted wrongful discharge laws by the early 1990s. Thus, the majority of firms in our sample are subject to wrongful discharge laws.

monetary losses to the firm, but also legal and reputational losses to managers who wrongfully adjust labor investments through the firing process. Hence, senior managers who compete for the CEO position may avoid engaging in the firing process as wrongfully firing employees could cost the manager the chance of winning the tournament. In addition, Cao and Rees (2020) studies employee-friendly treatment on labor investments and find the effect is mainly driven by hiring rather than firing, further suggesting that managers are reluctant to engage in firing when it comes to labor investments.

[Insert Table 5 Around Here]

4. Endogeneity and Identification

The endogeneity concerns in executive compensation and its economic consequences challenge us to infer causality between executive pay disparity and labor investment inefficiency. The adoption of firm fixed-effects models, to a certain extent, addresses the endogeneity issue that is attributed to omitted time-invariant firm heterogeneity. However, other concerns remain. First, the association between the pay gap and labor investment inefficiency may run from the opposite direction. It is possible that labor investment inefficiency drives a large executive pay gap. For instance, CEOs who manage a large company with more employees may be rewarded with higher compensation than other executives. Second, both managerial compensation and labor investments may be driven by unobserved factors and can be simultaneously determined. In this section, we adopt several approaches to address potential endogeneity issues further.

4.1 Instrumental Variable Approach

We first adopt a two-stage least squares instrumental variables (IV) estimation treating the *Ln [Pay Gap]* as endogenous to alleviate spurious correlation concerns. Our first instrument for *Ln [Pay Gap]* is the industry median executive pay gap (*Ind Ln [Pay Gap]*) because Murphy (1999) shows that the level and structure of executive compensation has an industry-wide

component, and Bebchuk et al. (2011) argue that the optimal executive pay disparity varies by industries and the choice of industry is largely exogenous. In addition, Bebchuk et al. (2011) argue that more executives with the same title suggest greater similarity among the subordinate executives, which allows the CEOs to differentiate themselves from other executives by demanding higher pay. Therefore, we use the number of executives with the title "Vice President (or VP)" among the top five executives (*Number VP*) as our second instrument.

The first-stage results, reported in column (1) of Table 6, show that both instrument variables are significantly related to the pay gap. The results of the second-stage estimation of labor investment inefficiency on the fitted value of the pay gap are presented in Column (2) of Table 6. The coefficient on *Fitted Ln [Pay Gap]* is found to be positive and significant at the 1% level, indicating the positive relation between tournament incentives and labor investment inefficiency is robust after further controlling for the potential endogeneity problem with the IV approach.[11] In addition, the Hansen-Sargan statistic (0.258, p=0.612) does not reject the null hypothesis that the overidentifying restrictions are valid, confirming the validity of our instrumental variables.

[Insert Table 6 Around Here]

4.2 Propensity-score Matching

Our results are robust to firm or industry and year fixed effect regression that controls for influences of firm-specific time constant omitted variables or industry- and year-specific omitted variables. However, the compensation gap could be affected by unobserved and omitted variables that are neither firm-specific nor industry-specific. To reduce the impact of omitted observable variables and alleviate the endogeneity concern of our results, we then

[11] As in Hasan et al. (2020) and Shen and Zhang (2018), we report a greater coefficient on *Fitted Ln [Pay Gap]* than that in our baseline results. This could be the case that the instrumental-variable estimate mainly captures the causal effect on the compilers (i.e., those always provide a high pay gap) (Angrist and Pischke, 2008). This is a common problem in empirical studies (Jiang, 2017). Therefore, we only interpret the economic meaning of tournament incentives using the baseline estimates.

follow Shen and Zhang (2018) to adopt a propensity score matching (PSM) approach. In this PSM approach, firms are assorted into quartiles based on *Ln [Pay Gap]*. Firms in the highest quartile of the pay gap are sorted into the treatment group, while firms in the bottom quartile of the pay gap are used as control firms. *High Pay Gap* is a dummy variable set to one for the treatment group and zero for the control group. The propensity of a firm being in the treatment is computed in a Probit regression using all the control variables from Eq. (2). We do not allow replacement in the matching, and each treatment firm is only matched to a control firm with the closest propensity score within 1% caliper.[12] The regression analysis results based on the matched sample are reported in Columns (3) of Table 6. The positive and significant coefficients on *High Pay Gap* suggest that, for comparable firms providing different tournament incentives to their senior executives, labor investment is more inefficient for firms with a large executive pay gap.

4.3 Difference-in-Differences Test

Further, we adopt a continuously designed Difference-in-Differences (DiD) analysis to draw clearer inferences between tournament incentives and labor investment inefficiency.

To facilitate greater executive accountability and a closer alignment of executives' interests with that of shareholders, the US Congress passed the Dodd–FrankWall Street Reform and Consumer Protection Act (Dodd-Frank) that allow shareholders to vote on executives' compensation in a non-binding 'Say-on-Pay' vote (hereafter "SoP vote"). With the SoP vote coming into effect in 2011, shareholders can vote to indicate whether they approve executive compensations set by the board. Correa and Lel (2016) study the within-firm differences in executive compensation and find that the pay gap between CEO and non-CEO executives

[12] In unreported analysis, we perform several additional matching by using the median level of *Ln [Pay Gap]* to define the treatment and control group, changing the caliper, and allowing replacement. We find similar results from these alternative matching methods.

decreases significantly after adopting the SoP vote. Therefore, we use the SoP vote in 2011 as an exogenous shock to the executive pay gap in our DiD analysis.

However, as the SoP provision is mandatory for all public firms, the identification strategy is extremely challenging. Correa and Lel (2016) show that the effect of the SoP vote on reducing the managerial pay gap is more pronounced in samples with high excessive CEO pay, and the reduction in executive pay gap is due to a reduction in CEO compensation without significant changes in other senior executives' pay (Jia, 2018). We, therefore, develop our identification strategy based on CEO excess compensation (*Excess CEO Pay*). We then choose 2007 to 2010 as the pre-SoP window and 2011 to 2014 as the post-SoP window in the DiD analysis.[13] *SoP* is a dummy variable indicating the years after the adoption of SoP vote. Since a positive *Excess CEO Pay* indicate over-paid CEO and negative *Excess CEO Pay* indicate under-paid CEO, we expect the effect of the SoP vote to have a stronger impact on reducing the pay gap for firms with over-paid CEO. Therefore, we sort a firm into the treatment group if its median *Excess CEO Pay* in the pre-SoP period is positive, and a firm is stored into the control group if its median *Excess CEO Pay* in the pre-SoP period is zero or negative. *Treated* is a variable set to one for the treatment group and zero for the control group.[14]

We first verify the effect of SoP vote on the pay gap in Table A2 in the Appendices. The negative and highly significant coefficient on the interaction term between *Treated* and *SoP* confirms greater *Ln [Pay Gap]* reduction for the treated firms. Thus, the SoP vote appears to be a valid shock to tournament incentives. We then examine the effect of SoP vote on labor investment inefficiency in Column (4) of Table 6. The DiD regression results present a positive and significant coefficient on *Treated*, suggesting that the treated firms had greater labor investment efficiency before adopting SoP vote. Importantly, the coefficient on the interaction

[13] We limit the sample from 2007 to 2014 to alleviate the sequential correlation concerns raised from long-sample in DID analysis (Bertrand et al., 2004).
[14] We are able to identify 3,917 treated firm-year observations and 3,453 control firm-year observations, and 3,699 post-SoP observations and 3,671 pre-SoP observations.

term between *Treated* and *SoP* is negative (-0.014) and significant at the 5% level, suggesting that the labor investment inefficiency reduces more for treated firms. Thus, as the executive pay gap subsides after the SoP law, firms' labor investment inefficiency also reduces, confirming that the tournament incentives lead to more inefficient labor investments.

An underlying assumption of DiD design is that the two groups of firms in comparison display a similar trend in the pre-treatment period. Therefore, we adopt the dynamic DiD model discussed in Atanasov and Black (2016) to verify the parallel trend assumption and present the results in Table A3 in the Appendices.[15] We find that only coefficients of interaction terms for the years after the SoP vote are significant, but not of that in the years prior to the SoP when the dependent variable is *Labor Inefficiency*, suggesting that the parallel trend assumption is likely to hold in our setting. However, we are conscious of the potential flaws in our DiD identification strategy as Correa and Lel (2016) point out that using a single county data to examine the effect of SoP law can be problematic since all public firms in the county are subject to the regulation's influence. As a result, the effectiveness of the SoP vote on executive pay gap has been inconclusively documented in previous studies (Brunarski et al., 2015, Cuñat et al., 2016, Ferri and Maber, 2013, Iliev and Vitanova, 2019). Nevertheless, our DiD analysis, to some extend, alleviated the endogeneity concerns and lend support to our argument that tournament incentives cause inefficient labor investment.

4.4 Change-on-Change Analysis

In our last attempt to address the endogeneity concern, we maximize the temporal variations in our data and infer the causal relationship between the pay gap and labor investment inefficiency by adopting a long-window change-on-change analysis, which is better at removing the time-

[15] Atanasov and Black (2016) use the term "leads and lags model" to describe the dynamic DiD model. We follow this procedure to choose 2007 (4 years before the shock) as the base year and replace the treatment dummy with four year-specific variables to denote the treated firms in 2 and 3 years before the shock, the year before the shock, the year after the shock, and 2 to 4 years after the shock.

invariant unobservable firm-level characteristics than the firm fixed-effect model with slow-moving variables (Griffin et al., 2021). Specifically, we compute the 3-year rolling window differences for all our variables, where the differences in labor investment inefficiency are computed from year t to year t+3, and the differences for pay gap and all control variables are computed from year t-4 to t-1. Results from the long window change-on-change are presented in Column (5) of Table 6. The positive and significant coefficients on the changes of the two executive pay disparity measures show that the temporal changes in tournament incentives are followed by subsequent changes in labor investment inefficiency: the increase in tournament incentives leads to more inefficient labor investments.

Despite that our analysis may not completely solve the endogeneity problems, the series of analyses in Tables 6, collectively, are qualitatively consistent with our baseline specifications reported and support the causal interpretation between tournament incentives and firm labor investment inefficiency.

5. Further Robustness Checks

5.1 Role of Non-labor Investment

It is possible that tournament incentives only indirectly affect labor investments through their influence on other non-labor investments. For example, executives who wish to win the tournament may approve more risky projects to invest in that would normally be forgone, hence, require large labor input. In this case, labor investment is merely a complement to other non-labor investments, and therefore the relation between tournament incentives and labor investment inefficiency is driven by other non-labor investments. Although we have controlled for the investment inefficiency of other non-labor investments in our regressions, we address this concern more comprehensively by following the approach adopted in prior works (Cao and Rees, 2020, Ben-Nasr and Alshwer, 2016, Jung et al., 2014, Khedmati et al., 2019), and presents the results in Table 7.

[Insert Table 7 Around Here]

In each panel of Table 7, we examine a specific type of non-labor investment, namely, CAPEX, R&D, acquisition, and advertising. The sample is sorted into three groups according to the relationship between net-hiring and each type of non-labor investment. Column (1) of each panel in Table 7 analyzes the subsample when labor investment complements the non-labor investment (i.e., the positive relationship between net-hiring and the non-labor investment); column (2) of each panel examines the subsample when labor investment substitutes the non-labor investment (i.e., the negative relationship between net-hiring and the non-labor investment), and column (3) investigates the subsample when labor investment or non-labor investment is zero or missing. If the influence of tournament incentives on labor investment inefficiency is indirectly through the effect of executive pay disparity on non-labor investment, we should only expect to find a significant coefficient on *Ln [Pay Gap]* in the subsample with the complementary relationship between labor and non-labor investment (i.e., Column 1). However, we find positive and significant associations between tournament incentives and labor investment inefficiency across all samples in all panels, suggesting our finding is not driven by non-labor investment such as CAPEX, R&D, acquisition or advertising. Thus, labor investment is an independent input that can be influenced by managers' tournament incentives.

5.2 Alternative Measures

Our analysis so far has adopted the standard measure of the tournament incentive (Ln (*Pay Gap)*) and labor investment efficiency in prior literature. In table 8, we explore the sensitivity of our results to alternative measures of tournament incentive and labor investment inefficiency by repeating our baseline analysis.

[Insert Table 8 Around Here]

Panel A presents the results when using two alternative proxies of executive pay disparity. First, tournament incentives in Column (1) are measured as the Gini coefficient of top-five executive pay (*Gini Top5*). The higher the Gini coefficient, the more unequal distribution of executive compensation. Second, Column (2) adopts the coefficient of variation of the top five executives' total compensation (*CV Top5*) as the proxy for tournament incentives. The coefficients on the two alternative measures of tournament incentives are positive and significant across all columns, suggesting that our main finding is robust to various choices of tournament incentives measures.

We further repeat our baseline analysis using several alternatives of the optimal level of labor investment and present the results in Panels B of Table 8. First, the optimal level of labor investment in columns (1) is simply proxied by the industry median level of net hiring in a given year (Cao and Rees, 2020). Second, we adopt the Biddle et al. (2009) model to estimate the optimal labor investment cross-sectionally by industry and year and present the results in columns (2). Furthermore, in columns (3), we follow Cao and Rees (2020) to add CAPEX, R&D, acquisition investment, industry labor union coverage, and the natural logarithm of GDP per capita in the estimation model outlined in Eq. (1) to estimate optimal labor investment. Lastly, the optimal level of labor investment used in columns (4) is estimated by additionally controlling for year fixed effects in Eq. (1). The coefficients on *Ln [Pay Gap]* remain positive and significant across all columns, reaffirming that the positive link between the tournament incentives and labor investment inefficiency is not sensitive to alternative measures of labor investment inefficiency.

5.3 Executive Alignment Incentives

So far, our analysis assumes that the potential pay gap is the only incentive driving subordinate executives to compete in the tournament. However, the different components in compensation also provide executives with performance alignment incentives associated with the company's

stock performance and risk, and these incentives may also drive executives' labor investment decisions (Sualihu et al., 2021). Therefore, the robustness tests in this section relate to including executive equity compensation incentives and splitting the overall tournament incentive into different components.

First, to control for the effect of the executive's performance-based incentives (delta) and risk-taking incentives (vega), we compute delta and vega as in Hayes et al. (2012). Specifically, delta measures the dollar value change in the executive's compensation for a 1% change in the firm's stock price, and vega measures the dollar value change in the executive's compensation for a 1% change in the volatility of the firm's stock return. Following Kini and Williams (2012), we add the CEO's compensation delta and vega, and the median value of subordinate top four executive's delta and vega as additional controls. Column (1) of Table 9 shows that the CEO compensation delta (*CEO Delta*) does not significantly affect labor investment inefficiency, while CEO compensation vega (*CEO Vega*) is negatively related to labor investment inefficiency at the 10% level. The median value of subordinate executives' compensation delta (*Med VP Delta*) and vega (*Med VP Vega*) does not significantly affect firm labor investment efficiency. However, we continue to find tournament incentives lead to more labor investment inefficiency as the coefficient on *Ln [Pay Gap]* remains positive and highly significant.

[Insert Table 9 Around Here]

Second, Sualihu et al. (2021) find stock options and restricted stock have differing effects on labor investment inefficiency as stock options exacerbate the problem while restricted stock mitigates it. Therefore, we control for the CEO and the median of other non-CEO executives' options and restricted stocks compensation in Column (2). We do not find equity compensation components from the CEO and non-CEO executives significantly

influence labor inefficiency. However, the positive effect of tournament incentives on labor investment inefficiency still holds.

Third, to further investigate the effect of different compensation components on labor investment, we decompose *Ln [Pay Gap]* into cash pay gap and the equity pay gap between the CEO and the median level of the other four subordinate executives in column (3). Executive cash compensation includes basic salary, bonus, and non-equity incentive plan compensation, while equity compensation is the sum of restricted stocks, option grants, and long-term incentive plan awards (LTIP). We find that both *Cash Pay Gap* and the *Equity Pay Gap* can lead to inefficient labor investment. Last, we further decompose the equity compensation gap into *Restricted Stock Gap*, *Option Gap*, and *LTIP Gap* in column (4). We find the gap between each type of compensation is positively related to labor investment inefficiency. Collectively, the results in Table 9 suggest that irrespective of the different incentives provided by different compensation components, the tournament incentives created by the pay difference between the CEO and the next layer of executive can result in inefficient investment in labor.

6. Conclusion

The literature to date has documented inconclusive empirical evidence of the effect of tournament incentives on corporate outcomes. While Lazear and Rosen (1981) predict the promotion tournament induce managers to work harder and facilitate positive outcomes, a number of studies, including Baker, Jense, & Murphy (1988) and Henderson & Fredrickson (2001), recognize the flaws in tournament incentives as it diminishes collaboration and damages a firm's ability to integrate human capital (Grant, 1996, Messersmith et al., 2014, Dale, 2003). Hence, it remains an empirical question as to whether tournament incentives induce efficient labor investments.

Using a sample of US firms over the period 1993-2018, we show that strong tournament incentives, captured by the pay gap between the CEO and the next layer of executives, lead to

higher deviations of labor investment from the optimal level justified by the firm's financial fundamentals. Our results are robust to instrumental variable analysis, propensity-score matching analysis, Difference-in-Differences analysis, and change-on-change analysis. Furthermore, our empirical results are not sensitive to the choice of measures for tournament incentives and labor investment inefficiency.

In addition, we rule out the concerns that the observed relation between pay gap and labor investment inefficiency is due to CEO entrenchment by explicitly controlling for CEO entrenchment and using the residual pay gap that is independent of CEO entrenchment in a two-stage approach. The positive relation between the pay gap and labor investment inefficiency becomes weaker when subordinate executives are less eager to compete in the promotion tournament, further supporting the tournament interpretation of our results. We also show that the influence of tournament incentives on labor investment inefficiency is not through the non-labor investments, confirming that labor investment is an important policy that the tournament can directly affect.

Our paper adds to the literature examining the dysfunctional consequences of tournament incentives (Haß et al., 2015, Baker et al., 1988) as we show that inefficient labor investment is an unintended effect of the promotion-based tournament. In addition, we also contribute to the growing literature studying the determinant of labor investment efficiency (Jung et al., 2014, Khedmati et al., 2019) by showing that tournament incentives play a key role in corporate labor investments. Further, we shed light on studies focusing on inequity aversion as tournament incentives can contribute to the increasing CEO-worker pay gap. We show that a large pay gap negatively impacts labor investments and causes inefficient utilization of human capital. Therefore, our findings highlighted the costs of tournament incentives and offer new insight into the trade-off for corporate board to consider when setting executive compensations that benefit both shareholders and employees. We also join the

literature that supports labor investment is an independent investment that implanted by corporate managers and provide reasoning for shareholders and regulators to scrutinize the monitoring in labor investment, and for investors to assess the labor-related costs in their decision-making process.

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Appendices

Table A1. Variable Definition.

Variable	Definition (Compustat data items in parentheses))
Net Hiring	Change in the number of employees (emp) from the previous period to the current period, scaled by the number of employees in the previous period.
Sale Growth	Change in revenue (revt) from the previous period to the current period, scaled by revenue in the previous period.
Ch ROA	Change in ROA from the previous period to the current period, scaled by the ROA in the previous period.
ROA	ROA is calculated as net income (ni) divided by the book value of total assets (at).
Stock Return	Annualized stock return from CRSP.
Firm Size	Natural logarithm of the market vaue of equity (csho × prcc_f).
Firm Size Rank	Percentile rank of Firm Size.
Quick Ratio	Sum of cash and short-term Investments (che) and total receivables (rect), scaled by total current liabilities (lct).
Ch Quick Ratio	Change in Quick Ratio from the previous period to the current period, scaled by Quick Ratio in the previous year.
Leverage	Sum of debt in current liabilities (dlc) and total long-term debt (dltt), scaled by the book value of total assets (at).
Asset Turnover	Revenue (revt) scaled by the book value of total assets (at).
Loss Bin 1-5	Dummy variables set to one for every 0.005 intervals of ROA from 0 to -0.025. Loss Bin 1 equals one if ROA ranges from -0.005 to 0, and zero otherwise. Loss Bin 2 equals one if ROA ranges from -0.010 to -0.005, and zero otherwise. Loss Bin 3 equals one if ROA ranges from -0.015 to -0.010, and zero otherwise. Loss Bin 4 equals one if ROA ranges from -0.020 to -0.015, and zero otherwise. Loss Bin 5 equals one if ROA ranges from -0.025 to -0.020, and zero otherwise.
Labor Inefficiency	Absolute value of the residuals from the labor investment estimation model in Eq. (2).
Ln [Pay Gap]	Natural logarithm of the difference between the total compensation (tdc1) and the median total compensation rewarded to the other highest-paid four executives.
Accounting Quality	The standard deviation of the residuals from the accounting quality model developed by Dechow and Dichev (2002) that is modified by McNichols (2002) and Francis et al. (2005) over the previous 5-years, times negative one. The model regress working capital accruals on cash flow from operations in the previous year, current year, and the year ahead, the change in revenue, and tangibility cross-sectional by year and industry.
Market-to-Book	Market value of equity (csho × prcc_f) to the book value of equity (seq).
Dividend	Dummy variable equals one if the firm paid dividends (dvpsp_f), and zero otherwise.
Cash Flow	Cash flow from operation (oancf), scaled by the book value of total assets (at).
Vol Cash Flow	Standard deviation of Cash Flow over the previous five years.
Vol Sales	Standard deviation of revenue (revt) over the previous five years.
Vol Net Hire	Standard deviation of Net Hire over the previous five years.
Tangibility	Property, plant, and equipment (ppent), scaled by the book value of total assets (at).
Loss	Dummy variable equals one if the firm reports negative net income (ni), and zero otherwise.
Labor Intensity	Number of employees (emp) to the book value of total assets (at).
Labor Union	Number of employees covered by labor union to the number of total employees in the industry. Data retrieved from Unionstats.com.
Non-labor Inefficiency	Absolute value of the residuals from the non-labour investment estimation model developed by Biddle et al (2009). The total investment, including capital expenditure (capx - sppe) , R&D (xrd), and acquisition (acq) scaled by the book value of total assets (at) is regressed on sales growth cross-sectionally by industry and year.
CEO Duality	Dummy variable set to one if the CEO also holds the Chairman position, and zero otherwise.
CEO Ownership	Proportion of share outstanding held by the CEO.

CEO Tenure	Natural logarithm of the number of years the incumbent CEO holds the postion plus one.
CEO Excess Pay	Estimated residual from regressing CEO total compensation on firm size (Firm Size), Return-on-Asset (ROA), annual stock return (Stock Return), market-to-book ratio (Market-to-Book) cross-sectionally by year and industry as in Core, Holthausen, and Larcker (1999) and Ferri and Maber (2013).
CEO Pay Slice	CEO total compensation (tdc1) scaled by the sum of the total compensation of the highest-paid five executives.
E-Index	Entrenchment index is constructed using six anti-takeover provisions as in Bebchuk, Cohen, and Derrel (2009).
Board Size	Number of directors on the board.
Board Independence	Proportion of independent directors on the board.
Compensation Committee Size	Number of directors on the Compensation Committee.
Compensation Committee Independence	Proportion of independent directors on the Compensation Committee.
Audit Committee Size	Number of directors on the Audit Committee.
Audit Committee Independence	Proportion of independent directors on the Audit Committee.
Institutional Ownership	Proportion of share outstanding held by institutional investors.
New CEO	Dummy variable that equals one in the year and the following year after a CEO turnover, and zero otherwise.
High Similarity	Dummy variable that equals one for firms with above-median product similarly score from Hoberg and Phillips (2016).
High Concentration	Dummy variable that equals one for firms with below-median industry concentration Herfindahl-Hirschmann index from Hoberg and Phillips (2016).
Gini Top5	Gini coefficient based on the total compensation among the highest-paid five executives, calculated as $1 + \frac{1}{n} - \frac{2}{n^2 \bar{z}} \sum_{i=1}^{n} (i \times z_i)$, where n = 5 for the five executives; z_1, z_2, z_3, z_4, and z_5 are the total compensation for each of the five executives in descending order; $\bar{z}$ is the mean total compensation of the five executives.
CV Top5	Coefficient of variation based on the total compensation (tdc1) among the highest-paid five executives, calculated as the standard deviation of the total compensation of the five executives, scaled by the mean of the total pay among the five executives.

Table A2. SoP Vote on Pay Gap.

Note: This table presents the Difference-in-Differences (DiD) analysis to infer the casual relationship between tournament incentives and labor investment inefficiency. The dependent variable is *Ln [Pay Gap]*. *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. The sample period is from 2007 to 2014, of which 2007 to 2010 is defined as the pre-Say-on-Pay (pre-SoP) period and 2011 to 2014 is defined as the post-SoP period. Post is set one to indicate the post-SoP period and zero for the pre-SoP period. Treated is a dummy variable set to one for firms with positive median excess CEO compensation in the pre-SoP period, and zero otherwise. *CEO Excess Pay* is the regression residual from regressing CEO total compensation on *Firm Size, ROA, Stock Return,, Market-to-Book* cross-sectionally by year and industry as in Core, Holthausen, and Larcker (1999) and Ferri and Maber (2013). Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Ln [Pay Gap]*
	(1)
Treated	0.744***
	(0.037)
× *Post*	-0.266***
	(0.036)
Accounting Quality	0.482
	(0.345)
Market-to-Book	-0.002
	(0.002)
Firm Size	0.425***
	(0.012)
Quick Ratio	-0.053***
	(0.011)
Leverage	0.303***
	(0.083)
Dividend	-0.106***
	(0.032)
Vol Cash Flow	-0.108
	(0.178)
Vol Sales	0.089
	(0.065)
Tangibility	-0.326***
	(0.083)
Loss	0.146***
	(0.030)
Year FE	Yes
Industry FE	Yes
Constant	5.004***
	(0.393)
Observations	7,370
Adjusted R-squared	0.583

Table A3. Dynamic DiD.

Note: This table presents the dynamic DiD analysis to verify the parallel assumption under the Difference-in-Differences in Table 7. The dependent variable is *Labor Inefficiency*, which is the absolute value of the residual from the labor investment estimation in Eq. (1). *2 to 3 Year Before* equals one for the treated firms in year 2008 and 2009. *1 Year Before* equals one for the treated firms in year 2010. *1 Year After* equals one for the treated firms in year 2011. *2 to 4 Year After* equals one for the treated firms in year 2012, 2013 and 2014. *Treated* is a dummy variable set to one for firms with positive median excess CEO compensation in the pre-SoP period, and zero otherwise. *CEO Excess Pay* is the regression residual from regressing CEO total compensation on *Firm Size*, *ROA*, *Stock Return*, *Market-to-Book* cross-sectionally by year and industry as in Core, Holthausen, and Larcker (1999) and Ferri and Maber (2013). Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Labor Inefficiency*
	(1)
2 to 3 Year Before	0.006
	(0.005)
1 Year Before	-0.000
	(0.007)
1 Year After	-0.019***
	(0.007)
2 to 4 Year After	-0.018***
	(0.005)
Constant	0.121***
	(0.002)
Observations	7,370
Adjusted R-squared	0.003

Tables

Table 1. Descriptive statistics.

Note: This table presents the summary statistics for the 22,426 firm-year observations in the full sample for the period from 1993 to 2018. *Labor Inefficiency* is the absolute value of the residual from the labor investment estimation in Eq. (1). *Over Investment* is the positive residual from the labor investment estimation in Eq. (1). *Under Investment* is the absolute value of the negative residual from the labor investment estimation in Eq. (1). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. *Accounting Quality* is the standard deviation of the residual from the accounting quality model developed by Dechow and Dichev (2002) modified by McNichols (2002) and Francis et al. (2005) model over the previous 5-years times negative one. *Market-to-Book* is the ratio of the market value of equity to the book value of equity. *Firm Size* is the natural logarithm of the market value of equity. *Quick Ratio* is the ratio of the sum of cash and short-term investments and total receivables to total current liabilities. *Leverage* is the ratio of the sum of debt in current liabilities and total long-term debt to the book value of total assets. *Dividend* is a dummy variable equals one if the firm paid dividends, and zero otherwise. *Vol Cash Flow* is the standard deviation of cash flow from operation over the previous five years. *Vol Sales* is the standard deviation of revenue over the previous five years. *Tangibility* is the ratio of property, plant, and equipment to the book value of total assets. *Loss* is a dummy variable equals one if the firm reports negative net income, and zero otherwise. *Net Hire* is the change in the number of employees from the previous period to the current period, scaled by the number of employees in the previous period. *Vol Net Hire* is the standard deviation of *Net Hire* over the previous five years. *Labor Intensity* is the number of employees to the book value of total assets. *Labor Union* is the number of employees covered by union to the total number of employees in the industry. *Non-labor Inefficiency* is the absolute value of the residual from the non-labour investment estimation model developed by Biddle et al (2009). Table A1 in the Appendix provides detailed variable definitions. All continuous variables are winsorized at the 1% level for both tails to mitigate the influence of outliers.

Variable	Obs	Mean	Sd	p25	p50	p75
Ln [Pay Gap]	22,426	7.754	1.153	6.974	7.829	8.642
Labor Inefficiency	22,426	0.127	0.169	0.043	0.083	0.144
Over Investment	6,607	0.179	0.301	0.031	0.080	0.191
Under Investment	15,819	0.107	0.099	0.047	0.083	0.134
Accounting Quality	22,426	-0.052	0.046	-0.062	-0.039	-0.025
Market-to-Book	22,426	2.909	5.670	1.492	2.319	3.669
Firm Size	22,426	7.223	1.542	6.150	7.122	8.255
Quick Ratio	22,426	1.761	2.006	0.796	1.228	1.979
Leverage	22,426	0.220	0.206	0.053	0.201	0.326
Dividend	22,426	0.509	0.500	0.000	1.000	1.000
Vol Cash Flow	22,426	0.064	0.093	0.026	0.043	0.073
Vol Sales	22,426	0.239	0.269	0.087	0.157	0.284
Tangibility	22,426	0.305	0.254	0.119	0.232	0.419
Loss	22,426	0.179	0.384	0.000	0.000	0.000
Net Hire	22,426	0.065	0.253	-0.030	0.026	0.110
Vol Net Hire	22,426	0.195	0.390	0.059	0.110	0.205
Labor Intensity	22,426	0.007	0.009	0.002	0.004	0.008
Labor Union	22,426	0.105	0.093	0.037	0.073	0.133
Non-labor Inefficiency	22,426	0.094	0.110	0.030	0.063	0.120

Table 2. Tournament Incentives and Labor Investment Inefficiency.

Note: This table presents the regression analysis of the influence of tournament incentives on labor investment inefficiencies. The sample consists of 22,426 firm-year operations from 1993 to 2018. The dependent variable is *Labor Inefficiency*, which is the absolute value of the residual from the labor investment estimation in Eq. (1). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Labor Inefficiency*	
	(1)	(2)
Ln [Pay Gap]	0.009***	0.005***
	(0.002)	(0.002)
Accounting Quality	-0.149***	-0.053
	(0.046)	(0.060)
Market-to-Book	0.000	0.000
	(0.000)	(0.000)
Firm Size	-0.009***	-0.018***
	(0.001)	(0.003)
Quick Ratio	0.005***	0.006***
	(0.001)	(0.002)
Leverage	-0.002	-0.055***
	(0.007)	(0.013)
Dividend	-0.003	0.006
	(0.003)	(0.006)
Vol Cash Flow	0.019	0.002
	(0.024)	(0.020)
Vol Sales	0.019***	0.019**
	(0.007)	(0.009)
Tangibility	-0.010	0.009
	(0.009)	(0.020)
Loss	0.022***	0.004
	(0.004)	(0.004)
Vol Net Hire	0.023***	-0.030***
	(0.006)	(0.007)
Labor Intensity	-0.472***	-1.314**
	(0.164)	(0.657)
Labor Union	0.022	0.029
	(0.023)	(0.055)
Non-labor Inefficiency	0.052***	0.005
	(0.016)	(0.018)
Year FE	Yes	Yes
Industry FE	Yes	No
Firm FE	No	Yes
Constant	0.077***	0.210***
	(0.030)	(0.028)
Observations	22,426	22,426
Adjusted R-squared	0.054	0.020

Table 3. Tournement Incentives versus CEO Entrenchment.

Note: This table tests the tournament incentives and CEO entrenchment on labor investment inefficiencies. The dependent variable is *Labor Inefficiency*, which is the absolute value of the residual from the labor investment estimation in Eq. (1). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. *Pay Slice* is the total CEO compensation scaled by the sum of the total compensation of the highest-paid five executives. *Residual Pay Gap* is the regression residual from regressing *Ln [Pay Gap* on *E-Index, CEO Duality, Board Size, Board Independence, Compensation Committee Size, Compensation Committee Independence, Audit Committee Size, Audit Committee Independence, Institutional Ownership,* and *CEO Ownership*. *CEO Duality* is a dummy variable set to one if the CEO also holds the Chairman position. *CEO Ownership* is the proportion of share outstanding held by the CEO. *CEO Tenure* is the natural logarithm of the number of years since the appointment as CEO. *CEO Excess Pay* is the regression residual from regressing CEO total compensation on *Firm Size, ROA, Stock Return, Market-to-Book* cross-sectionally by year and industry as in Core, Holthausen, and Larcker (1999) and Ferri and Maber (2013). Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Labor Inefficiency*		
	(1)	(2)	(3)
Ln [Pay Gap]	0.008***	0.008***	
	(0.002)	(0.002)	
CEO Pay Slice		0.009	
		(0.017)	
Residual Pay Gap			0.005***
			(0.002)
Accounting Quality	-0.118**	-0.149***	-0.055
	(0.048)	(0.046)	(0.057)
Market-to-Book	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Firm Size	-0.008***	-0.008***	-0.007***
	(0.001)	(0.001)	(0.001)
Quick Ratio	0.005***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)
Leverage	0.004	-0.001	0.017*
	(0.008)	(0.007)	(0.010)
Dividend	-0.001	-0.003	0.002
	(0.003)	(0.003)	(0.003)
Vol Cash Flow	0.053*	0.018	0.043
	(0.032)	(0.024)	(0.051)
Vol Sales	0.016**	0.019***	0.010
	(0.007)	(0.007)	(0.009)
Tangibility	-0.005	-0.010	-0.005
	(0.010)	(0.009)	(0.009)
Loss	0.020***	0.022***	0.018***
	(0.004)	(0.004)	(0.004)
Vol Net Hire	0.018***	0.023***	0.017
	(0.005)	(0.006)	(0.011)
Labor Intensity	-0.417**	-0.465***	-0.018
	(0.177)	(0.164)	(0.179)
Labor Union	0.016	0.023	0.023
	(0.026)	(0.023)	(0.028)
Non-labor Inefficiency	0.041**	0.052***	0.010
	(0.018)	(0.016)	(0.018)
CEO Duality	-0.003		
	(0.003)		
CEO Ownership	0.009		
	(0.009)		
CEO Tenure	-0.004***		
	(0.001)		
CEO Excess Pay	0.002		
	(0.003)		
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.073*	0.080***	0.101***
	(0.042)	(0.030)	(0.019)
Observations	18,640	22,426	10,098
Adjusted R-squared	0.047	0.053	0.036

Table 4. VP Incentives.

Note: This table tests the tournament incentives on labor investment inefficiencies when considering VPs' incentives to compete in the promotion tournament. The dependent variable is *Labor Inefficiency*, *which* is the absolute value of the residual from the labor investment estimation in Eq. (1). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. *New CEO* equals one if the firm just hired a new CEO, and zero otherwise. *High Similarity* equals one for firms with above-median product similarly score, and zero otherwise. *High Concentration* equals one for firms with below-median industry concentration Herfindahl-Hirschmann index, and zero otherwise. Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Labor Inefficiency*		
	(1)	(2)	(3)
Ln [Pay Gap]	0.010***	0.011***	0.010***
	(0.001)	(0.002)	(0.002)
× *New CEO*	-0.005**		
	(0.002)		
× *High Similarity*		-0.004**	
		(0.002)	
× *High Concentration*			-0.003*
			(0.002)
New CEO	0.045**		
	(0.019)		
High Similarity		0.041***	
		(0.015)	
High Concentration			0.029**
			(0.015)
Accounting Quality	-0.149***	-0.148***	-0.148***
	(0.041)	(0.041)	(0.041)
Market-to-Book	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Firm Size	-0.009***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)
Quick Ratio	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)
Leverage	-0.002	-0.001	-0.001
	(0.007)	(0.007)	(0.007)
Dividend	-0.003	-0.002	-0.002
	(0.003)	(0.003)	(0.003)
Vol Cash Flow	0.019	0.016	0.017
	(0.019)	(0.019)	(0.019)
Vol Sales	0.019***	0.019***	0.019***
	(0.007)	(0.007)	(0.007)
Tangibility	-0.010	-0.011	-0.011
	(0.007)	(0.007)	(0.007)
Loss	0.021***	0.021***	0.022***
	(0.003)	(0.003)	(0.003)
Vol Net Hire	0.023***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)
Labor Intensity	-0.471***	-0.445***	-0.466***
	(0.136)	(0.136)	(0.137)
Labor Union	0.023	0.021	0.021
	(0.020)	(0.020)	(0.020)
Non-labor Inefficiency	0.052***	0.053***	0.053***
	(0.015)	(0.015)	(0.015)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.074***	0.066**	0.070**
	(0.028)	(0.029)	(0.029)
Observations	22,426	22,426	22,426
Adjusted R-squared	0.054	0.054	0.054

Table 5. Over-investment and Under-investment in Labor.

Note: This table presents the regression analysis of the influence of tournament incentives on four types of labor investment inefficiencies. The dependent variable is *Over Investment, Over Hiring, Under Firing, Under Investment, Under Hiring,* and *Over Firing* in columns (1) through (6), respectively. *Over Investment* is the positive residual from the labor investment estimation in Eq. (1). *Over Hiring* (*Under Firing*) is over-investment in labor when the expected level of net hiring is positive (negative). *Under Investment* is the absolute value of the negative residual from the labor investment estimation in Eq. (1). *Under Hiring* (*Over Firing*) is under-investment in labor when the expected level of net hiring is positive (negative). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Over Investment*	*Over Hiring*	*Under Firing*	*Under Investment*	*Under Hiring*	*Over Firing*
	(1)	(2)	(3)	(4)	(5)	(6)
Ln [Pay Gap]	0.018***	0.017***	0.008	0.004***	0.004***	0.005
	(0.004)	(0.004)	(0.011)	(0.001)	(0.001)	(0.005)
Accounting Quality	-0.181**	-0.196**	-0.051	-0.087**	-0.080**	0.040
	(0.091)	(0.089)	(0.136)	(0.037)	(0.040)	(0.116)
Market-to-Book	-0.000	0.000	-0.002	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Firm Size	-0.014***	-0.017***	-0.006	-0.005***	-0.005***	0.007
	(0.004)	(0.003)	(0.010)	(0.001)	(0.001)	(0.005)
Quick Ratio	0.007***	0.008***	0.000	0.001	0.002**	-0.005**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Leverage	-0.016	0.012	-0.066*	0.004	0.002	-0.047**
	(0.015)	(0.021)	(0.036)	(0.008)	(0.009)	(0.021)
Dividend	0.002	-0.000	0.008	0.004**	0.004*	0.019*
	(0.009)	(0.008)	(0.022)	(0.002)	(0.002)	(0.011)
Vol Cash Flow	-0.022	-0.043	0.039	0.027	0.044	0.001
	(0.041)	(0.035)	(0.075)	(0.024)	(0.029)	(0.069)
Vol Sales	0.036*	0.025	0.065*	0.005	-0.005	0.052**
	(0.019)	(0.017)	(0.039)	(0.005)	(0.005)	(0.023)
Tangibility	-0.049	-0.034	-0.123**	-0.003	0.001	-0.080***
	(0.031)	(0.026)	(0.060)	(0.006)	(0.006)	(0.028)
Loss	-0.017	-0.004	-0.016	0.042***	0.043***	0.009
	(0.012)	(0.012)	(0.018)	(0.003)	(0.003)	(0.010)
Vol Net Hire	0.048***	0.044***	0.001	0.010***	0.012***	-0.011
	(0.014)	(0.015)	(0.020)	(0.003)	(0.004)	(0.011)
Labor Intensity	-3.145***	-2.631***	-4.264*	0.247*	0.342**	-0.243
	(0.660)	(0.588)	(2.223)	(0.127)	(0.144)	(0.733)
Labor Union	0.040	0.060	-0.041	0.024*	0.021	0.026
	(0.085)	(0.074)	(0.097)	(0.014)	(0.014)	(0.085)
Non-labor Inefficiency	0.127***	0.106***	0.240**	0.016	0.027	-0.011
	(0.040)	(0.038)	(0.120)	(0.013)	(0.016)	(0.065)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.182	0.155	0.137*	0.069***	0.063***	-0.013
	(0.143)	(0.102)	(0.073)	(0.020)	(0.019)	(0.050)
Observations	6,607	6,054	553	15,819	14,637	1,182
Adjusted R-squared	0.043	0.046	0.110	0.103	0.106	0.135

Table 6. Endogeneity.

Note: This table addresses the endogeneity concerns in the relationship between tournament incentives and labor investment inefficiency. The dependent variable is *Ln [Pay Gap]* in Column (1), and *Labor Inefficiency* in Columns (2) through (4). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. *Labor Inefficiency* is the absolute value of the residual from the labor investment estimation in Eq. (1). Columns (1) and (2) present the instrumental variables (IV) approach. *Fitted Pay Gap* is the fitted Pay Gap estimated from the first stage. *Ind CEO Pay Gap* is the industry median executive pay gap. *Number VPs* is the natural logarithm of the number of VPs among the top five executives. Column (3) reports the analysis from the propensity score matching (PSM) method. *High Pay Gap* is a dummy variable set to one for firms in the highest quartile of executive pay gap and zero for firms in the bottom quartile of executive pay gap. Column (4) presents the Difference-in-Differences (DiD) analysis. The sample period in Column (4) is from 2007 to 2014, of which 2007 to 2010 is defined as the pre-Say-on-Pay (pre-SoP) period and 2011 to 2014 is defined as the post-SoP period. Post is set one to indicate the post-SoP period and zero for the pre-SoP period. *Treated* is a dummy variable set to one for firms with positive median excess CEO compensation in the pre-SoP period, and zero otherwise. Column (5) presents the long-window change-to-change analysis. The dependent variable is *Δ Labor Inefficiency*, which is the difference in labor investment inefficiency from year t to year t+3. All control variables in Column (4) are all change variables from year t-4 to t-1. Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

	IV		PSM	DiD	Change-on-Change
	First-Stage	Second-Stage			
Dep. Var.	*Ln [Pay Gap]*	*Labor Inefficiency*			*Δ Labor Inefficiency*
	(1)	(2)	(3)	(4)	(5)
Ind Pay Gap	0.176***				
	(0.024)				
Number VP	0.077***				
	(0.012)				
Fitted Ln [Pay Gap]		0.056***			
		(0.021)			
High Pay Gap			0.054***		
			(0.008)		
Treated				0.017***	
				(0.005)	
× *Post*				-0.014**	
				(0.007)	
Δ Ln [Pay Gap]					0.003*
					(0.002)
Accounting Quality	0.109	-0.155***	-0.005	0.012	0.029
	(0.157)	(0.032)	(0.091)	(0.050)	(0.054)
Market-to-Book	-0.001	0.000	-0.001	-0.000	0.000
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Firm Size	0.498***	-0.032***	-0.017***	-0.007***	-0.028***
	(0.005)	(0.010)	(0.003)	(0.002)	(0.003)
Quick Ratio	-0.033***	0.007***	0.004**	0.008***	0.006***
	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)
Leverage	0.411***	-0.021**	0.038	-0.006	-0.079***
	(0.030)	(0.010)	(0.023)	(0.009)	(0.014)
Dividend	-0.186***	0.005	0.007	0.002	0.007
	(0.013)	(0.005)	(0.006)	(0.004)	(0.007)
Vol Cash Flow	0.130*	0.012	-0.015	0.050*	0.012
	(0.075)	(0.015)	(0.029)	(0.026)	(0.024)
Vol Sales	0.064**	0.016***	0.039**	0.017*	-0.003
	(0.026)	(0.005)	(0.018)	(0.009)	(0.008)
Tangibility	-0.311***	0.004	-0.040**	-0.012	-0.121***
	(0.032)	(0.009)	(0.019)	(0.010)	(0.016)
Loss	0.139***	0.015***	0.019**	0.016***	-0.025***
	(0.016)	(0.004)	(0.008)	(0.005)	(0.005)
Vol Net Hire	0.150	0.022***	0.006	0.029***	-0.010*
	(0.015)	(0.003)	(0.009)	(0.005)	(0.005)

Labor Intensity	-0.051	-0.471***	-0.284	-0.291	-0.078
	(0.766)	(0.153)	(0.450)	(0.243)	(0.600)
Labor Union	0.014	0.020	0.033	0.110***	-0.204**
	(0.098)	(0.020)	(0.050)	(0.035)	(0.080)
Non-labor Inefficiency	0.064	0.049***	0.009	0.031*	-0.150***
	(0.057)	(0.012)	(0.034)	(0.018)	(0.016)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Constant	2.653***	-0.116	0.161***	0.087***	0.011
	(0.233)	(0.089)	(0.028)	(0.031)	(0.048)
F-statistics	46.88				
Sargan statistic		0.258			
Observations	22,426	22,426	3,656	7,370	11,352
Adjusted R-squared	0.469	0.003	0.062	0.055	0.037

Table 7. Role of Non-labor Investment.

Note: This table presents the regression analysis of the effect of other non-labor investments on the relationship between CEO pay slice on specific types of labor investment inefficiency. Panel A to D shows the results for the subsamples based on capital expenditure, R&D expense, acquisition, and advertising expenditure. The dependent variable is labor investment inefficiency in all columns. Column (1) of each panel analyses the subsample with a positive relationship between net-hiring and the non-labor investment, columns (2) examines the subsample with a negative relationship between net-hiring and the non-labor investment, and column (3) investigates the subsample when labor investment or non-labor investment is zero or missing. *Labor Inefficiency* is the absolute value of the residual from the labor investment estimation in Eq. (2). *Ln [Pay Gap]* is the natural logarithm of the difference between CEO total compensation and the median total pay of the next highest-paid four executives. All columns include the same set of control variables as in Eq. (2). Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Panel A: CAPEX

	Positive	Negative	Zero
	(1)	(2)	(3)
Ln [Pay Gap]	0.012***	0.004***	0.009***
	(0.002)	(0.002)	(0.004)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.033	0.138**	-0.030
	(0.031)	(0.058)	(0.043)
Observations	11,871	9,499	1,056
Adjusted R-squared	0.057	0.052	0.138

Panel B: R&D

	Positive	Negative	Zero
	(1)	(2)	(3)
Ln [Pay Gap]	0.011***	0.006***	0.009***
	(0.003)	(0.002)	(0.002)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.187**	0.077***	0.035*
	(0.087)	(0.025)	(0.021)
Observations	6,282	5,360	10,784
Adjusted R-squared	0.059	0.093	0.051

Panel C: Acquisition

	Positive	Negative	Zero
	(1)	(2)	(3)
Ln [Pay Gap]	0.010***	0.009***	0.007***
	(0.003)	(0.003)	(0.002)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.152***	0.038	0.033
	(0.057)	(0.032)	(0.031)
Observations	9,149	4,650	8,627
Adjusted R-squared	0.052	0.069	0.091

Panel D: Advertising

	Positive	Negative	Zero
	(1)	(2)	(3)
Ln [Pay Gap]	0.013***	0.005***	0.011**
	(0.002)	(0.002)	(0.005)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Constant	0.040	0.086***	0.147
	(0.055)	(0.027)	(0.135)
Observations	10,826	10,450	1,150
Adjusted R-squared	0.059	0.083	0.105

Table 8. Alternative Measures.

Note: This table presents the regression analysis of the influence of tournament incentives on labor investment inefficiencies with alternative measures of tournament incentives and labor investment inefficiency. Panel A presents the results using two alternative measures of tournament incentives. *Gini Top5* is the Gini coefficient based on the total compensation among the highest-paid five executives, calculated as $1+\frac{1}{n}-\frac{2}{n^2\bar{z}}\sum_{i=1}^{n}(i\times z_i)$, where n = 5 for the five executives; z_1, z_2, z_3, z_4, and z_5 are the total compensation for each of the five executives in descending order; $\bar{z}$ is the mean total compensation of the five executives. *CV Top5* is the coefficient of variation based on the total compensation among the highest-paid five executives, calculated as the standard deviation of the total compensation of the five executives, scaled by the mean of the total pay among the five executives. Panel B presents the results using alternative measures of labor investment inefficiency. *Labor Ineff Med* in Columns (1) and (2) of Panel B is estimated as the deviation from the industry median level net hiring. *Labor Ineff Biddle* in Columns (3) and (4) of Panel B is the absolute value of the residual from the Biddle et al. (2009) model. *Labor Ineff Additional* in Columns (3) and (4) of Panel B is the residual from the labor investment estimation in Eq. (1) by adding capital expenditure, R&D, acquisition investment, industry labor union coverage, and the natural logarithm of GDP per capita as additional controls. *Labor Ineff YearFE* in Columns (5) and (6) of Panel B is the residual from the labor investment estimation in Eq. (1) by controlling for both year and industry fixed effects. All columns include the same set of control variables as in Eq. (2). Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Panel A: Alternative Measures of Tournament Incentives

Dep. Var.	*Labor Inefficiency*	
	(1)	(2)
Gini Top5	0.034***	
	(0.010)	
CV Top5		0.021***
		(0.005)
Controls	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Constant	0.102***	0.106***
	(0.029)	(0.029)
Observations	22,426	22,426
Adjusted R-squared	0.052	0.052

Panel B: Alternative Measures of Labor Inefficiency

Dep. Var.	*Labor Ineff Med*	*Labor Ineff Biddle*	*Labor Ineff Additional*	*Labor Ineff YearFE*
	(1)	(2)	(3)	(4)
Pay Gap	0.009***	0.008***	0.009***	0.009***
	(0.002)	(0.001)	(0.001)	(0.001)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Constant	0.097**	0.111***	0.087***	0.077**
	(0.042)	(0.029)	(0.029)	(0.030)
Observations	22,426	22,426	22,426	22,426
Adjusted R-squared	0.058	0.067	0.060	0.065

Table 9. Executive Alignment Incentives.

Note: This table presents the regression analysis of the influence of tournament incentives on labor investment inefficiencies by controlling for CEO and subordinate executives' alignment incentives. *Labor Inefficiency* is the absolute value of the residual from the labor investment estimation in Eq. (1). *CEO Delta* is the performance-based incentive (Delta) in CEO compensation. *CEO Vega* is the risk-taking incentive (Vega) in CEO compensation. *Med VP Delta* (*Med VP Vega*) is the median Delta (Vega) of the next highest-paid four executives. *CEO Option* (*Restricted Stock*) is the natural logarithm of CEO option (restricted stock) compensation. *Med VP Option* (*Med Restricted Stock*) is the natural logarithm of the median option (restricted stock) compensation of the next highest-paid four executives. *Cash* (*Equity, Restricted Stock, Option, LTIP*) *Pay Gap* is the natural logarithm of the difference between CEO cash (equity, restricted stock, option, and long-term incentive plan) compensation and the median total pay of the next highest-paid four executives. Equity compensation is the sum of restricted stock, option, and long-term incentive plan. Table A1 in the Appendix provides detailed variable definitions. Standard errors are clustered at the firm level and presented in parentheses. ***, **, and * denote significant at the 1%, 5% and 10% level, respectively.

Dep. Var.	*Labor Inefficiency*			
	(1)	(2)	(3)	(4)
Pay Gap	0.008***	0.010***		
	(0.002)	(0.002)		
CEO Delta	0.003			
	(0.002)			
CEO Vega	-0.002*			
	(0.001)			
Med VP Delta	0.000*			
	(0.000)			
Med VP Vega	-0.000			
	(0.000)			
CEO Option		-0.001		
		(0.001)		
CEO Restricted Stock		0.000		
		(0.001)		
Med VP Option		0.000		
		(0.001)		
Med VP Restricted Stock		0.001		
		(0.001)		
Cash Pay Gap			0.004**	0.004**
			(0.002)	(0.002)
Equity Pay Gap			0.002***	
			(0.001)	
Restricted Stock Pay Gap				0.001***
				(0.000)
Option Pay Gap				0.001*
				(0.000)
LTIP Pay Gap				0.001**
				(0.000)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Constant	0.087***	0.072**	0.099***	0.097***
	(0.032)	(0.031)	(0.031)	(0.031)
Observations	22,426	22,278	21,387	20,300
Adjusted R-squared	0.054	0.054	0.052	0.052