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# The Impact of Relative CEO Pay on Employee Productivity

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## ABSTRACT

In this study, we examine the relationship between within-firm pay inequality and employee productivity. We use hand-collected data on a sample of S&P 1500 companies from 2018-2022 and find a concave relationship between the relative CEO pay and employee productivity. Consistent with tournament theory, we show that the pay gap between the CEO and the Vice Presidents initially positively affects employee productivity. However, this positive effect only works up to a certain level, at which - as expressed by the CEO-employee pay ratio - employee discontent initiates a fall in firm-level productivity. We identify this tipping point as the point at which CEO pay exceeds the median worker's pay by a factor of 40. The average CEO-employee pay ratio in our sample is 193:1, suggesting that most firms could have avoided a fall in productivity by reducing their CEO-employee pay ratio. Our results remain robust after controlling for endogeneity. From a public policy perspective, our findings pave the way for corporate self-regulation of CEO pay to avoid politically imposed hard laws.

**Keywords:** *CEO pay, CEO pay-employee ratio, Employee productivity, Tournament incentives*

**JEL:** *G18, G32, G34, J24, J33, M12*

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## 1. Introduction

Since the early 2000s, media and politicians in numerous countries have become increasingly concerned about the significant pay gap between executives and workers. This has brought the CEO pay issue into a broader public debate about societal inequality. In response to such public concerns, legislation to limit CEO pay has been proposed. One of the first such cases was the 2013 Swiss referendum on capping CEO pay at 12 times the salary of the lowest-paid worker in the same company. Although the Swiss vote went against this proposal, it sparked similar debates in many countries. The broader debate is well-captured by the title of a recent Economist article: *“Pay guaranteed, performance optional. How CEO pay in America got out of whack.”*<sup>1</sup>

In the U.S., the average pay ratio between CEOs and employees increased for the 350 largest firms from 20:1 in 1965 to 278:1 in 2018 (Mishel and Wolfe 2019). However, despite this development, there is a lack of research on how such growing pay ratios affect employee behavior and productivity. Here, we address this issue and capitalize on a recent Securities and Exchange Commission (SEC) mandate - Section 953(b) of the Dodd-Frank Act - requiring all publicly listed firms (from 2018 on) to report the annual compensation of their CEO and median employee. This newly mandated firm-based data on CEO and employee compensation provided in the proxy filings allows more accurate comparisons of rank-and-file employee compensation to be made across firms. We apply the CEO-to-median-employee pay ratio (hereafter, pay ratio) as a measure of within-firm pay inequality. Specifically, we aim to extend the literature on executive compensation by addressing the following research question: How does CEO compensation - relative (1) to that of the workers and (2) to the rest of the top management team - affect employee productivity? Focusing on employee productivity allows us to assess the potential effects of CEO pay on lower-level employees' incentives and behavior and to identify a new “cost” dimension of CEO pay.

We emphasize two theoretical channels by which CEO compensation is expected to impact employee productivity. The first channel is based on the theory of fairness, expressed by inequity aversion (Adams 1965; Cowherd and Levine 1992) and relative deprivation theory (Martin 1981). The

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<sup>1</sup> <https://www.economist.com/business/2020/07/11/how-ceo-pay-in-america-got-out-of-whack>

literature on pay dispersion shows that employees perceive large pay differentials as unfair, which is expected to adversely affect employee morale and lead to lower productivity (Breza, Kaur, and Shamdasani 2018). Furthermore, past research indicates that lower pay dispersion leads to productivity-enhancing behavior, such as more team orientation, increased cooperation, and a stronger sense of a common goal (Cowherd and Levine 1992; Pfeffer and Langton 1993).

The tournament theory is the second channel contributing to our understanding of how CEO pay may impact employee productivity (Lazear and Rosen 1981). The theory suggests that large pay differentials create a compelling intra-organizational contest between employees aiming to climb the corporate career ladder. These employees' efforts depend on the promotion prize, which is the pay gap between their current rank and the expected higher rank (Bognanno 2001). The tournament argument applies to employees at all levels, but we argue it is particularly appropriate at the top management level, where pay differences are relatively significant and the number of possible candidates for the top job is limited. Past research indicates that substantial pay gaps between the CEO and top-ranked executives can trigger greater effort by these executives, leading to improved firm performance and higher firm value (Kale, Reis, and Venkateswaran 2009).

According to the tournament theory, top-ranked executives compete to be the company's next CEO to maximize their long-term expected total compensation. Therefore, each top management team member will try to monitor and incentivize employees, to increase their productivity and achieve recognition for themselves for their unique contribution to the organization's performance. This way, the top-ranked executives aim to maximize their likelihood of being appointed as the new CEO. The tournament theory effect could also be applied to the pay relation between the CEO of a company and its workers in a direct way, with the argument that the "prize" gained by jumping from blue-collar worker to CEO of the same company is big and tempting. However, success stories of this kind are historically hard to find. Hence, we concentrate on the indirect effect on employee productivity captured by tournament theory and the extent to which this effect is channeled via the CEO-top-management relation.

We address our research question by analyzing data from S&P 1500 firms from 2018 to 2022. Our sample provides us with 1,403 unique firms and 4,686 firm-year observations. To measure the pay ratio, we use the ratio of the total compensation of the CEO to that of the median employee. As measures of employee productivity, we use the ratio of sales to the number of employees and total factor productivity (TFP).

Our results, across the two productivity measures, indicate a curvilinear (concave) association between the relative CEO pay and employee productivity. An increase in CEO pay initially increases employee productivity, but when CEO total compensation reaches about 40 times that of the median employee (a pay ratio of 40:1), the workers' productivity starts to decline. We argue that the initial positive relationship between CEO pay and employee productivity indicates that top management - in the spirit of tournament theory - is working hard to get the employees to deliver. As CEO pay keeps rising, a tipping point is reached where employees start to consider the huge CEO pay as unfair. At this point, employees' disappointment and demotivation make them put less effort into their work, resulting in lower productivity. The results are economically meaningful, with, for example, a one percent increase in the pay ratio related to a 0.31 percent decrease in the sales-to-employees ratio.

Our multi-year analysis reveals that the observed tipping point (between the positive tournament effect and the negative fairness effect) is far lower than the average CEO pay ratio (193:1) for our period under investigation. This implies that many firms in that period had opportunities to gain increased productivity by lowering their CEO-employee pay ratio. Our further analysis shows that higher CEO ownership mitigates the negative relationship between pay ratio and productivity, while CEO-chair duality aggravates it. These results align with the findings that CEO ownership impacts CEO long-term incentives (Jensen and Murphy 1990), and CEO-chair duality leads to CEO entrenchment (Finkelstein and D'Aveni 1994).

Our study contributes to the top management compensation literature by examining the impact of relative CEO pay on employee productivity. We provide evidence of a concave relationship between the two. In doing so, we build on the research of Crawford et al. (2021), Jung et al. (2021), Lee et al. (2019), Pan et al. (2022), and Vo and Canil (2019). This way, we extend the literature by combining

the tournament theory (Lazear and Rosen 1981) and the fairness/deprivation theory (Adams 1965; Cowherd and Levine 1992). Additionally, we contribute to the literature on CEO long-term orientation and corporate governance by demonstrating that higher CEO ownership helps to mitigate the adverse effects of the pay ratio on productivity.

Our findings have important implications for corporations and policymakers, highlighting the need for corporate self-regulation of pay ratios to enhance employee productivity. Specifically, our results can assist owners and boards of directors in determining the optimal CEO total compensation relative to that of the median employee.

The remainder of this paper is structured as follows. In the next section, we review the relevant theories and formulate our hypotheses. Following this, we describe our research design and sample. We then present our results in a dedicated section before concluding with a summary of our findings.

## **2 Literature Review and Hypotheses**

### ***2.1 CEO Pay Ratio and Employees' Productivity***

Standard application of agency theory suggests that CEOs should be given “high-powered” incentives to reduce the owner’s exposure to moral hazard (e.g., Jensen and Meckling 1976). As a result, CEO pay tends to increase, especially in firms with high performance (Faleye, Reis, and Venkateswaran 2013). However, the perception of pay equity is a critical counterargument to high CEO pay and a high CEO-employee pay ratio. Employees may feel a sense of inequity if they perceive their compensation to be lower than that of their colleagues. This feeling of unfairness can lead to employee dissatisfaction and reduced effort, eventually lowering productivity (Breza et al. 2018).

Despite the above arguments, the extant literature does not provide clear empirical evidence that a higher CEO pay ratio affects employee performance in general, or productivity in particular. Faleye et al. (2013) find no relationship between CEO pay ratios and employee productivity using U.S. data from 1996 to 2006. Likewise, Rouen (2020) finds no significant relationship between pay ratio and employee productivity using U.S. data from 2006 to 2013. However, these two studies are based on

voluntary disclosure by firms of their labor expenses, exposing the results to self-selection bias. Moreover, media coverage of pay ratios has recently increased dramatically, which may have heightened employees' awareness of pay inequalities.

More importantly, recent regulatory reforms have improved the availability of data related to within-firm pay dispersion. The Dodd-Frank Act requires publicly listed firms to disclose their annual CEO and median employee compensation, as well as the ratio between the two. The regulatory reform allows for an analysis without self-selection bias now. Based on the arguments above, we hypothesize that:

*HYPOTHESIS 1: There is a negative association between a firm's CEO-employee pay ratio and its employee productivity.*

## **2.2 CEO versus Vice President Pay Gap and Employee Productivity**

The literature on executive compensation distinguishes between performance-based and promotion-based incentives (Coles, Li, and Wang 2018; Henderson and Fredrickson 2001; Kini and Williams 2012; Ma, Pan, and Stubben 2020). While CEO compensation is typically tied to performance, other executives may receive both promotion-based and performance-based incentives, with promotion-based incentives often referred to as tournament incentives (Lazear and Rosen 1981; Rosen 1986). In a rank-order tournament, the senior executive with the highest relative performance among the Vice Presidents typically wins the tournament, gets promoted to the CEO position, and receives the promotion prize. The size of the promotion prize, which is the pay gap between the CEO and Vice Presidents (hereafter, pay gap), is an important determinant of effort, as larger pay gaps lead to greater effort and improved firm performance (Bognanno 2001; Kale et al. 2009).

Empirical studies on tournament theory have shown a positive link between the pay gap and overall firm performance (Heyman 2005; Kale et al. 2009), which could be attributed to enhanced employee productivity. Accordingly, we hypothesize that a higher pay gap is positively associated with improved employee productivity. This is because potential CEO candidates, currently Vice Presidents,

may strive to motivate lower-level employees to increase their productivity in their pursuit of the CEO position. Based on the above, we suggest the following:

*HYPOTHESIS 2: There is a positive association between a firm's pay gap between the CEO and Vice Presidents and its employee productivity.*

### **2.3 Tournament Theory, Fairness, and Employee Productivity**

We propose that combining tournament theory and the theory of fairness supports a curvilinear relationship between pay structure and employee productivity. Specifically, we predict that an increase in the pay gap between the CEO and Vice Presidents will initially have a positive effect on employee productivity due to tournament theory, but at a certain level of CEO pay, perceived unfairness will become dominant and negatively impact productivity. This tipping point is supported by Pfeffer and Langton (1993), who find that a very high pay gap between the CEO and average workers triggers negative emotions among employees, resulting in job dissatisfaction and disengagement. Faleye et al. (2013) suggest that large wage dispersions will not motivate rank-and-file employees due to the low probability of promotion, and may even lead to shirking behavior.

The inequity aversion theory (e.g., Adams 1965; Cowherd and Levine 1992) supports the idea that a high pay gap negatively impacts firm productivity and value by creating a feeling of unfairness among employees. As CEO pay increases, there is a declining interest in monitoring employee behavior, which may lead to non-cooperative behavior and employee sabotage (Henderson and Fredrickson 2001). Employees may perceive CEO compensation as “fair” up to the tipping point, but above it they will assume they are paid less than they deserve, resulting in decreased productivity, in line with the agency theory (Campbell et al. 2016).

For the inequality argument and fairness/deprivation theory to be valid, employees must be informed of the pay ratio so as to react with lower effort. We identify three patterns of employee reactions: ignorance, refraining from reducing effort, or feeling that it is unfair. The media and labor



unions may play a crucial role in informing workers of the pay ratio and in underpinning a feeling of unfairness. Based on these arguments, we formulate the following hypothesis:

*HYPOTHESIS 3: There is a curvilinear (concave) association between a firm's relative CEO pay and its employee productivity*

#### **2.4 Pay Ratio, Employee Productivity, and CEO Characteristics**

Jensen and Meckling's (1976) seminal research paper highlights the significance of CEO ownership in influencing corporate performance and decision-making. They contend that the separation of ownership and control creates agency problems, with management exploiting information asymmetries to prioritize their interests over those of ordinary shareholders. They assert that CEO interests become more aligned with those of other shareholders when they have higher stock ownership. Supporting this, Von Lilienfeld-Toal Ruenzi (2014) find that firms with high managerial stock ownership deliver better stock market performance than those with low ownership. Similarly, Mehran and Carroll (1995) provide evidence that firm performance largely depends on the percentage of stock the management owns and their equity-based compensation.

Cronqvist et al. (2009) investigate whether entrenched managers pay their workers more and find that CEOs with greater corporate control tend to pay more to closely associated employees (in the corporate hierarchy). They suggest that higher pay for these employees is motivated by CEOs' personal benefits, such as lower wage bargaining and improved social relations with employees. In contrast, Lambert, Larcker, and Weigelt (1993) and Core, Holthausen, and Larcker (1999) find that CEO compensation decreases as CEO ownership increases. They explain the negative relationship between ownership and pay by stating that CEO pay sets the compensation benchmark for other executives in the firm. Therefore, lower CEO pay leads to a decrease in the firm's total compensation and an increase in the residual return to owners. Thus, a CEO with higher stock ownership can benefit from lower pay as it is offset by an increase in their financial return. The lower CEO pay can result in a smaller pay ratio between the CEO and the median employee, which may enhance productivity. CEOs with higher

ownership may also decrease within-firm pay dispersion by offering higher compensation to motivate ordinary employees. Consequently, we formulate the following hypothesis:

*HYPOTHESIS 4: Higher CEO ownership moderates the adverse impact of the pay ratio on employee productivity.*

Another vital CEO characteristic is the possibility of holding the positions of both CEO and chair of the company. This combination, known as CEO-chair duality, provides a unity of command at the top of the firm through strong and unambiguous leadership. However, agency theory suggests that CEO duality can lead to CEO entrenchment by limiting board monitoring effectiveness, particularly in firms with weak corporate governance (Finkelstein and D'Aveni 1994). Dual chairs may use their significant bargaining power over other board members to hold multiple directorships, restrict mandatory disclosures, limit the demand for higher-quality financial reports, and increase CEO compensation by selecting high-paid peers (Bassett, Koh, and Tutticci 2007; Chen, Liu, and Li 2010; G. P. Martin, Wiseman, and Gomez-Mejia 2019; Tuggle et al. 2010). On the other hand, board chairs who are not CEOs may facilitate a culture that enhances board monitoring and persuades management to invest in long-term value-enhancing projects, such as research and development (R&D) and diversification in both domestic and international markets (Sanders and Carpenter 2017; Wang, Chung, and Lim 2015; Zahra, Neubaum, and Huse 2000). However, separating the board chair and the CEO positions may not always be the best approach, especially during a crisis or when operating in a competitive environment (Byrd et al. 2012; Van Essen, Engelen, and Carney 2013).

While some studies find that CEO duality leads to increased CEO compensation, others report no significant effects (Conyon and Peck 1998). Nonetheless, the literature suggests that CEO-chairs influence their compensation to reflect their risk preferences. Risk-averse CEOs may avoid risk by ensuring that the fixed portion of their pay is high and the performance-based portion is low (Westphal and Zajac 1995). However, such compensation packages may not benefit shareholders as they encourage CEOs to ignore high-risk strategic investments, which can constrain growth opportunities and affect corporate profitability (Jensen and Murphy 1990). In the long term, the decrease in strategic

investments can make the firm less competitive, less attractive to skilled labor (Alcacer and Chung (2014), and less productive. This leads to the following hypothesis:

*HYPOTHESIS 5: CEO-chair duality exacerbates the adverse impact of the pay ratio on employee productivity.*

### **3 Data and Methodology**

#### **3.1 Data**

In August 2015, the SEC began to make public firms disclose their pay ratio, as mandated by the Dodd-Frank Wall Street Reform and Consumer Protection Act. This rule provides shareholders with additional information with which to assess CEO total compensation relative to that of other employees when voting on “say on pay.” Since January 1, 2017, all publicly listed firms have had to report the CEO’s and the median employee’s annual total compensation for benchmarking (SEC, 2015).

For this study, we hand-collect our CEO-employee pay ratio measure from the proxy statements of S&P 1500 firms using the SEC’s database EDGAR. Our sample covers fiscal years from 2018 to 2022, including 1,403 unique firms and 4,686 firm-year observations. We obtain executive total annual compensation (TDC1) and other data related to CEO characteristics from S&P’s ExecuComp, which provides detailed data for firms in the S&P 1500. Additionally, we gather financial data from Compustat and Worldscope and stock data from CRSP. We are lacking information on individual variables for 93 firms which are therefore not included in the sample. However, the missing observations are randomly distributed and assumed to have no systematic impact on our results.

#### **3.2 Dependent Variable**

We use two productivity measures to examine how the pay ratio impacts employee performance. Drawing on prior studies by Faleye et al. (2013) and Sánchez and Benito-Hernández (2013), we utilize two proxies for employee productivity: the natural logarithm of the ratio of total sales to the total number

of employees (*Sales to Employees*) and total factor productivity (*TFP*). To estimate *TFP*, we adopt the Cobb-Douglas production function and formulate it as follows:

$$Y_{it} = \lambda L_{it}^a K_{it}^b \quad (1)$$

where  $Y_{it}$ ,  $L_{it}$ , and  $K_{it}$  are total sales, number of employees, and capital input (net property, plant, and equipment), respectively, for firm  $i$  at time  $t$ . Following prior research, we employ the residuals obtained from our estimation of Equation 1's natural log transformation for all Compustat firms to determine firm-level *TFP* (Faleye, Mehrotra, and Morck 2006; Faleye et al. 2013). We estimate the regression by industry to control for industry-fixed effects, with the two-digit SIC code serving as the industry.

### 3.3 Main Explanatory Variables

Building on prior research (Crawford et al. 2021; Pan et al. 2022), we measure *Pay Ratio* as the natural logarithm of the ratio between CEO pay (TDC1 in ExecuComp) and the median employee's pay. We hand-collect the median employee total compensation from the definitive proxy statements of our sample firms in the SEC's database EDGAR. *Pay Ratio* serves as our key variable in testing H1, H3, H4, and H5. In testing H2, we use *Pay Gap* as the primary explanatory variable, which we define as the total compensation difference between the CEO and the median-paid VP (Bloom 1999; Bognanno 2001; Kini and Williams 2012).

We also perform cross-sectional tests using two CEO characteristics as interaction variables. The first is *CEO Ownership*, defined as the percentage of the company's stocks owned by the CEO. The second variable is *CEO Duality*, which is a dummy variable that equals one when the CEO also serves as the board's chairman and zero otherwise.

### 3.4 Main Empirical Model

We examine the relationship between the pay ratio and employee productivity by estimating the following regression model:

$$\begin{aligned} \text{Productivity}_{it} = & \beta_0 + \beta_1 \text{Pay Ratio}_{it} + \beta_2 \text{CEO Characteristics}_{it} + \beta_3 \text{Firm Characteristics}_{it} + u_{it} \\ & + v_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

where *Productivity* refers to one of the two measures of employee productivity: *Sales to Employees* or *TFP*; *Pay Ratio* is the natural logarithm of the ratio of total annual CEO compensation to the median employee's total compensation; *u* is an industry dummy in the equation; and *v* is a year dummy. A negative  $\beta_1$  would be consistent with the hypothesized argument that the pay ratio is negatively related to employee productivity.

We control for various CEO and firm characteristics when examining the pay ratio and productivity relationship. Specifically, we control for *CEO Founder*, which has been found to have a positive relationship with firm performance in previous research (Anderson and Reeb 2003). We also control for *CEO Age*, which has been shown to affect firm productivity in various ways (Serfling 2014). Older CEOs may behave opportunistically, but solid organizational culture can mitigate this behavior (Abernethy, Jiang, and Kuang 2019). Moreover, long-serving CEOs may have better abilities to extract rents which may also lead to reduced firm performance due to lower monitoring intensity (Dikolli, Mayew, and Nanda 2014; Hou, Priem, and Goranova 2014). Hence, we control for *CEO Tenure*.

As for firm characteristics, we control for *Firm Size*, which has been found to have a positive relationship with CEO pay (Bae, Kang, and Wang 2011; Chang, Dasgupta, and Hilary 2010; Nguyen and Nielsen 2014). We also control for international operations by using the variable *Foreign Segments*, which is assumed to be positively related to CEO compensation (Keller and Olney 2021; Oxelheim and Randøy 2005). *Leverage* and *Book to Market* are also included as control variables as they can affect the wage rate of ordinary workers and CEO compensation (LaViers, Sandvik, and Xu 2022). Finally,

we control for industry competition using the *HH Index* (Gartenberg and Wulf 2020). Detailed variable definitions are provided in Appendix A.

## 4 Results

### 4.1 Descriptive Statistics and Univariate Analysis

The average CEO-employee *Pay Ratio* is 193 (with a median of 108). This indicates that, on average, a CEO's total compensation is approximately 193 times that of the median employee. The higher standard deviation of *Pay Ratio* (253.67) highlights significant variations in both CEO and median employee pay. The mean (median) *CEO Pay* is \$8.740 (\$6.842) million, while the mean (median) *Emp Pay* is \$71,833 (\$62,955). These summary statistics for *Pay Ratio* and its components align with recent studies (e.g., Jung et al., 2021; LaViers et al., 2022). Additionally, six percent of the CEOs in our sample are founders of their respective firms, while 17 percent serve as chairpersons of their boards.

Panel B of Table 1 reports the mean and median of *Pay Ratio* and its components across the Fama-French Industry Code (12 industries). The utilities have a relatively low *Pay Ratio*, whereas the wholesale, retail, and services industries have the highest. To account for the effect of outliers, we utilize the natural logarithm of *Pay Ratio* in our analysis.

[Insert Table 1 about here]

### 4.2 Univariate Analysis

Table 2 displays the correlation matrix. As expected, the two employee productivity measures are positively correlated. The table also shows that *Pay Ratio* negatively correlates with the two employee productivity measures, supporting our H1. Further, larger firms and those with more foreign segments (i.e., more internationalized) positively correlate with *Pay Ratio*. In contrast, firms with higher labor unionization, intense industry competition, and volatile stock prices negatively correlate with *Pay Ratio*. No multicollinearity issues appear to be present, as all variance inflation factors (VIFs) are below four.

[Insert Table 2 about here]

### 4.3 *Baseline Results*

We estimate Equation 2 to examine the relationship between *Pay Ratio* and employee productivity. The results are presented in Table 3, where column 1 shows that *Pay Ratio* is significantly and negatively associated with *Sales to Employees* ( $\beta = -0.319^{***}$ ), providing support for H1. A one percent increase in *Pay Ratio* leads to a 0.31 percent decrease in *Sales to Employees*, indicating an economically important relationship. Additionally, the control variables, *Firm Size*, *STD Cashflows*, and *Unionization*, are positively associated with employee productivity, while *Foreign Segments* is negatively associated, as expected. In column 2 of Table 3, the analysis is repeated using *TFP* as the dependent variable. The results show a consistent negative relationship between *Pay Ratio* and employee productivity ( $\beta = -0.282^{***}$ ).

### 4.4 *Endogeneity Controls*

The results presented in columns 1 and 2 of Table 3 may be subject to endogeneity concerns. This arises from the possibility of unobserved time-invariant firm characteristics affecting both *Pay Ratio* and employee productivity, leading to omitted variable bias. OLS fixed effect estimates may yield inconsistent results by showing a spurious relationship between *Pay Ratio* and employee productivity. To address this, the regression models are re-estimated using entropy-balanced samples. Appendix B provides the covariate balances before and after applying the weighting scheme. The differences in the first and second moments indicate that the treatment and control samples have almost identical distributions. Consistent with the previous results, the analyses in columns 3 and 4 of Table 3 support that *Pay Ratio* is negatively associated with employee productivity.

[Insert Table 3 about here]

To further address the potential endogeneity concerns, we employ instrumental variable (IV) analysis. In our IV analysis, we use *Social Capital* at the county level, obtained from Rupasingha, Goetz, and Freshwater (2006), as an instrument to address endogeneity concerns. *Social Capital* is measured based on secular norms and social networks surrounding headquarters. We also use *Industry Pay Ratio*, the median *Pay Ratio* of the two-digit SIC industry (excluding the firm in question), as another instrument. We choose these instruments because they satisfy the two IV conditions: Both are statistically significant predictors of *Pay Ratio*. Also, no empirical evidence indicates that either social capital or the median industry value of *Pay Ratio* directly affects employee productivity.

The results in Table 4, column 1, indicate that *Social Capital* and *Industry Pay Ratio* significantly explain the variation in *Pay Ratio*. Additionally, *CEO Age*, *Firm Size*, *Foreign Segments*, and *HH Index* (competition within a two-digit SIC industry) are positively related to *Pay Ratio*. Conversely, *CEO Tenure* and *Book to Market* are negatively associated with *Pay Ratio*. The results in columns 2 and 3 are consistent with those reported in Table 3, demonstrating that *Pay Ratio* has a negative relationship with employee productivity. In summary, our IV analysis addresses endogeneity concerns and provides evidence that supports our earlier findings regarding the negative association between *Pay Ratio* and employee productivity.

[Insert Table 4 about here]

#### **4.5 CEO Pay Gap and Employee Productivity**

We use an OLS fixed effects regression to test H2, hypothesizing a positive association between *Pay Gap* and employee productivity. *Pay Gap* is the total compensation gap between the CEO and the median-paid senior executive (VP). In Table 5, we present the results of our analysis. The coefficients in columns 1 and 2 show a positive relationship between the CEO pay gap and employee productivity. This finding supports the idea that tournament incentives motivate VPs to exert more effort, leading to greater employee productivity. The coefficients for the control variables in this analysis are similar to those reported in earlier tables.



[Insert Table 5 about here]

#### 4.6 *Nonlinear Specification*

Companies offer high CEO compensation primarily to incentivize CEOs to work hard and increase shareholder wealth (Thanassoulis 2012). However, our study suggests that high CEO pay coupled with significant pay disparity within the company may lower employee productivity, raising concerns about the effectiveness of executive compensation in generating economic benefits. Nevertheless, CEO compensation may be effective as long as it is not excessively high compared to ordinary employee compensation. In other words, a nonlinear relationship between *Pay Ratio* and productivity might exist in line with our H3.

To address this potential curvilinear relationship, we conduct two additional tests. We use a piece-wise regression with different thresholds of *Pay Ratio* and a non-parametric kernel regression. For the first test, we start by dividing the sample into two subgroups based on the median value of *Pay Ratio* and test whether the relationship between *Pay Ratio* and employee productivity differs across these groups. Columns 1 and 2 of Table 6 show that the relationship between *Pay Ratio* and productivity becomes negative only when *Pay Ratio* exceeds the sample median. Below the median, the relationship between the two is positive.

We then proceed by dividing the sample into five subgroups based on the quintiles of the pay ratio. *Pay Ratio (Q1)* is a dummy variable that takes the value of one if *Pay Ratio* falls in the first quintile and zero otherwise. A similar approach is applied when defining the subsequent subgroups. The results in column 3 show that the relationship between *Pay Ratio* and employee productivity is positive and statistically significant for firms with pay ratios falling in the first and second quintiles of *Pay Ratio*, as expected. In contrast, the relationship is negative for firms with pay ratios falling in the fourth and fifth quintiles. The coefficients for the pay ratio in the different subgroups range from the positive 0.301\*\*\* for *Pay Ratio (Q1)* to the negative -0.419\*\*\* for *Pay Ratio (Q5)*.

In column 4, we use *TFP*, our second measure of employee productivity, and re-estimate our earlier regression. We again find that the coefficient on the pay ratio flips to negative as we move to

larger quantiles of *Pay Ratio*. The coefficients on the pay ratios of different subgroups change from positive 0.261\*\*\* for *Pay Ratio (Q1)* to negative -0.371\*\*\* for *Pay Ratio (Q5)*. The results suggest a nonlinear relationship between *Pay Ratio* and employee productivity. Therefore, CEO pay could be an effective mechanism for motivating CEOs to work hard, but may have an adverse effect above a certain threshold, at which point employees perceive it as a sign of discrimination.

[Insert Table 6 about here]

Next, in our second additional test, we utilize a non-parametric kernel regression to analyze the relationship between *Sales to Employees* and *Pay Ratio*. This method allows us to visually observe the empirical relation between the two variables without imposing any linear or nonlinear constraints at a pre-specified tipping point. Figure 1 displays the fitted values from the kernel regression. The curve remains nearly flat when *Pay Ratio* is below 3.7 (equivalent to a pay ratio of 40:1). However, the curve becomes strongly negatively sloped when *Pay Ratio* exceeds 3.7. Hence, we can conclude that *Pay Ratio* has a negative relationship with employee productivity only when it has surpassed a specific threshold. Below the threshold, *Pay Ratio* exhibits a positive relationship with productivity. In untabulated tests, we substitute *Sales to Employees* with *TFP* and find similar outcomes to those reported in this table.

[Insert Figure 1 about here]

#### **4.7 On the Role of CEO Ownership and CEO Duality**

To test H4 and H5, we investigate how CEO characteristics, as interaction variables, influence the relationship between *Pay Ratio* and employee productivity. Previous studies have shown that CEO pay serves as a benchmark for lower-level managers' compensation (Core et al. 1999; Lambert et al. 1993). CEOs who own a higher proportion of the company may choose to forgo excessive compensation, as it can increase the firm's total compensation expenses, reduce reported earnings, and lower the market

value of the CEO's ownership. Alternatively, CEOs with higher ownership may choose to offer higher pay to ordinary workers to retain them and motivate them to work harder. Thus, we expect that firms with higher CEO ownership will have lower within-firm pay dispersion and be less impacted by the adverse effects of the pay ratio.

To test this hypothesis, we divide our sample into low (lower quantities) and high (top quintile) CEO ownership subgroups. We then create an indicator variable that takes the value of one if the firm falls in the top CEO ownership quintile and zero otherwise. The coefficients for *Pay Ratio*  $\times$  *High CEO Ownership* in columns 1 and 2 of Table 7 are positive and statistically significant. The results in columns 1 and 2 indicate that firms with higher CEO ownership experience a 6.4% and 5.8%, respectively, smaller decline in productivity due to a one percent increase in *Pay Ratio* relative to those with lower CEO ownership. Thus, we find support for H4.

The literature on executive compensation and corporate governance suggests that CEO-chairs significantly influence their compensation package to suit their risk preferences. Risk-averse CEO-chairs are likely to have a higher proportion of their compensation package in the form of fixed pay and a smaller proportion in the form of performance-based pay (Westphal and Zajac 1995). In such cases, CEOs may avoid investing in long-term projects like R&D, making the firm less competitive in the market and less attractive to skilled labor (Alcacer and Oxley 2014). This could also negatively impact employee productivity in the long run. Therefore, we hypothesized in H5 firms with CEO-chair duality to be even more exposed to the negative effects of a high *Pay Ratio*.

To test H5, we create an interaction term between *Pay Ratio* and *CEO Duality*. The coefficient for *Pay Ratio*  $\times$  *CEO Duality* is negative and statistically significant across the two productivity measures in columns 3 and 4. The results in these columns show that firms with CEO duality experience a further decline of 4.4% and 3.3% in their employee productivity due to a one percent increase in the pay ratio, compared to those with separate chair and CEO. Therefore, our results support H5, indicating that firms with CEO duality are more vulnerable to the decline in productivity caused by the pay ratio than firms without CEO duality.

[Insert Table 7 about here]

#### **4.8 Robustness Tests**

We conduct four tests to confirm the robustness of our findings. Firstly, we do a subsample analysis. We remove financial firms (SIC codes 6000-6999) and re-estimate the regression model. Then, we keep only financial firms and re-estimate the regression. The results in columns 1 and 2 of Table 8 show that the primary conclusions remain sturdy, signifying a negative association between the pay ratio and productivity.

Secondly, we employ an alternative measure of the pay ratio, the percentile rank measure, following Crawford et al. (2021). Thirdly, we include state-fixed effects in our regression model to control for state-level governance mechanisms that could impact CEO pay. Both these tests support our findings.

Finally, we make an additional test of the importance of the internationalization of the firm to our findings. We do this in order to make sure that our results are not driven by the fact that CEOs of internationally orientated firms enjoy higher compensation relative to their domestic peers (Oxelheim and Randøy 2005) and where this compensations appears in combination with low employee compensation and productivity in developing countries, In Panel B of Table 8, we restrict our sample to firms whose subsidiaries are only located in the United States, as indicated in columns 1 and 2. We find that the negative relation remains for purely domestic firms.

Overall, these robustness tests support the reliability of our results, indicating a negative relationship between the pay ratio and employee productivity. The exclusion of regulated industries, limiting the sample to U.S.-only subsidiaries, using an alternative measure of the pay ratio, and controlling for state-fixed effects all confirm the consistency of our main findings.

[Insert Table 8 about here]

## 5 Conclusion

The aim of this study was to investigate the impact of relative CEO pay on employee productivity. Specifically we did focus on the ratio of total compensation received by the CEO to that of the median-paid employee across S&P 1500 companies. Consistent with the theory of fairness and inequality, we found that there is a negative association between the pay ratio and employee productivity once the pay ratio has increased to a certain level. Before that tipping point, in line with tournament theory, we find a significant positive association between the gap between the CEO pay and the pay to the median VP and the employee's productivity. Hence, our findings indicate a curvilinear relationship, where the tipping point occurs when the CEO's compensation reaches 40 times that of the median employee. This tipping point suggests where employees start viewing the pay ratio as unfair and demotivating.

To address potential endogeneity concerns, we employed several tests, including entropy balancing and instrumental variable analysis. Our study found that, even after accounting for these concerns, the pay ratio is still inversely related to employee productivity. Additionally, two interaction variables were used to test for the effects of CEO ownership and CEO-chair duality on the relationship between pay ratios and employee productivity. Our findings suggest that higher CEO ownership may mitigate the negative association between pay ratios and employee productivity, while firms with CEO-chair duality experience a larger decline in employee productivity due to the pay ratio, compared to firms with separate chairs and CEOs. These findings contribute to the corporate governance literature on incentive programs and provide insights into the impact of pay ratios on employee productivity.

Our study has significant policy implications, particularly in the context of high pay ratios. Many countries have considered imposing a ceiling on pay ratios to address alleged unfairness. However, our findings suggest self-regulation to be the way forward to avoid hard laws being imposed. Corporate boards will be inclined to address excessively high pay ratios once the high cost in terms of lower employee productivity will be known to them.

While our study provides valuable insights into the relationship between pay ratios and employee productivity, there are limitations that suggest avenues for future research. One limitation is that the study was conducted on U.S. firms only, and the external validity of the results may be limited to the

U.S. or Anglo-American corporate governance regimes. Another limitation that may warrant further investigation is the role played by foreign employees of U.S. firms. Nonetheless, our study highlights the potential benefits of reducing pay ratios for many S&P 1500 firms.

## 6 References

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TABLE 1

Descriptive statistics.

All continuous variables are winsorized at the 1st and 99th percentiles to adjust for potential outliers. Variables are defined in Appendix A.

	Obs.	Mean	Std. Dev.	P25	Median	P75	
Pay-related variables							
<i>Pay Ratio</i>	4,686	193.045	253.667	56.827	108.291	208.000	
<i>CEO Pay (in \$100,000s)</i>	4,686	87.402	68.061	38.873	68.422	116.694	
<i>Emp Pay (in \$1,000s)</i>	4,686	71.833	45.054	42.590	62.955	91.630	
<i>Pay Gap (in \$100,000s)</i>	4,686	58.547	91.019	22.280	43.551	76.416	
Productivity measures							
<i>Sales on Employees<sub>t+1</sub></i>	4,686	0.902	5.514	5.943	6.610	6.066	
<i>Total Factor Productivity<sub>t+1</sub></i>	4,686	0.846	-0.251	0.144	0.792	0.264	
CEO characteristics							
<i>CEO Founder</i>	4,686	0.061	0.240	0.000	0.000	0.000	
<i>CEO Duality</i>	4,686	0.175	0.380	0.000	0.000	0.000	
<i>CEO Age</i>	4,686	4.050	0.111	3.989	4.060	4.127	
<i>CEO Tenure</i>	4,686	1.799	0.887	1.099	1.792	2.485	
<i>CEO Ownership (%)</i>	4,686	1.252	3.436	0.083	0.269	0.753	
Firm characteristics							
<i>Firm Size</i>	4,686	8.600	1.632	7.407	8.523	9.693	
<i>Foreign Segments</i>	4,686	1.299	1.129	0.000	1.386	2.303	
<i>Leverage</i>	4,686	0.292	0.206	0.119	0.281	0.414	
<i>Book to Market</i>	4,686	0.468	0.407	0.194	0.381	0.665	
<i>STD Return</i>	4,686	0.306	0.181	0.185	0.255	0.368	
<i>STD Cashflows</i>	4,686	0.040	0.048	0.014	0.026	0.046	
<i>HH Index</i>	4,686	-0.075	0.080	-0.080	-0.043	-0.029	
<i>Unionization (%)</i>	4,686	7.233	5.414	2.706	7.700	8.450	
Panel B: Summary statistics for <i>Pay Ratio</i> , <i>CEO Pay</i> (in \$100,000s), and <i>Emp Pay</i> (in \$1,000s) by industry using initial sample							
Industry	Obs.	<i>Pay Ratio</i>		<i>CEO Pay</i>		<i>Emp Pay</i>	
		Mean	Median	Mean	Median	Mean	Median
Business Equipment	738	212.688	131.726	1067.431	780.279	74.221	71.951
Chemicals and Allied Products	185	166.701	97.282	1010.069	737.238	74.166	71.374
Consumer Durables	148	243.806	177.661	794.891	671.949	48.321	40.457
Consumer Non-Durables	223	327.510	168.746	828.271	717.160	45.370	44.974
Finance	875	110.878	77.964	750.137	522.947	78.615	67.667
Healthcare and Drugs	440	149.822	101.504	946.630	718.906	95.010	71.113
Manufacturing	545	170.073	123.485	807.838	626.956	59.036	55.683
Mines, Construction, Transport, ..	188	98.137	80.610	931.286	842.065	123.513	126.086
Oil, Gas, and Coal Extraction	551	184.939	103.804	763.870	546.970	62.852	62.150
Telephone and T.V. Transmission	87	196.926	109.996	1271.630	657.164	78.654	64.495
Utilities	220	73.809	70.577	733.810	666.523	121.115	120.447
Wholesale and Retail	486	408.100	230.455	757.013	599.494	34.435	24.772

TABLE 2

Pairwise correlation.

All continuous variables are winsorized at the 1st and 99th percentiles to adjust for potential outliers. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
[1] <i>Pay Ratio</i>	1.00															
[2] <i>Sales to Employees<sub>t+1</sub></i>	-0.33*	1.00														
[3] <i>TFP<sub>t+1</sub></i>	-0.33*	0.98*	1.00													
[4] <i>CEO Founder</i>	-0.09*	0.00	0.00	1.00												
[5] <i>CEO Duality</i>	0.07*	0.03	0.03	0.14*	1.00											
[6] <i>Ln(CEO Age)</i>	0.02	-0.01	-0.02	0.08*	0.20*	1.00										
[7] <i>Ln(CEO Tenure)</i>	-0.08*	-0.02	-0.03	0.28*	0.25*	0.41*	1.00									
[8] <i>CEO Ownership</i>	-0.17*	-0.07*	-0.07*	0.28*	0.20*	0.18*	0.35*	1.00								
[9] <i>Firm Size</i>	0.37*	0.25*	0.23*	-0.13*	0.14*	0.08*	-0.08*	-0.24*	1.00							
[10] <i>Foreign Segments</i>	0.24*	-0.18*	-0.19*	-0.04	0.00	-0.05*	-0.03	-0.04	-0.03	1.00						
[11] <i>Leverage</i>	0.22*	0.01	0.02	-0.06*	-0.02	-0.06*	-0.13*	-0.10*	0.09*	0.00	1.00					
[12] <i>Book to Market</i>	-0.17*	0.17*	0.17*	-0.05*	-0.02	0.07*	-0.01	-0.04*	0.12*	-0.18*	-0.24*	1.00				
[13] <i>STD Stock Return</i>	-0.12*	0.01	0.01	0.01	-0.05*	-0.02	-0.03	0.06*	-0.33*	-0.06*	0.13*	0.17*	1.00			
[14] <i>STD Cashflows</i>	-0.16*	0.08*	0.09*	0.12*	-0.02	-0.05*	0.01	0.08*	-0.32*	-0.01	0.01	-0.09*	0.29*	1.00		
[15] <i>HH Index</i>	-0.23*	0.20*	0.20*	0.00	0.00	-0.04	0.01	-0.08*	0.07*	0.10*	-0.13*	0.03	-0.12*	-0.01	1.00	
[16] <i>Unionization</i>	-0.11*	0.09*	0.10*	-0.05*	-0.03	-0.03	-0.04*	-0.04	-0.03	0.02	0.11*	-0.07*	-0.02	0.02	0.08*	1.00

TABLE 3

Baseline model.

This table presents the regression results on the effect of the CEO pay ratio on employee productivity. Columns 1 and 2 present the baseline version of Equation 2, in which we regress productivity measures on *Pay Ratio*. In columns 3 and 4, we re-estimate the regressions in the previous three columns and use an entropy-balanced sample. The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Dependent Variable:	Baseline Model		Entropy-balanced	
	(1) <i>Sales to Employees<sub>t+1</sub></i>	(2) <i>TFP<sub>t+1</sub></i>	(3) <i>Sales to Employees<sub>t+1</sub></i>	(4) <i>TFP<sub>t+1</sub></i>
<i>Pay Ratio</i>	-0.319*** (0.023)	-0.282*** (0.022)	-0.364*** (0.043)	-0.337*** (0.037)
<i>CEO Founder</i>	0.110** (0.056)	0.105* (0.054)	0.016 (0.148)	0.014 (0.137)
<i>CEO Duality</i>	-0.005 (0.039)	-0.009 (0.037)	0.204* (0.110)	0.110 (0.083)
<i>Ln(CEO Age)</i>	-0.152 (0.151)	-0.143 (0.144)	-0.133 (0.289)	0.005 (0.261)
<i>Ln(CEO Tenure)</i>	0.007 (0.017)	0.004 (0.017)	-0.065** (0.032)	-0.055* (0.030)
<i>CEO Ownership</i>	-0.008 (0.006)	-0.008 (0.006)	-0.019 (0.018)	-0.015 (0.014)
<i>Firm Size</i>	0.215*** (0.015)	0.177*** (0.014)	0.210*** (0.034)	0.160*** (0.027)
<i>Foreign Segments</i>	-0.085*** (0.021)	-0.083*** (0.020)	-0.063* (0.037)	-0.091*** (0.028)
<i>Leverage</i>	0.148 (0.097)	0.215** (0.090)	0.146 (0.194)	0.244 (0.177)
<i>Book to Market</i>	-0.061 (0.046)	-0.048 (0.043)	0.238** (0.097)	0.187** (0.087)
<i>STD Stock Return</i>	0.151* (0.089)	0.087 (0.082)	0.214 (0.263)	0.089 (0.264)
<i>STD Cashflows</i>	1.369*** (0.387)	1.392*** (0.370)	3.961*** (1.163)	3.879*** (1.028)
<i>HH Index</i>	-0.631 (0.609)	-0.572 (0.591)	1.089** (0.459)	1.198*** (0.414)
<i>Unionization</i>	0.017 (0.013)	0.018 (0.012)	0.006 (0.006)	0.005 (0.006)
Intercept	5.974*** (0.665)	0.305 (0.649)	6.400*** (1.097)	0.427 (1.024)
Year FE	Yes	Yes	No	No
Industry FE	Yes	Yes	No	No
Adjusted $R^2$	0.586	0.570	0.314	0.286
Observations	4,686	4,686	4686	4686

TABLE 4

Instrumental variable (IV) analysis.

This table presents the IV regression results on the effect of the CEO pay ratio on employee productivity. The CEO pay ratio is instrumented with the county-level social capital and annual two-digit SIC industry median pay ratio. The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Dependent Variable:	(1) <i>Pay Ratio</i>	(2) <i>Sales to Employees<sub>t+1</sub></i>	(3) <i>TFP<sub>t+1</sub></i>
<i>Predicted Pay Ratio</i>		-0.221** (0.114)	-0.207* (0.111)
<i>Social Capital (IV)</i>	-0.054** (0.023)		
<i>Industry Pay Ratio (IV)</i>	0.487*** (0.058)		
<i>CEO Founder</i>	-0.019 (0.075)	0.095* (0.056)	0.088 (0.054)
<i>CEO Duality</i>	0.075 (0.050)	-0.002 (0.042)	-0.007 (0.040)
<i>Ln(CEO Age)</i>	0.183 (0.187)	-0.127 (0.153)	-0.115 (0.146)
<i>Ln(CEO Tenure)</i>	0.015 (0.022)	0.002 (0.018)	0.001 (0.017)
<i>CEO Ownership</i>	-0.037*** (0.009)	-0.004 (0.007)	-0.006 (0.007)
<i>Firm Size</i>	0.288*** (0.016)	0.188*** (0.035)	0.155*** (0.034)
<i>Foreign Segments</i>	0.130*** (0.022)	-0.103*** (0.027)	-0.098*** (0.025)
<i>Leverage</i>	0.253** (0.105)	0.114 (0.103)	0.204** (0.096)
<i>Book to Market</i>	-0.182*** (0.050)	-0.050 (0.051)	-0.039 (0.048)
<i>STD Stock Return</i>	-0.167* (0.097)	0.153 (0.093)	0.085 (0.086)
<i>STD Cashflows</i>	-0.743** (0.335)	1.472*** (0.404)	1.472*** (0.388)
<i>HH Index</i>	0.079 (0.520)	-0.686 (0.618)	-0.568 (0.599)
<i>Unionization</i>	-0.009 (0.007)	0.016 (0.014)	0.017 (0.013)
Intercept	0.035 (1.105)	5.505*** (0.767)	-0.054 (0.747)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Adjusted $R^2$	0.518	0.582	0.568
Kleibergen-Paap $F$ -statistic	39.689		
Observations	4,553	4,553	4,553



TABLE 5

This table presents the regression results on the relationship between the CEO pay gap and employee productivity. The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Dependent Variable:	(1) <i>Sales to Employees<sub>t+1</sub></i>	(2) <i>TFP<sub>t+1</sub></i>
<i>Pay Gap</i>	0.045** (0.019)	0.063*** (0.018)
<i>CEO Founder</i>	0.105* (0.061)	0.100* (0.059)
<i>CEO Duality</i>	-0.035 (0.042)	-0.037 (0.039)
<i>Ln(CEO Age)</i>	-0.194 (0.164)	-0.187 (0.157)
<i>Ln(CEO Tenure)</i>	-0.005 (0.019)	-0.009 (0.018)
<i>CEO Ownership</i>	0.005 (0.006)	0.004 (0.006)
<i>Firm Size</i>	0.101*** (0.016)	0.070*** (0.014)
<i>Foreign Segments</i>	-0.127*** (0.022)	-0.123*** (0.021)
<i>Leverage</i>	0.059 (0.106)	0.133 (0.097)
<i>Book to Market</i>	0.006 (0.048)	0.016 (0.045)
<i>STD Stock Return</i>	0.210** (0.091)	0.137 (0.084)
<i>STD Cashflows</i>	1.463*** (0.402)	1.462*** (0.381)
<i>HH Index</i>	-0.695 (0.660)	-0.639 (0.637)
<i>Unionization</i>	0.019 (0.013)	0.019 (0.012)
Intercept	4.741*** (0.871)	-0.905 (0.852)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R <sup>2</sup>	0.528	0.519
Observations	4,686	4,686

TABLE 6

Nonlinear specification.

This table reports the results of a piece-wise regression with different thresholds of *Pay Ratio*. The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Dependent Variable:	<i>Sales to Employees<sub>t+1</sub></i>	<i>TFP<sub>t+1</sub></i>	(1) <i>Sales to Employees<sub>t+1</sub></i>	(2) <i>TFP<sub>t+1</sub></i>
<i>Pay Ratio &lt; median</i>	0.134** (0.053)	0.100** (0.050)		
<i>Pay Ratio &gt; median</i>	-0.172*** (0.051)	-0.165*** (0.048)		
<i>Pay Ratio (Q1)</i>			0.301*** (0.042)	0.261*** (0.040)
<i>Pay Ratio (Q2)</i>			0.158*** (0.035)	0.148*** (0.034)
<i>Pay Ratio (Q4)</i>			-0.155*** (0.033)	-0.134*** (0.032)
<i>Pay Ratio (Q5)</i>			-0.419*** (0.046)	-0.371*** (0.044)
<i>CEO Founder</i>	0.121** (0.060)	0.115** (0.058)	0.109* (0.058)	0.105* (0.056)
<i>CEO Duality</i>	-0.011 (0.041)	-0.014 (0.039)	0.009 (0.040)	0.004 (0.038)
<i>Ln(CEO Age)</i>	-0.189 (0.158)	-0.175 (0.151)	-0.172 (0.153)	-0.160 (0.147)
<i>Ln(CEO Tenure)</i>	0.005 (0.018)	0.002 (0.018)	0.010 (0.018)	0.006 (0.017)
<i>CEO Ownership</i>	0.002 (0.006)	-0.000 (0.006)	-0.002 (0.006)	-0.003 (0.006)
<i>Firm Size</i>	0.164*** (0.014)	0.131*** (0.013)	0.204*** (0.015)	0.167*** (0.014)
<i>Foreign Segments</i>	-0.110*** (0.022)	-0.105*** (0.020)	-0.088*** (0.021)	-0.086*** (0.020)
<i>Leverage</i>	0.076 (0.102)	0.150 (0.094)	0.114 (0.099)	0.184** (0.092)
<i>Book to Market</i>	-0.024 (0.048)	-0.015 (0.044)	-0.049 (0.046)	-0.037 (0.043)
<i>STD Stock Return</i>	0.187** (0.092)	0.119 (0.084)	0.160* (0.090)	0.094 (0.083)
<i>STD Cashflows</i>	1.574*** (0.395)	1.574*** (0.372)	1.479*** (0.393)	1.497*** (0.374)
<i>HH Index</i>	-0.642 (0.673)	-0.591 (0.649)	-0.584 (0.665)	-0.533 (0.639)
<i>Unionization</i>	0.019 (0.014)	0.020 (0.013)	0.019 (0.012)	0.019 (0.012)
Intercept	4.507*** (0.826)	-0.991 (0.804)	3.772*** (0.798)	-1.639** (0.781)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.543	0.531	0.571	0.556
Observations	4,686	4,686	4,686	4,686

FIGURE 1

Non-parametric kernel estimation of employee productivity on *Pay Ratio*.

This graph shows the plot of fitted values from a kernel estimation of employee productivity on *Pay Ratio*. The y-axis is the fitted value of *Sales to Employees*, a measure of employee productivity, and the x-axis is the logarithm of *Pay Ratio*. The kernel density is estimated with the Epanechnikov kernel.

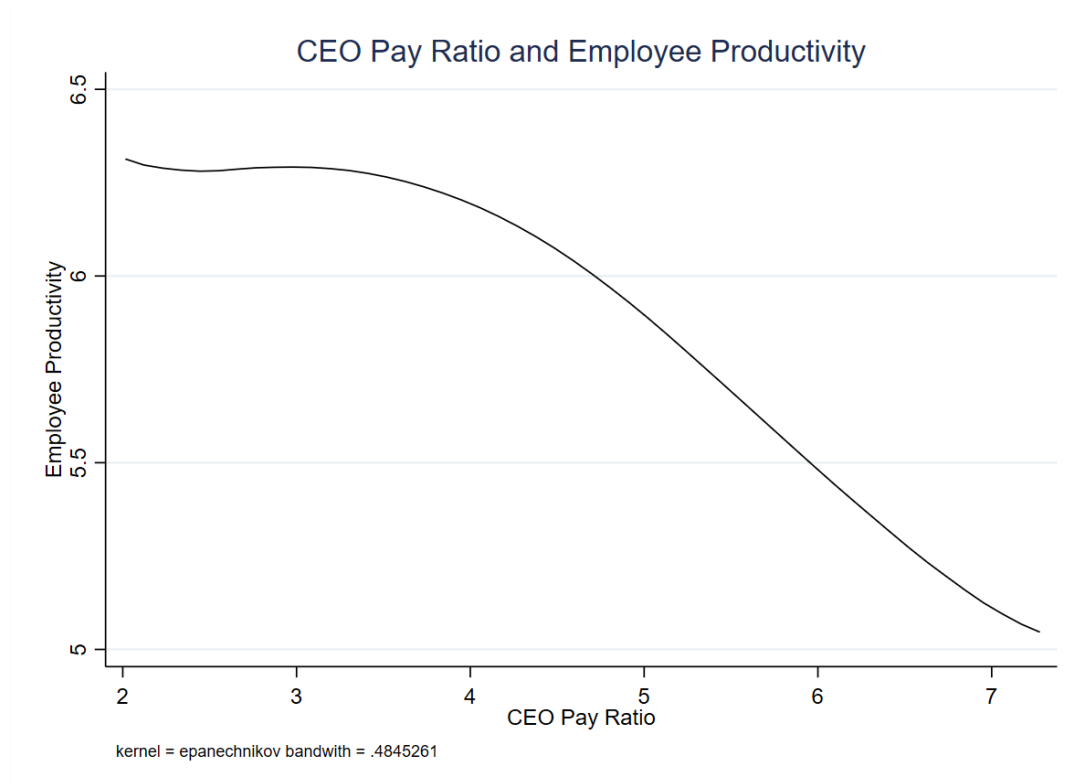


TABLE 7

On the role of CEO ownership and CEO-chair duality.

This table presents the OLS regression results of the cross-sectional analysis. The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Dependent Variable:	(1) <i>Sales to Employees<sub>t+1</sub></i>	(2) <i>TFP<sub>t+1</sub></i>	(4) <i>Sales to Employees<sub>t+1</sub></i>	(5) <i>TFP<sub>t+1</sub></i>
<i>Pay Ratio</i> × <i>High CEO Ownership</i>	0.064** (0.032)	0.058* (0.031)		
<i>Pay Ratio</i> × <i>CEO Duality</i>			-0.044* (0.023)	-0.033* (0.020)
<i>Pay Ratio</i>	-0.338*** (0.026)	-0.299*** (0.025)	-0.311*** (0.023)	-0.276*** (0.022)
<i>High CEO Ownership</i>	-0.289* (0.148)	-0.259* (0.143)		
<i>CEO Founder</i>	0.112** (0.055)	0.106** (0.053)	0.107* (0.056)	0.102* (0.054)
<i>CEO Duality</i>	-0.007 (0.039)	-0.010 (0.037)	0.206 (0.216)	0.150 (0.200)
<i>Ln(CEO Age)</i>	-0.155 (0.150)	-0.146 (0.144)	-0.153 (0.151)	-0.143 (0.144)
<i>Ln(CEO Tenure)</i>	0.006 (0.017)	0.004 (0.017)	0.008 (0.017)	0.005 (0.017)
<i>CEO Ownership</i>	-0.006 (0.006)	-0.007 (0.006)	-0.008 (0.006)	-0.009 (0.005)
<i>Firm Size</i>	0.218*** (0.015)	0.180*** (0.014)	0.215*** (0.015)	0.177*** (0.014)
<i>Foreign Segments</i>	-0.083*** (0.021)	-0.082*** (0.020)	-0.086*** (0.021)	-0.083*** (0.020)
<i>Leverage</i>	0.147 (0.097)	0.214** (0.090)	0.149 (0.097)	0.216** (0.090)
<i>Book to Market</i>	-0.063 (0.046)	-0.050 (0.043)	-0.061 (0.046)	-0.048 (0.043)
<i>STD Stock Return</i>	0.148* (0.089)	0.084 (0.082)	0.152* (0.089)	0.087 (0.082)
<i>STD Cashflows</i>	1.384*** (0.387)	1.405*** (0.371)	1.383*** (0.387)	1.402*** (0.369)
<i>HH Index</i>	-0.626 (0.608)	-0.568 (0.590)	-0.605 (0.612)	-0.553 (0.594)
<i>Unionization</i>	0.017 (0.013)	0.017 (0.012)	0.017 (0.013)	0.017 (0.012)
Intercept	5.961*** (0.672)	0.292 (0.658)	6.014*** (0.660)	0.334 (0.644)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted <i>R</i> <sup>2</sup>	0.587	0.571	0.587	0.570
Observations	4,686	4,686	4,686	4,686

TABLE 8

## Robustness Tests.

The standard errors clustered at the firm level are reported in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively. All variables are defined in Appendix A.

Panel A. Subsample analysis, an alternative measure of pay ratio, and state controls								
	Non-financial firms		Only financial firms		An alternative measure of pay ratio		Controlling for state-fixed effects	
	(1) <i>Sales to Employees<sub>t+</sub></i>	(2) <i>TFP<sub>t+1</sub></i>	(3) <i>Sales to Employees<sub>t+</sub></i>	(4) <i>TFP<sub>t+1</sub></i>	(5) <i>Sales to Employees<sub>t+</sub></i>	(6) <i>TFP<sub>t+1</sub></i>	(7) <i>Sales to Employees<sub>t+</sub></i>	(8) <i>TFP<sub>t+1</sub></i>
Dependent Variable:	<i>l</i>		<i>l</i>		<i>l</i>		<i>l</i>	
<i>Pay Ratio</i>	-0.324*** (0.024)	-0.284*** (0.023)	-0.308*** (0.068)	-0.273*** (0.061)	-0.012*** (0.001)	-0.011*** (0.001)	-0.306*** (0.023)	-0.268*** (0.022)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted <i>R</i> <sup>2</sup>	0.581	0.562	0.522	0.511	0.587	0.573	0.604	0.588
Observations	3,811	3,811	875	875	4,686	4,686	4,583	4,583
Panel B. Number of foreign geographical subsidiaries and the relationship between <i>Pay Ratio</i> and productivity								
	# Foreign Segments = 0		# Foreign Segments = 1 or 2		# Foreign Segments = 2 to 5		# Foreign Segments > 5	
	(1) <i>Sales to Employees<sub>t+</sub></i>	(2) <i>TFP<sub>t+1</sub></i>	(3) <i>Sales to Employees<sub>t+</sub></i>	(4) <i>TFP<sub>t+1</sub></i>	(5) <i>Sales to Employees<sub>t+</sub></i>	(6) <i>TFP<sub>t+1</sub></i>	(7) <i>Sales to Employees<sub>t+</sub></i>	(8) <i>TFP<sub>t+1</sub></i>
Dependent Variable:	<i>l</i>		<i>l</i>		<i>l</i>		<i>l</i>	
<i>Pay Ratio</i>	-0.215*** (0.040)	-0.201*** (0.037)	-0.329*** (0.075)	-0.254*** (0.075)	-0.338*** (0.049)	-0.304*** (0.047)	-0.348*** (0.035)	-0.304*** (0.033)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted <i>R</i> <sup>2</sup>	0.693	0.696	0.472	0.425	0.545	0.499	0.540	0.499
Observations	1,762	1,762	273	273	705	705	1,946	1,946

## Appendix A

### Variable definitions.

Variable	Definition
<i>Pay Ratio</i>	Natural logarithm of the ratio of total annual CEO compensation to the median employee's total compensation
<i>CEO Pay</i>	Total annual CEO compensation as reported in the firm's definitive proxy statement
<i>Median Employee Pay</i>	Total annual median employee's compensation as reported in the firm's definitive proxy statement
<i>Pay Gap</i>	The pay gap between the CEO and the median-paid senior executive (Vice President)
<i>Sales to Employees</i>	Total sales divided by the total number of employees
<i>Total Factor Production (TFP)</i>	Total factor productivity is the residuals from Cobb–Douglas production functions estimated by two-digit SIC industry using all Compustat firms
<i>CEO Founder</i>	Indicator variable that takes the value of one if the CEO is the founder of the firm, zero otherwise
<i>CEO Duality</i>	Indicator variable that takes the value of one if the CEO is also chair of the board, zero otherwise
<i>CEO Age</i>	Natural logarithm of the CEO's age
<i>CEO Tenure</i>	Natural logarithm of one plus the number of years since the CEO assumed office
<i>CEO Ownership</i>	Percentage of equity owned by the CEO
<i>Firm Size</i>	Natural logarithm of total assets
<i>Foreign Segments</i>	Natural logarithm of one plus the number of foreign geographical segments
<i>Leverage</i>	Long-term debt plus short-term debt divided by total assets
<i>Book to Market</i>	The book value of shareholders' equity divided by the market value of shareholders' equity
<i>STD Stock Return</i>	The standard deviation of stock returns over the fiscal years t-4 to t, requiring a minimum of five years of data to estimate
<i>STD Cashflows</i>	The standard deviation of cash flow from operations (scaled by total assets) over the fiscal years t-4 to t, requiring a minimum of five years of data to estimate
<i>HH Index</i>	The Herfindahl index based on sales, calculated across all Compustat companies operating in the same industry
<i>Unionization</i>	Percentage of industry-level labor unionization

## Appendix B

Univariate statistics before and after entropy balancing.

This table reports the univariate statistics for treatment and control groups before and after entropy balancing. *Pay Ratio Dummy* is an indicator variable that equals one if *Pay Ratio* is greater than its annual median value (*Treatment*) in a given year and zero otherwise (*Control*). All other variables are defined in Appendix A.

Covariate balancing:	Before balancing				After balancing	
Statistic:	Mean	Variance	Mean	Variance	Mean	Variance
Treatment/Control:	<i>Pay Ratio</i> <i>Dummy = 1</i>	<i>Pay Ratio</i> <i>Dummy = 1</i>	<i>Pay Ratio</i> <i>Dummy = 0</i>	<i>Pay Ratio</i> <i>Dummy = 0</i>	<i>Pay Ratio</i> <i>Dummy = 0</i>	<i>Pay Ratio</i> <i>Dummy = 0</i>
<i>CEO Founder</i>	0.045	0.043	0.080	0.074	0.045	0.043
<i>CEO Duality</i>	0.205	0.163	0.140	0.120	0.205	0.163
<i>Ln(CEO Age)</i>	4.053	0.012	4.046	0.013	4.053	0.012
<i>Ln(CEO Tenure)</i>	1.754	0.747	1.853	0.828	1.754	0.747
<i>CEO Ownership</i>	0.815	5.921	1.776	18.364	0.816	5.929
<i>Firm Size</i>	9.138	2.476	7.954	2.127	9.138	2.476
<i>Foreign Segments</i>	1.556	1.195	0.992	1.198	1.556	1.195
<i>Leverage</i>	0.330	0.041	0.246	0.040	0.330	0.041
<i>Book to Market</i>	0.403	0.143	0.546	0.183	0.403	0.143
<i>STD Stock Return</i>	0.280	0.028	0.337	0.037	0.280	0.028
<i>STD Cashflows</i>	0.033	0.001	0.047	0.004	0.033	0.001
<i>HH Index</i>	-0.088	0.008	-0.060	0.004	-0.088	0.008
<i>Unionization</i>	6.802	22.147	7.750	37.432	6.802	22.145