CEO pay ratio and investment efficiency: Evidence from India

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Abstract

The study examines the association between the CEO-to-median employee pay ratio and corporate investment efficiency in India. Using India's mandated CEO pay ratio disclosures, we provide empirical evidence supporting the rent extraction hypothesis that greater within-firm pay disparity is associated with lower investment efficiency. Further analyses indicate that this relationship is exacerbated in firms with entrenched managerial power and heightened information asymmetry, consistent with agency-based explanations. Subsample analysis reveals that tech, low-R&D, and financially constrained firms have greater inefficiencies. The results highlight the critical role of CEO pay structures in shaping investment behavior, particularly in environments vulnerable to managerial opportunism.

Keywords: CEO-to-median employee pay ratio; Investment efficiency; Rent extraction; Agency problem; India; Dodd-Frank Act.

1. Introduction

A popular press article noted that "year after year, CEO pay explodes while workers' wages barely budge," highlighting firms' persistent and widening compensation gap.[1] The disparity between CEO and employee pay has become a prominent feature of modern corporate structures. In 1965, chief executive officers (CEOs) in the United States earned approximately 21 times the average worker's salary; by 2023, this ratio had increased significantly to nearly 290 times.[2] In the U.K., FTSE 100 CEOs earned 120 times the average worker's salary.[3] This pronounced rise in the pay gap between executives and employees has attracted growing attention from various stakeholders, including regulators, investors, and employees. Much of this scrutiny centers on whether the justification for such high levels of executive compensation lies in the necessity of rewarding exceptional managerial talent or reflects an imbalance of power favoring top executives. India, an early adopter of mandatory pay ratio disclosures, reported similarly elevated figures, with average CEO-to-employee pay ratios of 236:1 in 2023 and 251:1 in 2024. Despite the visibility of these figures, the implications of CEO pay disparity for real firm behavior remain unexplored, particularly in areas such as investment efficiency, where managerial incentives and long-term value creation may be misaligned.

The urgency of this question is further underscored by the rise in managerial remuneration in India. In recent years, Indian CEO compensation has soared by 40% post-COVID, while entry- and mid-level wages have stagnated (Deloitte, 2024; The Economic Times, 2024). The founder of one of India's largest IT firms publicly decried the growing pay gaps, proposing a more equitable CEO

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[1] Refer https://www.oxfam.org/en/press-releases/global-ceo-pay-increased-50-percent-2019-56-times-more-worker-wages (last accessed on 02/05/2025).
[2] https://fortune.com/2025/04/15/ceo-worker-pay-gap-problem-america/
[3] https://www.theguardian.com/business/article/2024/aug/12/ceo-pay-high-ftse-100-chief-executive. The FTSE 100 covers

pay level of 20 to 25 times that of the median employee.[4] Unlike in the U.S., where pay-ratio disclosures have fed into activist agendas and labor negotiations, similar disclosures in India have elicited little institutional response (The Times of India, 2024). This institutional vacuum makes India a fertile ground to examine whether high pay disparity translates into inefficient corporate behavior.

Theoretically, the CEO pay ratio reflects a fundamental trade-off. On the one hand, optimal contracting and talent assignment theories suggest that high pay differentials signal exceptional managerial talent and well-designed incentives (Mueller *et al.*, 2017; Rosen, 1981). From this perspective, firms offering large CEO premiums may experience better resource allocation and investment efficiency. On the other hand, the managerial power or rent extraction hypothesis posits that entrenched CEOs exploit their influence to inflate compensation, often at the expense of shareholder value (Bao *et al.*, 2021; Bebchuk *et al.*, 2011). If this view holds, high pay disparity should correlate with inefficient investment.

Despite these theoretical expectations, empirical studies on CEO-to-median employee pay ratios have primarily centered on shareholder reactions, say-on-pay votes, employee perceptions, measurement discretion, and the implications of supplemental pay ratio disclosures. Relatively little attention has been paid to the real economic consequences of such disparities. Nonetheless, empirical findings remain mixed, necessitating further exploration. Li *et al.* (2024) find that firms with high CEO pay disparity engage in more balanced labor investments, consistent with the talent hypothesis. Conversely, Bao *et al.* (2021) and Rouen (2020) show that unexplained pay disparities are associated with lower reporting quality and diminished firm performance. Motivated by this

[4] Refer https://www.financialexpress.com/business/industry-narayana-murthy-says-dont-pay-ceo-too-much-salary-wants-balance-of-power-between-management-board-2088181/

contrasting evidence and the contexts in which it is explored, we investigate the role of CEO pay disparity in shaping corporate investment efficiency, focusing on an emerging economy perspective.

Using data from Indian publicly listed firms from 2014–2024, the study examines whether the CEO-to-median employee pay ratio is associated with deviations from optimal investment levels. We proxy investment inefficiency using residuals from investment expectation models (Richardson, 2006), separating under- and over-investment. Our findings align with the managerial power view: firms with higher CEO pay ratios exhibit significantly greater investment inefficiency, driven predominantly by overinvestment. The results remain robust to alternative model specifications, industry-adjusted pay ratio proxies, and instrumental variable approaches that address potential endogeneity.

To explore underlying mechanisms, we conduct subsample analyses based on CEO entrenchment and firm-level information asymmetry. The CEO pay ratio's effect is more potent in firms where CEOs are the top-paid executives or exhibit concentrated power—consistent with entrenched managerial behavior. Similarly, the relationship persists in environments with weak corporate governance, proxied by lower board independence and reduced financial reporting quality. These findings support that agency problems are the primary drivers of the observed inefficiencies. The heterogeneity analysis shows a stronger relationship among firms operating in high-technology industries, non-R&D-intensive firms, and financially constrained firms.

This study contributes to the growing literature on executive compensation and corporate investment behavior in several important ways. First, it extends the discourse on CEO pay structures by linking intra-firm pay disparity—specifically, the CEO-to-median employee pay

ratio—to investment efficiency, a dimension of corporate finance that has received limited attention. While existing research has primarily examined the implications of CEO pay disparity (Delic and Schäfer, 2025; Pan *et al.*, 2022), financial performance (Burns *et al.*, 2022), say-on-pay votes (Chang *et al.*, 2023), corporate stakeholders' perceptions (Cheng and Zhang, 2024), cost of debt (Bardos *et al.*, 2021) and labor productivity (Boone *et al.*, 2024), we address a notable gap by exploring how this pay gap shapes capital allocation decisions within firms.

Second, the CEO-to-median employee pay ratio provides a more holistic proxy for internal income inequality than traditional measures such as CEO-to-executive pay gaps. This ratio reflects the magnitude of CEO compensation and the relative fairness of pay distribution across the firm. Prior studies have focused on factors such as executives' pay dispersion (Colak *et al.*, 2021), media exposure of CEOs (Zhang and Cai, 2023), CEO power (Chowdhury *et al.*, 2023), and CEO career concerns (Xie, 2015) to explain corporate investment outcomes. By contrast, our study introduces a broader organizational lens, examining whether vertical pay disparity with employees influences managers' investment behavior.

Third, we provide unique evidence from an emerging market setting by analyzing firms in India characterized by concentrated ownership structures, limited institutional monitoring, and relatively weaker governance frameworks. This context allows us to capture the agency frictions that are less prevalent in developed economies but highly relevant to many other developing countries. Our findings, therefore, offer policy-relevant insights into the interaction between compensation design and investment efficiency in institutional environments marked by power asymmetries and governance constraints (La Porta *et al.*, 1999).

The rest of the paper is as follows: Section 2 reviews the literature and develops hypotheses. Section 3 outlines the research design. Section 4 presents data and summary statistics. Section 5 reports empirical results. Section 6 provides mechanism tests, and Section 7 explores heterogeneity analysis. Section 8 presents robustness checks. Section 9 concludes.

2. **Literature review and hypothesis development**

2.1 Optimal contracting hypothesis

The optimal contracting hypothesis posits that pay disparity reflects efficient managerial contracting aligned with shareholders' interests and designed to mitigate agency conflicts. Significant CEO pay disparity within this framework is consistent with the Talent Assignment Hypothesis (TAH), which asserts that exceptionally skilled CEOs command higher compensation due to their ability to effectively manage complex organizational resources (Rosen, 1981, 1982). Minor differences in executive talent may result in disproportionately large differences in compensation, reflecting the convex nature of value creation at the top of the corporate hierarchy.

Additionally, the incentive provision argument suggests that managers of larger or more complex firms are compensated more to induce higher effort and performance. As such, intra-firm pay inequality can be an intentional mechanism to align CEO interests with those of the shareholders (Mueller *et al.*, 2017).

Empirical evidence supports this view. Faleye *et al.* (2013) show that CEO-to-employee pay disparity is not perceived as an inequitable income and may enhance firm value and labor productivity. Mueller *et al.* (2017) find that firms with greater internal pay dispersion exhibit stronger performance and higher valuations, consistent with managerial talent explanations. Li *et*

al. (2024) further document that higher CEO pay disparity is associated with more balanced labor investments, supporting the TAH. Bardos *et al.* (2021) also report that bondholders perceive high CEO pay disparity as a signal of efficient incentive alignment, often reflected in lower borrowing costs. These studies suggest that high CEO pay disparity may promote value creation through optimal contracting mechanisms.

2.2 Managerial power hypothesis

In contrast, the managerial power hypothesis argues that CEOs wield substantial influence over their compensation, enabling them to extract rents not justified by performance. Because lower-level employees cannot extract significant rents, their pay levels remain relatively stable across firms, leading to increased intra-firm disparity driven by rent-seeking at the top (Bebchuk *et al.*, 2011; Bebchuk and Fried, 2006).

A growing body of evidence supports this interpretation. Vo and Canil (2019) find that the disproportionate pay between CEOs and other executives reflects managerial dominance rather than incentive alignment. Rouen (2020) shows that unexplained pay disparity between CEO-to-median employee compensation is negatively associated with future firm performance. (Bao *et al.*, 2020, 2021) link large pay ratios to lower financial reporting quality and entrenched managerial behavior. More recently, He *et al.* (2023) associate vertical pay dispersion with operation inefficiencies, including increased data security breaches from reduced employee motivation and effort. These findings collectively indicate that excessive CEO pay disparity can be symptomatic of agency problems, undermining firm performance and governance integrity.

2.3 Corporate investment efficiency

A central issue in corporate finance is the efficient allocation of capital. In a frictionless market, firms are expected to undertake all projects with positive net present value (NPV), thereby maximizing shareholder wealth (Modigliani and Miller, 1958). Investment efficiency is realized when capital is allocated such that the marginal benefit of investment equals its marginal cost (Biddle *et al.*, 2009; Chen *et al.*, 2011).

However, real-world frictions like agency conflicts and information asymmetry often distort investment decisions (Hubbard, 1997; Jensen and Meckling, 1976). Overinvestment may arise when self-interested managers exploit free cash flow to pursue empire-building and increase personal benefits (Jensen, 1986; Jensen and Meckling, 1976; Richardson, 2006), while underinvestment can occur when risk-averse managers forgo positive NPV projects to avoid job risk or scrutiny (Bertrand and Mullainathan, 2003). Furthermore, information asymmetries increase the cost of external financing, potentially discouraging value-enhancing investment (Jensen and Meckling, 1976; Myers and Majluf, 1984).

These frictions highlight the critical role of CEO incentives and governance structures in shaping capital allocation efficiency (Chowdhury *et al.*, 2023). While some studies argue that incentive-based pay disparities enhance efficiency through tournament effects—for instance, Colak *et al.* (2021) find that CEO-to-executive pay gaps positively relate to investment efficiency—others emphasize the informational role of CEO visibility. For example, Zhang and Cai (2023) show that greater media exposure mitigates overinvestment by reducing information asymmetry. These findings suggest that compensation design and transparency mechanisms are essential in addressing inefficiencies in corporate investment behavior.

2.5 Hypothesis development

From the optimal contracting perspective, CEO-to-median employee pay ratios may reflect superior managerial capabilities or necessary incentives, enhancing decision-making and resource allocation. Accordingly, this view suggests that a higher CEO pay ratio is associated with greater investment efficiency. In contrast, the managerial power view posits that inflated pay ratios reflect rent extraction and weak governance, leading to suboptimal investment outcomes. Under this view, a higher CEO pay ratio may be associated with either overinvestment or underinvestment, reflecting investment inefficiencies.

These competing perspectives lead to the following hypotheses:

H1: Higher CEO pay ratios are associated with greater investment efficiency.

H2: Higher CEO pay ratios are associated with lower investment efficiency.

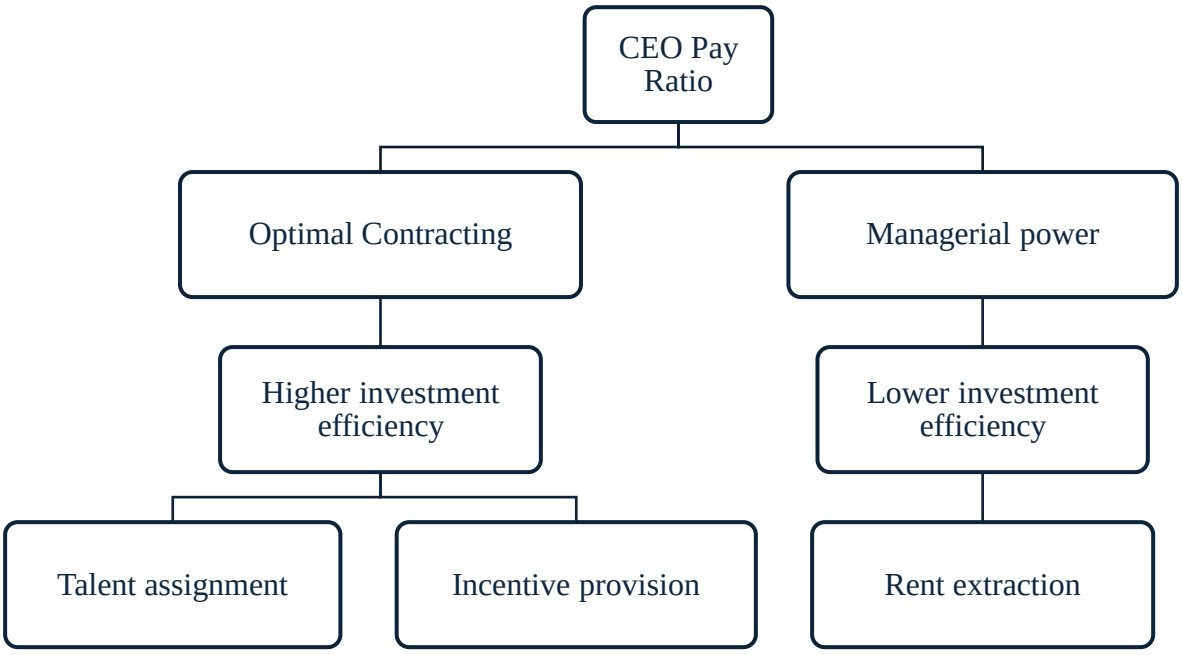


Figure 1: Conceptual framework linking CEO pay ratio to investment efficiency.

3. Research Design

3.1 CEO Pay ratio

As per Section 197 Rule 5(1) of the Companies, Act 2013 (Appointment and Remuneration of Managerial Personnel) Rules, 2014 Indian-listed firms are mandated to disclose the ratio of remuneration of each director to the median compensation of the employees of the company for the financial year. Therefore, we extract CEO remuneration from the median employee salary (CEO Pay Ratio) from the Prowess database.

3.2 Measurement of investment efficiency

Corporate investment efficiency is measured using Richardson (2006). This model regresses total investment spending on new projects against a positive net present value. The regression's fitted value represents the expected level of new investment, while the unexplained component (or absolute residual) represents lower investment efficiency.

Eq. (1) outlines the residual measurement model of Richardson (2006):

$$Invest_{i,t} = \beta_0 + \beta_1 Growth_{i,t-1} + \beta_2 Age_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Return_{i,t-1} + \beta_5 Invest_{i,t-1} + \beta_6 Leverage_{i,t-1} + \beta_7 Cash_{i,t-1} + \Sigma\, Industry_Indicator + \Sigma\, Year_Indicator + \varepsilon_{i,t}$$

Invest refers to total new investments on fixed assets, intangibles, other long-term assets, and acquisition expenditures, scaled by total assets at the beginning of the year. Growth indicating growth opportunities is measured using Tobin's Q, which is the equity market value plus the liabilities' book value scaled by total assets. Age is the natural logarithm of the years since listing on a stock exchange. Size is the natural log of total assets. Return is the annual return defined by

the annual return of equity with cash dividend reinvestment. Leverage is the total long-term liabilities scaled by lagged total assets. Cash indicates total cash scaled by lagged total assets. Industry and Year effects are included. The residuals obtained from the above equation represent the investment inefficiency. The positive residuals represent overinvestment, while the negative residuals represent underinvestment. Therefore, the absolute value of residuals (*InvEff*) measures the deviation from the optimal level of investment.[5]

3.3 Model specification

The following model captures the association of the CEO pay ratio on the corporate investment efficiency.

$$InvEff_{i,t} = \beta_0 + \beta_1\, CEO_Ratio_{i,t-1} + \beta_2\, CEO_Dual_{i,t} + \beta_3\, Prom_CEO_{i,t} + \beta_4\, ROA_{i,t} + \beta_5\, CFO_{i,t} + \beta_6\, LEV_{i,t} + \beta_7\, MTB_{i,t} + \beta_8\, SIZE_{,t} + \beta_9\, AGE_{,t} + \beta_{10}\, Tobin's_Q_{i,t} + \beta_{11}\, PPE_{i,t} + \beta_{12}\, Loss_{i,t} + \Sigma\, Firm_Effects + \Sigma\, Year_Effects + \varepsilon_{i,t}$$

CEO_Ratio is the natural log of one plus the CEO's pay-to-median employee remuneration ratio.[6] *CEO_Dual* is an indicator variable that takes one if the CEO holds the board's Chairperson position or zero otherwise. *Prom_CEO* is an indicator variable that takes one if the CEO is a promoter director of the firm or zero otherwise. *ROA* is the profit before extraordinary items scaled by total assets. *CFO* represents cash inflows from operations scaled by lagged total assets. *LEV* is the total long-term liabilities scaled by lagged total assets. *MTB* represents the market-to-book ratio. *SIZE* is the natural log of total assets at the beginning of the year. *AGE* is the natural log of the firm's

[5] The measure does not measure firms' 'true' investment efficiency. In contrast, it measures the residual investment component unexplained by investment opportunities. Following prior literature of Biddle *et al.* (2009), this study also labels the term' investment efficiency'.

[6] It is critical to recognize that the CEO pay ratio is an endogenously determined variable, which could be determined by factors relating to investment efficiency. Therefore, we use the lagged CEO pay ratio, not the contemporaneous CEO pay ratio.

Age since listing. *Tobin's Q* is the ratio of equity market value plus the liabilities' book value, scaled by total assets. *PPE* is the net property, plant, and equipment at the end of the year scaled by lagged total assets. *Loss* is an indicator variable that takes the value of one if the firm has a negative profit or zero otherwise. Additionally, we include firm and year-fixed effects and cluster standard errors at the firm level to address potential serial correlation and heteroscedasticity.

4. Sample selection and descriptive statistics

4.1 Sample selection and data

The initial sample consists of firms with CEO pay ratio data from the Prowess CMIE database covering 2014 to 2024. The sample period commences in the year in which the CEO-to-median employee pay ratio was first publicly disclosed. The variables measuring investment efficiency and control variables are sourced from the same database. The study initially had 3924 firm-year observations with CEO pay ratio data (after excluding financial firms). Then, we excluded 2367 observations without relevant financial and control variables. The final sample for the primary analysis is 1557 firm-year observations.[7] The year-wise and industry-wise distribution of the pay ratio is given in Appendix B.

Table 1 provides the descriptive statistics for the full sample. The mean (median) for the *CEO pay ratio* is 132.344 (63.63), indicating significant skewness.[8] The mean (median) of *InvEff* is 0.095 (0.023), which indicates the deviation from the optimum level of investments. Descriptive statistics for the control variables indicate that, on average, the firm-year observations in the sample are

[7] A significant number of observations pertaining to 2024 is not considered as the primary analysis checks the investment efficiency on a one-year lagged CEO pay ratio.
[8] This study considers the natural logarithm of CEO pay ratios for the regression analysis due to the significant skewness.

relatively large, with total assets (Size) of 10.383, a leverage ratio of 11.7 percent, and better growth opportunities, with Tobin's_Q of 1.977 times total assets. The natural log of firm Age (Age) has a mean value of 2.924, indicating that each firm has been listed on NSE/BSE for an average of 21 years. The cash flow from operations (CFO) is around 9 percent, while the ROA is 8.1 percent. The mean annual sales growth (Sales_Growth) is 12.1 percent. On average, the net property, plant, and equipment account for 27.7 percent of total assets for sample firms. Approximately 16.6 percent of sample firms report a negative profit after taxes. Around 10 percent of CEOs hold board chair positions (CEO_Dual). Around 20 percent of CEOs belong to promoter groups (Prom_CEO). These descriptive statistics suggest that the sample constitutes large, growing, established, and good-performing firms.

<<< Insert Table 1 here >>>

Table 2 presents the correlation matrix for the variables used in the primary analysis. The main outcome variable, InvEff, shows a positive correlation with both the CEO_Ratio and Adj_CEO_Ratio, with values of 0.112 and 0.111. The positive correlation suggests that higher CEO pay ratios are associated with lower levels of investment efficiency. These results are consistent with the rent extraction hypothesis rather than the talent assignment or incentive provision hypothesis. This table also shows that other financial variables like Size, Tobin's_Q, CFO, ROA, and Sales Growth are highly correlated. Therefore, these variables are also controlled with other firm and CEO characteristics that capture differences in investment efficiency in the regression analysis. Additionally, the multicollinearity test results showed that the variation inflation factors for the independent variables are within the threshold, indicating that multicollinearity is not a concern.

<<< Insert Table 2 here >>>

5. Empirical Results

5.1 Pay ratio and investment efficiency

Table 3 presents the baseline results of the relationship between the CEO pay ratio and firms' investment efficiency. The baseline results are estimated separately with and without control variables affecting investment efficiency. Column (1) presents the regression results without including control variables, with the coefficient of CEO_Ratio_{t-1} being positive and significant (0.012, p-value < 0.05). The control variables are added in Column (2). CEO_Ratio_{t-1} also produces a significantly positive coefficient (0.015, p-value < 0.01).[9]

<<< Insert Table 3 here >>>

The findings suggest that a greater disparity in compensation between CEOs and non-executive employees is associated with reduced investment efficiency. A higher CEO-to-employee pay ratio may indicate top executives' rent extraction, supporting the hypothesis. This phenomenon implies that CEOs can extract higher rent than the employee's potential, not necessarily as a reflection of superior talent or the need for incentive alignment, but rather as a result of their managerial power and influence over the compensation-setting process. The above results are consistent with Bebchuk *et al.* (2010), Grinstein and Hribar (2004), and Hoi *et al.* (2019) that the increase in pay dispersion is due to managerial rent extraction.

[9] The results are positive and significant after controlling for CEO and median employee compensation.

The analysis also reveals that a high level of financial leverage is negatively associated with investment efficiency (coefficient = -0.368, $p < 0.05$), indicating that increased debt levels may constrain optimal investment decisions. Conversely, firms characterized by strong growth prospects, as measured by Tobin's Q, and those with higher capital expenditures in property, plant, and equipment (PPE) exhibit improved investment efficiency.[10]

5.2 Overinvestment vs underinvestment

To gain further insight into the effect of the CEO pay ratio on investment inefficiency, we divide the sample into overinvestment firms (InvEff > 0) and underinvestment firms (InvEff < 0), which are presented in Table 4. In the overinvestment sample, the coefficient of CEO_Ratio_{t-1} is positive and significant (0.033, p-value < 0.05), whereas the coefficient in Column (4) is insignificant. These results indicate that pay disparity between CEOs and non-executive employees significantly increases the extent of corporate overinvestment, while its impact on underinvestment remains statistically insignificant. Therefore, CEO pay disparity appears to reduce investment efficiency primarily through overinvestment.

<<< Insert Table 4 here >>>

In summary, the observed patterns of investment distortions may be attributed to a misalignment between managerial and shareholder interests (Jensen, 1986; Jensen & Meckling, 1976), as well as the presence of asymmetric information between corporate insiders and external capital markets (Myers & Majluf, 1984). From an agency theory perspective, elevated levels of executive compensation can incentivize managers to pursue excessive investment to secure personal

[10] Unreported results show that the highest observed VIF value is 1.81, indicating that multicollinearity is not a concern.

benefits, often at the expense of shareholder value. Likewise, under conditions of information asymmetry, managers may exploit their discretionary power to engage in overinvestment, allocating resources to projects that are not value-maximizing. Such behavior ultimately contributes to reduced investment efficiency within the firm.

6. Mechanism Analysis: Managerial entrenchment and information asymmetry channels

We perform a series of subsample analyses to deepen the understanding of the mechanisms underlying the observed positive association between the CEO pay ratio and investment inefficiency. Specifically, this analysis distinguishes between two competing explanations: managerial entrenchment and information asymmetry.

We stratify the sample along four dimensions that proxy for these mechanisms. Managerial power is captured using indicators of CEO entrenchment: whether the CEO is the highest-paid executive (Top-Paid CEO) and whether the CEO possesses concentrated power (High CEO Power). In contrast, information asymmetry is proxied by financial reporting quality (measured via accruals quality) and board independence. These classifications enable us to assess whether investment inefficiencies are more sensitive to governance structures (suggesting agency problems) or information environments (suggesting frictions in monitoring).

6.1 Managerial entrenchment and investment efficiency

We begin by examining the role of CEO compensation structure and leadership influence. According to tournament theory (Lazear and Rosen, 1981; Rosen, 1985), a substantial gap in CEO pay may serve as an incentive mechanism, aligning managerial and shareholder interests and enhancing firm performance (Kale *et al.*, 2009). However, such disparities may reflect managerial

dominance. In this view, top-paid CEOs, due to their strategic importance and influence, are more likely to exert discretionary control over firm resources, potentially exacerbating inefficient investments. Similarly, CEO power is operationalized as a composite Z-score of three firm-level governance features: board size (smaller boards confer more CEO influence), board independence (less independence reduces oversight), and CEO duality (Adams *et al.*, 2005; Rajgopal and Srinivasan, 2006).

<<< Insert Table 5 here >>>

Consistent with this notion, the CEO pay ratio predicts investment inefficiency only among top-paid CEOs and firms with high CEO power (Columns 1 and 3 of Table 5). The effect is statistically insignificant among non-top-paid or low-power CEOs (Columns 2 and 4). The results confirm that higher CEO power strengthens the CEO pay-inefficiency link, indicating that entrenched CEOs may be more likely to pursue projects that benefit themselves at the expense of shareholder value.

6.2 Information asymmetry and investment efficiency

We also explore whether information asymmetry contributes to inefficient investment by reducing the ability of external stakeholders to monitor managerial actions. We employ two proxies measuring information asymmetry: financial reporting quality (Biddle *et al.*, 2009; Bushman and Smith, 2001; Leuz and Verrecchia, 2000), estimated using discretionary accruals from the modified Jones model (Dechow *et al.*, 1995; Jones, 1991; Kothari *et al.*, 2005), and board independence (Armstrong *et al.*, 2014; Linck *et al.*, 2008).

Consistent with prior research, the CEO pay ratio is significantly associated with investment inefficiency only among firms with low reporting quality and lower board independence (Columns

5 and 7 of Table 5). However, the association becomes statistically insignificant in the corresponding high-quality and high-independence subsamples (Columns 6 and 8), indicating that improved information environments may moderate the impact of CEO pay disparities.

The findings indicate that CEO entrenchment and information asymmetry explain the link between CEO pay ratio and investment inefficiency. The association is more substantial when CEOs are highly compensated or possess greater structural power, reflecting agency-driven behavior. At the same time, the effect remains significant in low transparency environments, where information asymmetry limits shareholder oversight, as shown by the results in firms with low financial reporting quality and board independence.

7. Heterogeneity analysis

i) Tech vs non-tech firms

Firms operating in high-technology industries tend to offer higher employee compensation due to the specialized skills required (D'Mello *et al.*, 2024), potentially narrowing the pay gap between CEOs and rank-and-file employees. Additionally, Siegel and Hambrick (2005) argue that high-tech sectors' collaborative and innovation-driven nature demands financial reward structures that promote firm-wide cooperation rather than emphasizing individual achievement. Therefore, a high CEO pay ratio in tech firms may more likely reflect managerial rent extraction, resulting in greater deviations from optimal investment decisions.

We classify firms into tech and non-tech sectors based on two-digit NIC codes to examine this. As presented in Table 6, Column (2), the association between the CEO pay ratio and investment inefficiency is more pronounced for tech firms than non-tech firms (Column 1). Untabulated

results further suggest that the observed investment inefficiency in tech firms is predominantly driven by overinvestment behavior.[11]

ii) R&D firms vs non-R&D firms

Prior research (Bebchuk *et al.*, 2011) documents that firms with significant R&D expenditures exhibit higher CEO pay disparities than non-R&D firms. Given that R&D signals long-term strategic focus and potential for value creation, it is essential to investigate whether the relationship between CEO pay ratio and investment inefficiency differs between R&D and non-R&D firms.

Following Bebchuk *et al.* (2011), we consider R&D-intensive firms to report positive R&D expenditures and non-R&D firms to be those with zero or missing R&D spending. Table 6 shows that the CEO pay ratio is significantly associated with greater investment inefficiency for non-R&D firms (Column 3), whereas the relationship is statistically insignificant for R&D firms (Column 4). Untabulated analysis indicates that the inefficiency observed among non-R&D firms primarily reflects underinvestment behavior.

iii) Financially constrained vs other firms

Finally, we explore the financial constraints influencing a firm's investment decisions. Theory suggests that firms with abundant internal resources may be more susceptible to inefficient investments due to weaker monitoring incentives and heightened agency problems (Acharya *et al.*, 2012). To measure financial constraints, we apply the Size-Age (SA) index proposed by Hadlock and Pierce (2010):

[11] Refer Appendix C for detailed results.

$SA = (-0.737*Size) + (0.043*Size^2) - (0.04*Age)$

Size is the natural logarithm of total assets, and Age is the number of years since incorporation. Firms with SA indices above the sample median are classified as financially constrained (Fahlenbrach *et al.*, 2021). As shown in Table 6, the association between CEO pay ratio and investment inefficiency is statistically significant among financially constrained firms (Column 5) but not among less constrained firms (Column 6). Untabulated results further reveal that financially constrained firms exhibit evidence of both overinvestment and underinvestment behavior.

<<< Insert Table 6 here >>>

In summary, the heterogeneity analysis shows that the positive association between CEO pay ratio and investment inefficiency is stronger in tech firms, non-R&D firms, and financially constrained firms. These results highlight that agency problems are more pronounced in these contexts where managerial rent extraction exacerbates deviations from optimal investment levels.

8. Robustness tests

8.1 CEO pay ratio adjusted for industry effects

The primary findings rely on the reported CEO pay ratio as the key explanatory variable. While the industry fixed effects are included in the regression models to control for industry differences that may influence investment behavior, they do not directly adjust for industry-specific variations in CEO compensation practices.[12] Prior research suggests that compensation structures, including

[12] Refer to Appendix D for OLS regression estimates.

CEO pay ratios, can vary systematically across industries, particularly when firms benchmark against peers (Albuquerque *et al.*, 2013). This robustness check redefines the CEO's pay ratio relative to the industry-median CEO pay ratio, calculated using the two-digit NIC industry classification.[13] This approach ensures that industry-level differences in compensation norms do not drive the findings and allows for better isolation of the role of firm-level CEO pay disparity in driving investment inefficiency.

<<< Insert Table 7 here >>>

The results in Table 7 demonstrate that the coefficients on the lagged industry-adjusted CEO pay ratio *(Adj. CEO Ratio$_{t-1}$)* in Columns (1) and (2) are consistent with the baseline findings reported in Table 3 in terms of the direction, magnitude, and statistical significance. The positive and significant association between CEO pay disparity and investment inefficiency remains robust to this alternate specification. Furthermore, as shown in Columns (3) and (4), the relationship is particularly pronounced with the over-investment subsample. At the same time, the under-investment results remain insignificant, suggesting that the effect of CEO pay disparity is more relevant in explaining excessive investment behavior.

8.2 Alternate measures of investment efficiency

To assess the robustness of our primary findings, we re-estimate investment efficiency using two alternative model specifications commonly adopted in prior literature. Specifically, we employ the

[13] National Industry Classification (NIC) codes are obtained from the Ministry of Statistics and Programme Implementation of India.

models proposed by Biddle *et al.* (2009) and McNichols and Stubben (2008) to construct alternative measures of investment efficiency.

The first model is specified as follows:

$$Invest_{i,t} = \beta_0 + \beta_1\ Tobin's_Q_{i,t-1} + \beta_2\ Sales_Growth_{i,t-1} + \Sigma\ Industry_Indicator + \Sigma\ Year_Indicator + \varepsilon_{i,t}$$

Where *Tobin's Q* and *Sales growth* proxy for investment opportunities (Biddle *et al.*, 2009; Chen *et al.*, 2011). Sales growth is the year-over-year change in sales scaled by lagged sales. *InvEff_2* is the absolute value of the residual estimated from Eq. (2), which represents the deviation from the expected level of investment.

The second specification includes an additional control for internal financing capacity:

$$Invest_{i,t} = \beta_0 + \beta_1\ Tobin's_Q_{i,t-1} + \beta_2\ CFO_{i,t} + \Sigma\ Industry_Indicator + \Sigma\ Year_Indicator + \varepsilon_{i,t}$$

where the CFO represents cash flow from operations scaled by total assets. The resulting absolute residuals (*InvEff_3*) similarly indicate the deviation from optimum investment levels, accounting for investment opportunities and financial flexibility.

<<< Insert Table 8 here >>>

The results based on these alternative measures of investment efficiency are consistent with our baseline findings, as shown in Tables 3 and 4. Specifically, we observe a positive and significant association between the CEO pay ratio and investment inefficiency. Notably, this relationship remains substantial only in the over-investment subsample, suggesting that the CEO pay gap contributes more strongly to excessive investment behavior than under-investment.

8.3 Endogeneity issues

This study employs multiple approaches to address potential endogeneity concerns throughout the analysis. First, we utilized the lagged CEO pay ratio instead of the contemporaneous measure to mitigate reverse causality concerns. Second, we incorporate firm fixed effects in the regression models to control for unobservable time-invariant company characteristics, focusing on within-firm variation in CEO pay ratio and investment efficiency. Third, we use an industry-adjusted CEO pay ratio as an alternative measure, ensuring that industry-specific compensation structures do not drive the results. In addition, we validate the findings using OLS regressions with industry-fixed effects as an additional robustness check.

Lastly, to address potential endogeneity concerns – including omitted variable bias and simultaneity - we implement a Two-Stage Least Squares (2SLS) approach. Following Bebchuk *et al.* (2011), we instrument the firm-level CEO pay ratio with the industry-year median CEO pay ratio. The rationale is that while industry-level compensation structures are likely correlated with firm-level CEO practices, they are plausibly exogenous to an individual firm's investment practices. Thus, the instrument satisfies the relevance and exclusion restrictions required for valid inference.

<<< Insert Table 9 here >>>

Table 9 presents the results from the 2SLS estimation. Column(1) reports the first-stage regression, where the dependent variable is the firm's CEO pay ratio (log-transformed as 1 plus the CEO ratio). The industry-median CEO pay ratio coefficient is positive and highly significant, indicating a strong first-stage relationship. Columns (2) to (4) report the second-stage regressions. Column (2) shows that a higher predicted CEO pay ratio is positively and significantly associated with greater

investment inefficiency. Columns (3) and (4) separately analyze over-investment and under-investment subsamples. Consistent with the main findings in Tables 3 and 4, the results reveal that the effect of CEO pay disparity is primarily driven by over-investment rather than under-investment.

Overall, the IV-based findings corroborate the primary findings that greater CEO-to-employee pay disparity is associated with lower investment efficiency, primarily through overinvestment channels. These results remain robust, even controlling for the endogenous relationship between CEO pay structures and firm-level investment decisions, further supporting the rent extraction hypothesis.

9. Conclusion

This study investigates the relationship between CEO-to-median employee pay ratios and corporate investment efficiency. While prior literature has primarily focused on market reactions to high CEO pay disparity, its impact on investment efficiency remains underexplored. Our findings provide empirical evidence that greater within-firm pay disparity is positively associated with investment inefficiency, particularly through overinvestment rather than underinvestment channels.

Further analyses indicate that this association is more pronounced in firms with stronger managerial entrenchment and heightened information asymmetry. This suggests that agency conflicts, rather than optimal talent allocation, drive the observed inefficiencies. Subsample analyses further reveal that the relationship is stronger among high-technology firms, non-R&D-intensive firms, and financially constrained firms—contexts where governance frictions are often more severe. Robustness checks employing industry-adjusted CEO pay ratios, alternative

investment efficiency metrics, and instrumental variable (2SLS) estimations confirm the consistency of the results.

Collectively, the evidence underscores the importance of CEO pay structures in shaping firm-level investment behavior, especially in environments prone to agency conflicts. Our findings have significant implications for corporate decision-makers and shareholders. First, firms should critically assess whether the pay disparity aligns with the long-term shareholder value, especially in weak monitoring contexts. Second, strengthening board independence, enhancing disclosure transparency, and enforcing performance-based pay can reduce agency problems and improve investment decisions. Lastly, investors and analysts can treat extreme pay ratios as a warning signal for potential inefficiencies or agency issues when combined with managerial entrenchment or high information asymmetry.

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Table 1. Descriptive Statistics

	Count	Mean	SD	Min	Q1	Median	Q3	Max
CEO_Ratio	1557	4.196	1.191	0.880	3.472	4.257	5.001	6.706
InvEff	1557	0.095	0.149	0.000	0.023	0.051	0.104	1.738
Size	1557	10.383	1.622	6.080	9.333	10.301	11.392	14.250
Tobin's_Q	1557	1.977	2.072	0.044	0.620	1.238	2.467	10.208
LEV	1557	0.117	0.135	0.000	0.021	0.069	0.169	0.908
Age	1557	2.924	0.688	1.099	2.565	3.045	3.497	3.784
CFO	1557	0.090	0.085	-0.343	0.041	0.086	0.139	0.421
ROA	1557	0.061	0.081	-0.383	0.016	0.051	0.104	0.386
Sales_Growth	1458	0.121	0.324	-0.851	-0.018	0.088	0.212	3.664
PPE	1557	0.277	0.195	0.001	0.107	0.253	0.427	0.905
Loss	1557	0.166	0.372	0.000	0.000	0.000	0.000	1.000
CEO_Dual	1557	0.098	0.297	0.000	0.000	0.000	0.000	1.000
Prom_CEO	1557	0.198	0.398	0.000	0.000	0.000	0.000	1.000

See Appendix A for detailed variable definitions.

Table 2. Correlation Table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) CEO_Ratio	1.000												
	(.)												
(2) InvEff	0.112	1.000											
	(***)	(.)											
(3) Size	0.437	0.092	1.000										
	(***)	(***)	(.)										
(4) Tobin's_Q	0.190	0.154	0.132	1.000									
	(***)	(***)	(***)	(.)									
(5) LEV	0.044	0.000	0.212	-0.121	1.000								
	(.)	(.)	(***)	(***)	(.)								
(6) Age	0.087	-0.047	0.233	-0.073	-0.073	1.000							
	(***)	(.)	(***)	(**)	(**)	(.)							
(7) CFO	0.181	0.095	0.130	0.453	-0.039	-0.003	1.000						
	(***)	(***)	(***)	(***)	(.)	(.)	(.)						
(8) ROA	0.200	0.160	0.065	0.562	-0.273	0.033	0.550	1.000					
	(***)	(***)	(*)	(***)	(***)	(.)	(***)	(.)					
(9) Sales_Growth	-0.065	0.067	-0.050	0.102	0.014	-0.040	0.014	0.196	1.000				
	(*)	(*)	(.)	(***)	(.)	(.)	(.)	(***)	(.)				
(10) PPE	0.115	-0.058	0.019	0.049	0.488	0.000	0.188[1]	-0.016	0.022	1.000			
	(***)	(*)	(.)	(.)	(***)	(.)	(***)	(.)	(.)	(.)			
(11) Loss	-0.154	-0.049	-0.068	-0.231	0.160	-0.066	-0.305	-0.598	-0.159	-0.035	1.000		
	(***)	(.)	(*)	(***)	(***)	(*)	(***)	(***)	(***)				
(12) CEO_Dual	0.037	-0.031	-0.146	-0.009	-0.039	0.003	-0.001	0.025	-0.035	-0.019	0.025	1.000	
	(.)	(.)	(***)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	
(13) Prom_CEO	0.107	-0.059	-0.149	-0.019	-0.086	-0.036	0.042	0.083	-0.029	0.018	-0.064	0.315	1.000
	(***)	(*)	(***)	(.)	(**)	(.)	(.)	(**)	(.)	(.)	(*)	(***)	(.)

See Appendix A for detailed variable definitions.

Table 3: Pay ratio and investment efficiency

	(1) $InvEff_{i,t}$	(2) $InvEff_{i,t}$
CEO_Ratio_{t-1}	0.012**	0.015***
	(2.12)	(2.70)
CEO_Dual		0.023
		(1.18)
Prom_CEO		-0.034
		(-1.56)
LEV		0.368**
		(2.15)
ROA		0.040
		(0.38)
CFO		0.016
		(0.24)
MTB		-0.004**
		(-2.08)
SIZE		-0.018
		(-0.54)
AGE		0.047
		(1.03)
Tobin's_Q		0.007
		(0.91)
PPE		-0.242**
		(-2.10)
Loss		0.003
		(0.13)
Constant	0.079***	0.143
	(3.05)	(0.45)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	1557	1557
adj. R^2	0.017	0.041

This table presents the regression results examining the relationship between the CEO pay ratio and investment efficiency. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. See Appendix A for detailed variable definitions. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 4: Overinvestment vs underinvestment

	(1)	(2)
	Over_Inv$_{i,t}$	*Under_Inv*$_{i,t}$
CEO_Ratio$_{t-1}$	0.033**	0.011
	(2.45)	(1.51)
CEO_Dual	0.058	0.008
	(1.27)	(0.49)
Prom_CEO	-0.092*	0.008
	(-1.78)	(0.38)
LEV	0.476	0.369*
	(1.58)	(1.86)
ROA	0.020	0.036
	(0.05)	(0.36)
CFO	0.090	-0.117*
	(0.51)	(-1.90)
MTB	-0.002	-0.006
	(-0.67)	(-1.26)
SIZE	-0.084	0.032
	(-1.22)	(0.93)
AGE	0.053	0.043
	(0.47)	(1.00)
Tobin's_Q	-0.002	0.023
	(-0.12)	(1.63)
PPE	-0.209	-0.300**
	(-0.87)	(-2.00)
Loss	0.041	-0.008
	(0.74)	(-0.48)
Constant	0.711	-0.336
	(1.13)	(-0.93)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	584	973
adj. R^2	0.077	0.060

This table presents the regression results examining the relationship between the CEO pay ratio and investment inefficiency, distinguishing between overinvestment and underinvestment behaviors. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. See Appendix A for detailed variable definitions. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 5: Managerial entrenchment and information asymmetry channels

Dep. Var.: $InvEff_{i,t}$	(1) *Top_Paid_CEO*	(2) *Non-Top_Paid_CEO*	(3) *High_CEO_Power*	(4) *Low_CEO_Power*	(5) *Low_AQ*	(6) *High_AQ*	(7) *Low_Board_Indep*	(8) *High_Board_Indep*
CEO_Ratio_{t-1}	0.024*	0.009	0.024**	0.008	0.025**	0.010	0.020**	0.010
	(1.97)	(1.29)	(2.45)	(1.03)	(2.53)	(1.26)	(2.04)	(1.54)
CEO_Dual	-0.011	0.027	0.006	0.067***	0.030	0.022	0.045	0.044
	(-0.35)	(0.52)	(0.15)	(2.74)	(1.04)	(0.70)	(1.52)	(1.21)
Prom_CEO	-0.038	-0.048**	-0.034*	-0.065	-0.071	-0.001	-0.056	-0.025
	(-0.95)	(-2.49)	(-1.86)	(-1.26)	(-1.65)	(-0.04)	(-1.17)	(-0.81)
LEV	0.549**	0.292***	0.237	0.488*	0.045	0.739**	0.322	0.413
	(2.27)	(3.10)	(1.26)	(1.87)	(0.37)	(2.53)	(1.61)	(1.54)
ROA	0.116	-0.065	0.000	0.088	-0.141	0.380	0.053	0.008
	(0.66)	(-0.64)	(0.00)	(0.32)	(-1.03)	(1.04)	(0.26)	(0.05)
CFO	0.049	0.185	0.028	0.145	0.043	-0.113	-0.037	0.018
	(0.46)	(1.27)	(0.29)	(0.84)	(0.43)	(-0.47)	(-0.44)	(0.16)
MTB	-0.005**	-0.008	-0.002	-0.007	-0.004	-0.005	-0.001	-0.002
	(-2.09)	(-1.28)	(-0.99)	(-1.64)	(-1.59)	(-1.44)	(-0.66)	(-0.64)
SIZE	-0.013	0.012	-0.041	-0.007	-0.017	0.014	0.014	0.008
	(-0.23)	(0.26)	(-1.10)	(-0.13)	(-0.41)	(0.29)	(0.38)	(0.13)
AGE	0.085	-0.029	-0.022	0.115	0.148**	-0.044	0.060	0.008
	(1.37)	(-0.37)	(-0.41)	(1.55)	(2.10)	(-0.60)	(0.81)	(0.10)
Tobin's_Q	0.002	0.032*	0.013	0.000	0.023**	-0.003	-0.010	-0.001
	(0.18)	(1.78)	(1.41)	(0.01)	(2.08)	(-0.21)	(-1.03)	(-0.06)
PPE	-0.341**	-0.174	-0.192	-0.229	-0.175	-0.270	-0.096	-0.324*
	(-2.07)	(-1.53)	(-1.20)	(-1.51)	(-1.12)	(-1.36)	(-0.81)	(-1.74)
Loss	0.009	0.009	-0.019	0.024	0.010	-0.008	-0.001	-0.028
	(0.33)	(0.40)	(-0.97)	(0.66)	(0.24)	(-0.44)	(-0.05)	(-1.01)
Constant	-0.009	-0.018	0.496	-0.117	-0.103	0.053	-0.255	0.037
	(-0.02)	(-0.03)	(1.14)	(-0.22)	(-0.27)	(0.11)	(-0.74)	(0.05)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	906	586	744	813	733	824	849	708
adj. R^2	0.060	0.074	0.045	0.078	0.079	0.116	0.044	0.058

This table presents regression results investigating the relationship between CEO pay ratio and investment inefficiency, disentangling the underlying channels of managerial entrenchment and information asymmetry. All models control for firm and year-fixed effects. Standard errors, clustered at the firm level, are reported in parentheses. See Appendix A for variable definitions. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 6: Heterogeneity analysis

	(1) $InvEff_{i,t}$ *Non-Tech*	(2) $InvEff_{i,t}$ *Tech*	(3) $InvEff_{i,t}$ *Non-R&D firms*	(4) $InvEff_{i,t}$ *R&D firms*	(5) $InvEff_{i,t}$ *High Fin. Constrain*	(6) $InvEff_{i,t}$ *Less Fin. Constrain*
CEO_Ratio_{t-1}	0.010*	0.051**	0.020***	0.007	0.023***	0.005
	(1.75)	(2.53)	(2.98)	(1.00)	(2.67)	(0.78)
CEO_Dual	0.027	-0.022	-0.003	0.021	0.018	0.049*
	(1.25)	(-0.66)	(-0.16)	(0.73)	(0.65)	(1.69)
Prom_CEO	-0.035	-0.049**	-0.076**	0.009	-0.059	-0.031
	(-1.39)	(-2.22)	(-2.11)	(0.38)	(-1.50)	(-1.38)
LEV	0.371*	0.285	0.064	0.709**	0.297*	0.109
	(1.92)	(1.07)	(0.87)	(2.16)	(1.87)	(1.10)
ROA	-0.064	0.433	-0.084	0.145	0.020	-0.006
	(-0.56)	(1.59)	(-0.75)	(0.88)	(0.11)	(-0.06)
CFO	0.041	-0.100	0.012	-0.012	0.020	-0.020
	(0.57)	(-0.58)	(0.15)	(-0.12)	(0.22)	(-0.25)
MTB	-0.005**	0.002	-0.002	-0.010*	-0.002	-0.005
	(-2.29)	(0.43)	(-1.63)	(-1.67)	(-1.22)	(-1.07)
SIZE	-0.025	-0.012	-0.014	-0.012	-0.055*	-0.030
	(-0.68)	(-0.29)	(-0.40)	(-0.17)	(-1.78)	(-0.62)
AGE	0.052	0.223	-0.021	0.151	0.034	0.169
	(1.06)	(0.93)	(-0.46)	(1.39)	(0.51)	(1.39)
Tobin's_Q	0.014*	-0.021	0.009	0.016	0.011	0.009
	(1.69)	(-1.05)	(1.20)	(0.87)	(0.91)	(1.04)
PPE	-0.270**	-0.032	-0.061	-0.347*	-0.225	-0.057
	(-2.10)	(-0.15)	(-0.71)	(-1.89)	(-1.65)	(-0.58)
Loss	0.004	-0.009	-0.003	-0.005	0.011	0.011
	(0.16)	(-0.17)	(-0.15)	(-0.17)	(0.31)	(0.83)
Constant	0.200	-0.473	0.245	-0.181	0.580*	-0.150
	(0.59)	(-0.56)	(0.70)	(-0.27)	(1.86)	(-0.23)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1293	264	903	654	778	779
adj. R^2	0.043	0.071	0.044	0.080	0.050	0.058

This table reports the results of subsample regressions examining the association between CEO pay ratio and investment inefficiency across different firm characteristics, including technology intensity, R&D activity, and financial constraints. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Refer to Appendix A for detailed variable definitions. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 7: Industry-adjusted CEO pay ratio and investment efficiency

	(1) $InvEff_{i,t}$	(2) $InvEff_{i,t}$	(3) $Over_Inv_{i,t}$	(4) $Under_Inv_{i,t}$
$Adj_CEO_Ratio_{t-1}$	0.012**	0.015***	0.033***	0.011
	(2.08)	(2.61)	(2.74)	(1.55)
CEO_Dual		0.023	0.061	0.008
		(1.19)	(1.33)	(0.48)
Prom_CEO		-0.035	-0.092*	0.008
		(-1.57)	(-1.81)	(0.37)
LEV		0.367**	0.469	0.370*
		(2.14)	(1.56)	(1.86)
ROA		0.042	-0.001	0.040
		(0.39)	(-0.00)	(0.40)
CFO		0.018	0.110	-0.117*
		(0.27)	(0.61)	(-1.91)
MTB		-0.004**	-0.002	-0.006
		(-2.06)	(-0.67)	(-1.24)
SIZE		-0.018	-0.082	0.032
		(-0.53)	(-1.20)	(0.93)
AGE		0.048	0.055	0.045
		(1.06)	(0.48)	(1.03)
Tobin's_Q		0.007	-0.002	0.023
		(0.91)	(-0.10)	(1.62)
PPE		-0.245**	-0.207	-0.305**
		(-2.12)	(-0.86)	(-2.01)
Loss		0.004	0.043	-0.007
		(0.17)	(0.77)	(-0.45)
Constant	0.124***	0.195	0.813	-0.297
	(6.20)	(0.61)	(1.29)	(-0.81)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	1557	1557	584	973
adj. R^2	0.017	0.041	0.077	0.061

This table presents regression results investigating the relationship between industry-adjusted CEO pay ratio and investment inefficiency, including overinvestment and underinvestment. All models control for firm and year-fixed effects. Standard errors, clustered at the firm level, are reported in parentheses. See Appendix A for variable definitions. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 8: CEO pay ratio and investment inefficiency (alternate measures)

	(1)	(2)	(3)	(4)	(5)	(6)
	InvEff_2$_{i,t}$	*InvEff_3*$_{i,t}$	*InvEff_2*$_{i,t}$	*InvEff_3*$_{i,t}$	*InvEff_2*$_{i,t}$	*InvEff_3*$_{i,t}$
			Over Investment		*Under Investment*	
CEO_Ratio$_{t-1}$	0.015**	0.013**	0.042***	0.027*	0.007	0.006
	(2.57)	(2.31)	(2.84)	(1.66)	(1.52)	(1.37)
CEO_Dual	0.034	0.025	0.083	0.083	0.010	0.006
	(1.43)	(1.20)	(1.54)	(1.59)	(0.76)	(0.46)
Prom_CEO	-0.055**	-0.056**	-0.116**	-0.092*	-0.008	-0.012
	(-2.23)	(-2.27)	(-2.25)	(-1.73)	(-0.96)	(-1.45)
LEV	0.191	0.149	0.473	0.410	0.033	0.046
	(1.12)	(0.89)	(1.63)	(1.40)	(0.67)	(0.90)
ROA	0.068	0.067	0.179	0.015	0.047	0.053
	(0.56)	(0.57)	(0.45)	(0.04)	(0.74)	(0.75)
CFO	-0.073	0.009	-0.323	-0.603***	-0.065*	0.242***
	(-1.28)	(0.12)	(-1.61)	(-2.82)	(-1.70)	(5.50)
MTB	-0.000	-0.000	-0.001	-0.002	-0.000	-0.001
	(-0.04)	(-0.09)	(-0.25)	(-0.31)	(-0.24)	(-0.51)
SIZE	-0.028	-0.011	-0.042	-0.022	-0.010	-0.001
	(-1.03)	(-0.45)	(-0.52)	(-0.28)	(-0.86)	(-0.12)
AGE	0.075	0.085	0.179	0.223	0.025	0.033
	(1.26)	(1.44)	(1.02)	(1.32)	(0.78)	(1.12)
Tobin's_Q	0.002	0.002	-0.014	-0.014	0.009*	0.011**
	(0.24)	(0.18)	(-0.50)	(-0.56)	(1.74)	(2.07)
PPE	-0.111	-0.138	-0.057	-0.065	-0.097	-0.085
	(-1.12)	(-1.40)	(-0.24)	(-0.32)	(-1.36)	(-1.24)
Loss	0.010	0.003	0.023	-0.020	0.013	0.011
	(0.54)	(0.17)	(0.49)	(-0.42)	(1.38)	(1.13)
Constant	0.241	0.071	0.187	-0.098	0.135	0.019
	(0.81)	(0.25)	(0.21)	(-0.11)	(0.84)	(0.13)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1467	1557	554	584	913	973
adj. R^2	0.035	0.035	0.129	0.117	0.033	0.094

This table reports regression results examining the association between CEO pay ratio and investment inefficiency, including overinvestment and underinvestment behaviors, using alternative measures of investment efficiency. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. See Appendix A for detailed variable definitions. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 9: Instrumental variable approach

	(1) *CEO_Ratio*	(2) $InvEff_{i,t}$	(3) $Over_Inv_{i,t}$	(4) $Under_Inv_{i,t}$
$CEO_Ratio_{(Industry\text{-}median)}$	0.279***			
	(3.52)			
$CEO_Ratio_{t\text{-}1(Predicted)}$		0.086**	0.182**	0.036
		(2.00)	(2.10)	(0.74)
CEO_Dual	0.293*	0.014	0.029	0.008
	(1.81)	(0.79)	(0.66)	(0.53)
Prom_CEO	0.075	-0.032	-0.083*	0.009
	(1.21)	(-1.48)	(-1.66)	(0.44)
LEV	-0.433	0.397**	0.524*	0.372*
	(-1.41)	(2.27)	(1.66)	(1.88)
ROA	0.487	0.019	-0.041	0.036
	(1.33)	(0.17)	(-0.09)	(0.34)
CFO	0.131	0.017	0.057	-0.124*
	(0.60)	(0.24)	(0.32)	(-1.95)
mtb	0.010	-0.005**	0.001	-0.006
	(1.36)	(-1.98)	(0.28)	(-1.11)
Size	0.218**	-0.035	-0.122*	0.028
	(2.21)	(-1.02)	(-1.71)	(0.77)
Age	-0.080	0.048	0.067	0.043
	(-0.72)	(1.05)	(0.58)	(0.97)
Tobins_Q	0.028	0.007	-0.014	0.021
	(1.05)	(0.73)	(-0.88)	(1.46)
PPE	0.602**	-0.248**	-0.184	-0.292**
	(2.00)	(-2.12)	(-0.73)	(-2.01)
Loss	-0.015	-0.000	0.035	-0.010
	(-0.21)	(-0.02)	(0.60)	(-0.60)
_cons	0.654	0.039	0.476	-0.393
	(0.68)	(0.11)	(0.73)	(-0.98)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	2022	1543	578	965
adj. R^2	0.056	0.043	0.084	0.058

This table presents the results of instrumental variable (IV) two-stage least squares (2SLS) regressions examining the relationship between CEO pay ratio and investment inefficiency, including overinvestment and underinvestment. Column (1) reports the first-stage regression results, while Columns (2) through (4) present the second-stage estimates. All models include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. See Appendix A for detailed variable definitions. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Appendix A. Variable definitions

Variable	**Definition**
CEO_Ratio	Natural log of one plus the CEO's pay-to-median employee remuneration ratio
InvEff	Absolute value of residuals calculated using Richardson's (2006) investment efficiency model.
Over_Inv	Positive residuals calculated using Richardson's (2006) investment efficiency model.
Under_Inv	Negative residuals calculated using Richardson's (2006) investment efficiency model.
CEO_Dual	An indicator variable that takes one if the CEO holds the board's Chairperson position or zero otherwise.
Prom_CEO	An indicator variable that takes one if the CEO is a promoter director of the firm or zero otherwise.
ROA	Profit before extraordinary items scaled by total assets.
CFO	Cash inflows from operations scaled by lagged total assets.
LEV	Total long-term liabilities scaled by lagged total assets.
MTB	Market-to-book ratio.
SIZE	Natural log of total assets at the beginning of the year.
AGE	Natural log of the firm's age since listing.
Tobin's Q	Ratio of equity market value plus the liabilities' book value, scaled by total assets.
PPE	Net property, plant, and equipment at the end of the year scaled by lagged total assets
Loss	An indicator variable that takes the value of one if the firm has a negative profit or zero otherwise.
Top_Paid_CEO	CEO is the top-paid executive in the firm.
Non_Top_Paid_CEO	CEO is not the top-paid executive in the firm.
High_CEO_Power	Composite Z-score is above the median value.
Low_CEO_Power	Composite Z-score is below the median value.
High_AQ	Absolute discretionary accruals above the median value.
Low_AQ	Absolute discretionary accruals below the median value.
Low_Board_Indep	Independent directors are less than or equal to 50% of the board size.
High_Board_Indep	Independent directors are more than 50% of the board size.
Adj. CEO Ratio	CEO ratio adjusted for industry-median (year-wise).
InvEff_2	Absolute value of residuals calculated using Biddle *et al.* (2009) investment efficiency model.
InvEff_3	Absolute value of residuals calculated using McNichols and Stubben's (2008) investment efficiency model.

Appendix B1. Pay-ratio year-wise

Year	No. of observations	Mean CEO Payratio	Median CEO Payratio
2015	176	107.45	39.37
2016	248	81.46	40.12
2017	299	101.07	38.53
2018	355	91.23	36.00
2019	423	94.54	38.61
2020	448	82.96	35.83
2021	444	85.92	36.36
2022	477	104.32	38.84
2023	514	89.32	41.37
2024	540	103.68	35.84
Total	3924	93.96	38.05

Appendix B2. Pay-ratio industry-wise

Industry	No. of observations	Mean CEO Payratio	Median CEO Payratio
Agriculture, forestry and fishing	20	32.40	31.56
Mining and quarrying	70	46.45	11.54
Manufacturing	2157	99.82	44.00
Electricity, gas, steam and air conditioning supply	38	37.11	29.23
Construction	258	92.05	32.50
Wholesale and retail trade and repair of motor vehicles and motorcycles	338	59.54	22.86
Transportation and Storage	94	53.76	19.39
Accommodation and Food Service Activities	79	155.24	93.55
Information and Communication	516	116.58	40.04
Professional, scientific and technical activities	80	59.17	35.70
Administrative and Support Service Activities	84	38.45	27.51
Public administration and defense; compulsory social security	4	16.75	17.18
Education	32	26.05	24.06
Human health and social work activities	67	123.93	104.65
Arts, entertainment, and recreation	12	30.49	11.20
Diversified	75	122.44	38.61
Total	3924	93.96	38.05

Appendix C

Sub-sample analysis on tech, non-R&D, and financially constrained firms.

	(1)	(2)	(3)	(4)	(5)	(6)
	Tech firms		*Non-R&D firms*		*Financially constrained firms*	
	InvEffi,t	*InvEffi,t*	*InvEffi,t*	*InvEffi,t*	*InvEffi,t*	*InvEffi,t*
	Over_Inv	*Under_Inv*	*Over_Inv*	*Under_Inv*	*Over_Inv*	*Under_Inv*
CEO_Ratio_{t-1}	0.082*	0.036	0.023	0.014*	0.039*	0.027**
	(1.73)	(1.19)	(1.29)	(1.72)	(1.74)	(2.24)
CEO_Dual	0.000	0.042	-0.022	-0.001	-0.019	-0.001
	(.)	(0.70)	(-0.44)	(-0.08)	(-0.31)	(-0.03)
Prom_CEO	-0.175	-0.030	-0.120*	-0.014	-0.113	0.013
	(-1.60)	(-1.26)	(-1.66)	(-1.13)	(-1.16)	(0.68)
LEV	0.548	0.294	0.103	0.114	0.191	0.549*
	(0.70)	(0.95)	(0.68)	(1.65)	(0.90)	(1.68)
ROA	2.558**	-0.045	-0.373	0.082	-0.026	0.068
	(2.46)	(-0.21)	(-0.81)	(0.73)	(-0.04)	(0.83)
CFO	0.106	-0.243*	-0.044	-0.155**	-0.026	-0.145*
	(0.14)	(-1.82)	(-0.20)	(-2.13)	(-0.11)	(-1.73)
MTB	0.018**	-0.000	0.001	-0.008*	0.002	-0.015***
	(2.23)	(-0.01)	(0.20)	(-1.85)	(0.61)	(-2.90)
SIZE	0.039	0.027	-0.021	0.013	-0.173*	0.011
	(0.21)	(0.74)	(-0.29)	(0.36)	(-1.84)	(0.33)
AGE	0.457	0.435	-0.031	-0.006	0.140	-0.016
	(0.58)	(1.14)	(-0.31)	(-0.11)	(0.79)	(-0.26)
Tobin's_Q	-0.090	0.009	0.020**	0.025*	-0.000	0.057***
	(-1.66)	(0.60)	(2.01)	(1.94)	(-0.01)	(3.41)
PPE	-0.535	-0.134	0.098	-0.101	-0.376	-0.382
	(-0.72)	(-0.86)	(0.75)	(-1.22)	(-0.87)	(-1.64)
Loss	0.034	-0.042	-0.039	-0.010	0.078	-0.036
	(0.26)	(-0.75)	(-0.73)	(-0.43)	(0.90)	(-1.30)
Constant	-1.838	-1.350	0.319	-0.056	1.643**	-0.039
	(-0.77)	(-1.32)	(0.49)	(-0.15)	(1.98)	(-0.11)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	95	169	348	555	301	477
adj. R^2	0.262	0.165	0.056	0.078	0.090	0.165

This table reports the results of subsample regressions examining the association between CEO pay ratio and investment inefficiency (overinvestment vs underinvestment) across technology, non-R&D, and financially constrained firms. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Refer to Appendix A for detailed variable definitions. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Appendix D

OLS Regression with industry-fixed effects analysis

	(1) *InvEffi,t*	(2) *Over_Inv$_{i,t}$*	(3) *Under_Inv$_{i,t}$*
CEO_Ratio$_{t-1}$	0.011**	0.022**	0.001
	(2.02)	(2.18)	(0.41)
CEO_Dual	-0.007	-0.009	-0.012
	(-0.40)	(-0.31)	(-1.36)
Prom_CEO	-0.026***	-0.035*	-0.011
	(-2.67)	(-1.95)	(-1.19)
LEV	0.099	0.071	0.071
	(1.43)	(0.65)	(1.22)
ROA	0.288***	0.473**	0.061
	(2.88)	(2.26)	(0.95)
CFO	-0.016	0.102	-0.172***
	(-0.23)	(1.00)	(-2.66)
MTB	0.000	0.002	-0.001
	(0.12)	(0.85)	(-0.55)
SIZE	0.004	-0.000	0.007**
	(1.03)	(-0.07)	(2.20)
AGE	-0.012	-0.017	-0.007
	(-1.50)	(-1.23)	(-1.44)
Tobin's_Q	0.002	-0.006	0.010***
	(0.46)	(-0.56)	(2.81)
PPE	-0.125***	-0.176**	-0.087**
	(-2.71)	(-2.11)	(-2.18)
Loss	0.011	0.056	-0.019*
	(0.66)	(1.47)	(-1.68)
Constant	0.049	0.115	0.034
	(1.25)	(1.26)	(0.81)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	1557	584	973
adj. R^2	0.079	0.117	0.091

This table presents the OLS regression results examining the relationship between the CEO pay ratio and investment efficiency. All regressions include industry and year-fixed effects. Standard errors are clustered at the firm level and reported in parentheses. See Appendix A for detailed variable definitions. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed).