

Climate Change Risk Exposure and Outside Directors' Pay: Does CEO Power Matter?

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ABSTRACT

This paper investigates a critical and unexplored topic which is the extent to which firm-level climate change risk exposure (CCE) influence outside directors' pay and consequently ascertains whether the firm-level CCE-outside directors' pay nexus is moderated by CEO power. Using a large sample of 17,021 observations from US listed firms over a period of 14 years, our baseline results suggest that firms with high climate change risk exposure tend to pay their outside directors low pay packages. Furthermore, our evidence indicates that the association between firm-level CCE and outside directors' pay is moderated/explained largely by CEO power. Our findings have important implications to policymakers, regulatory bodies, government, and other stakeholders, as well as informing future policies relating to linking outside directors pay to firm non-financial performance. Our findings are robust to the usage of alternative climate-change risk exposure measures, endogeneities and alternative estimation techniques.

Keywords: Climate change risk exposure; outside director pay; CEO power; managerial power theory; optimal contracting theory; US.

1. Introduction

This study investigates a critical and unexplored topic in the literature on strategic human resource management by examining the effect of firm-level climate change risk exposure (CCE) on outside directors' pay among US firms and consequently ascertains whether CEO power may moderate firm-level CCE - outside directors' pay nexus.

Over the recent years, there has been an increased regulatory, policy, academic and public interest in addressing issues related to climate change risks. This is primarily due to climate-related risks expected to continue to affect not only the global environment, but also this extends to having impacts on literally everything, including global economy, food security, and healthcare (Khalfaoui et al., 2024; Tol, 2018). For example, according to a recent study published in the journal *Nature Communications*, the damage caused by extreme weather disasters globally, is expected to cost \$16 million an hour, amounting to a total cost of about \$2.86 trillion in damage from 2000 to 2019 (Newman and Noy, 2023). In the US, and according to a recent report published by the NOAA National Centers for Environmental Information (2024), the total cost of US climate-related disasters over the past five years is about \$605.5 billion, with an average cost of \$121.1 billion per year. In addition, according to the fifth National Climate Assessment report¹, the annual US GDP growth is expected to decline by 13% with every 1-degree °F the Earth's global temperatures rise (Harvey, 2023). Overall, the emerging evidence shows the potential negative effects of climate-related risks on the wider community in general, and global economy, and countries economics growth, in particular. Therefore, several regulations, laws and acts have been drafted worldwide to tackle climate change risks. For example, in the US, as the leading global trader and world's largest national economy, the congress has enacted various federal statutes aimed at encountering climate-related issues, including the Oil Pollution Act (1924; 1961; 1973; 1990), Clean Air Act (1970; 1977; 1990), National Environmental Policy Act (1970); Energy Policy Act (2005), Energy Independence and Security Act (2007), Inflation Reduction Act (2022), and Earth Act to Stop Climate Pollution by 2030 (2023).

Despite of enacting various federal climate-related laws/acts, and according to the 2021 report published by Carbon Brief, the US is still ranked in the first place among countries most responsible for climate change over time as it has released more than 509GtCO₂ since 1850, which contributed towards about 20% of the global historical emissions. Similarly, in 2024, the Germanwatch, NewClimate Institute and Climate Action Network published the Climate

¹<https://nca2023.globalchange.gov/>

Change Performance Index (CCPI), which evaluate/compares the climate protection performance of 63 countries and the EU that are responsible for more than 90% of global greenhouse gas emissions. The index shows that the US is the eleventh-worst overall performer in the CCPI, the US is ranked 57 with very low ranking in the GHG Emissions, Renewable Energy, and Energy Use categories. This, arguably, has increased public attention and media debate about the effectiveness of US climate-related policies².

At the same time, and with the increased media debate and public awareness about environmental and climate change issues, as well as the increased pressure on US firms to enhance their long-term sustainability performance, the advisory and monitoring role of outside directors in overseeing climate change-related issues has become more important than ever (Ruiz-Castillo et al., 2024). This is largely due to that outside directors with diverse expertise and networks are expected, now more than ever, to support long-term corporate sustainability targets (i.e., reducing corporate climate change risks) and ensuring that climate change/environmental issues are incorporated into their firm's strategic decisions (Kushige et al., 2020)³. Further, outside directors have a significant influence on corporate strategic decisions (Chan et al., 2023) due to their dual roles in providing advisory and monitoring performance (Hempel and Fay, 1994; Kim et al., 2014). Specifically, they can provide more useful recommendations/suggestions based on their diverse expertise and networks (Kim et al., 2014). Furthermore, outside directors play a crucial monitoring role by overseeing management-developed strategies, ensuring alignment with the firm's goals and risk tolerance, and approving or rejecting projects that fall outside established risk boundaries (Chan et al., 2023; Patel et al., 2018).

It is a fact that equity-based compensation for outside directors is more commonly used by U.S. firms compared to firms in other countries, which prefer to pay cash compensation to outside directors (Hempel and Fay, 1994; Kushige et al., 2020; Patel et al., 2018). Additionally, the 2023 Meridian's analysis shows that the pay packages of outside directors for S&P 500 firms have comprised of 60% equity-based incentives (Guenther et al., 2023). Further, according to Chan et al. (2023) and Patel et al. (2018), the more equity-based compensation outside directors receive, the more involved they become in corporate strategic activities.

²For example, and according to two new national surveys conducted by Pew Research Center in 2020 and 2023, the majorities of Americans (above 60%) say that too little is being done by the federal government on key areas of environmental protection (Tyson and Kennedy, 2020; Kennedy et al., 2023).

³For example, and according to the 2023 report of the U.S. Spencer Stuart Board Index, the number of outside directors who hold leadership responsibilities for S&P 500 firms has significantly increased by 6% compared to 2022.

Therefore, and with the increased responsibilities of outside directors to contribute to achieving their firms' long-term sustainability performance targets, it has increasingly become crucial for US firms to ensure that outside directors receive appropriate and fair pay packages that are linked to their firms' long-term sustainability performance targets (Chan et al., 2023; Kushige et al., 2020). Furthermore, the CEO can influence corporate compensation policies for outside directors through several mechanisms: (1) influencing the compensation committee's decisions, which can impact outside directors' pay (Li and Qian, 2011); and (2) affecting corporate firm performance or company performance metrics, which in turn impacts outside directors' remuneration (Abernethy et al., 2015; Yermack, 2004). This study, therefore, seeks to address this crucial research lacuna regarding outside directors' pay and its link to firm-level CCE, and the moderating effect of CEO power on the firm-level CCE - outside directors' pay nexus.

Theoretically, prior studies have predominately relied on two theoretical perspectives to explain issues relating to pay and performance, which are optimal contracting theory and managerial power theory (i.e., Bebchuk and Fried, 2003; Chan et al., 2023; Jensen and Murphy, 1990; Sung et al., 2017). Briefly, optimal contracting theory suggests that outside directors have no influence over their pay and this result in creating incentive contracts that can help to align outside directors' interests with those of stakeholders (Jensen and Murphy, 1990; Patel et al., 2018). Further, optimal contracting theory suggests that firms with high climate change exposure risks are often subject to greater scrutiny and public criticism (Hossain et al., 2023), and hence they are expected to pay low packages to their outside directors in order to meet the expectations of the wider community/society. On the other hand, the managerial power theory indicates that outside directors may lack the ability, mandate, and incentives to support the sustainable growth of their firms, since they often serve on the board of several firms (Bebchuk and Fried, 2003; de Andrés et al., 2017), and hence outside directors pay packages are not expected to be linked to firm-level CCE.

Empirically, despite the increased controversy/debate on issues relating to firm-level CCE and outside director pay, strategic human resource management literature examining the impact of firm-level CCE on outside directors' pay are notably rare, but particularly acute when it comes to literature that further examine the moderating effect of CEO power on the firm-level CCE-outside directors' pay nexus. Specifically, and despite increasing the anecdotal evidence that the role of outside directors in overseeing climate change related issues has become increasingly important over the last few years (Ruiz-Castillo et al., 2024), and hence it's important to link their pay to their firms' long-term sustainability performance targets (i.e.,

reducing climate exposure risks) (Chan et al., 2023). However, very little attention has been paid to whether outside directors are paid appropriate pay packages that are linked to firm-level CCE. Previous empirical studies have largely focused on examining the impact of CCE on firm financial performance/market valuation (Berkman et al., 2024; Ongsakul, Papangkorn and Jiraporn, 2023), cost of capital and investment efficiency (Agoraki et al., 2024; Cepni, Şensoy and Yılmaz, 2024;), financing choices (Choi, 2024), and bankruptcy risk (Feng et al., 2025). However, and to the best of our knowledge, none of existing studies have examined the impact of firm-level CCE on outside directors' pay. This, arguably, may impair the current understanding of the extent to which outside directors' pay is linked to US firm-level CCE. Therefore, our study seeks to contribute to the extant literature by offering timely evidence on the extent to which outside director cash (i.e., salary), equity-based (i.e., stock and option) and total pay is linked to US firm-level CCE. Our findings show that firms with high climate-related exposure risks tend to pay (cash/equity-based/total) their outside directors low pay packages. In addition, and despite increasing theoretical suggestions and normative evidence that in firms with high climate-related exposure risks, powerful CEOs have more incentives to take actions that mitigate those risks (Breuer et al., 2022; PwC, 2023), including ensuring that outside director pay packages are linked to firm-level CCE⁴, however, and to the best of our literature search, none of the existing studies have examined the moderating effect of CEO power on the relationship between firm-level CCE and outside director pay. Our study, therefore, contributes to the existing literature by offering early evidence on whether CEO power moderates the firm-level CCE-outside director pay nexus. Our findings suggest that the negative firm-level CCE - outside director pay is moderated/explained largely by CEO power.

The rest of this paper is structured as follows. Section 2 reviews the relevant theories underpinning this study and develops the hypotheses of the study. Section 3 describes the data and methodology, whilst section 4 discusses the results. Section 5 provides the conclusion of the study.

⁴Breuer et al. (2022) suggests that powerful CEO have more incentives to reduce their firm's climate-related risks in order to meet and represent stakeholders' long-term interests as well as to boost their reputation, future pay and future job opportunities. Hence, it's expected that CEO power to positively moderate the association between firm-level CCE and outside director pay.

2. Literature Review and Hypotheses Development

2.1 Climate Change Risk Exposure and Outside Directors' Pay

It has been suggested that climate change risks have profound impacts on firms' operations, activities and overall survival. Hence, firms need to actively mitigate such risks to ensure sustainability and long-term success (Carrington, 2023; Harvey, 2023). As explained in the introduction section, one of the most effective ways that can help in mitigating such risks is linking outside directors' pay to firm long-term sustainability performance metrics, including those relating to climate change issues. Specifically, it is argued that the role of outside directors in combating climate change in the US firms has become increasingly important and challenging over the last few years (Ruiz-Castillo et al., 2024). This may be due to that outside directors are expected, now more than ever, to play key role in driving their corporations' climate change actions through their independent oversight, strategic guidance, and ability to balance various stakeholders' interests (Kushige et al., 2020). Further, and with the increased responsibilities of outside directors to contribute to achieving their firms' long-term sustainability performance targets, it has increasingly become crucial for US firms to ensure that outside directors receive appropriate and fair pay packages that are linked to their long-term sustainability performance targets (Chan et al., 2023).

Theoretically, optimal contracting theory (Edmans and Gabaix, 2009; Patel et al., 2018; Sung et al., 2017) indicates that the pay packages for directors are often designed to align their interests with those of stakeholders. Further, this theory suggests that directors' incentive contracts often result from close negotiations between strong boards and less influential directors, leading to creating efficient incentive contracts that seek to maximise directors' performance (Jensen and Murphy, 1990). In the context of climate change exposure risk, optimal contracting theory posits that firms facing high climate change-related risks are often subject to greater scrutiny from regulators, public, and activist groups, and this scrutiny may include criticism over the pay practices of outside directors, especially if they are perceived as misaligned with the firm's long-term sustainability performance (Hempel and Fay, 1994; Hossain et al., 2023). This scrutiny may force firms with high climate change-related risks to pay low packages to their outside directors in order to meet the expectations of stakeholders. Therefore, optimal contracting theory expects a negative association between outside directors pay and firm-level CCE. On the other hand, managerial power theory (Bebchuk and Fried, 2003) suggests that board directors tend to have significant influence over their own pay, and this can result in creating pay packages that may increase divergence of interests between directors and stakeholders. Further, this theory indicates that powerful outside directors,

especially those with greater experience/expertise in climate change-related issues (Shahgholian, 2017), may demand high pay packages, which may not necessarily be aligned with their firms' long-term sustainability performance. Managerial power theory also posits that powerful outside directors, especially those with strong reputational capital in sustainability, may demand a risk premium in their pay packages (Berrone and Gomez-Mejia, 2009) in order to compensate for the potential risk/damage to their reputation/status. Therefore, managerial power theory predicts a positive link between outside directors' pay and firm-level CCE.

Empirically, and despite the increased controversy/debate on issues relating to firm-level CCE and outside directors' pay, empirical studies examining the impact of firm-level CCE on outside director pay are notably rare. This offers a great opportunity to contribute to extant literature relating to outside directors' pay and firm performance. Specifically, previous studies have largely focused on examining the impact of climate change exposure on various firm outcomes, and the findings of these studies generally indicate that higher exposure to climate change are negatively associated with various firm outcomes, including financial performance (Reboredo and Ugolini, 2022), market valuation (Berkman et al., 2024; Li et al., 2024; Ongsakul et al., 2023), cost of capital and investment efficiency (Agoraki et al., 2024; Cepni et al., 2024; Hong et al., 2019; Javadi and Masum, 2021), revenue/operating income (Huang et al., 2022), financing choices (Huang et al., 2018; Choi, 2024), solvency performance (Feng et al., 2025). For example, and using a sample of 2,239 US firms, Berkman et al. (2024) report that firms that are more exposed to climate-related risks tend to have lower market valuation due to the increased perceived risk and future cost liabilities. Similarly, Feng et al (2025) find that climate change exposure risks are positively associated with bankruptcy risks of US firms. In relation to empirical literature that examined the association between firm-level CCE and pay, prior studies have mainly examined the impact of firm risks on the pay packages of executive directors, with particular focus on CEO pay (Brick et al., 2006; Dunbar et al., 2020; Gabaix and Landier, 2008; Gormley et al., 2013; Hossain et al., 2023), and the findings of these studies suggest that higher firm risks are associated with lower pay for executive directors. However, and to the best of our literature search, none of the existing literature has examined the influence of firm-level CCE on outside directors' pay. This, arguably, can undermine the current understanding of whether outside directors' pay is influenced by their firms' CCE. Nevertheless, this issue holds substantial relevance for both academic research and policy development, and hence unlike the current non-empirical evidence, our study offers new empirical evidence on the extent to which outside directors' is linked to their firms CCE.

Therefore, and consistent with prior studies which indicate that firm risks are often negatively associated with various firm outcomes (Agoraki et al., 2024; Berkman et al., 2024; Brick et al., 2006; Li et al., 2024; Gabaix and Landier, 2008), we hypothesise that:

Hypothesis 1. *Firm-level CCE is negatively associated with outside directors' pay.*

2.2 The Moderating Effect of CEO Power on the CCE-Outside Directors' Pay Nexus

As explained above, prior studies have largely focused on examining the impact of firm-level general risks on executive directors pay, with particular focus on CEO pay (Brick et al., 2006; Dunbar et al., 2020; Gabaix and Landier, 2008; Gormley et al., 2013), and the findings of these studies suggest that firms with higher risks tend to pay low packages to their executives. However, these studies have ignored the impact of firm-level CCE on outside directors' pay, as well as the moderating effect of CEO power on this association. It has been suggested that CEO power can have significant influence board strategic decisions, including those relating to outside directors' pay and firm risk management (i.e., firm-level climate change risk management) (Choe et al., 2014; Pathan, 2009). This study, therefore, seeks to contribute to extant literature by examining the moderating effect of CEO power, measured as a composite index consisting of seven attributes relating to CEO tenure, duality (CEO also being board chair), ownership stake, abnormal or high pay/pay slice, age, overconfidence, and social network/connections.

Theoretically, optimal contracting theory (Winschel and Stawinoga, 2019) indicates that powerful CEOs, with long-term visions, are often concerned with ensuring that directors' pay are aligned with long-term sustainability goals of their firms. Further, this theory suggests that powerful CEOs, through their influence, can advocate for pay structures that reflect the increased role and responsibilities of outside directors in high-risk environments (Lewellyn and Muller-Kahle, 2012; Ntim et al., 2019). Therefore, optimal contracting theory predicts CEO power to positively moderate the firm-level CCE-outside directors' pay nexus. In contrast, managerial power theory posits that powerful CEOs may prefer pay packages that emphasise short-term performance targets, which are more aligned with immediate business goals rather than long-term climate risk management (Bebchuk and Fried, 2003, 2006; de Andrés et al., 2017; Fama and Jensen, 1983). In addition, this theory suggests that powerful CEOs tend to have substantial influence on the pay decisions relating to board members, including those relating to outside directors. This influence can lead to less optimal pay incentives by allowing powerful CEOs to affect the structures of outside directors pay in a way that ensure support for

their own strategic preferences (e.g., short-term financial performance targets) (Van Essen et al., 2015), which may potentially undermine rigorous oversight of climate change exposure. Therefore, managerial power theory expects CEO power to negatively moderate the association between firm-level CCE and outside directors' pay.

Empirically, a great number of previous studies have evidence on the influence of CEO power on both financial and non-financial performance (Adams et al., 2005; Daily and Johnson, 1997; Pathan, 2009; Sariol and Abebe, 2017; Walls and Berrone, 2017). Indeed, CEO has both direct and indirect approach to adapt climate change such as increasing corporate social responsibility disclosure, environmental sustainability, and environmental innovation (Al-Shaer et al., 2023; Muttakin et al., 2016; Shui et al., 2022; Walls and Berrone, 2017). Furthermore, more powerful CEOs may exert greater pressure on board decisions (Ntim et al., 2019; Park et al., 2018; Schopohl et al., 2021). For example, they have influence on the appointment of board independence and their advice (Bansal and Thenmozhi, 2021; Bliss, 2011). Therefore, we could argue that CEOs could use their power to resist increases in outside directors' pay in response to climate change, weakening the relationship between climate change exposure and pay. However, and to the best of our knowledge, none of existing literature has examined the moderating effect of CEO power on the firm-level CCE-outside directors' pay nexus. This offers a great opportunity to contribute to existing literature relating to firm-level climate change exposure and outside directors' pay. From the regulatory perspective, the provisions of Sarbanes-Oxley Act (2002) explicitly recognise the importance of balancing power within top management as a good governance practices. One of the key provisions of Sarbanes-Oxley Act is to ensure that power is not overly concentrated in any one individual within top management. In addition, and by mitigating excessive CEO power and promoting independent insights/enhance accountability mechanisms, Sarbanes-Oxley Act helps in ensuring that outside directors' pay can be structured to support effective oversight of climate change risks. Therefore, we hypothesise that:

Hypothesis 2. *CEO power significantly moderate the association between outside directors' pay and firm-level CCE.*

3. Data and Methods

3.1 Sample and Data

We collected our data from several sources. Pay data is taken from EXECUCOMP. In this database, coverage of director-level pay becomes more comprehensive starting in 2006,

therefore, our sample begins in 2007 to accommodate a one-year lag in pay data. We identify outside directors using the EXECUCOMP database, excluding those listed in the ANNCOMP dataset, which details annual pay for the top five executives. Firm-level climate change exposures are from Sautner et al. (2023). Firm characteristics and board characteristics are from COMPUSTAT and BOARDEX respectively. Building on existing research, we exclude financial and utility companies from our analysis due to the unique regulatory environments and capital structures that characterize these industries. The final sample consists of 17,021 observations over the 2007-2020 period.

3.2 Firm-Level Climate Change Risk Exposure

The main variable of interest is a firm-level measure of climate change risk exposure developed by Sautner et al. (2023). This indicator was derived using bigram analysis from transcripts of firms' quarterly earnings conference calls. The exposure indices measure the occurrence frequency of certain climate change bigrams in the transcript, adjusting for the total bigram count in that transcript. It effectively reflects indicators of climate change events or shocks affecting the firm. This measure has gained recognition and has been utilized in several recent scholarly publications (e.g., Ben-Amar et al., 2022; Trinh et al., 2023).

3.3 Outside Directors' Pay

Outside directors' pay refers to the total pay made to members of a company's board of directors for their services. It is the aggregate value of all pay components including cash fees, stock awards, option awards, and any other forms of pay⁵. Following previous studies, total pay is the scale (divided) the outside directors' pay by the company's total assets to normalize for firm size. We further break down the total pay packages into two main subcomponents: (1) Stock and Option Awards granted during the period and (2) Cash Payments made during the period (retainers, meeting fees, etc.). This approach allows us to analyse the cash versus equity-based pay mix for directors and examine how pay structures relate to climate change exposure factors.

3.4 CEO Power

CEO power refers to the ability of the CEO to influence and control key decisions within the firm, overriding objections from others (Krause et al., 2016). CEO power stems from both formal and informal sources - formal power comes from the CEO's structural position of

⁵See more at: <https://harperjames.co.uk/article/a-guide-to-directors-remuneration/>

authority at the top of the organizational hierarchy, while informal power stems from factors like the CEO's expertise, personal relationships/networks, and reputation (Krause et al., 2016). Higher levels of CEO power concentrate more decision-making influence in the hands of the CEO, allowing them to exert their will and agenda more easily. This can lead to quicker decisions but may also reduce the board's oversight ability (Krause et al., 2016). The effects of high CEO power are debated - some view it as beneficial for firm performance by enabling decisive leadership (Adams et al., 2005), while others argue too much power concentration can lead to poor decisions if unchecked (Finkelstein, 1992).

This study, therefore, seeks to contribute to extant literature by examining the moderating effect of CEO power on the CCE-outside directors pay among US firms. Following well-known studies (Choe et al., 2014; Pathan, 2009), we construct CEO power index based on seven attributes relating to CEO tenure, duality (CEO also being board chair), ownership stake, abnormal or high pay/pay slice, age, overconfidence, and social network/connections. We focus on these seven CEO power attributes because: (i) they have been examined by prior studies (Adams et al., 2005; Ben-Shahar et al., 2024; Hossain et al., 2023; Ntim et al., 2019; Pathan, 2009); (ii) they are argued to have important impact on board efficiency and performance (Daily and Johnson, 1997; Sariol and Abebe, 2017); and (iii) these attributes can easily/reliably be measured (Al-Shaer et al., 2023).

3.5 Control Variables

Following the well-known papers (Bugeja et al., 2016; Goh and Gupta, 2016) on outside directors' pay, we also include some control variables such as board size, firm size, ROA and among others. Table 1 shows variable definitions.

Insert Table 1 about here

3.6 Baseline Identification

We employ the following regression model to investigate the impact of firm-level climate change risk exposure on outside directors' pay.

$$PAY_{i,t} = \alpha + \beta_1 TCCE_{i,t-1} + \sum_{k=1}^{13} \beta_k CONTROL_{i,t-1} + \vartheta_j + \mu_{i,j} + \epsilon_{i,t} + \varepsilon \quad (1)$$

Where *PAY* presents outside directors' pay. *TCCE*: Total climate change risk exposure. Control variables include firm financial characteristics and board characteristics. All the right-

hand side variables are employed in a one-year lagged fashion to mitigate the potential problem of reverse causality. ϑ_j is year fixed effect, and $\mu_{i,j}$ is industry fixed effect while $\epsilon_{i,j}$ is an overall error term. If β_1 is significant and negative, hypothesis 1 is supported.

Further, and in order to investigate Hypothesis 2, we use the given regression model as follows:

$$PAY_{i,t} = \alpha + \beta_1 TCCE_High_{i,t-1} + \beta_2 CEO_{i,t-1} + \beta_3 TCCE_High_{i,t-1} \times CEO_{i,t-1} + \sum_{k=1}^{13} \beta_k CONTROL_{i,t-1} + \vartheta_j + \mu_{i,j} + \epsilon_{i,t} + \varepsilon \quad (2)$$

Where: *CEO* represents CEO power. *TCCE_High*: dummy variable for high total climate change exposure. The interaction term *TCCE_High_{i,t-1} x CEO_{i,t-1}* captures the moderating effect of CEO power on the relationship between climate change exposure and outside directors' pay. If β_3 is significant, Hypothesis 2 is supported.

4. Empirical Results

4.1 Descriptive Statistics

The descriptive statistics for our study variables are provided in Table 2 offer valuable insights into the variables used in the analysis.

Insert Table 2 about here

Panel A presents the climate change exposure variables, which are the main explanatory variables of interest. The mean values for *TCCE*, *OPCCE*, *RGCCCE*, and *PHCCCE* are 0.7491, 0.2745, 0.0326, and 0.0118, respectively, suggesting varying levels of exposure to different types of climate change exposure across firms. Further, Panel B focuses on various measure of outside directors' pay, which are the key dependent variables in the study. The mean total pay for outside directors in the sample is \$1.3315 million, with a substantial standard deviation of \$1.7575 million, indicating considerable variation across firms. The average stock and option awards amount to \$0.7822 million, while cash payments have a mean of \$0.4906 million.

In addition, Panel C provides descriptive statistics for CEO power used as moderating variables. CEO power, which measures the influence of the CEO on the board, is from 0 (minimum power) to 100 (maximum power) with average of 40.7304, illustrating that we have a balance sample for CEO power. Further, Panel D focuses on firm and board characteristics, which used as control variables. The average firm size, measured by the natural logarithm of

total assets, is 7.6768, with a standard deviation of 1.6024. The mean return on assets (ROA) is 0.0588, indicating moderate profitability. The leverage ratio has a mean of 0.2477, suggesting a moderate level of debt financing. Other firm characteristics, such as cash holdings, dividend payout, intangible assets, sales growth, capital expenditures, research and development investment, and market-to-book ratio, are also reported. Overall, the summary statistics provide a comprehensive overview of the variables used in the analysis, allowing researchers to understand the central tendencies, dispersion, and range of values for each variable. This information is crucial for interpreting the regression results and drawing meaningful conclusions from the study.

4.2 The Impact of Firm-Level Climate Change Risk Exposure and Outside Directors' Pay

Table 3 presents the baseline results examining the impact of firm-level climate change exposure on outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). Columns (1), (4) and (7) display the regression results without considering any firm financial and board characteristics. In Columns (2), (5) and (8), we introduce controls for firm financial characteristics, and in Columns (3), (6) and (9), we further include board characteristics in the analysis. In all three specifications, we control for year and industry fixed effects, and robust standard errors are clustered at firm level.

Insert Table 3 about here

We find that the coefficient for climate change exposure is negative across all models and statistically significant at the 1% level in each case, illustrating that Hypothesis 1 is supported. For example, the effect is nontrivial and economically significant. In Column (3), the coefficient of -0.045 implies that if the climate change exposure increases by one standard deviation (1.3528), the decrease in total pay would be -0.0608 (-0.045×1.3528). Compared to the mean total pay of 1.3315, this decrease of approximately 0.061 represents a reduction of about 4.6% in total pay. This highlights the substantial effect of climate change exposure on director pay structures, suggesting that firms with higher climate change exposure are likely adjusting their pay policies to reflect the associated climate change. In other words, our findings suggest that higher climate change exposure is associated with lower outside directors' pay. Our results support optimal contracting theory (Edmans and Gabaix, 2009), which could explain that firms with high climate change exposure will pay low packages to their outside directors in order to meet the expectations of stakeholders. Our results are consistent with the findings of prior studies, which have found that firm risks are often negatively associated with various firm outcomes (Agoraki

et al., 2024; Berkman et al., 2024; Brick et al., 2006; Li et al., 2024; Gabaix and Landier, 2008). However, our findings are inconsistent with ones of Hossain et al (2023), who have showed evidence on the positive influence of climate change risks on CEO pay. It seems that firms could have various pay-for-climate-change-exposure policies for inside and outside directors due to It seems that firms could have various pay-for-climate-change-exposure policies for inside and outside directors due to their distinct roles and responsibilities. CEOs, as inside directors, receive more equity-based compensation to align their interests with the company's long-term performance and sustainability (Adu et al., 2022). This incentivizes them to effectively manage climate risks and drive strategic initiatives that enhance the firm's resilience and value over time. In contrast, unlike CEOs, outside directors play an important role in advising and monitoring firm performance and do not have day-to-day management responsibilities Kim et al., 2014). Therefore, their exposure to financial risks linked to climate change is lower. As a result, firms may justify lower outside director compensation since their roles in climate strategy oversight are more limited compared to executive leadership. Furthermore, high climate-risk firms often prioritise allocating resources toward executive leadership compensation to ensure strong strategic direction, which can lead to reduced budgets for outside directors' pay. By differentiating compensation in this way, firms can motivate their CEOs to prioritise climate risk management while ensuring robust and unbiased oversight from their outside directors.

With respect to the control variables, our results are in line with Bugeja et al (2016) on the negative influence of ROA on outside directors' pay. Similarly, we observe that firm size, leverage, intangible assets, and capital expenditures have a negative impact on outside directors' pay. Conversely, dividend payout, sales growth, and research and development expenditures positively influence outside director pay. Additionally, board characteristics such as board size and the percentage of independent directors positively influence pay, highlighting the role of governance structures in shaping pay policies. These control variables collectively underscore the complexity of factors influencing outside director pay beyond climate change exposure.

4.3 The Moderating Effect of CEO Power

Table 4 examines the moderating effects of CEO power on the relationship between climate change exposure and outside directors' pay. In this analysis, "Climate change - high exposure" is a dummy variable equal to 1 if a firm's climate change exposure is above the median, and "CEO power" is a dummy variable equal to 1 if the CEO's power is above the median value. The interaction variable (*TCCE_High*CEO power*) represents the combined effect of high climate

change exposure and high CEO power on outside directors' pay. The table presents the regression results for Total Pay (Panel A), Stock and Option Awards (Panel B) and Cash Payments (Panel C). Columns (1), (3), and (5) display the results without control variables, while columns (2), (4), and (6) include all control variables.

Insert Table 4 about here

The results indicate that both CCE and CEO power have significant standalone effects on outside directors' pay. Specifically, firms with high climate change exposure and firms where the CEO wields high power significantly reduce Total Pay, Stock and Option Awards, and Cash Payments to directors, as evidenced by the negative and statistically significant coefficients for the climate change-high exposure and CEO power dummy variables (except in Column (4)). However, the interaction term between high climate change exposure and high CEO power reveals a moderating effect. While the standalone impacts are negative, the interaction term coefficients are positive and significant for total pay and cash payments, not for stock and option awards, indicating that our findings partially support Hypothesis 2. Our results suggest that the negative impact of climate change on outside directors' pay is mitigated when the CEO has substantial power. Specifically, in firms with both high climate change exposure and high CEO power, the reduction in outside directors' pay is less pronounced, indicating that powerful CEOs may use their influence to buffer directors' pay against the adverse effects of high climate change exposure. As for the insignificant coefficients for the interaction term for stocks and option awards, this could be because cash and total pay are more immediate and flexible forms of pay, which can be adjusted more readily by powerful CEOs to buffer against the negative impacts of climate change. In contrast, stock and option awards are typically longer-term incentives tied to firm performance and stock market conditions, making them less amenable to short-term adjustments even by powerful CEOs.

Our results support manager power theory, which explain the power of CEO in deciding the structures of outside directors pay in a way that ensure support for their own strategic preferences (e.g., short-term financial performance targets) (Van Essen et al., 2015), which may potentially undermine rigorous oversight of climate change exposure. Our findings are consistent with previous articles (Combs et al., 2007; Ntim et al., 2019; Park et al., 2018; Schopohl et al., 2021) on the moderating role of CEO power. Specifically, powerful CEOs still pay higher outside directors' fees because of recruiting good outside directors and being confident in controlling the advice of outside directors (Bliss, 2011). Furthermore, powerful

CEOs have no influence on stock and options awards designs because they adopted these designs too quickly (Abernethy et al., 2015).

5. Sensitivity and Endogeneity Tests

Our baseline models excluded the possibility that (1) firm financial distress, (2) state-level social capital, and (3) state-level climate change could affect the relationship between CCE and outside directors' pay. To address such problems, we incorporate these measures as additional control variables when re-running the baseline regression. The results are presented in Table 5. Panel A, B and C presents the findings with Total Pay, Stock and Option Awards and Cash Payments, respectively, as dependent variables.

Insert Table 5 about here

Existing studies have showed evidence on the influence of financial distress on corporate outcomes (see Habib et al., 2020) as well as inside and outside directors' pay (Chang et al., 2016; Emuron and Yixiang, 2020, Gilson and Vetsuypens, 1993). Therefore, it could be argued that climate change may lead to corporate financial distress and/or financial constraints, and thus firms are paying their outside directors more to get better advice. For firm financial distress, we calculate the Altman Z-score and the KZ index (see Kaplan and Zingales, 1997), as these metrics are widely used in the literature to reflect the level of financial distress experienced by firms. The results of Altman Z-score (see Columns (1), (5), (6), (10), (11) and (15)) and KZ index (see Columns (2), (5), (7), (10), (12) and (15)) confirm that our main findings are not sensitive to the financial distress of financial constraints.

Prior studies have investigated the influence of social capital on pay policies (Hoi et al., 2019; Hossain et al., 2023). Thus, we argue that social capital could affect outside directors' pay. Following recent studies (Hoi et al., 2019; Hossain et al., 2023), we use the county-level data on social capital, gathered from the Northeast Regional Center of Rural Development (NERCRD) at Penn State University, to construct a state-level measure of social capital, with each state's social capital calculated as the weighted average of county-level social capital, using county populations as weights. The results are reported in Columns (3), (5), (8), (10), (13) and (15) confirm that our main results continue to hold.

Further, prior studies (Hossain et al., 2023) also suggest that state-level climate change has the same influence on outside directors' packages as firm-level climate change does. To measure state-level climate change, we use the Palmer Drought Severity Index (PDSI) from the National Centers for Environmental Information (NCEI), part of the National Oceanic and

Atmospheric Administration (NOAA). The original PDSI values range from -10 to +10, with lower values indicating more severe climate conditions. For ease of interpretation, we multiply the PDSI values by negative one, so higher scores indicate higher levels of climate change exposure. The results of state climate risk (see Columns (4), (5), (9), (10), (14) and (15)) confirm that our main findings have not changed. Overall, our results remain consistent even after controlling for financial distress, state-level social capital, and state-level climate change exposure.

We further investigate the influence of climate change exposure on outside directors' pay following the exogenous shock measured by Paris Agreement. We create two dummies: (1) *TCCE_High*, which takes the value of 1 if the value of climate change exposure is equal or higher than its median and 0 otherwise; (2) Paris Agreement dummy variable, which denotes the value of 1 if the observed year is in the post-2015 period and zero otherwise. The results are reported in Table 6.

Insert Table 6 about here

Columns (1), (3) and (5) display the results without considering any firm financial and board characteristics while in Columns (2), (4) and (6), we introduce all controls for firm financial and board characteristics. Overall, the findings demonstrate that high exposure to climate change is associated with substantially lower outside directors' pay, particularly in terms of total pay and stock and option awards. Our results also indicate that, while the interaction effects with the Paris Agreement are positive, they are relatively small in magnitude and mostly insignificant, providing limited evidence that the Paris Agreement counteracted the negative impacts of climate change exposure on outside directors' packages.

Furthermore, we address endogeneity and sample selection bias by employing the propensity score matching (PSM) technique, following recent well-known research (Hossain et al., 2023; Phung et al., 2023). These issues can arise in three scenarios: (i) when high outside directors' pay is not randomly distributed across firms; (ii) when certain variables are related to both firm-level climate change exposure and outside directors' pay; and (iii) when a reverse causal relationship exists between outside directors' pay and firm-level climate change exposure. We implement a three-step process, which has been done by many previous studies (Hossain et al., 2023; Phung et al., 2023). First, we estimate the propensity scores for firms with high versus low climate change exposure. We use the previously defined dummy variable "*TCCE_High*", which equals 1 if the climate change exposure value is equal to or above its median value, and 0 otherwise. This categorization results in a treatment group of firms with

high climate change exposure and a control group with low climate change exposure. The initial step involves performing a probit estimation on the *TCCE_High* including all control variables used in our main analysis. In the second step, we perform one-to-one nearest-neighbour matching with replacement ($n=1$) to obtain a matched sample that contains 8,937 observations. In the last step, we conduct regression analysis using the newly constructed matched sample and report the results in Table 7. We continue to document a negative and significant relationship between firm-level climate change exposure and outside directors' pay across all models (total pay, stock and option awards and cash payments). The results are consistent with our main finding reported in Table 3, illustrating that our sample is not biased.

Insert Table 7 about here

Additionally, and in order to ensure that our results are robust to the usage of different climate change exposure measures, we employed alternative proxies, which capture opportunity, regulatory as well as physical risks related to climate change exposure. Following recent papers (Ben-Amar et al., 2022), Table 8 presents the results of the effects of three individual climate change exposure on outside directors' pay.

Insert Table 8 about here

The results in Columns (1), (4) and (7) reveal a negative and statistically significant association at the 5% level between lagged opportunities to climate change exposure (*OPCCE*) and outside directors' pay, indicating that a higher degree of opportunity risks associated to climate change in the previous year corresponds to lower levels of pay packages for outside directors. Similarly, Columns (2), (5) and (8) display a similar pattern for lagged regulatory risks to climate change (*RGCCE*), which exhibits a negative coefficient significant at the 5% level. This finding suggests that greater regulatory risks to climate change in the preceding year is linked to diminished pay for outside directors. However, the coefficient on lagged physical risks to climate change (*PHCCE*) in Column (3), (6) and (9) is not statistically significant at conventional levels, providing no robust evidence that physical exposure impacts remuneration of outside directors. Overall, our findings suggest that opportunity and regulatory climate change exposures are negatively associated with outside directors' pay, while physical climate change exposure does not appear to significantly impact on remuneration of outside directors.

In addition, prior studies (Albuquerque et al., 2013; Bizjak et al., 2022) suggest that firms tend to follow peer benchmarking when setting pay policies. Therefore, we argue that focal firms' packages of outside directors may be driven by its benchmark's CCE. Hence, we

consider this argument as a robustness for our paper. Specifically, we have rerun our baseline model using peer-firm CCE, the industry (SIC2) top 70 and top 90 excluding the focal firms, as a main dependent variable. The results are reported in Table 9.

Insert Table 9 about here

The analysis is conducted for two thresholds of climate change exposure: the top 75th percentile and the top 90th percentile. Again, the results are in line with our baseline with significant negative impact on outside directors' pay across all model specifications. The effect is strongest in the base model (Columns (1), (4) and (7)) and remains significant even after controlling for firm characteristics and governance factors. The magnitude of the effect is slightly larger for the top 75th percentile compared to the top 90th percentile, indicating that the negative impact on remuneration is not limited to only the most extreme cases of climate change exposure. High CCE also negatively affects cash payments, although the effect is smaller compared to total pay and stock and option awards. This pattern again suggests that firms with high climate change exposure tend to reduce equity-based remuneration more than cash-based one for outside directors. The inclusion of firm controls (Columns (2), (5) and (8)) substantially increases the R-squared values, indicating that firm characteristics explain a large portion of the variation in pay. Adding governance controls (Columns (3), (6) and (9)) further improves the model fit, albeit to a lesser extent. All in all, the effect remains significant even after controlling for firm and governance factors, suggesting a robust relationship between high climate change exposure and lower outside directors' packages.

Finally, prior studies (D'Orazio and Dirks, 2022; Ramdani and Witteloostuijn, 2010) suggest that applying quantile regression may allow us to understand our results in detail than ordinary least squares (OLS) and discuss the heterogeneity of firm characteristics. Therefore, we re-run our baseline model with different quantiles (25th, 50th, and 75th percentiles) of outside directors' pay. The results are shown in Table 10. Our findings are consistent with the baseline regression results; however, we observe notable heterogeneity in the effect of CCE on outside directors' pay across the conditional distribution of pay. Specifically, for Total Pay and Stock and Option Awards, the negative effect of CCE is significant across all quantiles, with the largest coefficients observed at the 75th percentile, indicating a more pronounced impact on higher-paid directors. Interestingly, for Cash Payments, the CCE effect is only significant at the 75th percentile, suggesting that the impact on cash-based pay is primarily concentrated among the highest-paid directors. These results imply that firms with higher climate change exposure tend to implement more substantial reductions in pay for their higher-paid directors,

with a particular emphasis on equity-based pay. This pattern may reflect a strategic approach by firms to align director incentives with long-term climate-related risks and opportunities, especially for those in more influential or higher-paid positions. The heterogeneous effects across the pay distribution highlight the importance of considering the entire spectrum of director pay when assessing the impact of climate change exposure on corporate governance practices. This nuanced understanding can provide valuable insights for policymakers, investors, and corporate boards in addressing climate-related risks through pay structures.

Insert Table 10 about here

6. Conclusion

This study has examined the impact of firm-level CCE on outside directors' pay, and consequently ascertained the extent to which CEO power can moderate the firm-level CCE-outside directors' pay nexus. In doing so, this study extends and contributes to the existing literature in a number of ways. First, and despite increasing suggestions that the pay packages of outside directors are becoming equally important and should be linked to their firms' long-term sustainability performance targets (Chan et al., 2023), existing studies have mainly focused on examining the extent to which CEO pay is linked to firm performance (Hossain et al., 2023). This, arguably, may impair the current understanding of the extent to which outside director pay is linked to US firm-level CCE. Therefore, our study contributes to the existing literature by offering timely evidence on the extent to which outside directors' cash (i.e., salary), equity-based (i.e., stock and option) and total pay is linked to US firm-level CCE. We find that firms with high climate change risk exposure tend to pay (cash/equity-based/total) their outside directors' low pay packages. Second, and despite increasing suggestions that in firms with high climate change exposure, powerful CEOs have more incentives to take actions that mitigate those risks (Breuer et al., 2022), including ensuring that outside director pay packages are linked to firm-level CCE, however, and to the best of our literature search, none of the existing studies have examined the moderating effect of CEO power on the relationship between firm-level CCE and outside directors' pay. Therefore, our study contributes and extends the literature by offering new insights on the moderating effect of CEO power on the firm-level CCE-outside directors' pay nexus. Our evidence suggests that the firm-level CCE - outside director pay nexus is positively moderated by CEO power.

Our results have important implications to policymakers, governments, stakeholders, and researchers. For example, policymakers and governments can use our findings to inform the development of policies that aimed at mitigating firm-level climate risk exposure, including developing best practices/guidelines that ensure that climate-related risk assessments are integrated into decisions relating to outside directors' pay. The integration of climate change exposure assessments into outside directors' pay decisions may help in ensuring that firms are more proactive/accountable to their stakeholders in mitigating climate risks. Further, our findings can serve as a motivation to policymakers to find ways to strengthen regulatory frameworks relating to outside directors pay, including requiring from firms to disclose more information about their climate risk exposures and how these risks are integrated into outside directors' pay structures. In addition, the moderating evidence suggests that powerful CEOs have more incentives to take actions that mitigate climate-related risks, including ensuring that outside director pay packages are linked to firm-level CCE. This finding implies that appointing powerful CEOs can be helpful in ensuring that US firms are committed to representing and meeting stakeholders' expectations, including ensuring that firms deliver strong sustainability performance that match the pay packages of their outside directors. To researchers, our study offers early evidence regarding the impact of firm-level CCE on outside directors' cash, equity-based, and total pay. Additionally, our study offers early evidence relating to the moderating effect of CEO power on the firm-level CCE-outside directors' pay nexus. Therefore, our study opens new avenues and encourages further research on how firm-level climate risk assessments are factored into the pay structures of outside directors.

Finally, and despite its importance in highlighting the need to link outside directors' pay to firm-level CCE, this study has some limitations. First, this study focuses only on the US firms, and thus future studies may extend our analysis by including firms from other countries. Second, this study has relied on Sautner et al. (2023) measure of CCE, and this measure is mainly derived using bigram analysis from transcripts of firms' quarterly earnings conference calls. However, this measure may not necessarily capture firms' actual exposure to climate-related risks, since it is possible that managers may release information during conference calls on their firms' climate exposure risks for strategic purposes (i.e., as a mean of greenwashing to boost their pay packages) (Hossain et al., 2023). Therefore, future research may complement Sautner et al., (2023) measure by other official data (i.e., disclosure of climate risk in firm's 10-k filing report). In addition, this study has focused on examining the moderating effect of CEO power on the firm-level CCE-outside directors' pay nexus. However, corporate board may also play important role in influencing firm strategic decisions, including those relating to climate

change exposure and outside directors' pay, and hence, future studies may extend our analysis by examining the moderating effect of board characteristics that have not widely been examined in literature (e.g., board political connections) on the association between firm-level CCE and outside directors' pay. Additionally, the current study has only used quantitative research method to examine relationships among firm-level CCE, CEO power and outside directors' pay. therefore, and to enhance the generalisability of the obtained findings, future studies may use qualitative research approaches (i.e., interviews) to better understand and further explore the impact of firm-level CCE on outside director pay, as well as the role of CEO power in explaining this association.

References

- Abernethy, M. A., Kuang, Y. F. and Qin, B. (2015). The influence of CEO power on compensation contract design. *Accounting Review*, 90(4), 1265-1306.
- Adams, R. B., Almeida, H. and Ferreira, D. (2005). Powerful CEOs and their impact on corporate performance. *Review of Financial Studies*, 18(4), 1403-1432.
- Adu, D. A., Flynn, A., & Grey, C. (2022). Executive compensation and sustainable business practices: The moderating role of sustainability-based compensation. *Business Strategy and the Environment*, 31(3), 698-736.
- Agoraki, K. K., Giaka, M., Konstantios, D. and Negkakis, I. (2024). The relationship between firm-level climate change exposure, financial integration, cost of capital and investment efficiency. *Journal of International Money and Finance*, 141, 102994.
- Albuquerque, A. M., De Franco, G. and Verdi, R. S. (2013). Peer choice in CEO compensation. *Journal of Financial Economics*, 108(1), 160-181.
- Al-Shaer, H., Albitar, K. and Liu, J. (2023). CEO power and CSR-linked compensation for corporate environmental responsibility: UK evidence. *Review of Quantitative Finance and Accounting*, 60(3), 1025-1063.
- Bebchuk, L. A. and Fried, J. M. (2003). Executive compensation as an agency problem. *Journal of Economic Perspectives*, 17(3), 71-92.
- Bebchuk, L.A. and Fried, J.M. (2006). Pay without performance: Overview of the issues. *Academy of Management Perspectives*, 20(1), 5-24.
- Ben-Amar, W., Gomes, M., Khursheed, H. and Marsat, S. (2022). Climate change exposure and internal carbon pricing adoption. *Business Strategy and the Environment*, 31(7), 2854-2870.
- Ben-Shahar, D., Carmeli, A., Sulganik, E., & Weiss, D. (2024). Regulating Diversity and Inclusiveness in Boards of Directors. *Academy of Management Perspectives*. Forthcoming.
- Berkman, H., Jona, J. and Soderstrom, N. (2024). Firm-specific climate risk and market valuation. *Accounting, Organizations and Society*, 112, 101547.
- Berrone, P. and Gomez-Mejia, L.R. (2009). Environmental performance and executive compensation: An integrated agency-institutional perspective. *Academy of Management Journal*, 52(1), 103-126.
- Bizjak, J., Kalpathy, S., Li, Z. F. and Young, B. (2022). The choice of peers for relative performance evaluation in executive compensation. *Review of Finance*, 26(5), 1217-1239.
- Breuer, W., Hass, M. and Rosenbach, D. J. (2022). The impact of CEO power and institutional discretion on CSR investment. *Review of Financial Economics*, 40(1), 20-43.
- Brick, I.E., Palmon, O. and Wald, J.K. (2006). CEO compensation, director compensation, and firm performance: Evidence of cronyism?. *Journal of Corporate Finance*, 12(3), 403-423.
- Bugeja, M., Fohn, S. and Matolcsy, Z. (2016). Determinants of the levels and changes in non-executive director compensation. *Accounting & Finance*, 56(3), 627-667.
- Carrington, D. (2023). Climate crisis costing \$16m an hour in extreme weather damage, study estimates. The Gurdian. Available at: [Climate crisis costing \\$16m an hour in extreme weather damage, study estimates | Climate crisis | The Guardian](#). Accessed on 25th January 2025.
- Cepni, O., Şensoy, A. and Yilmaz, M. H. (2024). Climate change exposure and cost of equity. *Energy Economics*, 130, 107288.
- Chan, K., Chen, V. Y., Huang, Y. F. and Liang, J. W. (2023). Outside directors' equity incentives and strategic alliance decisions. *Journal of Corporate Finance*, 79, 102381.
- Chang, W. J., Hayes, R. M. and Hillegeist, S. A. (2016). Financial distress risk and new CEO compensation. *Management Science*, 62(2), 479-501.
- Choe, C., Tian, G.Y. and Yin, X. (2014). CEO power and the structure of CEO pay. *International Review of Financial Analysis*, 35, 237-248.

- Choi, S. (2024). Climate change exposure and the use of short-term debt. *Finance Research Letters*, 65, 105579.
- Combs, J. G., Ketchen Jr, D. J., Perryman, A. A. and Donahue, M. S. (2007). The moderating effect of CEO power on the board composition–firm performance relationship. *Journal of Management Studies*, 44(8), 1299-1323.
- D’Orazio, P. and Dirks, M. W. (2022). Exploring the effects of climate-related financial policies on carbon emissions in G20 countries: a panel quantile regression approach. *Environmental Science and Pollution Research*, 29(5), 7678-7702.
- Daily, C. M. and Johnson, J. L. (1997). Sources of CEO power and firm financial performance: A longitudinal assessment. *Journal of Management*, 23(2), 97-117.
- de Andrés, P., Arranz-Aperte, L. and Rodriguez-Sanz, J. A. (2017). Independent versus non-independent outside directors in European companies: Who has a say on CEO compensation?. *BRQ Business Research Quarterly*, 20(2), 79-95.
- Dunbar, C., Li, Z.F. and Shi, Y. (2020). CEO risk-taking incentives and corporate social responsibility. *Journal of Corporate Finance*, 64, 101714.
- Edmans, A. and Gabaix, X. (2009). Is CEO pay really inefficient? A survey of new optimal contracting theories. *European Financial Management*, 15(3), 486-496.
- Emuron, A.S.O. and Yixiang, T. (2020). Financial distress and non-executive director compensation: Evidence from state-owned enterprises in South Africa post King III. *African Development Review*, 32(2), 228-239.
- Fama, E.F. and Jensen, M. C. (1983). Separation of ownership and control. *Journal of law and Economics*, 26(2), 301-325.
- Feng, F., Han, L., Jin, J. and Li, Y. (2025). Climate change exposure and bankruptcy risk. *British Journal of Management*. Forthcoming.
- Finkelstein, S. (1992). Power in top management teams: Dimensions, measurement, and validation. *Academy of Management Journal*, 35(3), 505-538.
- Gabaix, X. and Landier, A. (2008). Why has CEO pay increased so much?. *Quarterly Journal of Economics*, 123(1), 49-100.
- Galbreath, J. (2010). Corporate governance practices that address climate change: An exploratory study. *Business Strategy and the Environment*, 19(5), 335-350.
- Gilson, S.C. and Vetsuypens, M. R. (1993). CEO compensation in financially distressed firms: An empirical analysis. *Journal of Finance*, 48(2), 425-458.
- Goh, L. and Gupta, A. (2016). Remuneration of non-executive directors: Evidence from the UK. *British Accounting Review*, 48(3), 379-399.
- Gormley, T.A., Matsa, D.A. and Milbourn, T. (2013). CEO compensation and corporate risk: Evidence from a natural experiment. *Journal of Accounting and Economics*, 56(2-3), 79-101.
- Guenther, C., Power, C. and Papineau, T. (2023). S&P 500 Outside Director Compensation Analysis Insights. *Meridian Compensation Partners, LLC*. Available at: [S&P 500 Outside Director Compensation Analysis Insights - Meridian Compensation Partners \(meridiancp.com\)](https://www.meridiancp.com). Accessed on 27th January 2025.
- Habib, A., Costa, M.D., Huang, H.J., Bhuiyan, M.B.U. and Sun, L. (2020). Determinants and consequences of financial distress: review of the empirical literature. *Accounting & Finance*, 60, 1023-1075.
- Harvey, C. (2023). National Climate Assessment predicts growing threats to society, economy. Available at: [National Climate Assessment predicts growing threats to society, economy - E&E News by POLITICO \(eenews.net\)](https://www.eenews.net/stories/1139444). Accessed on 14 February 2025.
- Hempel, P., & Fay, C. (1994). Outside director compensation and firm performance. *Human Resource Management*, 33(1), 111-133.

- Hoi, C.K.S., Wu, Q. and Zhang, H. (2019). Does social capital mitigate agency problems? Evidence from Chief Executive Officer (CEO) compensation. *Journal of Financial Economics*, 133(2), 498-519.
- Hong, H., Li, F.W. and Xu, J. (2019). Climate risks and market efficiency. *Journal of Econometrics*, 208(1), 265-281.
- Hossain, A., Masum, A.A., Saadi, S., Benkraiem, R. and Das, N. (2023). Firm-level climate change risk and CEO equity incentives. *British Journal of Management*, 34(3), 1387-1419.
- Huang, H.H., Kerstein, J. and Wang, C. (2018). The impact of climate risk on firm performance and financing choices: An international comparison. *Journal of International Business Studies*, 49, 633-656.
- Huang, H.H., Kerstein, J., Wang, C. and Wu, F. (2022). Firm climate risk, risk management, and bank loan financing. *Strategic Management Journal*, 43(13), 2849-2880.
- Javadi, S. and Masum, A.A. (2021). The impact of climate change on the cost of bank loans. *Journal of Corporate Finance*, 69, 102019.
- Jensen, M.C. and Murphy, K.J. (1990). Performance pay and top-management incentives. *Journal of Political Economy*, 98(2), 225-264.
- Kaplan, S., and L. Zingales, 1997, Do financing constraints explain why investment is correlated with cash flow?, *Quarterly Journal of Economics* 112, 169–215.
- Kennedy, B., Funk, C. and Tyson, A. (2023). Majorities of Americans say too little is being done on key areas of environmental protection. Available at: [Majorities in US say government does too little to protect environment in key ways | Pew Research Center](#). Accessed on 25th January 2025.
- Khalfaoui, R., Goodell, J. W., Mefteh-Wali, S., Chishti, M.Z. and Gozgor, G. (2024). Impact of climate risk shocks on global food and agricultural markets: A multiscale and tail connectedness analysis. *International Review of Financial Analysis*. Forthcoming.
- Kim, K., Mauldin, E., & Patro, S. (2014). Outside directors and board advising and monitoring performance. *Journal of accounting and economics*, 57(2-3), 110-131.
- Kling, G., Volz, U., Murinde, V. and Ayas, S. (2021). The impact of climate vulnerability on firms' cost of capital and access to finance. *World Development*, 137, 105131.
- Krause, R., Filatotchev, I. and Bruton, G.D. (2016). When in Rome, look like Caesar? Investigating the link between demand-side cultural power distance and CEO power. *Academy of Management Journal*, 59(4), 1361-1384.
- Kushige, T., Ogawa, N., Sato, Y. and Brown, J. (2020). Outside director pay landscape in Japan, the U.S. and Europe - 2020 analysis. Available at: [Outside director pay landscape in Japan, the U.S. and Europe — 2020 analysis - WTW \(wtwco.com\)](#). Accessed on 27th January 2025.
- Lewellyn, K.B. and Muller-Kahle, M.I. (2012). CEO power and risk taking: Evidence from the subprime lending industry. *Corporate Governance: An International Review*, 20(3), 289-307.
- Li, H., & Qian, Y. (2011). Outside CEO directors on compensation committees: whose side are they on?. *Review of Accounting and Finance*, 10(2), 110-133.
- Li, X., Luo, L. and Tang, Q. (2024). Climate risk and opportunity exposure and firm value: An international investigation. *Business Strategy and the Environment*. Forthcoming.
- Matsumura, E.M., Prakash, R. and Vera-Munoz, S.C. (2014). Firm-value effects of carbon emissions and carbon disclosures. *Accounting Review*, 89(2), 695-724.
- Newman, R. and Noy, I. (2023). The global costs of extreme weather that are attributable to climate change. *Nature Communications*, 14(1), 1-13.
- NOAA National Centers for Environmental Information. (2024). US Billion-Dollar Weather and Climate Disasters. Available at: [Billion-Dollar Weather and Climate Disasters | National Centers for Environmental Information \(NCEI\) \(noaa.gov\)](#). Accessed on 12th February 2025.

- Ntim, C.G., Lindop, S., Thomas, D. A., Abdou, H. and Opong, K.K. (2019). Executive pay and performance: The moderating effect of CEO power and governance structure. *International Journal of Human Resource Management*, 30(6), 921-963.
- Ongsakul, V., Papangkorn, S. and Jiraporn, P. (2023). Estimating the effect of climate change exposure on firm value using climate policy uncertainty: A text-based approach. *Journal of Behavioural and Experimental Finance*, 40, 100842.
- Pankratz, N., Bauer, R. and Derwall, J. (2023). Climate change, firm performance, and investor surprises. *Management Science*, 69(12), 7352-7398.
- Park, J.H., Kim, C., Chang, Y.K., Lee, D.H. and Sung, Y.D. (2018). CEO hubris and firm performance: Exploring the moderating roles of CEO power and board vigilance. *Journal of Business Ethics*, 147, 919-933.
- Patel, P.C., Li, M., del Carmen Triana, M., & Park, H.D. (2018). Pay dispersion among the top management team and outside directors: Its impact on firm risk and firm performance. *Human Resource Management*, 57(1), 177-192.
- Pathan, S. (2009). Strong boards, CEO power and bank risk-taking. *Journal of Banking & Finance*, 33(7), 1340-1350.
- Phung, G., Trinh, H. H., Nguyen, T. H. and Trinh, V. Q. (2023). Top-management compensation and environmental innovation strategy. *Business Strategy and the Environment*, 32(4), 1634-1649.
- PricewaterhouseCoopers – PwC. (2023). When CEOs see climate risk, they step up. Available at: [When CEOs see climate risk, they step up \(pwc.com\)](https://www.pwc.com/au/en/issues/climate-change/when-ceos-see-climate-risk-they-step-up.html). Accessed on 2nd February 2025.
- Ramdani, D. and Witteloostuijn, A. V. (2010). The impact of board independence and CEO duality on firm performance: A quantile regression analysis for Indonesia, Malaysia, South Korea and Thailand. *British Journal of Management*, 21(3), 607-627.
- Reboredo, J.C. and Ugolini, A. (2022). Climate transition risk, profitability and stock prices. *International Review of Financial Analysis*, 83, 102271.
- Ruiz-Castillo, M., Aragón-Correa, J. A. and Hurtado-Torres, N.E. (2024). Independent directors and environmental innovations: How the visibility of public and private shareholders' environmental activism moderates the influence of board independence. *Business Strategy and the Environment*, 33(2), 424-440.
- Sariol, A.M. and Abebe, M.A. (2017). The influence of CEO power on explorative and exploitative organizational innovation. *Journal of Business Research*, 73, 38-45.
- Sautner, Z., Van Lent, L., Vilkov, G. and Zhang, R. (2023). Firm-level climate change exposure. *The Journal of Finance*, 78(3), 1449-1498.
- Schopohl, L., Urquhart, A. and Zhang, H. (2021). Female CFOs, leverage and the moderating role of board diversity and CEO power. *Journal of Corporate Finance*, 71, 101858.
- Shahgholian, A. (2017). The effect of board roles on firm environmental governance. In 2017 *Academy of Management Proceedings*.
- Spencer Stuart. (2023). 2023 S&P 500 Compensation Snapshot. Available at: [2023 S&P 500 Compensation Snapshot \(spencerstuart.com\)](https://www.spencerstuart.com/2023-s-p-500-compensation-snapshot). Accessed on 27th January 2025.
- Sung, S.Y., Choi, J.N., & Kang, S.C. (2017). Incentive pay and firm performance: Moderating roles of procedural justice climate and environmental turbulence. *Human Resource Management*, 56(2), 287-305.
- Tol, R. S. (2018). The economic impacts of climate change. *Review of Environmental Economics and Policy*, 12(1), 4-25.
- Trinh, V. Q., Trinh, H.H., Nguyen, T. H.H. and Vo, X.V. (2023). Board gender diversity and firm-level climate change exposure: A global perspective. *Finance Research Letters*, 55, 103995.

- Tyson, A. and Kennedy, B. (2020). Two-Thirds of Americans Think Government Should Do More on Climate. Available at: [Two-Thirds of Americans Think Government Should Do More on Climate | Pew Research Center](#). Accessed on 25th January 2025.
- Van Essen, M., Otten, J. and Carberry, E.J. (2015). Assessing managerial power theory: A meta-analytic approach to understanding the determinants of CEO compensation. *Journal of Management*, 41(1), 164-202.
- Winschel, J. and Stawinoga, M. (2019). Determinants and effects of sustainable CEO compensation: a structured literature review of empirical evidence. *Management Review Quarterly*, 69, 265-328.
- Yermack, D. (2004). Remuneration, retention, and reputation incentives for outside directors. *The Journal of Finance*, 59(5), 2281-2308.

TABLE 1 Variable definitions.

<i>Variables</i>	<i>Description</i>	<i>Source</i>
<i>Independent variables (Firm-level climate risk exposure (CCE))</i>		
TCCE	This measure captures a firm's risk perception resulting from physical, regulatory, and transitional climate change shocks. This variable measures the overall relative frequency with which bigrams (two-word phrases) that capture climate change topics occur in a firm's earnings conference call transcripts. It captures the firm's total exposure to climate change issues.	Sautner et al., 2023
OPCCE	This measures the relative frequency of bigrams related specifically to potential opportunities arising from the transition to a low-carbon economy mentioned in the earnings calls. It captures the firm's exposure to climate change opportunities	Sautner et al., 2023
RGCCE	This variable quantifies the relative frequency of bigrams about regulatory risks and policies aimed at mitigating climate change, such as carbon pricing or emissions standards. It captures the firm's exposure to climate change regulatory risks.	Sautner et al., 2023
PHCCE	This measures the relative frequency of bigrams that capture physical shocks and risks related to climate change, such as extreme weather events or rising sea levels. It captures the firm's exposure to the physical risks from climate change.	Sautner et al., 2023
<i>Dependent variables (Outside directors' pay (PAY))</i>		
Total pay	Scale (divided) the outside directors' pay by the company's total assets to normalize for firm size	EXECUCOMP
Stock and option awards	Equity-based pay including (1) Stock awards (restricted stock, stock units) (2) Stock option awards	EXECUCOMP
Cash payments	Cash payments including (1) Annual retainer fees for serving on the board (2) Additional fees for attending board committee meetings (3) Committee membership chair fees	EXECUCOMP
<i>Moderating variables</i>		
CEO power	CEO power index based on <i>variables</i> common components including CEO tenure, duality (CEO also being board chair), ownership stake, abnormal or high pay/pay slice, age, overconfidence, and social network/connections	EXECUCOMP
Paris Agreement	Dummy variable takes value as 1 after 2015 and 0 otherwise.	
<i>Control variables</i>		
Firm size	The natural logarithm of firm's total assets	COMPUSTAT
ROA	Operating income before depreciation divided by book value of total assets	COMPUSTAT
Leverage	Total debt scaled by the book value of total assets	COMPUSTAT
Cash	Total cash and short-term investments scaled by the book value of total assets	COMPUSTAT
Dividend payout	The proportion or percentage of a company's net income that is paid out to shareholders in the form of dividends.	COMPUSTAT
Intangible assets	The total gross value of intangible assets scaled by the book value of total assets	COMPUSTAT
Sale growth	The increase in a company's sales from one year to the next year.	COMPUSTAT
CAPEX	The capital expenditures made by a company in a given period, as reported in its cash flow statement under investing activities. This item is scaled by total assets.	COMPUSTAT
R&D investment	The expenditures made by organizations towards research and development activities aimed at discovering and commercializing new technologies, products, processes, or enhancing existing ones. This item is scaled by total assets.	COMPUSTAT
M/B	Market-to-Book Ratio = Market Capitalization / Book Value of Equity. Where: Market Capitalization = Current Stock Price x Total Shares Outstanding; Book Value of Equity = Total Assets – Total Liabilities. The market-to-book ratio essentially shows how much the market values the company relative to the company's stated book value from its accounting records.	COMPUSTAT
Board size	The number of directors sitting on the board	BOARDEX
Gender ratio (%)	Percentage of female directors sitting on the board	BOARDEX
Independent director (%)	Percentage of independent directors sitting on the board	BOARDEX

TABLE 2 Descriptive statistics.

<i>Variables</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Panel A: Firm-level climate risk exposure</i>					
TCCE	17,021	0.7491	1.3528	0.0000	23.4754
OPCCE	17,021	0.2745	0.7475	0.0000	16.9473
RGCCE	17,021	0.0326	0.1321	0.0000	2.7483
PHCCE	17,021	0.0118	0.0760	0.0000	3.0815
<i>Panel B: Outside directors' pay</i>					
Total Pay	17,021	1.3315	1.7575	0.0172	10.4124
Stock & Options Awards	17,021	0.7822	1.1463	0.0094	6.9708
Cash Payments	17,021	0.4906	0.6288	0.0000	3.6673
<i>Panel C: Moderating variable</i>					
CEO power	17,021	40.7304	19.6485	0	100
<i>Panel D: Control variables</i>					
Firm size	17,021	7.6768	1.6024	4.3169	11.9222
ROA	17,020	0.0588	0.1240	-0.4865	0.3566
Leverage	16,956	0.2477	0.2040	0.0000	0.9420
Cash	17,003	0.2406	0.1980	0.0128	0.9852
Dividend payout	16,988	0.0164	0.0313	0.0000	0.1858
Intangible assets	16,847	0.2395	0.2106	0.0000	0.7802
Sale growth	16,997	0.0804	0.2261	-0.5012	1.1621
CAPEX	17,021	0.0452	0.0459	0.0018	0.2644
R&D investment	17,021	0.0343	0.0600	0.0000	0.3283
M/B	16,972	3.5296	6.0858	-17.2729	41.5152
Number of directors	17,021	10.8313	3.2777	4	23
Board size	17,021	2.4317	0.2784	1.7918	2.9444
Gender ratio (%)	17,021	0.8537	0.1110	0.5560	1.0000
Independent director (%)	17,021	0.7068	0.1408	0.3636	0.9091

Notes: This table illustrates the descriptive statistics for our variables

TABLE 3 The impact of firm-level climate change exposure on outside directors' pay.

	<i>Panel A: Total Pay</i>			<i>Panel B: Stock & Option Awards</i>			<i>Panel C: Cash Payments</i>		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TCCE	-0.080*** (0.021)	-0.045*** (0.010)	-0.045*** (0.010)	-0.051*** (0.014)	-0.026*** (0.0080)	-0.027*** (0.0081)	-0.022*** (0.0069)	-0.014*** (0.0038)	-0.013*** (0.0035)
Firm size		-0.65*** (0.023)	-0.73*** (0.029)		-0.38*** (0.016)	-0.41*** (0.019)		-0.24*** (0.0083)	-0.28*** (0.011)
ROA		-2.03*** (0.26)	-1.99*** (0.26)		-1.03*** (0.18)	-0.99*** (0.18)		-0.77*** (0.092)	-0.76*** (0.091)
Leverage		-0.53*** (0.12)	-0.54*** (0.11)		-0.32*** (0.076)	-0.33*** (0.076)		-0.17*** (0.048)	-0.17*** (0.047)
Cash		-0.13 (0.12)	0.018 (0.11)		-0.29*** (0.078)	-0.21*** (0.074)		0.12*** (0.046)	0.18*** (0.045)
Dividend payout		2.52*** (0.70)	2.34*** (0.67)		0.88** (0.46)	0.82** (0.45)		1.20*** (0.28)	1.12*** (0.27)
Intangible assets		-0.70*** (0.11)	-0.66*** (0.11)		-0.41*** (0.075)	-0.39*** (0.075)		-0.22*** (0.041)	-0.20*** (0.041)
Sale growth		0.17** (0.082)	0.26*** (0.081)		0.30*** (0.060)	0.34*** (0.060)		-0.11*** (0.028)	-0.071*** (0.027)
CAPEX		-1.13*** (0.55)	-1.03** (0.54)		-0.37 (0.42)	-0.31 (0.41)		-0.60*** (0.20)	-0.57*** (0.20)
R&D investment		6.50*** (0.63)	6.53*** (0.61)		5.13*** (0.45)	5.18*** (0.44)		1.16*** (0.26)	1.15*** (0.26)
M/B		0.0099*** (0.0026)	0.0088*** (0.0025)		0.0093*** (0.0020)	0.0089*** (0.0019)		0.00019 (0.00097)	-0.00036 (0.00095)
Board size			0.93*** (0.10)			0.49*** (0.070)			0.39*** (0.039)
Gender ratio (%)			-0.087 (0.20)			0.089 (0.14)			-0.20*** (0.077)
Independent director (%)			1.05*** (0.15)			0.71*** (0.10)			0.39*** (0.057)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms' Errors cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14627	14370	14370	14627	14370	14370	14627	14370	14370
R-sq	0.103	0.600	0.611	0.105	0.540	0.548	0.092	0.570	0.586
Adj. R-sq	0.099	0.598	0.609	0.100	0.538	0.546	0.088	0.568	0.584

Notes: This table presents the influence of firm-level climate change exposure on outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). All variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 4 The moderating role of CEO power on the CCE–outside directors’ pay nexus.

	<i>Panel A: Total Pay</i>		<i>Panel B: Stock & Option Awards</i>		<i>Panel C: Cash Payments</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
TCCE_High	-0.30*** (0.076)	-0.11*** (0.044)	-0.19*** (0.048)	-0.066*** (0.031)	-0.083*** (0.028)	-0.032** (0.017)
CEO power	-0.73*** (0.080)	-0.13*** (0.046)	-0.38*** (0.050)	-0.038 (0.031)	-0.30*** (0.029)	-0.072*** (0.018)
TCCE_High*CEO power	0.15** (0.082)	0.10*** (0.050)	0.070 (0.052)	0.042 (0.034)	0.059** (0.031)	0.044*** (0.019)
Firm size		-0.72*** (0.029)		-0.41*** (0.019)		-0.28*** (0.011)
ROA		-1.97*** (0.26)		-0.99*** (0.18)		-0.74*** (0.091)
Leverage		-0.55*** (0.11)		-0.33*** (0.076)		-0.18*** (0.047)
Cash		0.015 (0.11)		-0.20*** (0.073)		0.18*** (0.044)
Dividend payout		2.36*** (0.67)		0.84* (0.45)		1.12*** (0.27)
Intangible assets		-0.66*** (0.11)		-0.39*** (0.074)		-0.20*** (0.040)
Sale growth		0.26*** (0.081)		0.34*** (0.060)		-0.071*** (0.027)
CAPEX		-1.07*** (0.54)		-0.33 (0.41)		-0.59*** (0.20)
R&D investment		6.63*** (0.61)		5.22*** (0.43)		1.20*** (0.26)
M/B		0.0088*** (0.0025)		0.0089*** (0.0019)		-0.00029 (0.00094)
Board size		0.93*** (0.10)		0.49*** (0.070)		0.39*** (0.038)
Gender ratio (%)		-0.11 (0.20)		0.080 (0.14)		-0.20*** (0.076)
Independent director (%)		1.05*** (0.15)		0.71*** (0.10)		0.39*** (0.057)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firms’ Errors cluster	Yes	Yes	Yes	Yes	Yes	Yes
N	14627	14370	14627	14370	14627	14370
R-sq	0.139	0.611	0.129	0.548	0.137	0.587
Adj. R-sq	0.135	0.609	0.125	0.545	0.133	0.585

Notes: This table presents the influence of CEO powers on the relationship between firm-level climate change exposure and outside directors’ pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). All variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 5 Ruling out alternative explanations measured by firm financial distress, state-level social capital, state-level climate change.

	<i>Panel A: Total Pay</i>					<i>Panel B: Stock & Option Awards</i>					<i>Panel C: Cash Payments</i>				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
TCCE	-0.044*** (0.010)	-0.045*** (0.010)	-0.044*** (0.010)	-0.045*** (0.010)	-0.044*** (0.010)	-0.027*** (0.008)	-0.027*** (0.0081)	-0.026*** (0.008)	-0.027*** (0.008)	-0.027*** (0.008)	-0.013*** (0.004)	-0.013*** (0.004)	-0.013*** (0.004)	-0.014*** (0.004)	-0.013*** (0.004)
Altman Z-score	-0.058 (0.039)				-0.057 (0.039)	-0.030 (0.021)				-0.030 (0.021)	-0.021 (0.014)				-0.021 (0.014)
KZ index		0.012 (0.011)			0.011 (0.011)		0.014* (0.0076)			0.013* (0.0075)		-0.004 (0.004)			-0.004 (0.004)
State_social capital			-0.054* (0.031)		-0.061* (0.035)			-0.036* (0.021)		-0.047** (0.023)			-0.011 (0.013)		-0.005 (0.014)
State climate risk				0.003 (0.007)	-0.002 (0.006)				0.003 (0.005)	-0.001 (0.004)				0.001 (0.002)	0.001 (0.002)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms' Errors cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14062	14367	14349	14286	13975	14062	14367	14349	14286	13975	14062	14367	14349	14286	13975
R-sq	0.616	0.611	0.611	0.611	0.616	0.552	0.549	0.549	0.548	0.552	0.591	0.586	0.586	0.587	0.591
Adj. R-sq	0.614	0.609	0.609	0.608	0.614	0.549	0.546	0.546	0.545	0.549	0.588	0.584	0.584	0.584	0.589

Notes: This table presents the verification of our baseline results with additional control of variables that are likely influential factors (firm financial distress, state -level social capital, state-level climate change). The independent variable in Panel A, B and C is Total pay, Stock& Option Awards, Cash Payments, respectively. Most variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 6 The impact of Paris Agreement on CCE-outside directors' pay.

	<i>Panel A: Total Pay</i>		<i>Panel B: Stock & Option Awards</i>		<i>Panel C: Cash Payments</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
TCCE_High	-0.35*** (0.073)	-0.11*** (0.041)	-0.23*** (0.047)	-0.070** (0.028)	-0.090*** (0.026)	-0.028* (0.016)
Paris Agreement	-0.37*** (0.078)	0.064 (0.067)	-0.15*** (0.052)	0.13*** (0.050)	-0.18*** (0.026)	-0.044* (0.023)
TCCE_High*Paris Agreement	0.14* (0.078)	0.095* (0.052)	0.058 (0.051)	0.039 (0.037)	0.044* (0.027)	0.025 (0.018)
Firm size		-0.77*** (0.036)		-0.45*** (0.024)		-0.29*** (0.013)
ROA		-2.40*** (0.34)		-1.40*** (0.24)		-0.74*** (0.12)
Leverage		-0.49*** (0.12)		-0.30*** (0.084)		-0.17*** (0.053)
Cash		0.053 (0.15)		-0.19* (0.099)		0.23*** (0.057)
Dividend payout		3.10*** (0.80)		1.52*** (0.54)		1.17*** (0.31)
Intangible assets		-0.56*** (0.12)		-0.36*** (0.086)		-0.16*** (0.045)
Sale growth		0.25** (0.10)		0.35*** (0.075)		-0.096*** (0.034)
CAPEX		-1.26** (0.61)		-0.58 (0.43)		-0.48** (0.24)
R&D investment		6.47*** (0.66)		5.25*** (0.48)		1.01*** (0.28)
M/B		0.0062** (0.0026)		0.0067*** (0.0019)		-0.0013 (0.0011)
Board size		1.10*** (0.13)		0.60*** (0.085)		0.42*** (0.047)
Gender ratio (%)		-0.31 (0.24)		-0.075 (0.16)		-0.26*** (0.088)
Independent director (%)		0.52*** (0.18)		0.35*** (0.12)		0.24*** (0.068)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firms' Errors cluster	Yes	Yes	Yes	Yes	Yes	Yes
N	8325	8195	8325	8195	8325	8195
R-sq	0.109	0.630	0.113	0.578	0.098	0.596
Adj. R-sq	0.102	0.627	0.106	0.574	0.091	0.592

Notes: This table presents the influence of Paris agreement on the relationship between firm-level climate change exposure and outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). All variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 7 Propensity score matching.

	<i>Panel A: Total Pay</i>	<i>Panel B: Stock & Option Awards</i>	<i>Panel C: Cash Payments</i>
	(1)	(2)	(3)
TCCE	-0.049*** (0.010)	-0.030*** (0.0080)	-0.015*** (0.0035)
Firm size	-0.68*** (0.028)	-0.38*** (0.017)	-0.26*** (0.011)
ROA	-1.86*** (0.27)	-1.02*** (0.18)	-0.72*** (0.11)
Leverage	-0.50*** (0.12)	-0.33*** (0.081)	-0.15*** (0.049)
Cash	0.0024 (0.13)	-0.20*** (0.089)	0.18*** (0.050)
Dividend payout	1.45*** (0.70)	0.34 (0.45)	0.89*** (0.29)
Intangible assets	-0.69*** (0.12)	-0.42*** (0.079)	-0.25*** (0.043)
Sale growth	0.29*** (0.092)	0.32*** (0.069)	-0.027 (0.030)
CAPEX	-1.19*** (0.52)	-0.41 (0.37)	-0.62*** (0.21)
R&D investment	5.56*** (0.67)	4.42*** (0.47)	1.03*** (0.28)
M/B	0.0091*** (0.0031)	0.0093*** (0.0025)	-0.0016 (0.0012)
Board size	0.80*** (0.11)	0.41*** (0.068)	0.34*** (0.042)
Gender ratio (%)	-0.19 (0.22)	-0.021 (0.15)	-0.21*** (0.080)
Independent director (%)	0.81*** (0.17)	0.53*** (0.11)	0.35*** (0.061)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firms' Errors cluster	Yes	Yes	Yes
Observations	8937	8937	8937
R-sq	0.594	0.528	0.585
Adj. R-sq	0.590	0.523	0.581

Notes: This table presents the influence of alternative measures of firm-level climate change exposure on outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C) for Propensity Score Matching (PSM) sample. All variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 8 Alternative measures of climate change exposure.

	<i>Panel A: Total Pay</i>			<i>Panel B: Stock & Option Awards</i>			<i>Panel C: Cash Payments</i>		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
OPCCE	-0.055*** (0.019)			-0.030** (0.015)			-0.023*** (0.0059)		
RGCCE		-0.22*** (0.086)			-0.16*** (0.054)			-0.054*** (0.025)	
PHCCE			-0.15 (0.10)			-0.11 (0.073)			-0.042 (0.032)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms' Errors cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14370	14370	14370	14370	14370	14370	14370	14370	14370
R-sq	0.611	0.611	0.610	0.548	0.548	0.548	0.586	0.585	0.585
Adj. R-sq	0.609	0.608	0.608	0.545	0.545	0.545	0.584	0.583	0.583

Notes: This table presents the alternative measures of firm-level climate change exposure on outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). Most variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 9 Use of peer-firm CCE.

	<i>Panel A: Total Pay</i>			<i>Panel B: Stock & Option Awards</i>			<i>Panel C: Cash Payments</i>		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>(A) Climate change exposure = Top 75 quantile of CCE</i>									
CCE_top75	-0.28*** (0.051)	-0.14*** (0.030)	-0.13*** (0.030)	-0.18*** (0.033)	-0.084*** (0.020)	-0.084*** (0.020)	-0.066*** (0.019)	-0.032*** (0.012)	-0.029** (0.011)
Firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Governance controls	No	No	Yes	No	No	Yes	No	No	Yes
N	14627	14370	14370	14627	14370	14370	14627	14370	14370
R-sq	0.105	0.601	0.612	0.107	0.541	0.549	0.092	0.570	0.586
Adj. R-sq	0.101	0.598	0.609	0.102	0.538	0.546	0.088	0.568	0.583
<i>(B) Climate change exposure = Top 90 quantile of CCE</i>									
CCE_top90	-0.25*** (0.061)	-0.13*** (0.035)	-0.13*** (0.035)	-0.16*** (0.039)	-0.078*** (0.024)	-0.079*** (0.024)	-0.062*** (0.023)	-0.030** (0.014)	-0.026* (0.014)
Firm controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Governance controls	No	No	Yes	No	No	Yes	No	No	Yes
N	14627	14370	14370	14627	14370	14370	14627	14370	14370
R-sq	0.102	0.600	0.611	0.104	0.540	0.548	0.091	0.570	0.585
Adj. R-sq	0.098	0.598	0.609	0.100	0.537	0.545	0.087	0.567	0.583

Notes: This table present our baseline results (for both Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C)) are insensitive to the use of peer firm CCE measure as the key independent variable instead of firm CCE. We define peer firm CCE as the industry (SIC2) top 7 and top 90 excluding the focal firms. Most variables are defined in Table 1. Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.

TABLE 10 Quantile regression.

	<i>Panel A: Total Pay</i>			<i>Panel B: Stock & Option Awards</i>			<i>Panel C: Cash Payments</i>		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<i>q25</i>	<i>q50</i>	<i>q75</i>	<i>q25</i>	<i>q50</i>	<i>q75</i>	<i>q25</i>	<i>q50</i>	<i>q75</i>
TCCE	-0.0068**	-0.015***	-0.034***	-0.0054**	-0.0092***	-0.019***	-0.0014	-0.0029	-0.011***
	(0.0033)	(0.0050)	(0.010)	(0.0022)	(0.0033)	(0.0068)	(0.0014)	(0.0019)	(0.0038)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14370	14370	14370	14370	14370	14370	14370	14370	14370

Notes: The table presents the quantile regression results for the influence of firm level climate change exposure on outside directors' pay measured by Total Pay (Panel A), Stock & Option Awards (Panel B) and Cash Payments (Panel C). Standard errors are in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.