The Impact of Executive Pay Disparity on Corporate Carbon Emissions: Insights from Tournament Incentives

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Abstract

This paper explores the impact of pay disparity on corporate carbon emissions, framed within the context of tournament theory. While salary gaps between hierarchical levels can incentivize executives and enhance firm performance, they may also exacerbate carbon emissions due to excessive competition. We find a significant positive relationship between the pay gap and carbon emissions. To address potential endogeneity concerns, we perform a two-stage regression analysis, using the industry average pay gap and the industry average CEO compensation as instrumental variables. The results confirm a significant positive association between pay disparity and carbon emissions. Propensity-score matching further supports these findings. Additionally, we show that an increase in institutional ownership mitigates carbon emissions attributed to competition, whereas higher CEO turnover likelihood intensifies executive competition, resulting in elevated carbon emissions.

Keywords: tournament incentives, carbon emissions, pay gap, senior executive compensation

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1. Introduction

With the rapid development of the global economy, companies have generated substantial profits and accumulated significant capital. However, this economic growth has come at a cost to the natural environment, leading to issues such as climate change. Over the past decades, the implementation of corporate social responsibility has become a critical focus. Firms are now expected not only to create value for shareholders but also to address the rights and interests of stakeholders while contributing to the sustainable development of the environment and society. Consequently, striking a balance between maximizing shareholder wealth and achieving sustainable development has become a shared objective globally.

The CEO and the management team serve as critical decision-makers, influencing corporate operations and guiding the selection and execution of investment projects. Gan (2019) examines the impact of CEO managerial ability on investment efficiency. The empirical findings show that more capable CEOs make more effective investment decisions, leading to increased capital expenditures and overall investments. In contrast, Malmendier and Tate (2005) find that overconfident managers tend to overestimate the returns of investment projects, resulting in corporate investment distortions that adversely affect performance. Moreover, Bhuiyan, Huang, and de Villiers (2021) document that firms implementing CEO bonus plans tied to environmental performance are more likely to increase their environmental investments. There is no doubt that the crucial decision-making as well as environment investments of an enterprise usually depend on the firm executives (Hambrick and Mason, 1984).

However, due to the divergence between ownership and control rights within a company, senior executives may be motivated by self-interest and may not necessarily make decisions that align with the firm's optimal interests or maximize shareholder value. To address the agency problem between management and shareholders, prior literature suggests that shareholders and the board of directors typically determine the CEO’s compensation based on the firm performance (Leone, Wu, and Zimmerman, 2006; Matolcsy and Wright, 2011; Shi, Connelly, Mackey, and Gupta, 2019).

Specifically, when a firm performs well, the CEO is rewarded with higher compensation in recognition of their leadership and contributions. Conversely, when the firm underperforms, the CEO's compensation may be reduced as a penalty for poor performance. That means the CEO compensation is linked to firm performance (Gerhart, Rynes, and Fulmer, 2009). The perspective that links CEO compensation to firm performance posits that CEO pay should reflect past performance, which can help mitigate agency problems and prevent over-investment that may be detrimental to shareholder wealth.

Furthermore, aligning the interests of senior managers and shareholders could keep consistent through providing compensation-based incentives and result in increased firm performance (Mehran, 1995; Hirshleifer and Suh, 1992; Jensen and Meckling, 1976). The tournament theory suggests that pay disparity between hierarchical levels can encourage competition among employees and offer promotion opportunities (Lazear and Rosen, 1981), which is called as tournament incentives. These incentives, based on promotion, utilize the pay gap between the CEO and the next layer of senior executives to motivate non-CEO executives to exert effort. Consequently, it will motivate employees to compete with each other intra-organizational to strive for higher position, thereby enhancing firm performance, improving innovation efficiency, and undertaking greater risky investments to achieve consistent goals with shareholders (Shen, Zhang, 2018; Phan, Simpson, Nguyen, 2017; Kini, Williams, 2012; Kale, Reis, Venkateswaran, 2009; Goel and Thakor, 2008).

However, under the limited resources and competitive market, tournament incentive whether could satisfy both the promotion of company performance and the practice of environmental protection concepts simultaneously still as the absence of clear evidence. As we know that the environmental protection issues continue to pay attention in the 21st century, global warming is still accelerating and cannot be ignored. All of the world would like to achieve net-zero emission. The new economics of zero-carbon will also become the trend of future development. Therefore, we would like to observe how the tournament incentives will affect the firm's carbon emissions.

There are some reasons to conjecture the relationship between tournament incentives and carbon emissions. First of all, executives' competition in organizations may produce greater carbon emissions due to the expansion of production. According to previous literature, we know that tournament incentives encourage employees to work hard and expect to increase productions and firm performance (Faleye, Reis, and Venkateswaran, 2013). However, productivity increases will cause firms to use more resources, such as transportation and distribution of goods, waste disposal, etc., all of activities related to the company's value chain will expect to increase carbon emissions.[1] Furthermore, if there are more potential competitors within organization, executives might not accept environmental policies that exceed legal requirements nor adopt stricter activities than their peers. Because investment in the environment activity may cause higher risks and could not achieve a sufficient return (Berrone, Gomez-Mejia, Larraza-Kintana, 2010; Matsumura, Prakash, Vera-Muñoz, 2014). Fisher-Vanden and Thorburn (2011) find that firms announcing participation in reduction greenhouse gas emissions experience a significant negative abnormal stock returns. In addition, previous literatures find that stronger tournament incentives will make managers have a higher probability of fraud or manipulation reports in order to achieve their goals (Haß, Müller, Vergauwe, 2015; Harbring and Irlenbusch, 2011).

According to the above mentioned, we expect that the tournament will make executives focused on firm performance and personal interests, and result in ignoring the environmental issue of carbon emissions. As a result, the tournament effect may cause an adverse carbon emission phenomenon. In the case of the premise of corporate performance and personal interest, the promotion-based incentives may generate negative effects on environmental performance especially for stronger competition.

On the other hand, some literature suggests that wage disparity may lead to inequality aversion. The incentive effects of competition imply a significant disparity in compensation between CEOs and executives. That could also lead to an increase in

[1] Regarding Greenhouse Gas (GHG) Corporate Protocol definition, carbon emissions are measured based on greenhouse gas emissions which are caused by all commercial activities. For example, the electrical power, oil, natural gas, waste generation and use of water resources will affect carbon emissions.

executive turnover, a decrease in employee motivation and effort, thereby resulting in a decline in productivity (Chan, Kawada, Shin, and Wang). Kale, Reis, and Venkateswaran (2014) compare the compensation of individual VP relative to CEOs, other VPs within the company, and VPs of other companies with similar firm size, to measure pay inequality. They find that firms with higher levels of pay inequality are likely to increase the likelihood of resignation, resulting in higher VP turnover rates in firms. Furthermore, literature indicates that the turnover of executives may lead to a disruptive impact on the internal organizational structure and routines of a firm, negatively affecting its future sales and firm performance (Gjerløv-Juel, 2019; Messersmith, Lee, Guthrie, and Ji, 2014). If the pay gap causes senior executives to develop an aversion to inequality, leading to increased turnover and reduced productivity, it will detriment the future productivity and sales of the firm. Based on the above argument, it is expected that the pay disparity between CEOs and senior executives will have a negative impact on carbon emissions due to the worse sales and productivity.

Therefore, how pay gap affects firm's environmental policies is a worth exploring issue. This paper focus on the effect of firm tournament incentives based on pay gap between CEO and the next layer of senior executives on carbon emissions. We measure the carbon emissions for each company, so as to understand the influence of incentive schemes on social benefits.

Although previous literature extensively discusses about corporate social responsibility (CSR hereafter) and shows that firms engage in CSR could enhance reputation as well as generate a positive brand image (Jones, 2005; Smith and Higgins, 2000) and also have a positive relationship with firm performance (Zhu, Sun, and Leung, 2014; Miller, Eden, and Li, 2020). However, CSR puts forward broad concepts related promote sustainable operations directions consists of environment, human rights, community, diversity, and employee relations (Abeysekera, Fernando, 2020; Block, Wagner, 2014). But there is no objective standard that could observe the actual benefits to the environment and society. In other words, we could simply judge whether the company has invested in CSR activities, but it is difficult to quantify the contributions of various social responsibility activities. Even though many companies claim that they pay attention to environmental protection, practice social responsibility, and also comply with ethical standards, it is hard to measure the degree of social responsibility activities to social returns. Therefore, different from the measurement of CSR, we could use carbon emissions data to measure the actual contribution of social returns. In this study, we would like to focus on the tournament incentives on environmental consequences by measuring changes value in carbon emissions and determining whether there are different effects of tournament incentives.

To examine the above prediction, we collect sample of U.S. listed firms between 2010 and 2018 covered in ExecuComp and CDP to explore our main hypothesis. We obtain carbon emissions data from the CDP corporate database. Moreover, we collect other relevant information from Compustat and Center for Research in Security Prices (CRSP) respectively to measure firm characteristics and stock return volatility. In this paper, we would like to observe whether the incentive mechanism of CEO pay gap will affect the carbon emissions on environmental performance.

Since there are some unobserved factors that could influence both executive compensation and environmental performance simultaneously that will affect the empirical results. For instance, CEO ability and compensation have a positive and significant correlation. Brookman and Thistle (2013) argue that managerial skill is a critical factor to determine managers' compensation. The better the ability of the CEO, the higher the total compensation. Furthermore, CEOs with better abilities can also generate higher output for the company, consequently influencing carbon emissions. On the other hand, Yuan, Tian, Lu, and Yu (2019) find that CEOs with better managerial ability have a significant positive correlation with corporate social responsibility. They argue that capable CEOs have fewer concerns about their careers and consequently are more willing to engage in social responsibility. That is, CEO ability may affect both pay disparity and carbon emissions simultaneously. Accordingly, we use two instrumental variables as proxy variables for CEO pay gap to address endogeneity concerns, including the industry average of pay gap and the industry average of CEO total compensation. We consider that a firm's executive compensation is typically relevant to other firms in the same industry. Thus, the industry average pay gap and the industry average CEO compensation would likely exhibit a positive correlation with tournament incentives, but they are unrelated to the firm's carbon emissions.

Furthermore, the compensation structure may be affected by different factors such as firm characteristics, corporate governance, and financial condition (Sapp, 2008; Smith and Watts, 1992). Prior literatures show that companies with poor corporate governance are more likely to generate inefficiencies in management and result in poor performance, but CEOs tend to have higher compensation (Core, Holthausen, and Larcker, 1999). Hence, there might be a problem of non-random sample selection. We conduct a propensity-score matching procedure to address sample selection bias in order to further confirm whether tournament incentives indeed have a significant influence on carbon emissions.

Finally, we discuss two conditional tests consists of the institutional ownership and CEO turnover. First, the external institutional investors advice of decision-making for managers and the monitoring effect also could effectively reduce agency problems, therefore strengthen the corporate governance. Moreover, institutional investors believe that climate risks will affect portfolio performance. If firms reduce carbon dioxide emissions, it will benefit the increase in their portfolio value (Krueger, Sautner, and Starks, 2020; Azar, Duro, Kadach, and Ormazabal, 2021). We expect that the monitoring effect of institutional ownership weaken the positive significant relationship between pay gap and carbon emissions. Second, we find that the positive correlation between tournament incentives and carbon emissions should be more pronounced when CEO approaches turnover because of the possibility of promotion will increase substantially.

This paper is expected to contribute in two ways. First, tournament incentives provide promotion-based prizes for winners, which could reduce agency problems and improve firm performance. Previous studies mainly discussed the impact of compensation schemes on firm performance but were less concerned about the social environmental issues. However, excessive competition activities may have adverse effects on the social environment, such as increasing carbon emissions, which could offset the positive benefits. Therefore, this paper explores the impact of tournament incentives on social returns to contribute to the literature on tournament incentives. Second, concerning the issue of social benefits, most literature usually examines the practice of corporate social responsibility by a company. Firms engaging in corporate social responsibility could create goodwill and moral capital (Godfrey, Merrill, Hansen, 2009) to satisfy the requirements of stakeholders. However, corporate social responsibility lacks an objective standard that could measure the contributions and changes of social returns. In contrast, carbon emissions are different from corporate social responsibility. We can use the detailed information to measure the annual amount of reduction in carbon emissions. As a result, we can observe the direct contribution to the social environment and also possibly more accurately to assess the social returns from each firm.

The remainder of the paper proceeds as follows. Section 2 presents the data and sample selection. Section 3 discusses methodologies and research design. Section 4 reports empirical results. Section 5 concludes.

2. Data

Our sample includes all U.S. public firms with carbon emission data and covered in Compustat Executive Compensation (ExecuComp) database for the period 2010 to 2018. The executive compensation data which contains CEO pay gap, CEO Delta, and CEO Vega are collected from Compustat Execucomp database. Carbon emissions obtained from the Carbon Disclosure Project (CDP) corporate database. Other accounting variables related the characteristics of the firm and industry are collected from Compustat. In addition, stock price and return data from the Center for Research in Security Prices (CRSP), and institutional ownership data are collected from the Thomson's CDP/Spectrum database (13F).

3. Methodologies

3.1 Measuring tournament incentives

Lazer and Rosen (1981) proposed that the pay gap among executives within an organization can be regarded as a bonus given by the company for winning managers. The main purpose of the rank-order tournament is evaluated the performance of executives relative to their peers in order to stimulate executives and prompt them to make best efforts to advance the higher positions. Following Kini and Williams (2012) and Kale, Reis, Venkateswaran (2009), we construct tournament incentives as the pay gap between a CEO and the next layer of senior executives (VPs hereafter). It is calculated as the difference between a CEO's total compensation package and the mean of total compensation package of VPs. We obtain the total compensation package from the Execucomp variable TDC1, which consists of salary, bonus, total value of restricted stock grants, total value of stock option grants, long-term incentive payouts, and all other totals.

Because the CEO salary package includes stock and option grants, the higher volatility of stock price and return tends to increase CEO wealth sensitivity (Coles, Daniel, Naveen, 2006). Hence, besides using CEO pay gap to reflect promotion incentives, we also consider the following two variables to proxy for CEO compensation-based incentives: CEO delta and CEO vega. Following Core and Guay (2002) method, CEO delta measures the dollar change in a CEO's compensation portfolio if the stock price increases by 1%. Then, CEO vega measures the dollar change in a CEO's compensation portfolio if the stock return volatility increases by 1%. Furthermore, we compute the logarithm of CEO pay gap to minimize the potential problem of heteroscedasticity.

3.2 Measuring carbon emission

We obtain carbon emissions data from CDP corporate data. CDP is a global not-for-profit organization, they elicit information related carbon risks and carbon emissions from the world companies on behalf of investors, customers, and policy makers. CDP design climate change questionnaire to request information on carbon emissions data in metric tons, energy, and trading. With the rise of environmental awareness, investors and large organizations gradually request companies to disclose environmental information. Moreover, disclosure information could improve corporate environmental protection awareness and it is essential to effectively manage carbon and climate change risk. As of 2021, a total of 1,088 U.S. firms publicly disclose environmental data to CDP.

According to the Greenhouse Gas (GHG) Corporate Protocol definition, greenhouse gas emissions are categorized into three groups. The first one is scope 1 emissions that cover direct emissions from owned or controlled sources by an organization. Second, the scope 2 emission covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Third, the scope 3 emission includes all other indirect emissions that occur in a company's value chain, such as purchased goods and services, business travel, employee commuting, waste disposal, transportation and distribution of upstream and downstream, and investment, etc. From CDP corporate data, we could collect complete carbon emissions information, including company name, primary industry code, different types of carbon emissions annual data, equipment used to calculate carbon emission by each firm, etc. We use the total emissions value of scope 1 and scope 2 as carbon emission data. In addition, we will also explore which type of carbon emission is more obvious for tournament incentives.

3.3 Baseline regression analysis

To explore the primary research question, we conduct a regression analysis to investigate the relationship between tournament incentives and carbon emissions.

$$\begin{aligned} Ln(Carbon)_{i,t} = {} & \beta_0 + \beta_1 Ln(PayGap)_{i,t} + \beta_2 CEO\ Delta_{i,t} + \beta_3 CEO\ Vega_{i,t} + \\ & \beta_4 LnAsset_{i,t} + \beta_5 Leverage_{i,t} + \beta_6 ROA_{i,t} + \beta_7 CapexAsset_{i,t} + \\ & \beta_8 CEO\ Age_{i,t} + \beta_9 RD_{i,t} + \beta_{10} PPE_{i,t} + Year\ Dummies + \\ & Industry\ Dummies + \varepsilon_{i,t} \end{aligned} \tag{1}$$

The dependent variable in this paper is the level of carbon emissions. Specifically, we examine Scope 1 emissions, Scope 2 emissions, and total emissions (the sum of

Scope 1 and Scope 2), treating each category separately. We take the natural logarithm of each emission measures. We focus on discussing the impact of tournament incentives on carbon emissions. We are interested in major variable is *Ln*(*Pay Gap*), it measures tournament-based incentives among executives in organizations. We also calculate *CEO Delta* and *CEO Vega* to measure CEO compensation-based incentives, respectively. Furthermore, we control other corporate characteristics variables into the regression that may influence firm decision, including firm size (*LnAsset*), financial leverage (*Leverage*), profitability (*ROA*), capital expenditures (*CapexAsset*), the age of incumbent CEO (*CEO Age*), research and development (*RD*), and property, plant, and equipment (*PPE*) in a specific year. Moreover, regression models include controls for year and industry fixed effects. To mitigate concerns regarding outliers, we winsorize accounting variables at the 1^{st} and 99^{th} percentiles.

Panel A of Table 1 presents the descriptive statistics of pay gap, carbon emissions of each scope, and other regression control variables, where detailed definitions of variables are described in the Appendix Table. Panel B of Table 1, we divide our sample into three groups sorted by pay gap and provide the mean carbon emissions of each group. The "*High*" group represents firms with the largest pay disparities, corresponding to the top tercile of the pay gap distribution, while the "*Low*" group consists of firms with the smallest pay disparities, corresponding to the bottom tercile of the distribution. We find that the group with the largest pay gap has significantly higher carbon emissions, including the emissions of Scope 1, Scope 2, and the sum of emissions from both Scope 1 and Scope 2, compared to the group with the lowest pay gap. All results reach statistical significance. Based on the preliminary results of descriptive statistical analysis, the argument presented in this paper is supported.[2]

Insert Table 1 here

3.4 Instrumental variable

[2] We use the median of the pay gap to divide the sample into two groups for comparison, our results are still holds. The carbon emissions of the high pay gap group are significantly higher than those of the low pay gap group.

The baseline regressions results may be caused by unobserved variables. For instance, the ability of a CEO may affect both pay disparity and carbon emissions simultaneously. A talented CEO can receive higher pay and is also more likely to improve the firm's output, resulting in an influence on the carbon emissions. In this paper, in order to alleviate the missing variable problem, we conduct two instrumental variables and perform two-stage regression to examine the research issue.

In general, executive compensation is typically relevant to other firms in the same industry. Literature finds that firms will refer to the compensation of other firms in the same industry in order to retain, attract, and motive talent (Faulkender and Yang, 2010). Edmans, Gosling, and Jenter (2023) survey directors and investors and find that fair rewards are considered a significant benchmark to determine CEO compensation. Typically, CEO performance and the salary of peer firms are used as benchmarks to assess the fairness and reasonableness of CEO compensation. The CEO may be perceived as unfair if the pay is lower than other peer firms, which could also diminish their enthusiasm. Bizjak, Lemmon, and Naveen (2008) also mentioned that most companies use peer groups to determine executive salary, bonus, and stock option awards, and they find that the competitiveness among industries is a crucial factor in determining senior executive pay. Thus, the total executives' compensation and the pay gap between CEO and other VPs may be influenced by the same industry, but it will not affect environmental performance or carbon emissions. Therefore, we use the 3-digit SIC code industry average of the pay gap and total compensation as instrumental variables proxy for a firm's pay gap.

3.5 Propensity-score matching

Because senior executive compensation may be affected by financial condition, corporate governance, and firm characteristics for each company, the pay disparity between hierarchical in organizations would be generated sample selection bias. To alleviate endogenous problems due to sample selection concerns, we use a propensity-score (PS) matching procedure to select control firms and require a caliper width of 5% for propensity score to ensure the similarity of characteristics between the treatment and control firms.

We define high pay gap as treatment firms and low pay gap as control firms and perform a logit regression model. The dependent variable equals one if the firm pay gap is above the tercile, and regresses on a batch of firm characteristics consists of firm size, capital expenditure, cash flow, and return on assets in the propensity score matching. Next, we match one treatment firm and one control firm having the closest propensity score. We expect that the propensity score approach could support the main results and effectively reduce endogeneity concerns.

3.6 Further discussing on monitoring effects and CEO turnover

In this section, we further investigate how external monitor effect affects the positive relation between tournament incentives and carbon emissions. Literature suggests that external monitoring, such as institutional investors and independent directors, improves the firm performance because of the supervision role effectively reducing agency problems and strengthening internal corporate governance mechanisms, as well as fulfill supervise managers (Weisbach, 1988; Byrd and Hickman, 1992; Brickley, Coles, and Terry, 1994). Importantly, institutional investors, as one of the primary large investors, have significant influence on corporate decisions and investment. Additionally, literature finds that institutional investors believe reducing carbon dioxide emissions can effectively enhance the value of investment portfolios due to the risks posed by climate change to future business operations (Krueger, Sautner, and Starks, 2020; Azar, Duro, Kadach, and Ormazabal, 2021; Ren, Dong, Guo, and Liu, 2023). Thus, we expect that as the proportion of institutional investors' shareholding increases, they can play the role of market monitors to reduce firm carbon emissions.

Therefore, we consider that the monitoring effect of external institutional ownership will influence executive's decisions, and take the interest of stakeholders into consideration that could reduce carbon emissions caused by excessive competition. We expect that the monitor effect of institutional investors could weaken the positive relationship between tournament incentives and carbon emissions. To examine the above prediction, we use the average institutional ownerships of the firm as a proxy to measure monitor effect and define a new variable as *IO*. We expect that the coefficient of the interaction term between *LnPayGap* and *IO* in the following equation (2) is negative correlation.

$$Ln(Carbon)_{i,t} = \beta_0 + \beta_1 Ln(PayGap)_{i,t} + \beta_2 Ln(PayGap)_{i,t} \times IO_{i,t} + \beta_3 CEO\ Delta_{i,t} + \beta_4 CEO\ Vega_{i,t} + \beta_5 LnAsset_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 ROA_{i,t} + \beta_8 CapexAsset_{i,t} + \beta_9 CEO\ Age_{i,t} + \beta_{10} RD_{i,t} + \beta_{11} PPE_{i,t} + Year\ Dummies + Industry\ Dummies + \varepsilon_{i,t} \quad (2)$$

Next, the positive relationship between tournament incentives and carbon emissions should be more pronounced when the CEO approaches turnovers. It could be expected the possibility of CEO replacement will increase if a retiring CEO or firm performance worse than other peers. We refer to the literature of Shen and Zhang (2018), if the CEO replacement occurs in the next 5 years and satisfy the one of following two situations in a company that could be expected that the CEO will be replaced in the foreseeable future. The first one situation is that the incumbent CEO is older than 60 and expected to arrange retirement. Second, when the firm's industry-adjusted ROA median value based on 3-digit SIC code for the past 3 years is lower than sample median, the probability of CEO replacement will increase substantially. Therefore, we define CEO turnover as a dummy variable that is *CEOTurnDummy*, which is equal to one as the company satisfies the above conditions in the observation year and zero otherwise.

$$Ln(Carbon)_{i,t} = \beta_0 + \beta_1 Ln(PayGap)_{i,t} + \beta_2 Ln(PayGap)_{i,t} \times CEOTurnDummy_{i,t} + \beta_3 CEO\ Delta_{i,t} + \beta_4 CEO\ Vega_{i,t} + \beta_5 LnAsset_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 ROA_{i,t} + \beta_8 CapexAsset_{i,t} + \beta_9 CEO\ Age_{i,t} + \beta_{10} RD_{i,t} + \beta_{11} PPE_{i,t} + Year\ Dummies + Industry\ Dummies + \varepsilon_{i,t} \quad (3)$$

4. Empirical results

4.1 Baseline regressions of carbon emissions on pay gap

The tournament theory proposes that the pay gap between CEOs and non-CEO executives provides motivation for competition among non-CEO executives (Lazer and Rosen, 1981; Rosen, 1986). In a rank-order tournament, the pay gap among executives within an organization can be regarded as a bonus for promotion to CEO. Due to this pay gap and the uncertainty of promotions, it encourages non-CEO executives to exert more effort, contributing to enhancing company productivity. However, while tournament incentives increase company output, they may potentially overlook the impact on environmental pollution. In Table 2, we find that a significant positive correlation between pay gap and carbon emissions. In Model (1) and (2) of Table 2, we define the dependent variables as the natural logarithm of Scope 1 carbon emissions, and in Model (3) and (4), we use the natural logarithm of Scope 2 carbon emissions; and in Model (5) and (6), we combine the carbon emissions from Scope 1 and Scope 2. All results are positive and statistically significant at the 1% level of significance. This indicates that the greater the pay gap between CEO and non-CEO executives, the higher the carbon emissions tend to be.

Due to stock and option grants being part of the CEO's salary package, higher volatility in stock price and return tends to increase CEO wealth sensitivity. Therefore, in Model (2), (4), and (6), we further control for two variables, *CEO Delta* and *CEO Vega*, in the regression to account for the effects of compensation incentives. All results remain consistent.[3]

Insert Table 2 here

4.2 Two-stage regressions of carbon emissions on pay gap

The ability of a CEO may simultaneously influence both their compensation and carbon emissions. Capable CEOs are expected to receive higher pay and bonuses, and they also contribute to improving output of the firm, thereby affecting carbon emissions. To establish causality between pay gap and carbon emissions and to eliminate the possibility of omitted variable bias in regression analysis, we employ two instrumental

[3] We find that the impact of pay gap on carbon emissions is significant in direct carbon emissions from company activities (Scope 1) and indirect carbon emissions from firm purchases of electricity, steam, heating, and cooling (Scope 2). However, there is positive but no significant correlation between pay gap and carbon emissions generated in the value chain (Scope 3).

variables, the industry average of pay gap and the industry average of CEO compensation based on 3-digit SIC code, respectively, in a two-stage regression analysis. When firms aim to attract or retain talent, they are more likely to reference the compensation of other companies in the same industry to enhance their competitiveness. Therefore, a firm's executive compensation is more likely to be influenced by other companies in the same industry. We expect significant positive correlations between a firm's pay gap and the industry average pay gap and the industry average CEO compensation. However, the industry average compensation does not affect the individual firm's carbon emissions.

Model (1) and (3) of Table 3 are the first-stage regression, we indeed find a significant positive correlation between the industry averages of the pay gap (and industry averages of CEO compensation) and the pay gap of individual firms. Next, we use the fitted value of the pay gap obtained from the first-stage regression in the second-stage regression analysis. The results also indicate that the pay gap has a positive and significant impact on carbon emissions.[4]

Insert Table 3 here

4.3 Propensity-score matching

Next, we validate the main results of this study using the propensity-score matching method. We define the top tercile with the largest pay gaps as treatment firms and match one control firm with the closest propensity-score by controlling for firm size, capital expenditure, cash flow, and return on assets. In this approach, we require a caliper width of 5% for propensity score to ensure the similarity of characteristics between the treatment and control firms.[5] In Table 4, the dependent variables in Models (1), (2), and (3) represent Scope 1 carbon emissions, Scope 2 carbon emissions, and total carbon emissions, respectively. All results indicate that the pay gap between CEO and other executives has a significant positive effect on carbon emissions.

[4] When the dependent variables are individually Scope 1 carbon emissions and Scope 2 carbon emissions, the results of the two-stage regression for both variables show significant positive correlations.
[5] We adjust the caliper width of propensity score matching to 1% and 10% respectively, the results remain consistent.

Insert Table 4 here

4.4 Further discussions

Some evidence suggests that climate risks have financial implications for the portfolios of institutional investors (Krueger, Sautner, and Starks, 2020). The large investors believe that reducing carbon dioxide emissions increases their portfolio value. Therefore, institutional investors, acting as market monitors, are expected to contribute to reducing corporate carbon emissions. Ren, Dong, Guo, and Liu (2023) also demonstrate that institutional investors have a negative correlation impact on carbon emissions. They argue that because institutional investors own a larger share of listed firms, the monitoring and constraints imposed by institutional investors on high-emission firms can mitigate climate change. Moreover, Azar, Duro, Kadach, and Ormazabal (2021) observe the impact of big three investors (BlackRock, Vanguard, and State Street Global Advisors) on corporate carbon emissions, and finding a significant negative correlation. They also suggest that institutional investors in the market can drive firms to reduce carbon emissions.

Therefore, we expect that the monitoring effect of institutional investors can mitigate the increased carbon emissions resulting from the pay gap between CEOs and VPs. We use the interaction term of pay gap and institutional ownership to further examine the moderating effect of institutional ownership. In Table 5, we find that the interaction terms of pay gap and institutional ownership are significantly negative for Scope 1, Scope 2, and total carbon emissions. This result indicates that as institutional ownership increases, it leads to a decrease in the firm's carbon emissions.

Insert Table 5 here

We argue that the incentive effect arising from the pay gap between CEOs and other senior executives increases competition among management within the company, which prompts the expansion of production scale, and leads to higher carbon emissions. Hence, to confirm the positive relationship between the pay gap and carbon emissions, we expect that a higher likelihood of CEO turnover will intensify competition among executives, thereby resulting in a positive impact on carbon emissions. Following Shen and Zhang (2018), if the company replaces its CEO in the next five years and satisfies one of the following conditions: the incumbent CEO age exceeds 60, or the firm's ROA in the past three years is below the industry median, then we define the variable of *CEOTurnDummy* as 1, otherwise zero. That means a higher likelihood of CEO turnover, which will intensify the incentives for competition among senior executives.

In Table 6, we demonstrate that the interaction term between the pay gap and CEO turnover has a significant positive effect on carbon emissions. This indicates that as the probability of CEO turnover increases, the incentive effect intensifies, leading to a more pronounced competition among senior executives and subsequently increasing carbon emissions. This finding further supports our main results.

Insert Table 6 here

4.5 Alternative measurement

We use the total CEO compensation (ExecuComp item TDC1) minus the median of all other the next layer executives' total compensation (ExecuComp item TDC1) and take the natural logarithm to measure the pay gap and re-run Equation (1). The results of the alternative measurement are presented in Table 7. We find that the pay gap (median VPs) maintains a significant positive correlation with Scope 1 carbon emissions, Scope 2 carbon emissions, and total carbon emissions, all reaching the 1% significance level.

Insert Table 7 here

5. Conclusion

The objective of international development towards net-zero carbon economy through reduction in carbon emissions so as to protect the social environment, satisfy the requirements of the government, investors, communities, and stakeholders. Although the pay gap could encourage managers to work hard, reduce agency problems and achieve better firm performance, competition may also bring greater carbon emissions due to the production expansion. This study would like to explore the relationship between tournament incentives and carbon emissions. We find that there is a positive relation between pay gap and carbon emissions, this finding is consistent with the tournament incentives.

In order to address endogeneity problem and unobserved variables concerns, we conduct a series of tests in this paper. At first, we use the industry average of pay gap and the industry average of CEO compensation as instrumental variables to proxy for tournament incentives, and then perform two-stage regression. We find that there are positive correlations between tournament incentives and the industry average of pay gap as well as the industry average of CEO compensation; however, these two instrumental variables will not influence carbon emissions. Furthermore, we also use a propensity-score matching approach to alleviate endogeneity problems due to executive compensation that may affected by other factors.

Moreover, we further investigate two conditional tests, including the institutional ownership and CEO turnover. We further study how external monitor effect and CEO turnover affect the positive relation between tournament incentives and carbon emissions. We show that the monitoring effect of institutional ownership will affect executive's decisions that could reduce carbon emissions caused by excessive competition. The positive relationship between tournament incentives and carbon emissions should be more pronounced when a CEO approaches turnovers because of the possibility of promotion would be higher. Finally, we use the total CEO compensation minus the median of all other VPs' total compensation to replace the pay gap. All results are significant and support our argument.

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Appendix Table: Variable Definitions

Variables	Definition and description
LnPayGap	The natural logarithm of total CEO compensation (ExecuComp item TDC1) minus the mean of all other the next layer executives' total compensation (ExecuComp TDC1), in year *t*.
CEO Delta	*CEO Delta* measures the dollar change in a CEO's compensation portfolio if the stock price increases by 1%.
CEO Vega	*CEO Vega* measures the dollar change in a CEO's compensation portfolio if the stock return volatility increases by 1%.
LnScope1	The natural logarithm of Scope 1 carbon emissions for each firm in year *t*, which is obtained from CDP climate change data.
LnScope2	The natural logarithm of Scope 2 carbon emissions for each firm in year *t*, which is obtained from CDP climate change data.
LnCarbon	The unit of carbon emission is metric tonnes, and we take the logarithm of it. We define *LnCarbon* as the natural logarithm of the sum of Scope 1 and Scope 2 carbon emissions for each firm in year *t*, which is obtained from CDP climate change data.
LnAsset	The natural logarithm of firm's total assets of fiscal year *t*.
Leverage	*Leverage* is defined as the book value of short-term and long-term debts divided by the book value of total assets measured at the end of year *t*.
ROA	*ROA* (Return-on-assets ratio) is defined as operating income before depreciation divided by the book value of total assets that is measured at the end of fiscal year *t*.
CapexAsset	*CapexAsset* is the capital expenditure scaled by the book value of total assets measured at the end of year *t*.
CEO Age	*CEO Age* is defined as the age of the firm's CEO at the end of fiscal year t, which is sourced from ExecuComp.
RD	*RD* is defined as research and development expenditure divided by book value of total assets and measured at the end of fiscal year *t*. It is set to zero if missing.
PPE	*PPE* is the ratio of property, plant, and equipment divided by book value of total assets measured at the end of fiscal year *t*.
IO	*IO* is the institutional ownership in year *t* that is calculated as the average of four quarterly institutional ownership ratios (i.e., shares held by institutional investors divided by shares outstanding) reported through 13F.
CEO Turnover	We define CEO turnover as a dummy variable, defined as 1 if the company replaces its CEO in the next five years, and meeting one of the following two conditions in a company; otherwise, it is 0. The first condition occurs when the incumbent CEO is older than 60, while the second condition arises when the firm's industry-adjusted ROA median, based on the 3-digit SIC code for the past three years is lower than the sample median.

Table 1 Summary Statistics

This table reports the summary statistics for all variables used in this paper. The sample period is from 2010 to 2018. All variables are winsorized at the 1% and 99% percentiles. Detailed definitions of the variables are presented in Appendix Table.

Panel A: Descriptive statistics

Variable	Obs.	25th Percentile	Median	Mean	75th Percentile	Std.
LnScope1	2,945	9.5860	11.4890	11.6245	13.7579	3.2857
LnScope2	2,855	10.9412	12.2540	12.0653	13.4904	2.1777
LnCarbon	2,855	11.4585	12.8823	13.0364	14.6296	2.2894
LnPayGap	2,945	8.2905	8.7150	8.6259	9.0919	0.7199
CEO Delta	2,692	0.1626	0.4053	1.1043	0.8848	2.8078
CEO Vega	2,704	0.0052	0.1347	0.2549	0.3565	0.3428
LnAsset	2,945	8.6323	9.5888	9.6592	10.5664	1.4565
Leverage	2,945	0.1595	0.2680	0.2816	0.3788	0.1657
ROA	2,945	0.0859	0.1270	0.1338	0.1711	0.0722
CapexAsset	2,945	0.0159	0.0308	0.0398	0.0555	0.0336
CEO Age	2,945	53.0000	57.0000	56.7385	60.0000	5.5584
RD	2,945	0.0000	0.0021	0.0239	0.0288	0.0423
PPE	2,945	0.0728	0.1766	0.2631	0.3961	0.2417

Panel B: Carbon emissions sorted by pay gap

	LnScope1	LnScope2	Ln(Scope1+Scope2)
High	11.9777	12.6888	13.3889
Median	11.9392	12.1892	13.2335
Low	10.6928	11.2195	12.1683
High – Low	1.2850	1.4693	1.2206
T-statistics of High – Low	8.95	14.80	10.88

Table 2 The Impact of Tournament Incentives on Carbon Emissions

This table presents regressions of carbon emissions on CEO pay gap. In Models (1) and (2), the dependent variables are the natural logarithm of Scope 1 carbon emissions. In Models (3) and (4), the dependent variables are the natural logarithm of Scope 2 carbon emissions. In Models (5) and (6), the dependent variables are the natural logarithm of total carbon emissions (the sum of scope 1 and scope 2). The variable of *LnPayGap* is the natural logarithm of pay gap between a CEO and the next layer of senior executives. All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Dep. Var.	LnScope1		LnScope2		LnCarbon	
Model	(1)	(2)	(3)	(4)	(5)	(6)
LnPayGap	0.1852***	0.2089***	0.2065***	0.2809***	0.1309***	0.1547***
	(3.57)	(3.69)	(4.54)	(5.63)	(4.05)	(4.47)
CEO Delta		-0.0154		-0.0093		-0.0148*
		(-1.14)		(-0.79)		(-1.82)
CEO Vega		-0.1602		-0.2286**		-0.0855
		(-1.39)		(-2.26)		(-1.22)
LnAsset	0.9992***	0.9937***	0.9521***	0.9485***	0.8600***	0.8496***
	(32.13)	(29.61)	(34.83)	(32.08)	(44.34)	(41.48)
Leverage	0.3015	0.2611	0.3038	0.3728*	0.2613*	0.1895
	(1.33)	(1.09)	(1.53)	(1.76)	(1.85)	(1.29)
ROA	1.1126**	0.5946	1.9471***	1.7016***	1.0673***	0.8716**
	(2.01)	(1.01)	(4.00)	(3.26)	(3.09)	(2.41)
CapexAsset	-0.4394	-0.0714	1.8638	2.3281	2.7172**	2.4744**
	(-0.24)	(-0.04)	(1.15)	(1.38)	(2.36)	(2.12)
CEO Age	-0.0035	0.0010	0.0007	0.0057	-0.0084**	-0.0038
	(-0.61)	(0.16)	(0.15)	(1.04)	(-2.35)	(-1.01)
RD	-9.2985***	-9.1055***	-6.4730***	-6.0450***	-6.9027***	-6.7216***
	(-9.57)	(-9.08)	(-7.63)	(-6.88)	(-11.46)	(-11.05)
PPE	5.2418***	5.5072***	3.8080***	3.8298***	4.5385***	4.7393***
	(13.45)	(13.22)	(10.97)	(10.33)	(18.43)	(18.45)
Intercept	-0.7986	-1.1557**	-0.2056	-1.0245**	2.7449***	2.4337***
	(-1.61)	(-2.07)	(-0.47)	(-2.07)	(8.84)	(7.10)
Observations	2,944	2,690	2,854	2,604	2,854	2,604
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.760	0.767	0.590	0.589	0.813	0.825

Table 3 Two-stage Regressions of tournament incentives and carbon emissions

This table presents the two-stage regressions of carbon emissions. Dependent variables are the natural logarithm of total carbon emissions (the sum of scope 1 and scope 2). The instrument variables are the industry average of pay gap and the industry average of CEO compensation in Models (1) and (2), and in Models (3) and (4), respectively. In the first stage, we regress *LnPayGap* on the industry average of pay gap (industry average of CEO compensation). $LnPayGap^f$ is the fitted value from the first-stage regression. In the second stage, we examine the effect of pay gap between CEO and VPs on total carbon emissions (the sum of scope 1 and scope 2). All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Dep. Var.	*LnPayGap*	*LnCarbon*	*LnPayGap*	*LnCarbon*
Model	(1) 1st stage	(2) 2nd stage	(3) 1st stage	(4) 2nd stage
$LnPayGap^f$		0.8414***		0.6551***
		(6.33)		(4.73)
IV: IndustryLnGap	0.4242***			
	(14.65)			
IV: IndustryComp			0.5615***	
			(13.57)	
CEO Delta	0.0158***	-0.0252***	0.0145**	-0.0223**
	(3.52)	(-2.81)	(3.22)	(-2.55)
CEO Vega	0.2077***	-0.2673***	0.2151***	-0.2179***
	(5.38)	(-3.23)	(5.56)	(-2.68)
LnAsset	0.2728***	0.6663***	0.2586***	0.7159***
	(27.00)	(16.43)	(25.47)	(17.17)
Leverage	-0.0163	0.2176	0.0127	0.2067
	(-0.20)	(1.38)	(0.16)	(1.35)
ROA	1.8099***	-0.5761	1.794***	-0.1855
	(9.22)	(-1.22)	(9.09)	(-0.39)
CapexAsset	-2.526***	4.2652***	-2.562***	3.7682***
	(-3.93)	(3.28)	(-3.97)	(2.98)
CEO Age	0.0037	-0.0068*	0.0043*	-0.0061
	(1.78)	(-1.65)	(2.05)	(-1.52)
RD	0.9197**	-6.5540***	0.2160	-6.6011***
	(2.66)	(-10.01)	(0.64)	(-10.40)
PPE	0.0135	4.7325***	0.0783	4.7381***
	(0.10)	(17.14)	(0.55)	(17.69)
Observations	2,604	2,604	2,593	2,593
YearFE	Yes	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes	Yes
adj. R^2	0.362	0.511	0.352	0.542

Table 4 Propensity Score Matching

This table presents the linear regression analysis of pay gap and carbon emission using matched samples. We define the top tercile of firms with the highest pay gap as the treatment sample. We match each treatment firm with one propensity-score-matched firm, where we control for firm size, capital expenditure, cash flow, and return on assets in the propensity score matching. In Models (1) to (3), the dependent variables are the natural logarithm of Scope 1 carbon emissions, Scope 2 carbon emissions, and total carbon emissions (the sum of scope 1 and scope 2), respectively. The variable of *LnPayGap* is the natural logarithm of pay gap between a CEO and the next layer of senior executives. All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Dep. Var.	LnScope1	LnScope2	LnCarbon
Model	(1)	(2)	(3)
LnPayGap	0.4628***	0.1781**	0.2325***
	(5.05)	(2.42)	(3.41)
CEO Delta	-0.0284	-0.0080	-0.0213*
	(-1.63)	(-0.58)	(-1.67)
CEO Vega	-0.0468	-0.0382	0.0385
	(-0.32)	(-0.33)	(0.36)
LnAsset	0.9106***	0.8150***	0.8095***
	(17.55)	(19.46)	(20.83)
Leverage	-0.4977	0.2674	0.4456
	(-1.32)	(0.90)	(1.61)
ROA	0.6987	1.3780*	1.3165**
	(0.80)	(1.93)	(1.99)
CapexAsset	-1.4157	3.2000	-1.6777
	(-0.49)	(1.37)	(-0.77)
CEO Age	-0.0014	0.0074	-0.0087
	(-0.16)	(1.02)	(-1.30)
RD	-9.0539***	-7.0564***	-7.5898***
	(-7.38)	(-7.24)	(-8.40)
PPE	7.1195***	5.0465***	6.4496***
	(11.05)	(9.73)	(13.41)
Intercept	-2.5578**	0.8430	2.0055***
	(-2.48)	(1.02)	(2.62)
Observations	805	778	778
YearFE	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes
adj. R^2	0.849	0.668	0.849

Table 5 Regression Analysis of The Impact of Pay Gap on Carbon Emissions: Effect of Institutional Ownership

This table presents the regression analysis of carbon emissions and pay gap, discussing the effect of institutional ownership. In Models (1) to (3), the dependent variables are the natural logarithm of Scope 1 carbon emissions, Scope 2 carbon emissions, and total carbon emissions (the sum of scope 1 and scope 2), respectively. The variable of *LnPayGap* is the natural logarithm of pay gap between a CEO and the next layer of senior executives. All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Dep. Var.	LnScope1	LnScope2	LnCarbon
Model	(1)	(2)	(3)
LnPayGap	0.3769***	0.4117***	0.2753***
	(4.50)	(5.53)	(5.25)
LnPayGAP × IO	-0.1577***	-0.0919**	-0.0895***
	(-3.78)	(-2.47)	(-3.41)
CEO Delta	-0.0283	-0.0181	-0.0295**
	(-1.38)	(-1.00)	(-2.31)
CEO Vega	-0.4234***	-0.3626***	-0.2357**
	(-2.82)	(-2.73)	(-2.52)
LnAsset	1.0235***	0.9642***	0.8752***
	(21.91)	(23.18)	(29.86)
Leverage	0.3494	0.2166	0.1594
	(1.02)	(0.71)	(0.75)
ROA	-0.2124	1.5269**	0.6391
	(-0.28)	(2.25)	(1.34)
CapexAsset	1.7099	5.3974**	3.0027*
	(0.66)	(2.31)	(1.83)
CEO Age	0.0119	0.0172**	0.0086*
	(1.44)	(2.34)	(1.66)
RD	-8.0865***	-4.6566***	-5.7342***
	(-6.20)	(-4.04)	(-7.05)
PPE	5.9520***	4.0020***	5.1319***
	(10.03)	(7.48)	(13.61)
Intercept	-2.4399***	-2.3491***	1.0538**
	(-3.22)	(-3.48)	(2.22)
Observations	1,614	1,577	1,577
YearFE	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes
adj. R^2	0.771	0.602	0.822

Table 6 Regression Analysis of The Impact of Pay Gap on Carbon Emissions: Effect of CEO Turnover

This table presents the regression analysis of carbon emissions and pay gap, discussing the effect of CEO turnover. In Models (1) to (3), the dependent variables are the natural logarithm of Scope 1 carbon emissions, Scope 2 carbon emissions, and total carbon emissions (the sum of scope 1 and scope 2), respectively. The variable of *LnPayGap* is the natural logarithm of pay gap between a CEO and the next layer of senior executives. All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Model	(1)	(2)	(3)
LnPayGap	0.2015***	0.2780***	0.1470***
	(3.56)	(5.56)	(4.25)
LnPayGAP × CEO Turnover	0.0200**	0.0071	0.0189***
	(2.31)	(0.93)	(3.58)
CEO Delta	-0.0126	-0.0083	-0.0122
	(-0.94)	(-0.70)	(-1.49)
CEO Vega	-0.1634	-0.2296**	-0.0880
	(-1.42)	(-2.27)	(-1.26)
LnAsset	0.9952***	0.9489***	0.8506***
	(29.68)	(32.09)	(41.62)
Leverage	0.2637	0.3748*	0.1948
	(1.10)	(1.77)	(1.33)
ROA	0.7890	1.7718***	1.0576***
	(1.32)	(3.36)	(2.91)
CapexAsset	0.1452	2.4025	2.6718**
	(0.08)	(1.42)	(2.29)
CEO Age	-0.0060	0.0032	-0.0104**
	(-0.87)	(0.52)	(-2.48)
RD	-9.0011***	-6.0053***	-6.6162***
	(-8.97)	(-6.83)	(-10.89)
PPE	5.4466***	3.8089***	4.6839***
	(13.06)	(10.25)	(18.24)
Intercept	-0.7974	-0.8942*	2.7793***
	(-1.38)	(-1.74)	(7.82)
Observations	2,690	2,604	2,604
YearFE	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes
adj. R^2	0.767	0.589	0.826

Table 7 Robustness check: the Impact of Tournament Incentives on Carbon Emissions

This table presents regressions of carbon emissions on CEO pay gap. The natural logarithm of the pay gap in this table is calculated by subtracting the median total compensation of all other VPs from the CEO compensation of a firm in year *t*. In Models (1) and (2), the dependent variables are the natural logarithm of Scope 1 carbon emissions. In Models (3) and (4), the dependent variables are the natural logarithm of Scope 2 carbon emissions. In Models (5) and (6), the dependent variables are the natural logarithm of total carbon emissions (the sum of scope 1 and scope 2). The variable of *LnPayGap* is the natural logarithm of pay gap between a CEO and the next layer of senior executives. All regressions include the year fixed effect and the industry fixed effect. ***, ** and * denote significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Detailed definitions of the variables are presented in Appendix Table.

Dep. Var.	LnScope1		LnScope2		LnCarbon	
Model	(1)	(2)	(3)	(4)	(5)	(6)
LnPayGap	0.1657***	0.1984***	0.1815***	0.2497***	0.1145***	0.1389***
(median VP)	(3.27)	(3.61)	(4.08)	(5.15)	(3.63)	(4.14)
CEO Delta		-0.0156		-0.0093		-0.0150*
		(-1.17)		(-0.80)		(-1.86)
CEO Vega		-0.1527		-0.2172**		-0.0752
		(-1.32)		(-2.14)		(-1.07)
LnAsset	1.0000***	0.9927***	0.9552***	0.9540***	0.8618***	0.8518***
	(32.27)	(29.78)	(35.06)	(32.46)	(44.54)	(41.83)
Leverage	0.3301	0.2810	0.3290*	0.3874*	0.2739*	0.1953
	(1.47)	(1.18)	(1.67)	(1.84)	(1.96)	(1.34)
ROA	1.2211**	0.6845	2.0186***	1.8038***	1.1265***	0.9474***
	(2.24)	(1.17)	(4.20)	(3.50)	(3.30)	(2.65)
CapexAsset	-0.4395	-0.1340	1.8669	2.2170	2.6864**	2.3616**
	(-0.24)	(-0.07)	(1.16)	(1.32)	(2.34)	(2.03)
CEO Age	-0.0033	0.0009	0.0009	0.0055	-0.0082**	-0.0039
	(-0.59)	(0.15)	(0.19)	(1.01)	(-2.32)	(-1.04)
RD	-9.2999***	-9.0918***	-6.4466***	-6.0288***	-6.8797***	-6.7034***
	(-9.60)	(-9.09)	(-7.62)	(-6.88)	(-11.45)	(-11.04)
PPE	5.2076***	5.5054***	3.7765***	3.8268***	4.5134***	4.7429***
	(13.41)	(13.26)	(10.92)	(10.35)	(18.38)	(18.51)
Intercept	-0.6682	-1.0751*	-0.0429	-0.8191*	2.8515***	2.5369***
	(-1.36)	(-1.96)	(-0.10)	(-1.68)	(9.29)	(7.51)
Observations	2,961	2,703	2,871	2,617	2,871	2,617
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
IndustryFE	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.761	0.767	0.590	0.590	0.813	0.826