CEO Power and Carbon Emissions Management: Australian Evidence

Hoa Luong[a], Abeyratna Gunasekarage[b,#] and Jayanthi Kumarasiri[c]

[a]Department of Accountancy and Finance, University of Otago, Dunedin, New Zealand. Email: hoa.luong@otago.ac.nz

[b]Department of Banking and Finance, Monash Business School, Monash University, Melbourne, Australia. Email: abeyratna.gunasekarage@monash.edu

[c]School of Accounting, Information Systems and Supply Chain, RMIT University, Melbourne, Australia. Email: jayanthi.kumarasiri@rmit.edu.au

[#]Corresponding author.

CEO Power and Carbon Emissions Management: Australian Evidence

Abstract

Corporate leaders are under significant pressure from regulatory bodies and various stakeholders to reduce their carbon footprint. In this study, we investigate how CEO power contributes to the emissions management of Australian companies. Constructing a CEO power index and employing firm-level carbon emissions data, we document a significant negative relationship between CEO power and carbon emissions, suggesting that in the presence of powerful CEOs firms better manage their carbon emissions. This outcome continues to hold after addressing for potential endogeneity concerns. Extending our analyses into four dimensions of CEO power, we find that structural power and expert power reduce carbon emissions, but, in contrast, prestige power increases the carbon emissions of sample firms. Further analyses show that emissions management plays a significant mediating role in the association between CEO power and firm performance. The survey administered among sustainability managers reveals corroborative evidence that the leadership of powerful CEOs is an essential element in managing carbon emissions and mitigating the risk associated with climate change. The findings of this study provide insights to policy makers, regulators, and corporate top-management teams regarding an issue which is under severe public scrutiny and social pressure.

Keywords: Carbon emissions; Climate change; CEO power; Power dimensions; Sustainability managers.

JEL Classification: *G34; G14; Q54*

CEO Power and Carbon Emissions Management: Australian Evidence

1. Introduction

The Global Risk Perception Survey identifies "climate action failure as the number one long-term threat to the world and the risk with potentially the most severe impacts over the next decade" (World Economic Forum, 2022, p.8). Similarly, the Financial Stability Board headed by industry leaders such as Michael Bloomberg has identified climate change risk as "one of the most significant, and perhaps most misunderstood risks that organizations face today" (Task Force on Climate-related Financial Disclosure [TCFD], 2017). The excessive release of carbon dioxide and its equivalents (CO2e) into the atmosphere, commonly known as carbon emissions, has been identified as the primary cause of climate change, and global corporate activities are a major contributing factor for CO2e generation (Intergovernmental Panel on Climate Change, 2014). These criticisms, together with recent legislative changes and public pressure on protecting the climate, have compelled the top teams of companies to integrate emissions performance into their corporate strategic plans.

Within companies' top teams, CEOs have a unique influence over the strategic decision-making process (Bachmann et al., 2020; Sariol & Abebe, 2017). This influence is exemplified when the CEO possesses a great deal of power compared to others in the top team. Drawing from the social theory of power, Walls and Berrone (2017) contend that "power is a tool that can be used to influence others to do (or believe) something that they otherwise would not" (Walls & Berrone, 2017, p.295). Adams et al. (2005) apply this phenomenon to the corporate setting and claim that powerful CEOs can consistently influence key strategic decisions in their firms, irrespective of the potential opposition from other executives. Consequently, the influence of CEO power on the strategic decisions and outcomes of companies has been the subject of investigation in many empirical studies. The evidence uncovered in these studies reveals that CEO power has a significant influence on operating and return performances (Adams et al., 2005; Lee et al., 2008; Kale et al., 2009), cost of equity (Chen et al., 2013); acquisition decisions (Grinstein & Hribar, 2004; Bebchuk et al., 2011; Landier et al., 2012); credit ratings (Liu & Jiraporn, 2010); leverage choices (Korkeamäki et al., 2017); patents, citations and innovations (Sariol & Abebe, 2017; Sheikh, 2018); accounting manipulations (Feng et al., 2011); corporate fraud (Khanna et al., 2015); and audit committee effectiveness (Lisic et al., 2016).

In the spheres of corporate social responsibility (CSR) and environmental performance, a variety of CEO characteristics – such as ability, career horizon, hubris, ethical leadership, higher education, gender, political ideology, and personal values and incentives – have been found to be influential determinants of CSR and the environmental actions of companies (see Hemingway & Maclagan, 2004; Manner, 2010; Chin et al., 2013; Oh et al., 2014; Fabrizi et al., 2014; Tang et al., 2015; Wu et al., 2015; Petrenko et al., 2016; Yuan et al., 2019). The CSR literature highlights the importance of having the commitment and contribution of top executives, including the CEO, in achieving the desired environmental performance for a firm (see Lee & Ball, 2003; D'Amato & Roome, 2009; Walls et al., 2012).[1] However, our understanding of the influence of the power possessed by CEOs on the emissions management of their companies is limited. Carbon emissions initiatives are highly uncertain strategic actions that demand a long-term commitment and leadership from the top team of the firm, including the CEO. Therefore, an investigation of the influence of CEO power in managing carbon emissions and the associated risk can be of interest to many stakeholders of a firm.

Australia provides an interesting setting to investigate how the power possessed by CEOs influences the emissions management activities of their firms. Australia is one of the largest exporters of fossil fuels in the world and relies heavily on fossil fuels as its primary source of energy (Urne, 2021). During the period 2015–2020, Australia topped the list of coal power greenhouse gas emitters by reporting an annual average per capita level of emissions five times greater than the global average and 40% higher than any other major coal power user in the world (The Guardian, 2021). Consequently, the Australian government and Australian companies have come under significant pressure from international bodies, lobbying groups, and various stakeholders to reduce their carbon footprint (Crowley, 2021). This situation has been exacerbated by the absence of an effective climate change policy in Australia. As acknowledged by the Science, Technology, Environment, and Resources Section of the Parliament of Australia, the inconsistency in policy adoption and the lack of direction have hindered the country's commitment to climate change actions.[2]

[1]To summarise, Lee and Ball (2003) find that top management's commitment has both direct and indirect influences on a company's environmental actions. D'Amato and Roome (2009) contend that top management support is a vital ingredient for a company to make real progress toward environmental performance. Walls et al. (2012) find that the support for and the commitment of the board of directors towards environmental performance has a direct influence on their companies' environmental outcomes.

[2] The following link provides a chronology of climate change policy in Australia: https://parlinfo.aph.gov.au/parlInfo/download/library/prspub/4590624/upload_binary/4590624.pdf;fileType=application/pdf.

The lack of effective climate change policy guidance at the national level in Australia leaves the country's corporate leaders with the responsibility to come up with their own emissions management actions to combat the risk associated with climate change and to mitigate the impact arising from climate change risk on their businesses (Crowley, 2021). There is an expectation from Australian society for corporate leaders to take effective actions to curb and manage carbon emissions released to the atmosphere by their companies. For example, TCFD places climate change issues squarely on the shoulders of board members of Australian companies and considers climate change risk management as 'Directors Duties' (TCFD, 2019). The Australian Securities and Investments Commission (ASIC) holds a similar view. Mr, John Price, the commissioner of ASIC, emphasises that "directors who fail to consider climate change risk now could be found liable for breaching their duty of care and diligence in the future" (ASIC, 2018). The objective of putting direct pressure and placing the responsibility on corporate leaders' shoulders by stakeholders is the belief that leadership from top management is an essential factor in driving climate change risk–related actions from companies (Hoffman, 2007, Walls & Berrone, 2017).

The objective of this study is to investigate whether CEO power makes a significant contribution to the management of carbon emissions by Australian firms. In this regard, we first conduct a battery of empirical tests using firm-level financial data for the period 2009–2019 and investigate the influence of CEO power on the carbon emissions released by Australian companies and the influence of this relationship on the financial performance of sample firms. As a complement to our quantitative analyses, we administer a short questionnaire survey among a sample of top corporate managers directly involved in the carbon emissions management activities of Australian companies and analyse their views. We pursue this mixed method approach to determine whether the views of the experts in the field corroborate our empirical findings or whether they perceive the issue under investigation from a different perspective.

Our data analyses reveal that CEO power has a statistically significant negative influence on the emissions-to-sales ratio and energy consumption-to-sales ratio of sample firms, implying that companies with powerful CEOs better manage their emissions levels. This finding remains robust after addressing endogeneity concerns, such as reverse causality using two-stage least square regressions (2SLS), sample selection bias using Heckman's two-stage model, and omitted variable bias using the propensity score matching (PSM) technique. However, interesting differences emerge when we analyse different power dimensions that contribute to overall CEO power. While structural power and expert power are beneficial in emissions reduction, prestige power is found to increase the emissions levels of firms. Ownership power has no effect on emissions management. The climate change risk managers who participated in the survey expressed similar views to the evidence uncovered in quantitative analyses. These experts believe that the CEO as the leader of the top team has a vital role to play in emissions management, and that having a powerful CEO is important in the process of managing emissions levels and the risk associated with carbon emissions. While they believe that structural power and expert power are the most beneficial dimensions of power in mitigating emissions, they expressed some conflicting views regarding ownership power and prestige power. Our additional analyses reveal that the CEO power–emissions management relationship is not conditional on whether a firm operates in a carbon-intensive industry or during extreme weather periods. We also find that emissions management plays a significant mediatory role in the relationship between CEO power and firm performance.

Our study makes several contributions. First, in the governance literature, the role of CEOs has received huge academic attention due to their fiduciary duties and ability to affect board decisions. Most studies that have investigated the influence of CEO power on major financial decisions of firms tend to highlight the dark side of powerful CEOs. While the evidence on the influence of CEO power on the environmental orientation of firms is inconclusive, its role in emissions management remains largely unexplored. We tap into this literature and document that powerful CEOs better manage the carbon emissions of their firms and therefore provide evidence regarding the bright side of CEO power. Second, prior studies that have investigated CEOs' influence on the non-financial performance of firms (such as environmental performance) have limitations in terms of measuring such performance. For instance, studies that employ environmental, social, and governance (ESG) ratings as a proxy for non-financial performance do not disentangle the severity of environmental issues, such as carbon emissions, from other non-financial measures of performance. To counter this, we use an objective measure of environmental orientation, i.e., carbon emissions, which captures the direct impact of a firm's business activities on environmental damage. Therefore, our measure is an objective reflection of a firm's efforts to mitigate its environmental impacts or the extent of damage it makes to the environment. Third, since this is a topic of interest to various stakeholders in society, we complement our empirical analyses with views expressed by climate risk management experts in the field and provide evidence on whether the industry experts also subscribe to empirically testable theoretical explanations or whether their perceptions lead to different findings. Fourth, as the world faces the issue of climate change, businesses have an ethical responsibility to conduct their business activities in an environmentally friendly manner. Being the major emitters of CO2e that contributes to climate change, companies are under significant pressure to reduce carbon emissions and to curb their damaging effects. In this regard, our findings are vital for top management teams, including the CEOs who could provide the leadership and commitment to enhance the green image of their firms by better managing carbon emissions and promoting ethical and sustainable business practices. Finally, the findings of this study provide insights to regulators and policy makers in their efforts to tailor regulations and policies to reduce carbon emissions released into the atmosphere by companies and to achieve a green economy.

The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature and develops hypotheses. Section 3 describes the sample selected, defines the variables used, explains the data collected, and outlines the methodology employed in the study. Section 4 discusses the findings, while Section 5 presents the findings of additional analyses. The last section concludes.

2. Background literature and hypotheses development

2.1. Background literature

2.1.1. CEO power and strategic decisions

Top executives play a wide range of important roles in allocating resources, establishing policies and programs, developing their firm in line with its strategic direction, and implementing the overall corporate strategy of the firm (Cannella et al., 2009). It is argued that the entrustment of discretionary power to top executives is essential to achieve the strategic goals of firms (Walls & Berrone, 2017), and magnifying the leadership of the top team through the allocation of discretionary power is important, particularly when the business environment is highly unstable and uncertain (Thompson, 1967; Hambrick & Finkelstein, 1987; Agle et al., 2006).

Being the architects of their firms' overall strategy, CEOs dominate the strategic directions of their organisations (Rotemberg & Saloner, 2000; Berger et al., 2016). According to Gioia and Chittipeddi (1991), "the CEO is portrayed as someone who has primary responsibility for setting strategic directions and plans for the organization, as well as responsibility for guiding actions that will realize those plans" (p.434). Consequently, CEOs have a significant influence on the strategic decision-making process of their firms (Sariol & Abebe, 2017; Gunasekarage et al., 2020). Adams et al. (2005) claim that, while being highly influential in key decisions of their firms, CEOs are the sole decision makers of all the major decisions of some firms.

The literature on executive power argues that CEOs should be entrusted with the necessary power to take speedy decisions under conditions of uncertainty and to respond quickly to opportunities arising from changing market conditions (Finkelstein & D'Aveni, 1994; Boyd, 1995). This allows CEOs to establish a unified command among the top executives and to clarify their decision-making authority within the firm (Finkelstein & D'Aveni, 1994). Han et al. (2016) argue that having a powerful CEO expedites the decision-making process of the firm by mitigating conflicts within the top team and overcoming unnecessary bureaucratic constraints. A number of studies provide empirical support for these arguments. For example, Sariol and Abebe (2017) find that firms led by powerful CEOs focus more on organisational innovation, and, in particular, they are willing to pursue risky explorative innovations. Lewellyn and Muller-Kahle (2012) contend that, even though innovative strategic decisions carry significant risk, powerful CEOs are willing to pursue those strategies because they believe that those decisions enhance corporate wealth and expand the firm's current product-market portfolio. Chen (2014) uncovers evidence that research and development investments undertaken to enhance innovative capabilities are high in companies with powerful CEOs. As such, having necessary power is an essential prerequisite for a CEO to take strategic decisions in an uncertain environment.

2.1.2. Emissions management initiatives as uncertain strategic decisions

Companies take emissions management initiatives in response to stakeholder demands to address climate change issues (Ott & Schiemann, 2022). Addressing climate change is a strategic issue and uncertainty is at the core of this issue (Stern, 2007). In addition to the scientific uncertainty inherent in emissions management initiatives, uncertainties around climate change polices work as barriers to effective emissions management actions for companies (Visschers, 2018; Kumarasiri, 2016). Hallegatte (2009) finds that uncertainty around climate change issues makes the designing of emissions management investments extremely challenging. Crozier (1964) contends that the top executives of the firm, such as the CEOs, are in a unique position to manage internal and external uncertainty. In this context, Ramani and Ward (2019) claim that the leadership of corporate boards (i.e., CEOs) has a critical role to play in driving the climate change strategies (such as emissions management initiatives) of their companies.

Australia has been particularly prone to uncertainty surrounding climate change issues (Talberg et al., 2015). This has arisen from inconsistent climate policies and the lack of directions for emissions management initiatives in the country. A very recent example of this regulatory uncertainty is the repeal of the fixed-price Carbon Tax introduced by the Labour government in 2012 by the Liberals-led Coalition Government in 2014 and the replacement of it with the Direct-Action Plan. The directors of Australian companies consider the uncertainty of the government's climate policy as the biggest constraint they face in taking effective actions to manage carbon emissions (Australian Institute of Company Directors [AICD], 2021). These directors view climate change issues as a "high velocity strategic risk with significant ambiguity driven by external factors" (AICD, 2021, p. 14). Therefore, managing carbon emissions to address climate change issues remains a highly uncertain strategic decision for Australian corporate leaders.

2.2. Hypotheses development

The influence of CEOs on corporate strategies, together with the far-reaching consequences associated with CSR and environmental management actions of companies, has encouraged many scholars to investigate the influence of CEO power on CSR and the environmental performance of firms. By analysing a sample of 4,863 US companies over the period 2002–2017, Aibar-Guzmán and Frías-Aceituno (2021) find CEO power to be an essential factor in ensuring environmental innovation of firms. More specifically, CEO power plays a crucial role in implementing projects that do not entail a higher return in the short and medium terms, such as investments in clean technologies, ecological production processes, and development of environmentally sustainable products. By analysing a sample of 350 FTSE firms in the UK, Li et al. (2018) find a positive association between CEO power and greater commitment to ESG practices of companies. Similarly, Javeed and Lefen (2019) find a positive association between CEO power and CSR performance for Pakistani companies. However, Jiraporn and Chintrakarn (2013) uncover a non-monotonic relationship between CEO power and investments in CSR initiatives for a sample of US companies; the association between power and CSR is positive (negative) when CEOs are relatively less (more) powerful. Sheikh (2019) finds a negative relation between CEO power and firms' engagements in CSR; powerful CEOs tend to reduce CSR strengths but do not increase CSR concerns. Similarly, Muttakin et al. (2018) report that CEO power hampers the CSR practices of Bangladeshi firms. Walls and

Berrone (2017), who analysed a sample of US companies, find that CEOs' influence on the environmental performance of their companies is amplified when CEOs also enjoy formal power over the board of directors and the top management team.

Even though the above studies have investigated the relationship between CEO power and broader CSR or environmental performance, our understanding of the influence of CEO power on emissions management is limited. Corporations are under significant pressure from various stakeholder groups to take urgent and significant emissions management actions to adapt to climate change risk (O'Dwyer & Unerman, 2020). Australian firms face a significant amount of regulatory uncertainty, in addition to the scientific and strategic uncertainties inherent in emissions management initiatives, when integrating emissions management actions into their strategic plans. The literature on executive power argues that top executives, such as the CEOs, should be entrusted with power to deal with internal and external uncertainties (Thompson, 1967; Finkelstein, 1992). While Sheikh (2018) contends that powerful CEOs are more capable of leading their companies under conditions of uncertainty, Walls and Berrone (2017) foresee CEO power as an important area of investigation because power allows them (CEOs) to make decisions on how their companies should respond to social and environmental demands by stakeholders. Based on their finding that public outrage negatively affects excessive rent-seeking behaviour of powerful CEOs, Abernethy et al. (2015) believe that powerful CEOs could act quicker than other CEOs to minimise the economic and social costs of public outrage. Therefore, one could expect powerful CEOs to take emissions management actions more than their less powerful counterparts in response to the pressure exerted by stakeholders of their firms.

However, given that prior studies provide conflicting evidence in relation to the influence of CEO power on CSR and environmental performance of firms, we propose and test the following non-directional hypothesis:

H1: There is an association between CEO power and the emissions management of firms.

While we believe that we can propose H1 in a non-directional form, given that executives accrue power through different dimensions, we cannot rule out the possibility that some dimensions of power are more influential in managerial decision-making than others. Finkelstein (1992) identifies four different dimensions of power: (i) structural, (ii) ownership, (iii) expert, and (iv) prestige.

Structural power is based on a formal organisational structure and hierarchical authority (Finkelstein, 1992). With respect to CEO power, empirical studies commonly use CEO duality and CEO pay slice as representatives of structural power. Empirically, while Berrone et al. (2010) find no association between CEO duality and environmental performance, Walls et al. (2012) report that the environmental performance suffers when CEO duality is combined with high levels of institutional ownership. Jiraporn and Chintrakarn (2013) find CEO pay slice to have a non-monotonic relationship with CSR performance. Harper and Sun (2019) find that CEOs with structural power are less likely to engage in CSR activities of their companies.

With respect to ownership power, Finkelstein (1992) claims that a top executive with significant shareholdings in a company or who are founders of that company can be more powerful than a manager without such a base of control. Empirically, Javeed and Lefen (2019) find a positive association between CEO share ownership and CSR performance, implying CEOs' belief that investing in society provides their firms with maximum profits and a positive image in return. Wu et al. (2015) find that the ethical leadership of founder-CEOs, which captures ownership power, has a significant influence on the CSR actions of their companies. However, Sheikh (2019) finds a negative relation between the ownership dimension of CEO power and a firm's engagements in CSR activities.

CEOs can gain expertise power by having expertise in the relevant field (Finkelstein, 1992). Lines (2007) finds that top management with process and content expertise (expert power) are more likely to successfully implement strategic changes. In this regard, the literature links CEOs' tenure and their executive experience with the environmental performance of firms. Empirically, while Oh et al. (2014) find an insignificant relationship between CEO tenure and CSR performance, Yuan et al. (2019) find CEOs with shorter tenure to be more willing to undertake CSR activities. De Villiers et al. (2011) find that CEOs with business expertise lead their companies in obtaining vital resources necessary to pursue sound environmental initiatives. Similarly, Walls and Berrone (2017) and Huang et al. (2019) find that CEOs with experience in environmental matters have a direct influence on the environmental performance of their companies.

Finkelstein (1992) claims that top managers gain prestige power through their reputation in the institutional environment and among other stakeholders. CEOs who serve as directors for other firms and with elite educational backgrounds are viewed as those with prestige power (Lewellyn et al., 2012; Lisic et al., 2016). While the evidence on the influence of other directorships on environmental performance is absent in the literature, Manner (2010) finds CEOs with a bachelor's degree in the humanities have a positive impact on the CSR performance of their firms. Huang (2013) analyses eight different degrees held by CEOs and finds that MBA and MSc degrees are the only two qualifications that have a positive association with the CSR performance of their companies, suggesting the possibility that the integration of CSR education into these two degrees could be the reason for this influence.

The above discussion of existing findings does not provide a clear directional relationship between each dimension of CEO power and the CSR/environmental performance of firms. This suggests that any relationship that the above four power dimensions may have with emissions management remains an open empirical question. Therefore, we propose to test the following hypothesis:

H2: The degree of the relationship between CEO power and emissions management, if any, differs across the four power dimensions.

3. Sample selection, variable definitions, data, and methodology

3.1. Sample construct

3.1.1 Sample for empirical analyses

In Australia, under the National Greenhouse and Energy Reporting (NGER) Scheme, corporations that meet certain emissions thresholds must report to the Clean Energy Regulator their emissions, energy production, and energy consumption each financial year. [3] Therefore, we accessed the Clean Energy Regulator website for the carbon emissions data of ASX-listed companies for the period 2009–2019. Our sample period starts in 2009 because the Clean Energy Regulator started publishing emissions information in that year. As Panel 1 of Table 1 reveals, our initial sample consisted of 3,851 firm-year observations. We then collected information about the compensation of CEOs and other executives, current and past employment records of CEOs, and educational backgrounds of CEOs from the SIRCA and CAPITAL IQ databases. The same databases were used to collect the governance data for the sample firms. To optimise the sample size, if any of the above information is missing in the respective databases, we turned to company annual reports and manually collected the missing information. We then matched the information collected from the these sources with the initial sample and disregarded 1,834 observations (47.62%) for which the necessary core biography

[3] The current corporate group threshold is 50 kt or more of greenhouse gases (CO_2-e) (scope 1 and scope 2 emissions); production of 200 TJ or more of energy; or consumption of 200 TJ or more of energy.

data and governance data were not available. For the remaining sample, both accounting and market-based data that are necessary to estimate regression models were collected from Datastream and CAPITAL IQ. Consequently, 544 observations (14.13%) were dropped due to the non-availability of this information. This process provided us with a usable sample of 1,473 firm-year observations, representing 38.25% of the initial sample.

The industry distribution of the sample is provided in Panel B. As per the sectoral distribution of the sample based on GICS industry classification, the Electric Utilities industry makes the highest contribution (7.88%) followed by the Packaged Foods and Meats (6.65%) and Diversified Metal and Mining (5.70%) industries. While the contribution of other industries remains below 5%, a fair distribution of sample firms across a wide range of industries can be observed.

[Insert Table 1 about here]

3.1.2 Sample for qualitative analysis

We sent LinkedIn invitations to the managers responsible for climate change risk management of the highest-emitting 150 ASX listed companies in the financial year 2018/19, asking them to participate in a short questionnaire survey on emissions management. In these messages, we provided a brief description of the study, requested them to participate in a short survey questionnaire, and asked them to provide us with their email addresses to send the questionnaire, if they were willing to do so. Thirty-three managers responded to our request informing us of their willingness to participate; 25 of them provided email addresses, while the remaining eight were willing to receive the survey as an attachment to a LinkedIn message. The survey questionnaire, accompanied by a cover letter, was sent to these respondents. It was specifically mentioned that the participation in the survey was entirely voluntary. Two respondents withdrew after receiving the survey. Out of the remaining 31, three managers returned the survey within two weeks. A reminder email/message was sent two weeks after sending the survey, and six more managers returned the completed survey within three weeks after this email. A second reminder was sent five weeks after sending the survey, but no new completed questionnaires were received. Therefore, we have nine usable responses which represent 6% of the LinkedIn invitations sent and 27% of those who agreed to participate in the survey. These managers included six men and three women, and they hold the positions of either environmental manager or sustainability manager. Collectively, we refer to them as sustainability managers (SM) for convenience.

A brief description of each sustainability manager's position and professional background is provided in Appendix A.

3.2.Variable measurement

3.2.1. Dependent variable: Carbon emissions management

We use carbon emissions-to-sales ratio as the dependent variables in our regression models (presented in Section 3.3) to reflect the emissions management efficiency of a firm relative to its operations. The Clean Energy Regulator requires Australian companies that meet the emissions threshold requirement to report the following on an annual basis: (i) total carbon emissions released (*TOTALEMISSIONS*), (ii) Scope 1 carbon emissions released (*SCOPE1*), (iii) Scope 2 carbon emissions released (*SCOPE2*), and (iv) net energy consumed (*NEC*). Consequently, we use the following four measures as the representatives of the carbon emissions of a firm:

$$TOTALEMISSIONS = \frac{Total\ carbon\ emissions\ released\ (in\ million)}{Sales} \quad [1]$$

$$SCOPE1 = \frac{Scope\ 1\ carbon\ emissions\ released\ (in\ million)}{Sales} \quad [2]$$

$$SCOPE2 = \frac{Scop\ \ 2\ carbon\ emissions\ released\ (in\ million)}{Sales} \quad [3]$$

$$NEC = \frac{Net\ energy\ consumed\ (in\ million)}{Sales} \quad [4]$$

These emissions measures encapsulate a broad spectrum of climate change activities. As per the NGER scheme, Scope 1 refers to direct emissions from sources that are owned or controlled by the company; Scope 2 refers to indirect emissions released into the atmosphere from the use of purchased energy; Net energy consumption is calculated by subtracting the energy content of the secondary fuels and energy commodities produced from the operation of the facility from the total energy consumed by the operation of a facility.

3.2.2. Explanatory variable: CEO power

The main variable of interest in our models is CEO power. The existing studies on CEO power have used several CEO characteristics as the representatives of CEO power. For example, Adams et al. (2005) use three independent characteristics – CEO being one of the founders of the firm, CEO being the only insider on the board, and CEO holding both the titles of chairperson and president – to capture the decision-making authority of the CEO. Bebchuk et al. (2011) use CEO pay slice as a representative of the relative importance of CEOs and their dominance in the decision-making process of firms. Most of these studies examine the power vested in the CEO by the organisational structure and hierarchical authority and the power gained by having links to the founder families of the firm.[4] The much-cited paper on power in top management teams by Finkelstein (1992) identifies four dimensions of power: (i) structural power (related to the distribution of formal positions and titles within the organisational structure), (ii) ownership power (associated with ownership position and the links to the founders of the firm), (iii) expert power (related to executives' expertise in an area critical to an organisation and their breath of experience that makes them capable of dealing with critical contingencies), and (iv) prestige power (associated with executives' reputation in the institutional environment and among stakeholders which helps them absorb uncertainty coming from the institutional environment). In this context, the use of a single or multiple CEO characteristics as the representatives of power can be inadequate, as they may not necessarily capture the power stemming from all four dimensions referred to in Finkelstein (1992). Some studies advocate for the use of a composite measure of CEO power that captures all (or some of) the power dimensions referred to above (see, for example, Tang et al., 2011; Han et al., 2016; and Lisic et al., 2016). Therefore, we construct a CEO power index (*CEOPOWER*) for each firm in each year using the following variables representing the four dimensions of power:

- Structural power: We use two variables to capture structural power: (i) CEO pay slice (*CPS*) and (ii) CEO duality (*CEODUALITY*). While CEO compensation relative to the compensation of other executives shows CEOs' dominance in the decision-making process of firms (Bebchuk et al. 2011; Laksmana et al. 2012; Hooghiemstra et al. 2017), the placement of both CEO and chair positions on one individual's hands creates a strong personal powerbase within that individual (Finkelstein, 1992).

- Ownership power: We use CEO's equity ownership (*CEOOWNERSHIP*) in the firm to capture ownership power. From an agency theory perspective, a CEO with substantial equity ownership in the firm is an agent-cum-principal who can exercise substantial authority on important board decisions while reducing the influence exercised by other board members (Lisic et al., 2016; Pathan, 2009).

[4] For further evidence, see Agrawal and Knoeber (1996), Brass (1984), Brickley et al. (1994), Hambrick (1981), Perrow (1970), Rosenstein and Wyatt (1997), Tushman and Romanelli (1985), Villalonga and Amit (2006), Weisbach (1988), and Yermack (1996).

- Expert power: We use two variables to capture expert power: (i) CEO tenure (*CEOTENURE*) and (ii) executive positions held by the CEO in the firm prior to becoming the CEO (*CEOPRIORPOSITIONS*). While long-serving CEOs can create a powerbase by appointing board members and top managers loyal to them (Chava & Purnanandam, 2010; Hermalin & Weisbach, 1998), they gain the functional expertise necessary to deal with environmental uncertainties by holding key executive positions in the firm over the years (Chava & Purnanandam, 2010; Finkelstein, 1992; Hambrick, 1981; Hermalin & Weisbach, 1998).
- Prestige power: We use two variables to capture prestige power: (i) concurrent directorships held by the CEO in other companies (*CEOOTHERDIRECTORSHIPS*) and (ii) higher-degree qualifications held by the CEO (*CEOQUALIFICATIONS*). While institutional reputation gained through networks and ties helps CEOs to acquire resources critical to their firms' success and thereby to deal with institutional uncertainty (Finkelstein, 1992; Johnson et al. 1996), the level of education is reflective of individuals' knowledge and skill base together with their value system and cognitive preferences (Hambrick & Mason, 1984).[5]

We follow the following process in creating the CEO power index. We first collect the annual data for the above seven continuous variables for the study period. Then in each year for each variable, we create a dichotomous variable using the industry-year median as the cut-off; this variable takes the value of one if the value of the continuous variable is equal to or higher than the industry-year median and zero otherwise. We then sum these dichotomous variables across the seven characteristics to create the CEO power index (*CEOPOWER*) for each firm in each year. By construction, the higher the value of the *CEOPOWER* for a firm, the higher should be the power exercised by the CEO of that firm. We also calculate the power scores separately for each dimension of power: (i) structural power (*CEOPOWER_STRUCTURAL*), (ii) ownership power (*CEOPOWER_OWNERSHIP*), (iii) expert power (*CEOPOWER_EXPERT*), and (iv) prestige power (*CEOPOWER_PRESTIGE*).

The definitions of all the variables used in the study are provided in Appendix B.

[5] Compared with US companies, the information on some CEO characteristics – such as founder status, number of years the CEOs held various positions prior to becoming the CEO, and their non-profit board memberships – are not available for the Australian companies. We therefore rely on the available data to construct the four dimensions of power for Australian firms.

3.3. Analytical models

We first investigate the influence of CEO power on carbon emissions by employing ordinary least squares regression (OLS) on the following equation:

$$\begin{aligned} EMISSIONS_{i,t+1} = {} & \beta_0 + \beta_1 CEOPOWER_{i,t} + \beta_2 LNBOARDSIZE_{i,t} + \beta_3 BOARDINDEP_{i,t} + \\ & \beta_4 LNTOTALASSETS_{i,t} + \beta_5 ROA_{i,t} + \beta_6 LEVERAGE_{i,t} + \beta_7 MVBV_{i,t} + \\ & \beta_8 SALESGROWTH_{i,t} + \beta_9 CASHHOLDINGS_{i,t} + \beta_{10} CAPEX_{i,t} + \\ & \beta_{11} NEWFINANCING_{i,t} + \beta_{12} ASSETSNEWNESS_{i,t} + \\ & \beta_{13} LNFIRMAGE_{i,t} + \beta_{14} LITIGATIONRISK_{i,t} + \sum YEAR_t + \\ & \sum INDUSTRY_i + \varepsilon_{i,t} \qquad [5] \end{aligned}$$

where, in separate models, the dependent variable, *EMISSIONS*, is represented by the four carbon emissions measures described in 3.2.1 above: *TOTALEMISSIONS*; *SCOPE1*; *SCOPE2*; and *NEC*. *CEOPOWER* is the main explanatory variable built in Section 3.2.2 above. To support hypothesis 1 (H1), we expect a significant coefficient (positive or negative) for the *CEOPOWER* variable.

To test hypothesis 2 (H2), we estimate Equation (5) separately for each dimension of power where, in separate models, the *CEOPOWER* variable is replaced by *CEOPOWER_STRUCTURAL*, *CEOPOWER_OWNERSHIP*, *CEOPOWER_EXPERT,* and *CEOPOWER_PRESTIGE,* respectively. To support hypothesis 2 (H2), we expect signs and significances of the β_1 coefficient to differ across the above four dimensions of CEO power.

We include several control variables in Equation (5) for the following reasons. Board size (*LNBOARDSIZE*) and board independence (*BOARDINDEP*) were included to capture the influence of governance characteristics on the emissions performance of the firm. While some studies find that larger boards are better monitors that promote sustainability and environmental-related activities leading to enhanced environmental performance (Arena et al., 2015; de Andres & Vallelado, 2008; De Villiers et al., 2011), other studies find that board size has a positive impact on emissions disclosure (Mahmood & Orazalin, 2017; Tauringana & Chithambo, 2015) and reduced greenhouse gas emissions (Haque & Ntim, 2018). Haque (2017) argues that the monitoring role of independent directors is critical in resolving agency issues associated with climate-related investments.[6] Empirically, while De Villiers et al. (2011),

[6] Haque (2017) identifies two possible sources of climate-related activities that lead to agency issues. First, executives with short-term objectives may be reluctant to initiate climate change initiatives that require a long-

Mallin and Michelon (2011), and Post et al. (2015) find board independence to be associated with superior environmental performance, Walls et al. (2012) and Kock et al. (2012) find that board independence is associated with poor environmental performance. The firm size represented by the natural logarithm of total assets (*LNTOTALASSETS*) is used because of (i) the finding that larger firms tend to prioritise environmental issues in their management practices and manage them effectively (Clarkson et al., 2008), (ii) firm size is a driving factor in achieving environmental performance (de Villiers et al., 2011; Henri & Journeault, 2008), and (iii) there is a positive relationship between company size and disclosure of climate change practices (Eleftheriadis & Anagnostopoulou, 2015). Some studies find a positive association between financial performance and environmental performance (Nakao et al., 2007; Stanwick & Stanwick, 2000), while others find profitable firms and those with financial slack to be more proactive in environmental initiatives since they can divert resources towards sustainable practices, such as emissions reduction projects (de Villiers et al., 2011; McKendall et al., 1999; Qiu et al., 2016; Reverte, 2009). We therefore include return on assets (*ROA*), sales growth (*GROWTH*), cash holdings (*CASHHOLDINGS*), and new financing (*NEWFINANCING*) as control variables. Levered firms demonstrate better sustainable practices (Orazalin & Mahmood, 2018) and carbon reduction initiatives are positively influenced by the leverage of the firm (Haque, 2017); consequently, we control for the effect of leverage (*LEVERAGE*). Following the arguments that firms with greater capital intensity and asset newness utilise cleaner and more energy efficient technologies (Clarkson et al., 2008; Haque, 2017) and those with greater investment opportunities can foresee advantages associated with environmental performance (de Villiers et al., 2011), we include the following control variables: capital expenditure (*CAPEX*), asset newness (*ASSETSNEWNESS*), and market value-to-book value (*MVBV*). Firm age (*FIRMAGE*) is controlled for because older firms tend to possess better infrastructure facilities than their younger counterparts that are necessary to manage environmental issues at a lower cost (Mohana-Neill, 1995). We also control for the litigation risk since litigation-prone firms, such as high-carbon emitters, are subject to increased stakeholder pressure to justify their legitimacy (Bui et al., 2020). We also control for the influences stemming from year-specific (*YEAR*) and industry-specific (*INDUSTRY*) factors.

term commitment and bring long-term benefits to shareholders. Second, poorly performing CEOs may initiate symbolic carbon initiatives to neutralise stakeholder pressure in an attempt to secure their positions and to continue to engage in rent seeking behaviour.

4. Analyses and results

4.1. Descriptive statistics and correlations

Table 2 reports descriptive statistics. In Panel A of this table, the average total emissions released by the sample firms is 1.16 million of which 0.93 million is Scope 1, while 0.22 million is Scope 2. The average level of net energy consumed by sample firms is 16.25 million, while the median level is 1.58 million. The total emissions (in millions) as a percentage of sales is 0.86%, on average, and the same ratio for scope I and scope II emissions are 0.78% and 0.08% respectively. The net energy consumed (in millions) by a typical sample firm is 11.18% of its annual sales. In Panel B, the mean value of the CEO power index is 3.02, implying that Australian CEOs gather power across about half of the seven variables analysed in the study. The highest contributory dimension to CEO power is expert power (1.39), followed by structural power (0.63) and prestige power (0.60); the lowest contributory dimension is ownership power (0.39).

In Panel C of Table 1, a sample firm has about six board members, and 72% of them are independent directors. The average value of total assets of our sample firms is $14.4 billion (not reported). These companies are profitable firms that report an average ROA of 3.50%, and they finance one-third of their assets through debt (30%). As reflected by sales growth (6.79%) and capital expenditure-to-total assets ratio (6.35%), these companies are growing firms that invest funds in new capital expenditure projects; 57% of their assets can be identified as new assets. The new financing-to-total assets ratio is 2%, and their equity securities command a market value which is two times of their book value. An average sample firm is about 18 years old.

[Insert Table 2 about here]

We perform Pearson correlation analysis and present the correlation matrix in Table 3. CEO power has a significant negative correlation with three of the four emissions measures. Among the firm characteristics used, the variables such as firm size, profitability, new financing, firm age, and litigation risk have a significant negative association with the level of emissions, while variables such as growth, cash holdings, and capital expenditure have a significant positive association. Several control variables included in Equation (5) have significant correlations among themselves, but their magnitudes are not large enough to cause a multicollinearity issue in our regressions.[7]

[Insert Table 3 about here]

4.2.CEO power and emissions management

In this section, we report the output generated by Equation (5), which was designed to test the study's first hypothesis (H1). Table 4 presents the results. We find that the coefficients for *CEOPOWER* are negative in all four models, three of which are significant at the 5% level (models 1, 2, and 4). These findings indicate that greater CEO power is associated with a reduction in total emissions, Scope 1 emissions, and net energy consumption but has no impact on Scope 2 emissions released by the firm. The reason for the insignificant coefficient generated for Scope 2 emissions could be that CEOs have limited control over these indirect emissions. The CEOs may find moving to renewable energy to reduce indirect emissions as costly decisions, as renewable energy projects are highly capital intensive in nature (Heal, 2020). With respect to economic significance, we infer that a one-standard-deviation increase in CEO power is associated with the following decreases in the carbon emissions of the sample firms: total emissions to sales by 0.0047 (-0.0039 * 1.2108); Scope 1 emissions to sales by 0.0027 (-0.0022 * 1.2108); and net energy consumption to sales by 0.0352 (-0.0291 * 1.2108). Considering the average values of total emissions, Scope 1 emissions and net energy consumed ratios (0.0086, 0.0078, and 0.1118, respectively), these decreases can be considered economically significant. Our findings therefore support H1 and provides evidence that Australian companies demonstrate an efficiency in managing carbon emissions in the presence of powerful CEOs on their boards.

Turning to control variables, we find that variables such as board size, market value-to-book value, capital expenditure, and assets newness have a significant positive influence on all four variants of carbon emissions, while variables such as firm size and profitability have a significant negative influence. As the R^2 values reflect, a substantial fraction of the variability in emissions-to-sales ratios are explained by models (1) to (4). All the model F-statistics are significant at the conventional levels.

[7] The highest correlation of 0.69 exists between total assets and new financing variables. As per Gujarati and Porter (2009), multicollinearity problems occur when the correlation coefficients between variables exceed 0.80, implying that our models do not suffer from this issue. We also conducted variance inflation factor (VIF) test for the control variables and found the largest VIF score of 1.22 for the *LNTOTALASSETS* variable, which is far below the threshold of 10 beyond which multicollinearity concerns arise (Kennedy, 1992).

[Insert Table 4 about here]

4.2. Endogeneity correction

Wintoki et al. (2012) claim that empirical corporate governance studies are generally plagued with endogeneity concerns. Our main variable of interest, CEO power, plays a key role in the governance structure of firms. Therefore, even though we have uncovered a negative influence of CEO power on carbon emissions, our findings could be affected by endogeneity issues. In this section, we address three possible sources of endogeneity: (i) reverse causality, (ii) sample selection bias, and (iii) omitted variable bias. For this purpose, we follow prior studies (Wintoki et al. 2012; Wooldridge, 2010) and employ three influential techniques, namely, instrumental variable 2SLS regressions, Heckman's two-stage model, and PSM technique, to generate endogeneity-corrected outputs to reassure the findings produced by the OLS regression models.

4.2.1. Reverse causality and instrumental variable 2SLS regressions

In the context of our study, reverse causality can be present if better emissions performance leads to greater CEO power. Adams et al. (2005) claim that if a firm has reported a record of better performance in the past, it might give leverage to its CEO to implement changes necessary to strengthen his/her powerbase. Berrone and Gomez-Mejia (2009) find that good environmental performance leads to an increase in CEO pay. In a similar vein, when a firm shows better carbon performance over time, it may give its CEO the opportunity to implement policies that increase the CEO's power. This could give rise to reverse causality between CEO power and emissions management. To address this issue, following prior studies (Shipman et al. 2017; Wooldridge, 2010; Rosenbaum & Rubin, 1983), we estimate instrumental variable 2SLS regressions. For this purpose, we use the proportion of non-CEO directors who resigned each year in a particular industry (*NONCEOTURNOVERIND*) as the instrumental variable. Landier et al. (2012) argue that non-CEO director turnover allows CEOs to appoint loyal individuals as company directors and to consolidate their power. We therefore expect *NONCEOTURNOVERIND* to be related to the endogenous regressor (i.e., CEO power). But we cannot expect non-CEO director turnover in the industry to have a direct link to the carbon emissions management of a firm. Therefore, *NONCEOTURNOVERIND* works as a strong and valid candidate for an instrumental variable. Consequently, we estimate a model where the CEO power variable is the dependent variable, *NONCEOTURNOVERIND* is the instrumental variable, and the firm characteristics included in Equation (5) are the control variables. Once the first-stage model is estimated, we use its coefficients to calculate predicted CEO power

(*IVCEOPOWER*) for each firm in the sample and use this variable as the main explanatory variable in estimating Equation (5), the second-stage regression.

The findings are reported in Table 5. In Panel A, the estimates of the first-stage model confirm our prediction that industry-level non-CEO-director turnover has a positive and significant influence on the CEO power of a firm. The *NONCEOTURNOVERIND* variable generates a positive coefficient (1.5926) which is significant at the 1% level. The regression diagnostics provide robust evidence of the strength and validity of the instruments used. The Kleibergen-Paap rk Wald *F*-statistic generated for the weak instrument test is 224.09, exceeding the recommended minimum of 10 by a significant margin, thus rejecting the null hypothesis that the instrument is weakly identified (Larcker and Rusticus, 2010). More importantly, the second-stage regression output reported in Panel B confirms the results reported in Table 4. The *IVCEOPOWER* variable generates negative and significant coefficients when the dependent variable represents either total emissions, Scope 1 emissions or net energy consumed. Additionally, three out of four Durbin-Wu-Hausman tests are significant, justifying the use of the 2SLS regression estimates.

[Insert Table 5 about here]

4.2.2. Sample selection bias and Heckman's two-stage model

Even though our sample comes from a cross-section of firms listed on the ASX, it is possible for sample selection bias to exist. Specifically, carbon emissions data are available from the Clean Energy Regulator for only those companies that meet a particular emissions threshold. Therefore, our sample may demonstrate a systematic bias if firms that meet the emissions threshold differ systematically in character from those that do not meet the threshold. To correct for this possible sample selection bias, we adopt Heckman's (1979) two-stage selection procedure. In the first-stage model (selection model), we develop a model to predict the probability of a firm belonging to the high-emitting category. For this purpose, we create a categorical variable for each of the four carbon emissions measures (*DTOTAL EMISSIONS*, *DSCOPE1*, *DSCOPE2,* and *DNEC*) using their industry-year medians as the cut-offs: a value of one is assigned to a firm if it is identified as a high-emitting firm and a value of zero is assigned to a firm if it is identified as a low-emitting firm. According to Lennox et al. (2012), the imposition of 'exclusion restrictions' in the selection model is important when applying Heckman's (1979) procedure to prevent the emergence of biased estimates in the second-stage model. This requires the inclusion of at least one variable in the selection model that is conceptually excluded from the second-stage model. We therefore use the industry average of the emissions-to-sales ratio of a particular year in the first-stage model. This variable should capture industry pressure: a rise in industry-level carbon emissions could possibly exert some pressure on member firms in that industry to reduce their firm-level emissions. We then estimate the first-stage regression model by regressing the categorical variable on the above instrument and other control variables contained in Equation (5).

The output of the first-stage regressions is presented in Panel A of Table 6. We find that the industry average emissions level of a given year is significantly negatively related to the probability of a firm being identified as a high-emitting firm in the following year. We use the predicted values of the first-stage regressions to calculate the lambda self-selection parameters (i.e., inverse Mills ratio), namely *IMR_DTOTALEMISSIONS*, *IMR_DSCOPE1*, *IMR_DSCOPE2,* and *IMR_DNEC*, and include them as additional control variables in Equation (5) in estimating the second-stage regressions. The outputs of these second-stage models are presented in Panel B of Table 6. The *CEOPOWER* variable generates negative and significant coefficients in models (5), (6), and (8) which are similar in magnitude to those reported in Table 4. Additionally, the self-selection parameters enter respective models with insignificant coefficients. These findings re-enforce the evidence reported in Table 4 and rule out the possibility that our main findings are subject to sample selection bias.

[Insert Table 6 about here]

4.2.3. Omitted variable bias and PSM approach

While we have included a range of control variables in Equation (5) to capture the influence of firm-specific variables on the carbon emissions of firms, it is possible that we may have omitted some variables that might mechanically affect the emissions management variables used in our study. For example, informal controls (i.e., organisational culture) of an organisation can have a strong influence on its social and environmental proactivity (Adams, 2002), while an organisational culture that supports environmental management encourages employees to be actively involved in activities that enhance environmental performance (Renwick et al., 2013). Similarly, management control systems could play an influential role by coordinating environmental activities, providing relevant information, and facilitating companies to perform their business activities in an environmentally friendly manner (Henri & Journeault 2010; Strauss & Zecher 2013). These qualitative aspects are not controlled for in our regression models.

The PSM technique has been advanced as a suitable method to mitigate omitted variable bias. The PSM technique requires estimation of the probability that a firm in the sample has a CEO with high power. Therefore, following the process adopted in prior studies (Shipman et al., 2017), we split the sample into two groups as high-CEO-power firms and low-CEO-power firms using the industry-year median as the cut-off. We then create a dummy variable (*DCEOPOWER*) by assigning a value of one to firms belonging to the former group and zero to those belonging to the latter group. Thereafter, using this dichotomous variable as the dependent variable, we estimate a logistic model (first-stage model) using the same control variables contained in Equation (5). Once this logistic model is estimated, we use the propensity scores obtained from the output to select the optimal match, with a caliper distance of 0.01, to control for the differences in characteristics between firms with high CEO power (treatment group) and those with low CEO power (control group). This is done to ensure that each high-CEO-power firm is paired with a low-CEO-power firm in the same industry and year to have the lowest difference in propensity scores. Finally, we estimate Equation (5) for the propensity score–matched sample (second-stage model) but use *DCOPOWER* as the main explanatory variable in place of the *CEOPOWER* variable.

Table 7 reports the results. The first-stage regression output reported in Panel A reveals that variables such as board size, profitability (*ROA*), market-to-book value, growth, cash holdings, and assets newness are significantly influential in determining the probability of a firm being identified as a high-CEO-power firm in the industry. The statistics in Panel B reveal that none of the deterministic variables of CEO power differ between the treatment group and control group in statistically significant terms. In Panel C, the results generated by the second-stage models for the propensity score–matched sample paint a similar picture to what is observed in Table 4. The coefficients of the *DCEOPOWER* variable are negative in all four models, while those in models (1), (2), and (4) are statistically significant. However, we observe that the magnitudes of these coefficients are larger in size compared with those reported in Table 4. Nevertheless, the results based on PSM analysis confirm our main findings: the existence of a powerful CEO is associated with a reduction in carbon emissions released by the firm.

[Insert Table 7 about here]

4.3. CEO power dimensions and carbon emissions

We now test H2 by investigating whether the positive impact of CEO power on emissions management remains constant across all four dimensions of CEO power. While it is possible for some CEO power dimensions to have a stronger influence on emissions management than others, there is also a possibility to observe opposite influences among some dimensions. Therefore, we estimate Equation (5) for each dimension separately and present the findings in Table 8. Panel A of this table presents results for structural power, Panel B for ownership power, Panel C for expert power, and Panel D for prestige power.

An observation of this table reveals some interesting differences across the four power dimensions with respect to the relationship between CEO power and emissions management. The findings for structural power in Panel A are similar to those observed when the effect of overall CEO power is analysed; the coefficient of *CEOPOWER_STRUCTURAL* is negative across all four models but a significant influence of this power dimension can be seen only with respect to total emissions, Scope 1 emissions and net energy consumed. In Panel B, none of the coefficients generated for the *CEOPOWER_OWNERSHIP* variable is statistically significant, implying that the power obtained by Australian CEOs through equity ownership does not play any role in emissions management in their firms. However, in Panel C, the *CEOPOWER_EXPERT* variable enters all four models with negative and significant coefficients, implying that the functional expertise possessed by CEOs is an essential element in mitigating all types of emissions levels released by their companies to the atmosphere. In contrast, in Panel D, we find that the coefficients generated for the *CEOPOWER_PRESTIGE* variable is positive and significant across all four models estimated. It appears that entrusting prestige power with CEOs is harmful to the environment, as those companies seem to release a high level of emissions rather than taking actions to reduce emissions levels. Our findings therefore support H2 that the degree of the influence of CEO power on emissions management differs across the four power dimensions analysed.

[Insert Table 8 about here]

4.4. Sustainability managers' views

This section discusses the views expressed by the survey participants. In the survey instrument, we first provided the information relating to CEO power and asked participants to comment on the role that a powerful CEO could play in the process of reducing carbon emissions and managing emissions risk. We then provided information relating to the four dimensions of power, and then asked sustainability managers to identify and comment on the dimensions of CEO power that they think would make the highest contribution and commitment in reducing carbon emissions and managing the emissions risk of their companies. We then requested them to identify and comment on the dimensions of CEO power that would make the lowest contribution and commitment. We acknowledge that our sample of sustainability managers is not an exhaustive sample that represents a cross section of industries analysed in the study. As such, we use sustainable managers' views only to further scrutinise our findings to see if their views corroborate or contradict the evidence uncovered through empirical analyses.

All the sustainability managers are unanimous in the view that CEOs should play a leading role and actively engage in driving their companies towards low-carbon-emissions entities. The following views are representative of this opinion:

> *Any CEO can powerfully influence and engage management in the process of reducing carbon emissions and managing emissions risk if they demonstrate to their management team how central the issue is to the long-term profitability of the business…. This, of course, requires the CEO to first understand this [the importance of emissions management] [SM1].*
>
> *The CEO must be on the front foot and understand how his business relates to it all [carbon emissions] and what the business itself can do [SM6].*

The consequences of not recognising the importance of emissions management by the CEO and not playing a leading role were also highlighted by some participants.

> *The CEO has a vital role in influencing the culture of an organisation and is therefore a key to setting the priorities for the organisation. If the CEO does not view climate change risk as a significant risk to the organisation, then it is very unlikely that reducing carbon emissions and managing emissions risk will be taken seriously by the organisation [SM2].*
>
> *At our Company, this understanding [emissions management] and education was delegated to expert managers by the CEO, so the whole of Company strategic response has been slower than it should have been, because real action was not implemented by the CEO. ... So, while the process of reducing carbon emissions and managing emissions risk is now actively being incentivised through KPIs and linked to executive remuneration, this has occurred probably two to five years later than it should have for the Company to be where investors and financial institutions now expect the Company to be on this issue [SM1].*

While recognising the influential role that a CEO can play in reducing the carbon emissions of a company and mitigating the associated risk, several sustainability managers highlighted the importance of having a powerful CEO in this process.

> *A powerful CEO is critical to managing an effective business. For emission reductions, they can set the scene, outline their expectations, and communicate the end goal. They can also effectively resource such actions to achieve their desires. A less powerful CEO, or one hostage to Boards, would struggle to make that a reality [SM5].*

> *A powerful CEO can use their power to enthuse others in the business to go above and beyond their normal duties. Similarly, if the CEO is weak, subordinates may go off on tangents and focus on their own achievements and lose sight of the company's objectives and goals [reducing carbon emissions and managing emissions risk] [SM7].*

These views are in line with our finding of a negative association between CEO power and emissions-to-sales ratios; the presence of a powerful CEO seems to be an important aspect that needs to prevail at the highest level of the company in its attempts to reduce carbon emissions and manage emissions risk.

With respect to the dimensions of CEO power, most of the participants viewed structural power and expert power to be the highest contributing dimensions in reducing carbon emissions and managing emissions risk. Some managers highlighted the influence of structural power in this process as follows:

> *If we are talking specifically about a CEO and their role as such, it would be the first dimension [structural power]. ... The role of CEO with structural power is the most influential role in most companies [that] I have worked in. ... They [a CEO with structural power] can set expectations and provide the resources necessary without having to seek approval, provide justification etc. A CEO and Chair [structural power associated with CEO duality] can simply make things happen much more than any other role [SM5].*

> *The CEO's position plays a strong role just by virtue of their position in the company and view across the business as well as presence with the company Board [SM3].*

The respondents expressed similar views with respect to the importance of expert power.

> *A CEO, who is a functional expert, would respect the expertise of other functions and in my opinion would allow for those functions or subject matter experts to take ownership of their function and lead initiatives. I feel that CEOs within this dimension of power would be more willing to accept advice from other functions and be more receptive to innovations that other functions may put forward, thereby making the highest contribution and commitment in reducing carbon emissions and managing emissions risk of their companies [SM2].*

> *Climate change is based on science and science is showing us that climate action is urgent. It is critical for the CEO to understand the physical and transitional risks for the business. Someone that deeply understand and believe that sustainability practices and carbon emissions are tied to economic value and value creation (or destruction) in the short, medium, and long-term [SM8].*

These views agree with our findings that both structural power and expert power have significant negative influences on the emissions-to-sales ratios and are therefore influential in the process of managing emissions levels released by sample firms to the atmosphere. However, while none of the respondents identified expert power as the least influential dimension of power, one respondent viewed structural power to be a destructive force in achieving emissions efficiency. In that respondent's words,

> *[A] CEO of this dimension of power [structural power] would make the lowest contribution and commitment in reducing carbon emissions and managing emissions risk of their companies as they would be less receptive to strategies or initiatives that do not align directly with their beliefs and values ... In my experience these sorts of CEOs are more focussed on financial performance of the organisation and are less receptive to initiatives that do not relate to financial performance of the organisation [SM2].*

We did not find a consistent pattern of respondents identifying a particular dimension of power as the least influential in managing carbon emissions. Therefore, we discuss general perceptions revealed by the respondents in relation to ownership power and prestige power. We found mixed evidence in relation to the influence of ownership power. Some respondents viewed ownership power to be important in driving CEOs to reduce carbon emissions.

> *Having equity and a substantial holding of that, provides the greatest influence on any direction, whether carbon emission or otherwise. You have a profound interest and influence over the company directions with limited ability to be challenged [SM5].*

> *CEOs with ownership power would be more directly invested in the direction of the company and have a broader knowledge of all risks to the success of the organisation including climate change risk [SM2].*

Some other respondents viewed ownership power to have no influence in their companies' carbon emissions management. They attributed this either to the lack of equity ownership of CEOs,

> *[T]he CEO has very little ownership in the company ... I'm unaware of what share [of] equity he would have ... this is very definitely the least of the CEO power base [SM6]*;

or to the short termism associated with CEO equity ownership,

> *Ownership power is a double-edged sword if remuneration is not linked to ESG [environmental, social and governance] performance. CEOs are usually so bottom-line and focused on short-term return, particularly as a self-interested [SM8].*

The view expressed by SM8 is interesting in the context that climate change initiatives (such as emissions reduction projects) are strategic choices with a great deal of uncertainty attached and therefore need a long-term commitment from top executives. While lower equity ownership may not give the necessary power to CEOs to have a significant influence on the strategic decisions of firms, excessive equity ownership may motivate them to focus on short-term returns at the expense of long-term projects, such as emissions reduction initiatives. Therefore, it is hardly surprising that we did not uncover a meaningful relationship between ownership power and emissions levels.

Except for one respondent who identified prestige power as the least contributory power dimension in managing carbon emissions, most sustainability managers had a positive perception about this power dimension.

> *Prestige power can be important as in climate change it sometimes needs the whole system moving and that is where network of relations can make a difference [SM3].*

> *Prestige is critical for a CEO that wants to play a role in climate change. There is no silver bullet to solve climate change, so it is vital to have the skills set to absorb knowledge, ideas from different networks [SM8].*

The manager who identified prestige power to be the least contributory dimension was very critical about it.

> *CEOs relying upon their networks or being 'professional directors' and sitting on multiple boards, lack credibility. Consequently, their ability to influence and shape company direction is somewhat limited. They still have authority, however, they would need to convince the rest of the Board about an approach, like emission reductions. Such arguments would need to be founded with a convincing economic argument to sway other directors. [SM5].*

The consensus view of sustainability managers that prestige power is important in managing carbon emissions contradicts our empirical findings. We find a positive and significant association between prestige power and emissions-to-sales ratios, implying that companies having CEOs with prestige power emit more carbon into the atmosphere. It is possible that the prestige power captured by the variables we used in our analyses (other directorships and higher-degree qualifications) may differ from what the sustainability managers may view as prestige. Further, researchers observe a significant ambiguity and less proximal nature of this dimension of CEO power when compared to the other dimensions (Tang et al., 2011; Han et al., 2016). These reasons may have led to the difference in findings between our empirical analyses and managers' views.

An interesting outcome of this short survey questionnaire is the revelation by sustainability managers of the need to address endogeneity issues, such as omitted variable bias. Two managers, SM4 and SM9, who did not answer the questions separately but provided an overall view about the questions contained in the survey, referred to the variables that are not captured by qualitative models. While SM4 referred to the influence of organisational structure and CEO personality as follows,

> *Those dimensions don't resonate with me in terms of how they impact performance specifically around climate change. Two key things that have worked in our business are getting the right organisational structure in place to drive the change and the CEO personally driving the outcome [SM4],*

SM9 referred to the expectations of various stakeholders of the firm,

> *I agree that having a powerful CEO is incredibly important to progress emissions management. I feel all of them [four power dimensions] contribute to CEO focus and actions. However, in my opinion, there are stronger factors beyond the 'powers' listed. Investor, customer, community and employee clear expectations that companies must respond are driving accelerated change in regard to all aspects of sustainability [SM9].*

Several respondents shared views similar to what was expressed by SM9. The pressure exerted by external parties, such as shareholders, banks, general public, regulators, etc., drives companies towards low-carbon initiatives. As SM4 expressed, *'CEOs don't really have many options except understanding the process and acting to reduce carbon emissions.'* In this context, providing robust evidence that the presence of powerful CEOs is essential in the process of driving emissions levels down while addressing endogeneity issues in empirical models is a needy exercise.

5. Additional tests

5.1. Carbon-intensive industries, extreme weather, and internal monitoring

We conduct some additional analyses to see if CEO power is more influential in managing carbon emissions of high-carbon-intensive industries and during extreme weather periods. We also investigate whether the negative effect of prestige power on emissions management can be mitigated if a firm has a strong internal monitoring system in place.

Some studies claim that industry membership is an essential factor that drives companies' environmental activities (Hackston & Milne, 1996; Khanna & Anton, 2002; Gonzalez-Benito & Gonzalez-Benito, 2006). For example, Hackston and Milne (1996) find that companies with business activities most affecting the environment, such as in the extractive industries, are more likely to disclose their environmental information compared with those from other industries. Based on this evidence, one could argue that companies operating in most carbon-intensive industries are the ones who are most in need of powerful CEOs to manage their emissions levels. Therefore, a more pronounced relationship between

CEO power and carbon emissions can be present in companies operating in carbon-intensive industries. To investigate this, we modify Equation (5) by adding a dummy variable representing companies operating in carbon-intensive industries and the interaction between this dummy and CEO power. Based on the classification of the US Environmental Protection Agency, we identify companies operating in transportation, electricity production, industrials, land use, and forestry as high-carbon-intensive companies. The estimates of this regression equation are presented in Panel A of Table 9. While we find that the carbon-intensive dummy generates positive and significant coefficients, its interaction term with the CEO power variable generates insignificant coefficients. The CEO power variable retains its statistical significance, implying that the CEO power–emissions management relationship remains similar across both carbon-intensive and non-intensive industries.

Extreme and unpredictable weather conditions are considered one of the biggest climate change–related risks faced by companies (Solomon et al., 2011). This is because those weather conditions could make substantial damages to facilities and infrastructure used by companies. This potential damage to infrastructure, together with the resource shortage caused by extreme weather conditions, could translate into an increased business cost (CDP Report, 2009). Based on this evidence, one could conjecture that CEO power is most essential in mitigating the emissions levels of companies during extreme weather conditions. To investigate this possibility, we modify Equation (5) by adding a dummy variable representing extreme weather periods and the interaction between this dummy and CEO power. We use historical information provided by the Bureau of Meteorology Australia to identify any years during which extreme weather events, such as droughts, bushfires, floods, heat waves, landslides, and storms, occur in the state in which the firm's headquarter is located. The findings of this estimate are reported in Panel B of Table 9. While both the extreme weather variable and its interaction term with CEO power enter all the models with insignificant coefficients, the CEO power variable enters models (1), (2), and (4) with negative and significant coefficients. This finding suggests that the CEO power–emissions management relationship remains similar across both normal weather and extreme weather periods.

When analysing the influence of different dimensions of CEO power, we found that prestige power is associated with an increase in carbon emissions. We test whether having a strong internal monitoring system is a useful mechanism to mitigate this negative effect. To do this, we create an internal monitoring variable (*INTERNALMONITORING*) that captures the presence of the following four aspects of the firm: (i) compensation committee, (ii) audit committee, (iii) nomination committee, and (iv) other directors' ownership. Each of the variables (i) to (iii) is assigned a value of one if a firm has that committee, while variable (iv) is assigned the value of one if other directors' equity ownership is higher than the industry median. We then add the values of four categorical variables together to create the internal monitoring variable. Thereafter, Equation (5) is modified by adding this internal monitoring variable and its interaction term with the prestige power variable. The coefficient estimates of this regression equation are reported in Panel C of Table 9. We find that the internal monitoring variable generates negative and significant coefficients across all four models, implying that companies with strong internal control mechanisms in place better manage their emissions levels. More importantly, the *CEOPOWER_PRESTIGE*INTERNALMONITORING* interaction term generates negative and significant coefficients while the *CEOPOWER_PRESTIGE* variable generates insignificant coefficients. The implication is that the negative influence of prestige power on emissions management is significantly less pronounced in companies with strong internal control systems.

[Insert Table 9 about here]

5.2. CEO power, carbon emissions, and firm performance

The evidence thus far suggests that, on average, firms having CEOs with greater power show better emissions management performance, as implied by the negative association between CEO power and emissions-to-sales ratios. The existing evidence suggests that both emissions management and CEO power have significant influences on firm performance. According to Porter and Van der Linde (1995), companies that take actions, such as carbon initiatives, to tackle environmental concerns can reap competitive advantagee in the long run. In European countries, capital markets reward firms with higher returns for reporting lower levels of carbon emissions and reporting improvements in carbon efficiency (Liesen et al., 2017; Bernardini et al., 2021). However, contrasting evidence that emissions performance is associated with lower portfolio returns has been reported by Bolton and Kacperczyk (2021) for the US market. Nevertheless, some studies uncover a positive association between improved environmental performance and the operating performance of the firm (Capece et al., 2017; Delmas et al., 2015). In the CEO power literature, studies such as Bebchuk et al. (2011) and Landier et al. (2012) find a negative association between CEO power and the operating and return performance of the firm. However, Adams et al. (2005) find that firms with greater CEO power show a greater variability in their performance. In Australia, while Lee et al. (2008) and Kale et al. (2009) find a significantly positive impact of CEO power on the return and operating performance of firms, Gunasekarage et al. (2020) find this positive influence to be more pronounced for growth-oriented firms compared to their non-growth counterparts.

Because of the above findings, in this section, we examine the inter-relationship among CEO power, carbon performance, and firm performance in a simultaneous equation framework. Specifically, we examine if emissions management plays a mediating role in the relationship between CEO power and firm performance. For this purpose, we estimate the following system of equations simultaneously:

$$LEADROA_{i,t} = \beta_0 + \beta_1 CEOPOWER_{i,t} + \sum Controls_{i,t} + \sum Year_t + \sum Industry_i + \varepsilon_{i,t} \tag{6.1}$$

$$EMISSIONS_{i,t} = \gamma_0 + \gamma_1 CEOPOWER_{i,t} + \sum Controls_{i,t} + \sum Year_t + \sum Industry_i + \varepsilon_{i,t} \tag{6.2}$$

$$LEADROA_{i,t} = \omega_0 + \omega_1 CEOPOWER_{i,t} + \omega_2 EMISSIONS_{i,t} + \sum Controls_{i,t} + \sum Year_t + \sum Industry_i + \varepsilon_{i,t} \tag{6.3}$$

where *LEADROA* is the return on assets in year (t+1). Following Baron and Kenny (1986) and Wen and Ye (2014), we consider the *EMISSIONS* variable in Equation (6.3) as a mediator if the following conditions are upheld: (i) in Equation (6.1), *CEOPOWER* has a significant influence on *LEADROA* (i.e. $\beta_1 \neq 0$ and statistically significant); (ii) in Equation (6.2), *CEOPOWER* has a significant influence on *EMISSIONS* (i.e. $\gamma_1 \neq 0$ and statistically significant); and (iii) in Equation (6.3), *EMISSIONS* has a significant influence on *LEADROA* after controlling for *CEOPOWER* ($\omega_2 \neq 0$ and statistically significant). If both *CEOPOWER* (treatment variable) and *EMISSIONS* (mediator variable) enter Equation (6.3) with significant coefficients, the findings support partial mediation. On the other hand, if the significant influence that the treatment variable displayed in Equation (6.1) disappears in Equation (6.3) while the mediator variable enters with a significant coefficient, then the results support full mediation. Once the above relationships are established, we use the bootstrapped Sobel-Goodman test (Preacher & Hayes, 2004) to observe whether the mediator variable (*EMISSIONS*) carries the influence made by the treatment variable (*CEOPOWER*) to the dependent variable.

The findings are reported in Table 10. The statistics reported in this table reveal strong evidence that the *EMISSIONS* variable plays a mediation role in the relationship between CEO power and firm performance. In model (1), the *CEOPOWER* variable generates a positive and significant coefficient showing a positive influence of CEO power on firm performance. As we observed in Table 4, models (2), (4), and (8) show that the greater CEO power is significantly associated with lower emissions levels. Additionally, the *EMISSIONS* variable enters models (3), (5), (7), and (9) with negative and significant coefficients, implying that better emissions management (i.e., lower emissions levels) leads to improved financial performance of the firm. The mediation effect played by the *EMISSIONS* variable reflects a full mediation because in models (3), (5), (7), and (9), the *CEOPOWER* variable loses the statistical significance it retained in model (1). As per mediation statistics reported in the table, the total effect of *EMISSIONS* on firm performance is 0.0014 of which 0.0012 (85.71%) is attributable to direct effect, while 0.0002 (14.29%) is attributable to indirect (mediation) effect. As revealed by the z-statistics for indirect effect, this mediation effect is statistically significant. Therefore, the findings of our mediation analysis provide evidence that *EMMISSIONS* is a reliable channel through which CEO power affects firm performance.

[Insert Table 10 about here]

6. Conclusion

In this study, we investigate the association between CEO power and the firm-level emissions management of Australian companies. We find that the emissions-to-sales ratios are negatively associated with overall CEO power, implying that the presence of powerful CEOs leads to an improvement in emissions management of sample firms. This main finding remains robust to addressing reverse causality, sample selection bias, and omitted variable bias, and to separation of firms in the sample into different groups based on carbon intensiveness and extreme weather periods. We also find evidence that emissions management has a significant mediating influence on the association between CEO power and the financial performance of firms.

When we analysed the influence of four dimensions of CEO power, namely, structural power, ownership power, expert power, and prestige power, we uncovered evidence that the most useful sources of power in managing the emissions levels of firms are structural power and expert power. While ownership power has no effect on emissions-to-sales ratios, prestige power is found to increase the emissions levels of firms. It appears that the degree of the influence of CEO power on emissions management depends on the type of power held by the CEO.

The questionnaire administered among sustainability managers provides corroborating evidence to what is uncovered in our regression analyses. These professionals believe that the CEOs, as the architects of their firms' corporate strategy, should play a leading role in driving the companies they lead toward low-carbon-emissions entities. In particular, they believe that a powerful CEO can set the scene, outline expectations, communicate goals, and obtain the necessary resources in the process of managing carbon emissions. The majority of the sustainability managers view structural power and expert power to be the most influential sources of power in this exercise. They provide mixed views regarding the importance of ownership power and prestige power.

Australia has been identified as the worst-performing country in the developed world with respect to carbon emissions management. While Australia relies heavily on fossil fuel as the main source of energy, there is a marked lack of effective carbon policy in the country. In the absence of strong government intervention, corporate boards have come under continuous pressure and scrutiny from stakeholder groups and regulatory bodies to manage their companies' carbon emissions and to effectively combat climate change issues. In such an environment, CEOs, who lead their companies' strategic decision-making process, have an enormous responsibility to take the leadership to drive their companies toward low-carbon entities. By shedding light on how CEO power and its dimensions influence emissions management of Australian companies, the current study makes an important and timely contribution since the findings of this study are useful to regulators, policy makers, corporate management, and other stakeholders.

We would like to end this article with an important view presented by a sustainability manager regarding the type of future CEO they would like to have to deal with the important issue of emissions management.

> *A powerful CEO can play a critical role in the process of reducing carbon emissions and managing emissions risk. As the climate change ambassador, CEO will dictate the rules of a new operational model and change management. Given the importance of this agenda [reducing carbon emissions and managing emissions risk], I think we'll see a different type of leader [CEO] start to emerge. We need leaders to step up, be bold, and be courageous [SM8].*

To this end, our study contributes to the Australian society since its findings highlight the types of power that should be entrusted with CEOs to achieve emissions efficiency of their companies, which in turn would help achieve the objective of a net-zero emissions economy.

References

Abernethy, M.A., Kuang, Y.F., & Qin, B. (2015). The influence of CEO power on compensation contract design. *Accounting Review*, 90(4), 1265-1306.

Adams, C.A. (2002). Internal organizational factors influencing corporate social and ethical reporting: beyond current theorising. *Accounting, Auditing & Accountability Journal*, 15(2), 223-250.

Adams, R., Almeida, H., & Ferreira, D. (2005). Powerful CEOs and their impact on Corporate Performance. *Review of Financial Studies*, 18(4), 1403–1432.

Australian Institute of Company Directors. (2021). Climate governance study risk and opportunity insights from Australian directors. Australian Institute of Company Directors.

Aibar-Guzmán, B., & Frías-Aceituno, J.V. (2021). Is it necessary to centralize power in the CEO to ensure environmental innovation? *Administrative Sciences*, 11(1), 27.

Agle, B. R., Nagarajan, N. J., Sonnenfeld, J. A., & Srinivasan, D. (2006). Does CEO charisma matter? An empirical analysis of the relationships among organizational performance, environmental uncertainty, and top management team perceptions of CEO charisma. *Academy of Management Journal*, 49(1), 161-174.

Agrawal, A., & Knoeber, C.R. (1996). Firm performance and mechanisms to control agency problems between managers and shareholders. *Journal of Financial and Quantitative Analysis*, 31(3), 377–397.

Arena, C., Bozzolan, S., & Michelon, G. (2015). Environmental reporting:Transparency to stakeholders or stakeholder manipulation? An analysisof disclosure tone and the role of the board of directors. *Corporate Social Responsibility and Environmental Management*, 22(6), 346–361.

ASIC. (2018). Keynote address by John Price. Commissioner, Australian Securities and Investments Commission, Centre for Policy Development: Financing a Sustainable Economy, Sydney, Australia, 18 June 2018. https://asic.gov.au/about-asic/news-centre/speeches/climate-change/.

Bachmann, R. L., Loyeung, A., Matolcsy, Z. P., & Spiropoulos, H. (2020). Powerful CEOs, cash bonus contracts and firm performance. *Journal of Business Finance & Accounting*, 47(1-2), 100-131.

Baron, R.M., & Kenny, D.A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.

Bebchuk, L.A., Cremers, K.M., & Peyer, U.C. (2011). The CEO pay slice. *Journal of financial Economics*, 102(1), 199-221.

Berger, R., Dutta, S., Raffel, T., & Samuels, G. (2016). Innovating at the top: how global CEOs drive innovation for growth and profit. Palgrave Macmillan.

Berrone, P., & Gomez-Mejia, L. R. (2009). Environmental performance and executive compensation: An integrated agency-institutional perspective. *Academy of Management Journal*, 52(1), 103-126.

Berrone, P., Cruz, C., Gomez-Mejia, L. R., & Larraza-Kintana, M. (2010). Socioemotional wealth and corporate responses to institutional pressures: Do family-controlled firms pollute less? *Administrative science quarterly*, 55(1), 82-113.

Bernardini, E., Di Giampaolo, J., Faiella, I., & Poli, R. (2021). The impact of carbon risk on stock returns: evidence from the European electric utilities. *Journal of Sustainable Finance and Investment*, 11(1), 1–26.

Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk?. *Journal of Financial Economics*, 142(2), 517–549.

Boyd, B. (1995). CEO duality and firm performance: A contingency model. *Strategic Management Journal*, 16, 301-312.

Brass, D.J. (1984). Being in the right place: a structural analysis of individual influence in an organization. *Administrative Science Quarterly*, 29, 518–539.

Brickley, J.A., Coles, J.L., & Terry, R.L. (1994). Outside directors and the adoption of poison pills. *Journal of Financial Economics*, 35, 371–390.

Bui, B., Houqe, M.N., & Zaman, M. (2020). Climate governance effects on carbon disclosure and performance. *British Accounting Review*, 52(2), 100880.

Cannella, B., Finkelstein, S., & Hambrick, D.C. (2009). Strategic leadership : Theory and research on executives, top management teams, and boards. Oxford University.

Capece, G., Di Pillo, F., Gastaldi, M., Levialdi, N., & Miliacca, M. (2017). Examining the effect of managing GHG emissions on business performance. *Business Strategy and the Environment*, 26(8), 1041–1060.

Carbon Disclosure Project (CDP) Report. (2009). Carbon disclosure project report 2009 Australia and New Zealand.

Chava, S., & Purnanandam, A. (2010). CEOs versus CFOs: Incentives and corporate policies. *Journal of Financial Economics*, 97(2), 263–278.

Chen, H. L. (2014). Board capital, CEO power and R&D investment in electronics firms. *Corporate Governance: An International Review*, 22(5), 422-436.

Chen, Z., Huang, Y., & Wei, K.C.J. (2013). Executive pay disparity and the cost of equity capital. *Journal of Financial Quantitative Analysis*, 48, 849–885.

Chin, M., Hambrick, D.C., & Trevin˜o, L.K. (2013). Political ideologies of CEOs: The influence of executives' values on corporate social responsibility. *Administrative Science Quarterly*, 58(2), 197–232.

Clarkson, P.M., Li, Y., Richardson, G.D., & Vasvari, F.P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society*, 33(4-5), 303-327.

Crowley, K. (2021). Fighting the future: The politics of climate policy failure in Australia (2015–2020). *Wiley Interdisciplinary Reviews: Climate Change*, 12(5), e725.

Crozier, M. 1964. The bureaucratic phenomenon. University of Chicago Press, Chicago.

D'Amato, A., & Roome, N. (2009). Toward an integrated model of leadership for corporate responsibility and sustainable development: A process model of corporate responsibility beyond management innovation, *Corporate Governance*, 9(4), 421-434.

de Andres, P., & Vallelado, E. (2008). Corporate governance in banking: The role of the board of directors. *Journal of Banking and Finance*, 32, 2570–2580.

De Villiers, C., Naiker, V., & van Staden, C.J. (2011). The effect of board characteristics on firm environmental performance. *Journal of Management*, 37(6), 1636–1663.

Delmas, M.A., Nairn-Birch, N., & Lim, J. (2015). Dynamics of environmental and financial performance: the case of greenhouse gas emissions. *Organisation and Environment*, 28(4), 374–393.

Eleftheriadis, I.M., & Anagnostopoulou, E.G. (2015). Relationship between corporate climate change disclosures and firm factors. *Business Strategy and the Environment*, 24(8), 780-789.

Fabrizi, M., Mallin, C., & Michelon, G. (2014). The role of CEO's personal incentives in driving corporate social responsibility. *Journal of Business Ethics*, 124(2), 311–326.

Feng, M., Ge, W., Luo, S., & Shevlin, T. (2011). Why do CFOs become involved in material accounting manipulations? *Journal of Accounting and Economics*, 51(1-2), 21-36.

Finkelstein, S. (1992). Power in top management teams: Dimensions, measurement and validation. *Academy of Management Journal*, 35(3), 505-538.

Finkelstein, S., & D'aveni, R. (1994). CEO Duality as a Double-Edged Sword: How boards of directors balance entrenchment avoidance and unity of command. *Academy of Management Journal*, 37, 1079-1108.

Gioia, D.A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic management journal*, 12(6), 433-448.
González-Benito, J., & González-Benito, Ó. (2006). A review of determinant factors of environmental proactivity. *Business Strategy and the environment*, 15(2), 87-102.
Grinstein, Y., & Hribar, P. (2004). CEO Compensation and incentives: Evidence from M&A bonuses. *Journal of Financial Economics*, 73(1), 119-143.
Gujarati, D.N., Porter, D.C., 2009. Basic Econometrics. McGraw-Hill Irwin, New York, NY:
Gunasekarage, A., Luong, H., & Truong, T.T. (2020). Growth and market share matrix, CEO power, and firm performance. *Pacific-Basin Finance Journal*, 59, 101257.
Hackston, D., & Milne, M. J. (1996). Some determinants of social and environmental disclosures in New Zealand companies. *Accounting, auditing & accountability journal*, 9(1), pp. 77-108.
Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. *Global environmental change*, 19(2), 240-247.
Haque, F., & Ntim, C.G. (2018). Environmental policy, sustainable development, governance mechanisms and environmental performance. *Business Strategy and the Environment*, 27(3), 415–435.
Haque, F. (2017). The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms. *British Accounting Review*, 49(3), 347–364.
Hambrick, D.C., & Finkelstein, S. (1987). Managerial discretion: A bridge between polar views of organizational outcomes. Research in organizational behavior.
Hambrick, D.C. (1981). Environment, strategy, and power within top management teams. *Administrative Science Quarterly*, 26, 252–275.
Hambrick, D.C., & Mason, P.A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management review*, 9 (2), 193–206.
Harper, J., & Sun, L. (2019). CEO power and corporate social responsibility. *American Journal of Business*, 34(2), 93-115.
Han, S., Nanda, V.K., & Silveri, S.D. (2016). CEO power and firm performance under pressure. *Financial Management*, 45(2), 369–400.
Heal, G. (2020). Reflections-the economics of renewable energy in the United States. *Review of Environmental Economics and Policy*, 4(1), 139–154.
Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1), 153-161.
Hemingway, C.A., & Maclagan, P.W. (2004). Managers' personal values as drivers of corporate social responsibility. *Journal of Business Ethics*, 50(1), 33–44.
Henri, J.F., & Journeault, M. (2010). Eco-control: The influence of management control systems on environmental and economic performance. *Accounting, Organizations and Society*, 35(1), 63-80.
Henri, J.F., & Journeault, M. (2008). Environmental performance indicators: An empirical study of Canadian manufacturing firms. *Journal of environmental management*, *87*(1), 165-176.
Hermalin, B., & Weisbach, M. (1998). Endogenously chosen boards of directors and their monitoring of the CEO. *American Economic Review*, 88(1), 96-118.
Hoffman, A.J. (2007). *Carbon strategies: How leading companies are reducing their climate change footprint*: University of Michigan Press.
Hooghiemstra, R., Kuang, Y.F., & Qin, B. (2017). Does obfuscating excessive CEO pay work? The influence of remuneration report readability on say-on-pay votes. *Accounting and Business Research*, 47(6), 695−729.
Huang, S.K. (2013). The impact of CEO characteristics on corporate sustainable development. *Corporate Social Responsibility and Environmental Management*, 20, 234–244.

Huang, Q., Chen, X., Zhou, M., Zhang, X., & Duan, L. (2019). How does CEO's environmental awareness affect technological innovation?. *International Journal of Environmental Research and Public Health*, 16(2), 261.

Javeed, S.A., & Lefen, L. (2019). An analysis of corporate social responsibility and firm performance with moderating effects of CEO power and ownership structure: A case study of the manufacturing sector of Pakistan. *Sustainability*, 11(1), 248.

Jiraporn, P., & Chintrakarn, P. (2013). How do powerful CEOs view corporate social responsibility (CSR)? An empirical note. *Economics Letters*, 119(3), 344-347.

Johnson, J.L., Daily, C.M., & Ellstrand, A.E. (1996). Boards of directors: A review and research agenda. *Journal of Management*, 22(3), 409–438.

Kale, R., Reis, E., & Venkateswaran, A. (2009). Rank-order tournaments and incentive alignment: The effect on firm performance. *Journal of Finance*, 64(3), 1479-1512.

Khanna, M., & Anton, W. R. Q. (2002). Corporate environmental management: regulatory and market-based incentives. *Land economics*, 78(4), 539-558.

Khanna, V., Kim, E.H., & Lu, Y. (2015). CEO connectedness and corporate fraud. *Journal of Finance*, 70(3), 1203-1252.

Kock, C.J., Santaló, J., & Diestre, L. (2012). Corporate governance and the environment: What type of governance creates greener companies?. *Journal of Management Studies*, 49(3), 492–514.

Korkeamäki, T., Liljeblom, E., & Pasternack, D. (2017). CEO power and matching leverage preferences. *Journal of Corporate Finance*, 45, 19-30.

Kumarasiri, J. (2016). Policy uncertainty continues to hamper carbon emissions management. *The Conversation*. 14 November 2016. https://theconversation.com/policy-uncertainty-continues-to-hamper-carbon-emissions-management-68565

Landier, A., Sauvagnat, J., Sraer, D., & Thesmar, D. (2012). Bottom-up corporate governance. *Review of Finance*, 17(1), 161-201.

Laksmana, I., Tietz, W., & Yang, Y.-W. (2012). Compensation discussion and analysis (CD&A): Readability and management obfuscation. *Journal of Accounting and Public Policy*, 31(2), 185-203.

Larcker, D.F. and T. O. Rusticus (2010). On the use of instrumental variables in accounting research, *Journal of Accounting and Economics*, Vol. 49, No. 3, pp. 186−205.

Lee, K.H., & Ball, R. (2003). Achieving sustainable corporate competitiveness, *Greener Management International*, 44, 89-104.

Lee, K., Lev, B., & Yeo, G. (2008). Executive pay dispersion, corporate governance, and firm performance. *Review of Quantatitive Finance and Accounting*, 30(3), 315−338.

Lennox, C.S., Francis, J.R., & Wang, Z. (2012). Selection models in accounting research. *The Accounting Review*, 87(2), 589–616.

Lewellyn, K.B., & Muller-Kahle, M.I. (2012). CEO Power and Risk Taking: Evidence from the Subprime Lending Industry. *Corporate Governance: An International Review*, 20(3), pp. 289–307.

Li, Y., Gong, M., Zhang, X.-Y., & Koh, L. (2018). The impact of environmental, social, and governance disclosure on firm value: The role of CEO power. *British Accounting Review*, 50(1), 60-75.

Liesen, A., Figge, F., Hoepner, A., & Patten, D.M. (2017). Climate change and asset prices: are corporate carbon disclosure and performance priced appropriately? *Journal of Business Finance and Accounting*, 44(1–2), 35–62.

Lines, R. (2007). Using power to install strategy: The relationships between expert power, position power, influence tactics and implementation success. *Journal of Change Management*, 7(2), 143-170.

Lisic, L.L., Neal, T. L., Zhang, I.X., & Zhang, Y. (2016). CEO Power, internal control quality, and audit committee effectiveness in substance versus in form. *Contemporary Accounting Research*, 33(3), 1199-1237.
Liu, Y., & Jiraporn, P. (2010). The effect of CEO power on bond ratings and yields. *Journal of Empirical Finance*, 17, 744-762.
Mahmood, M., & Orazalin, N. (2017). Green governance and sustainability reporting in Kazakhstan's oil, gas, and mining sector: Evidence from a former USSR emerging economy. *Journal of Cleaner Production*, 164, 389–397.
Mallin, C., & Michelon, G. (2011). Board reputation attributes and corporate social performance: An empirical investigation of the US best corporate citizens. *Accounting and Business Research*, 41(2), 119–144.
Manner, M.H. (2010). The impact of CEO characteristics on corporate social performance. *Journal of Business Ethics*, 93(1), 53–72.
McKendall, M., Sánchez, C., & Sicilian, P. (1999). Corporate governance and corporate illegality: The effects of board structure on environmental violations. *International Journal of Organizational Analysis*, 7(3), 201–223.
Mohan-Neill, S.I. (1995). The influence of firm's age and size on its environmental scanning activities. *Journal of Small Business Management*, 33(4), 10.
Muttakin, M.B., Khan, A., & Mihret, D.G. (2018). The effect of board capital and CEO power on corporate social responsibility disclosures. *Journal of Business Ethics*, 150(1), 41-56.
Nakao, Y., Amano, A., Matsumura, K., Genba, K., & Nakano, M. (2007). Relationship between environmental performance and financial performance: an empirical analysis of Japanese corporations. *Business Strategy and the Environment*, 16(2), 106-118.
National Greenhouse and Energy Reporting (NGER) Scheme http://www.cleanenergyregulator.gov.au/NGER
O'Dwyer, B., & Unerman, J. (2020). Shifting the focus of sustainability accounting from impacts to risks and dependencies: researching the transformative potential of TCFD reporting. *Accounting, Auditing & Accountability Journal,* 33(5), 1113-1141.
Oh, W.Y., Chang, Y.K. & Cheng, Z. (2014). When CEO career horizon problems matter for corporate social responsibility: The moderating roles of industry-level discretion and blockholder ownership. *Journal of Business Ethics*, 133(2), 279–291.
Orazalin, N., & Mahmood, M. (2018). Economic, environmental, and social performance indicators of sustainability reporting: Evidence from the Russian oil and gas industry. *Energy Policy*, 121, 70-79.
Ott, C., & Schiemann, F. (2022). The market value of decomposed carbon emissions. *Journal of Business Finance & Accounting*, 49, 1–28.
Palia, D. (2001). The endogeneity of managerial compensation in firm valuation: A solution. *Review of Financial Studies*, 14(3), 735–764.
Pathan, S. (2009). Strong boards, CEO power and bank risk-taking. *Journal of Banking and Finance*, 33(7), 1340-1350.
Perrow, C. (1970). Departmental power in industry. In: Zald, M. (Ed.), Power in Organizations. Vanderbilt University Press, Nashville, 59–89.
Petrenko, O.V., Aime, F., Ridge, J., & Hill, A. (2016). Corporate social responsibility or CEO narcissism? CSR motivations and organizational performance. *Strategic Management Journal*, 37(2), 262–279.
Porter, M.E., Van der Linde, C. (1995). Toward a new conception of the environment competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118.
Post, C., Rahman, N. & McQuillen, C. (2015). From board composition to corporate environmental performance through sustainability-themed alliances. *Journal of Business Ethics*, 130(2), 423–435.

Preacher, K.J., & Hayes, A.F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36: 717-731.

Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *British Accounting Review*, 48(1), 102-116.

Ramani, V., & Ward, B. (2019). How board oversight can drive climate and sustainability performance. *Journal of Applied Corporate Finance,* 31(2), 80-85.

Renwick, D.W., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International journal of management reviews*, 15(1), 1-14.

Reverte, C. (2009). Determinants of corporate social responsibility disclosure ratings by Spanish listed firms. *Journal of Business Ethics*, 88(2), 351–366.

Rosenstein, S., & Wyatt, J.G. (1997). Inside directors, board effectiveness, and shareholder wealth. *Journal of Financial Economics*, 44, 229–250.

Rosenbaum, P.R., & Rubin, D.B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41–55.

Rotemberg, J. J., & Saloner, G. (2000). Visionaries, managers, and strategic direction. *RAND Journal of Economics*, 693-716.

Sariol, A.M., & Abebe, M.A. (2017). The influence of CEO power on explorative and exploitative organizational innovation. *Journal of Business Research*, 73, 38-45.

Stanwick, S.D., & Stanwick, P.A. (2000). The relationship between environmental disclosures and financial performance: an empirical study of US firms. Eco-Management and Auditing: *Journal of Corporate Environmental Management*, 7(4), 155-164.

Sheikh, S. (2018). The impact of market competition on the relation between CEO power and firm innovation. Journal of Multinational Financial Management, 44, 36-50

Sheikh, S. (2019). An examination of the dimensions of CEO power and corporate social responsibility. *Review of Accounting and Finance,* 18(2), 221-244.

Shipman, J.E., Swanquist, Q.T., & Whited, R.L. (2017). Propensity score matching in accounting research. *Accounting Review*, 92(1), 213–244.

Solomon, J.F., Solomon, A, Norton, S.D., & Joseph, N.L. (2011). Private climate change reporting: An emerging discourse of risk and opportunity? *Accounting, Auditing and Accountability Journal*, 24(8), 1119-1148.

Stern, N. (2007). The economics of climate change: The Stern review. Cambridge: Cambridge University Press.

Strauss, E., & Zecher, C. (2013). Management control systems: A review. *Journal of Management Control*, *23*(4), 233-268.

Tushman, M., & Romanelli, E. (1985). Organizational evolution: a metamorphosis model of convergence and reorientation. In: Cummings, L., Staw, B. (Eds.), *Research in Organizational Behavior* 7. JAI Press, Greenwich, CT.

Talberg A., Hui, S., & Loynes, K. (2015). Australian climate change policy to 2015: a chronology', https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1516/Climate2015

Tang, Y., Qian, C., Chen, G., & Shen, R. (2015). How CEO hubris affects corporate social (ir)responsibility. *Strategic Management Journal*, 36(9), 1338-1357.

Tang, J., Crossan, M. W., & Rowe, W.G. (2011). Dominant CEO, deviant strategy, and extreme performance: The moderating role of a powerful board. *Journal of Management Studies*, 48(7), 1479-1503.

Tauringana, V., & Chithambo, L. (2015). The effect of DEFRA guidance on greenhouse gas disclosure. *British Accounting Review*, 47(4), 425–444.

The Guardian, 2021. Australia shown to have highest greenhouse gas emissions from coal in world on per capita basis. Assessed on 1 Feb 2022 https://www.theguardian.com/environment/2021/nov/12/australia-shown-to-have-highest-greenhouse-gas-emissions-from-coal-in-world-on-per-capita-basis.

Thompson, J. (1967). Organisations in Action: Social Science bases of Administrative Theory, Working paper. https://ssrn.com/abstract=1496215

Uren, D. (2021). Australia at the centre of tension between record fossil-fuel prices and the move to net zero, Australian Strategic Policy Institute, Assessed on 1 Feb 2022, https://www.aspistrategist.org.au/australia-at-the-centre-of-tension-between-record-fossil-fuel-prices-and-the-move-to-net-zero/.

Villalonga, B., Amit, R. (2006). How do family ownership, control and management affect firm value? *Journal of Financial Economics*, 80(2), 385–417.

Visschers, V.H. (2018). Public perception of uncertainties within climate change science. *Risk Analysis*, 38(1), 43-55.

Walls, J.L., & Berrone, P. (2017). The power of one to make a difference: How informal and formal CEO power affect environmental sustainability. *Journal of Business Ethics*, 145(2), 293-308.

Walls, J.L., Berrone, P., & Phan, P.H. (2012). Corporate governance and environmental performance: Is there really a link? *Strategic Management Journal*, 33(8), 885–913.

Weisbach, M.S. (1988). Outside directors and CEO turnover. *Journal of Financial Economics,* 20, 431–460.

Wintoki, M.B., Linck, J.S., & Netter, J.M. (2012). Endogeneity and the dynamics of internal corporate governance. *Journal of Financial Economics*, 105(3), 581−606.

Wooldridge, J. M., 2010. Econometric analysis of cross section and panel data: MIT press.

World Economic Forum. (2022). The Global Risks Report 2022, World Economic Forum.

Wu, L.-Z., Kwan, H.K., Yim, F.H.-K., Chiu, R.K., & He, X. (2015). CEO ethical leadership and corporate social responsibility: A moderated mediation model. *Journal of Business Ethics*, 130(4), 819–831.

Yuan, Y., Tian, G., Lu, L.Y., & Yu, Y. (2019). CEO ability and corporate social responsibility. *Journal of Business Ethics*, 157(2), 391-411.

Yermack, D. (1996). Higher market valuation of companies with a small board of directors. *Journal of Financial Economics*, 40, 185–211.Xue, B., Zhang, Z., & Li, P. (2020). Corporate environmental performance, environmental management and firm risk. *Business Strategy and the Environment*, 29(3), 1074–1096.

Table 1: Sample selection and industry distribution

Panel A: Sample selection

Description	**Observations**	**Percent**
Observations with carbon emissions data: 2009–2019	3,851	100.00
Less: missing observations for CEO, executive and governance data	1,834	47.62
Less: missing observations for control variables	544	14.13
Final observations for analyses	1,473	38.25

Panel B: Industry distribution

Industry category	**Observations**	**Percent**
Electric Utilities	116	7.88
Packaged Foods and Meats	98	6.65
Diversified Metals and Mining	84	5.70
Gold	54	3.67
Water Utilities	54	3.67
Oil and Gas Exploration and Production	51	3.46
Coal and Consumable Fuels	47	3.19
Commodity Chemicals	37	2.51
Steel	36	2.44
Air Freight and Logistics	35	2.38
Others	861	58.45
Total	**1,473**	**100.00**

This table presents sample selection (Panel A) and sample distribution across industries (Panel B).

Table 2: Descriptive statistics

	Mean	Std. Dev.	1st Quartile	Median	3rd Quartile
Panel A: Dependent Variables					
TOTALEMISSIONS (mil)	1.1570	2.9970	0.0943	0.1867	0.7312
SCOPE1 (mil)	0.9342	2.9531	0.0162	0.0619	0.3114
SCOPE2 (mil)	0.2229	0.3716	0.0470	0.0960	0.2119
NEC (mil)	16.2504	77.3732	0.6783	1.5779	5.1511
TOTALEMISSIONS	0.0086	0.0925	0.0001	0.0003	0.0009
SCOPE1	0.0078	0.0543	0.0000	0.0001	0.0005
SCOPE2	0.0008	0.0040	0.0000	0.0001	0.0003
NEC	0.1118	0.7750	0.0007	0.0021	0.0082
Panel B: Independent Variables					
CEOPOWER	3.0182	1.2108	2.0000	3.0000	4.0000
CEOPOWER_STRUCTURAL	0.6251	0.5544	0.0000	1.0000	1.0000
CEOPOWER_OWNERSHIP	0.3945	0.4889	0.0000	0.0000	1.0000
CEOPOWER_EXPERT	1.3931	0.5642	1.0000	1.0000	2.0000
CEOPOWER_PRESTIGE	0.6042	0.6451	0.0000	1.0000	1.0000
Panel C: Firm Characteristics					
BOARDSIZE	6.3682	2.2745	5.0000	6.0000	8.0000
LNBOARDSIZE	1.9512	0.3028	1.7918	1.9459	2.1972
BOARDINDEPENDENCE	0.7218	0.1624	0.6364	0.7778	0.8333
LNTOTALASSETS	7.4230	1.7641	6.4366	7.3925	8.4354
ROA	0.0350	0.0383	0.0101	0.0365	0.0576
LEVERAGE	0.2987	0.2244	0.1128	0.2711	0.4400
MVBV	2.0139	1.3837	0.9500	1.5400	2.7400
GROWTH	0.0679	0.1683	-0.0308	0.0407	0.1140
CASHHOLDINGS	0.0820	0.1047	0.0152	0.0461	0.1131
CAPEX	0.0635	0.0739	0.0233	0.0462	0.0757
NEWFINANCING	0.0200	0.0439	0.0020	0.0073	0.0214
ASSETSNEWNESS	0.5713	0.2187	0.4307	0.5633	0.7316
FIRMAGE	18.7168	14.5223	8.0000	15.0000	28.0000
LNFIRMAGE	2.7720	1.3068	2.3026	2.9957	3.7612
LITIGATIONRISK	0.4073	0.4915	0.0000	0.0000	1.0000

This table presents the descriptive statistics for the main dependent variables in Panel A, independent variables in Panel B, and firm-level control variables in Panel C. All variables are defined in Appendix B.

Table 3: Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
TOTALEMISSIONS	(1)	1.00																	
SCOPE1	(2)	0.98***	1.00																
SCOPE2	(3)	0.75***	0.71***	1.00															
NEC	(4)	0.97***	0.96***	0.74***	1.00														
CEOPOWER	(5)	-0.05*	-0.05*	-0.03	-0.04*	1.00													
LNBOARDSIZE	(6)	-0.02	-0.02	0.00	-0.02	-0.03	1.00												
BOARDINDEPENDENCE	(7)	-0.01	-0.01	-0.03	-0.00	-0.02	0.07***	1.00											
LNTOTALASSETS	(8)	-0.32***	-0.32***	-0.30***	-0.31***	0.02	0.10***	0.11***	1.00										
ROA	(9)	-0.20***	-0.20***	-0.20***	-0.20***	-0.01	0.09***	0.05**	0.01	1.00									
LEVERAGE	(10)	-0.03	-0.03	-0.08***	-0.03	0.06**	-0.06**	-0.03	0.16***	-0.04	1.00								
MVBV	(11)	0.01	0.01	-0.01	0.01	0.04	-0.01	0.04	0.05**	0.09***	0.00	1.00							
GROWTH	(12)	0.10***	0.10***	0.15***	0.09***	-0.02	0.04	0.03	-0.04	0.13***	-0.04	-0.01	1.00						
CASHHOLDINGS	(13)	0.12***	0.11***	0.14***	0.12***	-0.01	-0.05**	0.07***	-0.12***	0.06**	-0.30***	-0.01	0.06**	1.00					
CAPEX	(14)	0.31***	0.30***	0.35***	0.31***	0.02	0.09***	0.05*	-0.20***	-0.04*	-0.03	-0.01	0.08***	0.06**	1.00				
NEWFINANCING	(15)	-0.15***	-0.15***	-0.18***	-0.15***	0.02	0.12***	0.15***	0.69***	0.06**	0.32***	0.03	0.03	-0.15***	0.00	1.00			
ASSETSNEWNESS	(16)	0.17***	0.16***	0.12***	0.16***	-0.02	0.04	-0.02	0.10***	-0.05*	0.01	-0.03	0.18***	-0.02	0.25***	0.17***	1.00		
LNFIRMAGE	(17)	-0.08***	-0.09***	-0.06**	-0.06**	-0.02	0.05*	0.09***	0.03	0.04	-0.20***	0.03	-0.02	0.09***	0.01	0.05*	-0.10***	1.00	
LITIGATIONRISK	(18)	-0.10***	-0.10***	-0.12***	-0.11***	-0.07***	-0.07***	-0.07***	0.16***	0.12***	0.09***	0.05**	-0.01	-0.18***	-0.15***	0.15***	0.12***	-0.06**	1.00

This table presents the correlation among variables used in the study. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 4: CEO power and carbon emissions

	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER	-0.0039**	-0.0022**	-0.0001	-0.0291**
	(-2.30)	(-2.14)	(-1.61)	(-2.04)
LNBOARDSIZE	0.0245*	0.0140**	0.0012*	0.1820*
	(1.97)	(1.97)	(1.91)	(1.74)
BOARDINDEPENDENCE	-0.0043	-0.0021	-0.0005	-0.0009
	(-0.45)	(-0.39)	(-1.11)	(-0.01)
LNTOTALASSETS	-0.0226***	-0.0133***	-0.0009***	-0.1768***
	(-3.73)	(-3.86)	(-3.04)	(-3.45)
ROA	-0.4655***	-0.2569***	-0.0215***	-3.6736***
	(-3.43)	(-3.52)	(-3.34)	(-3.22)
LEVERAGE	0.0195	0.0106	-0.0008	0.2219
	(0.59)	(0.54)	(-0.96)	(0.79)
MVBV	0.0045**	0.0026**	0.0001	0.0361**
	(2.13)	(2.14)	(0.95)	(2.02)
GROWTH	0.0148	0.0096	0.0027	0.0673
	(0.54)	(0.60)	(1.60)	(0.28)
CASHHOLDINGS	0.0830*	0.0407	0.0039	0.7319*
	(1.74)	(1.63)	(1.34)	(1.71)
CAPEX	0.2316*	0.1321*	0.0153***	1.9957*
	(1.74)	(1.68)	(2.92)	(1.73)
NEWFINANCING	-0.0004	-0.0002	0.0001	-0.0037
	(-0.29)	(-0.22)	(0.19)	(-0.34)
ASSETSNEWNESS	0.0765***	0.0430***	0.0015	0.5894**
	(2.90)	(2.82)	(0.81)	(2.47)
LNFIRMAGE	0.0024	0.0016	-0.0001	0.0315
	(0.80)	(0.89)	(-0.27)	(1.23)
LITIGATIONRISK	0.0048	0.0028	0.0009	0.0462
	(0.28)	(0.29)	(1.18)	(0.32)
CONSTANT	0.0802**	0.0468**	0.0045**	0.5668**
	(2.32)	(2.32)	(2.42)	(1.98)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
F-stat	13.17	15.10	7.11	12.62
Prob	0.0000	0.0000	0.0000	0.0000
R^2	0.4898	0.5239	0.3414	0.4792
N	1,473	1,473	1,473	1,473

This table presents the regression results of CEO power on carbon emissions with other control variables. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 5: CEO power and carbon emissions: 2SLS regressions

	Panel A: Stage 1	Panel B: Stage 2			
	(1) CEOPOWER	(3) TOTALEMISSIONS	(4) SCOPE1	(5) SCOPE2	(6) NEC
NONCEOTURNOVERIND	1.5926***	-	-	-	-
	(3.98)				
IVCEOPOWER	-	-0.0038**	-0.0021**	-0.0001	-0.0280*
		(-2.21)	(-2.04)	(-1.53)	(-1.95)
LNBOARDSIZE	-0.2264	0.0253**	0.0145**	0.0012*	0.1880*
	(-1.41)	(2.01)	(2.02)	(1.93)	(1.78)
BOARDINDEPENDENCE	-0.1709	-0.0036	-0.0017	-0.0004	0.0044
	(-0.82)	(-0.37)	(-0.32)	(-1.06)	(0.06)
LNTOTALASSETS	0.0047	-0.0226***	-0.0133***	-0.0009***	-0.1769***
	(0.13)	(-3.73)	(-3.86)	(-3.04)	(-3.45)
ROA	0.7009	-0.4682***	-0.2584***	-0.0216***	-3.6938***
	(0.68)	(-3.43)	(-3.53)	(-3.35)	(-3.23)
LEVERAGE	0.1372	0.0191	0.0104	-0.0008	0.2193
	(0.63)	(0.58)	(0.53)	(-0.97)	(0.78)
MVBV	0.0057	0.0044**	0.0026**	0.0001	0.0358**
	(0.22)	(2.12)	(2.14)	(0.93)	(2.01)
GROWTH	-0.3514*	0.0161	0.0104	0.0027	0.0772
	(-1.79)	(0.60)	(0.64)	(1.63)	(0.33)
CASHHOLDINGS	-0.3632	0.0844*	0.0415*	0.0040	0.7424*
	(-0.97)	(1.77)	(1.66)	(1.35)	(1.73)
CAPEX	0.3807	0.2304*	0.1314*	0.0152***	1.9865*
	(0.54)	(1.73)	(1.67)	(2.92)	(1.72)
NEWFINANCING	0.0014	-0.0004	-0.0002	0.0001	-0.0038
	(0.06)	(-0.30)	(-0.23)	(0.18)	(-0.34)
ASSETSNEWNESS	-0.0333	0.0767***	0.0431***	0.0015	0.5910**
	(-0.17)	(2.91)	(2.82)	(0.82)	(2.47)
LNFIRMAGE	-0.0172	0.0024	0.0016	-0.0001	0.0320
	(-0.54)	(0.82)	(0.91)	(-0.26)	(1.25)
LITIGATIONRISK	-0.0474	0.0050	0.0029	0.0009	0.0471
	(-0.09)	(0.29)	(0.30)	(1.19)	(0.33)
CONSTANT	1.8213**	0.0674**	0.0397**	0.0041**	0.4706*
	(2.41)	(2.05)	(2.09)	(2.32)	(1.73)
R2	0.0996	0.4896	0.5237	0.3413	0.4790
N	1,473	1,473	1,473	1,473	1,483
Weak identification test					
Kleibergen-Paap rk Wald F-statistic	224.09	-	-	-	-
p-value	0.0000				
Test of endogeneity: Durbin-Wu-Hausman test:					
F-statistics	-	4.20	4.17	2.33	3.79
p-value		0.0415	0.0423	0.1280	0.0527

This table reports the endogeneity-corrected regression results by employing the 2SLS regressions approach. Panel A reports first-stage regression output where the categorical CEO power variable is regressed on the instrumental variable and other firm-specific control variables. Panel B reports the second-stage regression output where the carbon emissions variables are regressed on the instrumented CEO power variable and other control variables. Robust two-tailed t-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 6: CEO power and carbon emissions: Self-selection correction models

	Panel A: Stage 1				Panel B: Stage 2			
	(1) DTOTALEMISSIONS	(2) DSCOPE1	(3) DSCOPE2	(4) DNEC	(5) TOTALEMISSIONS	(6) SCOPE1	(7) SCOPE2	(8) NEC
CEOPOWER					-0.0035**	-0.0022**	-0.0001	-0.0239*
					(-2.27)	(-2.28)	(-1.25)	(-1.87)
TOTALEMISSIONSIND	-2.7513***							
	(-3.36)							
SCOPE1IND		-2.9445**						
		(-2.22)						
SCOPE2IND			-3.7059*					
			(-1.66)					
NECIND				-0.3261***				
				(-3.11)				
IMR_DTOTALEMISSIONS					-0.0017			
					(-0.13)			
IMR_DSCOPE1						-0.0101		
						(-1.38)		
IMR_DSCOPE2							-0.0006	
							(-0.60)	
IMR_DNEC								0.0084
								(0.07)
LNBOARDSIZE	-0.3125*	-0.2597	-0.0381	-0.2235	0.0143	0.0101	0.0009	0.1013
	(-1.83)	(-1.49)	(-0.22)	(-1.24)	(1.06)	(1.36)	(1.39)	(0.92)
BOARDINDEPENDENCE	-0.0299	-0.3133	-0.2356	-0.3567	0.0107	0.0085	-0.0003	0.1126
	(-0.13)	(-1.31)	(-1.02)	(-1.50)	(0.91)	(1.27)	(-0.57)	(1.20)
LNTOTALASSETS	-0.1299**	-0.0783	-0.0598	-0.1113**	-0.0147***	-0.0080***	-0.0005**	-0.1160**
	(-2.57)	(-1.55)	(-1.24)	(-2.20)	(-2.61)	(-2.79)	(-2.49)	(-2.50)
ROA	-2.7188*	-5.0912***	-2.3871	-3.0914**	-0.4694***	-0.2253***	-0.0240***	-3.7878***
	(-1.87)	(-3.38)	(-1.60)	(-2.10)	(-3.29)	(-3.12)	(-3.57)	(-3.14)
LEVERAGE	0.1324	0.0041	-0.1538	-0.0381	0.0217	0.0114	-0.0004	0.2159
	(0.44)	(0.01)	(-0.48)	(-0.13)	(0.68)	(0.64)	(-0.56)	(0.83)
MVBV	-0.0371	-0.0305	-0.0153	-0.0216	0.0056**	0.0035**	0.0001	0.0456**
	(-1.40)	(-1.17)	(-0.57)	(-0.79)	(2.21)	(2.25)	(1.46)	(2.11)
GROWTH	0.2420	0.4472*	0.2648	0.1240	0.0426	0.0217	0.0037**	0.2972
	(0.97)	(1.84)	(1.09)	(0.50)	(1.61)	(1.40)	(2.10)	(1.25)
CASHHOLDINGS	-0.6278	-1.0410*	-1.0331*	-0.4286	0.1047**	0.0622**	0.0049	0.8870**

	(-1.17)	(-1.81)	(-1.75)	(-0.82)	(2.11)	(2.24)	(1.50)	(2.04)
CAPEX	0.2772	0.9471	0.6255	0.5480	0.3032**	0.1691**	0.0160***	2.6152**
	(0.37)	(1.36)	(0.87)	(0.68)	(2.24)	(2.22)	(2.78)	(2.30)
NEWFINANCING	-0.0333	-0.0288	-0.0014	-0.0215	0.0022	0.0015*	0.0001	0.0128
	(-1.02)	(-0.85)	(-0.04)	(-0.68)	(1.50)	(1.74)	(0.03)	(1.08)
ASSETSNEWNESS	0.0189	-0.2554	0.1687	-0.0537	0.0509*	0.0302**	0.0005	0.4024*
	(0.06)	(-0.78)	(0.55)	(-0.18)	(1.93)	(2.02)	(0.37)	(1.76)
LNFIRMAGE	0.1134**	0.1147**	-0.0485	0.1197**	0.0004	-0.0008	-0.0001	0.0155
	(2.13)	(2.04)	(-0.85)	(2.21)	(0.10)	(-0.41)	(-1.00)	(0.50)
LITIGATIONRISK	0.0319	0.0229	-0.0608	0.0216	0.0025	0.0007	0.0001	0.0241
	(0.20)	(0.14)	(-0.40)	(0.14)	(0.42)	(0.22)	(0.19)	(0.50)
CONSTANT	1.0565*	0.9551*	0.3612	0.9549*	0.0220	0.0149	0.0034**	0.1080
	(1.92)	(1.76)	(0.63)	(1.71)	(0.87)	(0.93)	(2.35)	(0.51)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2 / R2	0.1525	0.1155	0.0982	0.1274	0.3034	0.3033	0.2720	0.2903
N	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473

Panel A of this table presents the first stage of Heckman's (1979) self-selection model which consists of logit regressions on the probabilities of a firm having high or low carbon emissions after controlling for firm characteristics variables. Panel B presents the second stage of Heckman's (1979) self-selection model of CEO power on carbon emissions with other control variables. IMRM4COMP and IMRM4COMP are the self-selection parameters. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 7: CEO power and carbon emissions: Propensity score matching analysis

Panel A: First-stage logistic regression results

	Coefficient	***z*-stat**	***p*-value**
LNBOARDSIZE	-0.0924	-2.17	0.03**
BOARDINDEPENDENCE	-0.3222	-0.39	0.70
LNTOTALASSETS	0.0425	0.26	0.79
ROA	-1.7869	4.52	0.00***
LEVERAGE	0.0461	-0.99	0.32
MVBV	0.0154	-1.98	0.05*
GROWTH	-0.4572	1.92	0.05*
CASHHOLDINGS	-0.8244	-3.07	0.00***
CAPEX	1.0481	0.61	0.54
NEWFINANCING	-0.0300	-1.32	0.19
ASSETSNEWNESS	0.0142	2.38	0.02**
LNFIRMAGE	0.0456	0.03	0.98
LITIGATIONRISK	-0.2599	-0.48	0.63
CONSTANT	1.0377	2.34	0.02**
Year Fixed Effects		Yes	
Industry Fixed Effects		Yes	
Wald Chi Square		35.68	
Pseudo R2		0.0214	
N		1,473	

Panel B: Mean differences between treated and control groups

	Mean		**Difference test**
	Treated group: High CEO power	Control group: Low CEO power	p-value
TOTALEMISSIONS	0.0066	0.0196	0.06
SCOPE1	0.0040	0.0118	0.05
SCOPE2	0.0007	0.0008	0.70
LNNEC	0.0651	0.1573	0.10
LNBOARDSIZE	1.9424	1.9359	0.77
BOARDINDEPENDENCE	0.7143	0.7115	0.81
LNTOTALASSETS	7.3714	7.3903	0.88
ROA	0.0314	0.0332	0.53
LEVERAGE	0.2976	0.3081	0.54
MVBV	2.0281	2.0684	0.69
GROWTH	0.0568	0.0642	0.55
CASHHOLDINGS	0.0784	0.0801	0.81
CAPEX	0.0679	0.0696	0.76
NEWFINANCING	4.5102	4.4488	0.74
ASSETSNEWNESS	0.5708	0.5740	0.84
LNFIRMAGE	2.8134	2.7868	0.77
LITIGATIONRISK	0.3602	0.3172	0.21

Panel C: Second-stage regression results of association between CEO power and carbon emissions

	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
DCEOPOWER	-0.0143**	-0.0081**	-0.0002	-0.1048*
	(-2.22)	(-2.19)	(-0.51)	(-1.94)
LNBOARDSIZE	0.0513***	0.0292***	0.0024***	0.3755***
	(3.89)	(3.89)	(3.75)	(3.41)
BOARDINDEPENDENCE	-0.0002	-0.0008	-0.0009	0.0172
	(-0.01)	(-0.07)	(-0.89)	(0.10)
LNTOTALASSETS	-0.0347***	-0.0201***	-0.0011***	-0.2608***
	(-9.94)	(-10.10)	(-6.47)	(-8.93)
ROA	-0.5211***	-0.2857***	-0.0249***	-4.0349***
	(-5.26)	(-5.05)	(-5.12)	(-4.87)
LEVERAGE	0.0107	0.0066	-0.0030***	0.1793
	(0.58)	(0.62)	(-3.35)	(1.16)
MVBV	0.0060**	0.0037***	0.0001	0.0512***

	(2.58)	(2.77)	(1.05)	(2.63)
GROWTH	0.0247	0.0170	0.0033***	0.1390
	(1.23)	(1.49)	(3.33)	(0.83)
CASHHOLDINGS	0.0679*	0.0250	0.0030	0.5299*
	(1.80)	(1.16)	(1.64)	(1.68)
CAPEX	0.1657***	0.0949***	0.0155***	1.4572***
	(3.67)	(3.69)	(7.01)	(3.87)
LNNEWFINANCING	-0.0001	-0.0001	0.0001	-0.0054
	(-0.06)	(-0.04)	(0.11)	(-0.30)
ASSETSNEWNESS	0.0988***	0.0555***	0.0014	0.7310***
	(5.27)	(5.19)	(1.57)	(4.66)
LNFIRMAGE	-0.0001	-0.0001	-0.0002	0.0182
	(-0.03)	(-0.06)	(-1.60)	(0.69)
LITIGATIONRISK	0.0310	0.0158	0.0022	0.2448
	(0.73)	(0.65)	(1.05)	(0.69)
CONSTANT	0.0959*	0.0595*	0.0039	0.6747
	(1.76)	(1.91)	(1.46)	(1.48)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
R2	0.6137	0.6131	0.4238	0.6031
N	751	751	751	751

This table presents the propensity score matching results of CEO power on carbon emissions with other control variables. Panel A reports the mean differences of dependent and independent variables between the control group and matched group. Panel B reports the regression estimates using these two groups. Robust two-tailed t-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 8: CEO power dimensions and carbon emissions

	Panel A: Structural power				Panel B: Ownership power			
	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER_STRUCTURAL	-0.0092**	-0.0047**	-0.0003	-0.0690*				
	(-2.11)	(-1.99)	(-1.54)	(-1.87)				
CEOPOWER_OWNERSHIP					0.0086	0.0051	0.0001	0.0653
					(1.48)	(1.56)	(0.25)	(1.35)
LNBOARDSIZE	0.0254**	0.0146**	0.0012*	0.1891*	0.0260**	0.0149**	0.0012*	0.1935*
	(2.02)	(2.03)	(1.94)	(1.79)	(2.05)	(2.06)	(1.92)	(1.81)
BOARDINDEPENDENCE	-0.0001	0.0001	-0.0003	0.0306	0.0028	0.0020	-0.0004	0.0531
	(-0.01)	(0.01)	(-0.73)	(0.39)	(0.30)	(0.38)	(-1.01)	(0.70)
LNTOTALASSETS	-0.0225***	-0.0132***	-0.0009***	-0.1761***	-0.0225***	-0.0132***	-0.0009***	-0.1758***
	(-3.77)	(-3.89)	(-3.05)	(-3.48)	(-3.75)	(-3.88)	(-3.04)	(-3.47)
ROA	-0.4677***	-0.2582***	-0.0216***	-3.6901***	-0.4661***	-0.2571***	-0.0216***	-3.6775***
	(-3.44)	(-3.54)	(-3.36)	(-3.24)	(-3.44)	(-3.55)	(-3.35)	(-3.24)
LEVERAGE	0.0200	0.0108	-0.0008	0.2260	0.0189	0.0102	-0.0008	0.2173
	(0.61)	(0.56)	(-0.94)	(0.81)	(0.57)	(0.53)	(-0.98)	(0.78)
MVBV	0.0044**	0.0026**	0.0001	0.0357**	0.0045**	0.0027**	0.0001	0.0362**
	(2.12)	(2.13)	(0.93)	(2.01)	(2.12)	(2.14)	(0.93)	(2.02)
GROWTH	0.0155	0.0101	0.0027	0.0725	0.0164	0.0105	0.0027	0.0790
	(0.58)	(0.63)	(1.62)	(0.31)	(0.61)	(0.65)	(1.63)	(0.33)
CASHHOLDINGS	0.0836*	0.0410	0.0040	0.7361*	0.0852*	0.0419*	0.0040	0.7485*
	(1.76)	(1.64)	(1.34)	(1.72)	(1.77)	(1.66)	(1.34)	(1.73)
CAPEX	0.2290*	0.1307*	0.0152***	1.9759*	0.2311*	0.1318*	0.0152***	1.9915*
	(1.71)	(1.66)	(2.90)	(1.71)	(1.71)	(1.66)	(2.89)	(1.71)
NEWFINANCING	-0.0003	-0.0001	0.0001	-0.0035	-0.0003	-0.0001	0.0001	-0.0035
	(-0.27)	(-0.20)	(0.20)	(-0.32)	(-0.27)	(-0.20)	(0.19)	(-0.32)
ASSETSNEWNESS	0.0765***	0.0430***	0.0015	0.5895**	0.0778***	0.0437***	0.0015	0.5992**
	(2.92)	(2.83)	(0.81)	(2.48)	(2.93)	(2.84)	(0.82)	(2.50)
LNFIRMAGE	0.0025	0.0016	-0.0001	0.0325	0.0025	0.0016	-0.0001	0.0325
	(0.84)	(0.94)	(-0.24)	(1.27)	(0.85)	(0.95)	(-0.26)	(1.28)
LITIGATIONRISK	0.0049	0.0028	0.0009	0.0464	0.0014	0.0008	0.0009	0.0200
	(0.28)	(0.29)	(1.18)	(0.32)	(0.08)	(0.08)	(1.16)	(0.13)
CONSTANT	0.0675**	0.0397**	0.0041**	0.4716*	0.0592*	0.0348*	0.0041**	0.4080
	(2.06)	(2.09)	(2.32)	(1.74)	(1.85)	(1.90)	(2.23)	(1.53)

Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat	13.19	15.09	7.14	12.64	13.13	15.07	7.07	12.60
Prob	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R2	0.4902	0.5238	0.3422	0.4796	0.4891	0.5234	0.3402	0.4787
N	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473

	Panel C: Expert power				**Panel D: Prestige power**			
	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) LNNEC	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER_EXPERT	-0.0085*	-0.0049*	-0.0006**	-0.0676*				
	(-1.85)	(-1.92)	(-2.35)	(-1.70)				
CEOPOWER_PRESTIGE					0.0090**	0.0049**	0.0004**	0.0623**
					(2.47)	(2.45)	(2.38)	(2.21)
LNBOARDSIZE	0.0241**	0.0138**	0.0011*	0.1789*	0.0251**	0.0144**	0.0012*	0.1866*
	(2.00)	(2.01)	(1.91)	(1.77)	(2.00)	(2.00)	(1.92)	(1.76)
BOARDINDEPENDENCE	-0.0032	-0.0015	-0.0004	0.0071	-0.0049	-0.0025	-0.0005	-0.0048
	(-0.34)	(-0.29)	(-1.02)	(0.09)	(-0.52)	(-0.45)	(-1.21)	(-0.06)
LNTOTALASSETS	-0.0225***	-0.0132***	-0.0009***	-0.1758***	-0.0226***	-0.0133***	-0.0009***	-0.1767***
	(-3.73)	(-3.85)	(-3.07)	(-3.45)	(-3.76)	(-3.88)	(-3.05)	(-3.47)
ROA	-0.4696***	-0.2592***	-0.0217***	-3.7051***	-0.4681***	-0.2583***	-0.0216***	-3.6929***
	(-3.45)	(-3.55)	(-3.37)	(-3.25)	(-3.45)	(-3.55)	(-3.36)	(-3.25)
LEVERAGE	0.0182	0.0099	-0.0009	0.2120	0.0190	0.0103	-0.0008	0.2188
	(0.54)	(0.50)	(-1.05)	(0.75)	(0.58)	(0.53)	(-0.97)	(0.78)
GROWTH	0.0045**	0.0027**	0.0001	0.0365**	0.0042**	0.0025**	0.0001	0.0343*
	(2.15)	(2.16)	(1.01)	(2.04)	(2.05)	(2.07)	(0.84)	(1.96)
CASHHOLDINGS	0.0147	0.0096	0.0026	0.0661	0.0157	0.0102	0.0027	0.0744
	(0.55)	(0.60)	(1.57)	(0.28)	(0.58)	(0.63)	(1.63)	(0.32)
CAPEX	0.0836*	0.0410*	0.0039	0.7359*	0.0819*	0.0401	0.0039	0.7255*
	(1.76)	(1.65)	(1.35)	(1.72)	(1.71)	(1.59)	(1.31)	(1.68)
NEWFINANCING	0.2284*	0.1302	0.0151***	1.9705*	0.2246*	0.1282	0.0150***	1.9464*
	(1.70)	(1.65)	(2.91)	(1.70)	(1.68)	(1.63)	(2.87)	(1.69)
ASSETSNEWNESS	-0.0005	-0.0002	0.0001	-0.0044	-0.0005	-0.0002	0.0001	-0.0046
	(-0.36)	(-0.29)	(0.12)	(-0.40)	(-0.39)	(-0.31)	(0.13)	(-0.41)
LNFIRMAGE	0.0025	0.0016	-0.0001	0.0325	0.0025	0.0016	-0.0001	0.0326
	(0.84)	(0.93)	(-0.22)	(1.26)	(0.86)	(0.96)	(-0.23)	(1.29)
LITIGATIONRISK	0.0790**	0.0463**	0.0049***	0.5631**	0.0629*	0.0372**	0.0039**	0.4395
	(2.40)	(2.46)	(2.70)	(2.10)	(1.96)	(2.00)	(2.23)	(1.64)

CONSTANT	0.7283*	0.2900	0.5822*	1.6686**	0.4282	0.0334	0.3288	1.3732**
	(1.66)	(0.66)	(1.93)	(2.59)	(0.93)	(0.07)	(0.97)	(2.06)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat	13.17	15.11	7.25	12.64	13.23	15.14	7.19	12.65
Prob	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R2	0.4898	0.5241	0.3459	0.4795	0.4909	0.5247	0.3438	0.4796
N	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473

This table presents the regression results of four dimensions of CEO power on carbon emissions with other control variables. Robust two-tailed t-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 9: Additional tests

Panel A: Carbon-intensive industry effect

	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER	-0.0008*	-0.0003**	-0.0001	-0.0053*
	(-1.68)	(-2.36)	(-1.29)	(-1.71)
CARBON INTENSIVE DUMMY	0.0744***	0.0480***	0.0026**	0.6043***
	(2.79)	(3.22)	(2.32)	(2.69)
CEOPOWER*CARBON INTENSIVE DUMMY	-0.0045	-0.0035	-0.0001	-0.0348
	(-0.53)	(0.35)	(-0.67)	(-0.44)
CONSTANT	0.0097	0.0019	0.0021	-0.0074
	(0.29)	(0.10)	(1.06)	(-0.03)
Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
F-stat	13.07	15.01	7.04	12.52
Prob	0.0000	0.0000	0.0000	0.0000
R2	0.4904	0.5251	0.3416	0.4798
N	1,473	1,473	1,473	1,473

Panel B: Extreme weather effect

	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER	-0.0042**	-0.0021*	-0.0002	-0.0351*
	(-2.22)	(-1.74)	(-1.04)	(-1.69)
EXTREME WEATHER DUMMY	-0.0049	-0.0005	-0.0005	-0.0619
	(-0.49)	(-0.09)	(-0.75)	(-0.72)
CEOPOWER* EXTREM EWEATHER DUMMY	0.0004	-0.0002	0.0001	0.0072
	(0.15)	(-0.13)	(0.21)	(0.30)
CONSTANT	0.0841**	0.0472**	0.0050**	0.6167**
	(2.36)	(2.27)	(2.55)	(2.08)
Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
F-stat	12.90	14.78	7.00	12.38
Prob	0.0000	0.0000	0.0000	0.0000
R2	0.4900	0.5239	0.3426	0.4795
N	1,473	1,473	1,473	1,473

Panel C: Prestige power effect with internal monitoring

	(1) TOTALEMISSIONS	(2) SCOPE1	(3) SCOPE2	(4) NEC
CEOPOWER_PRESTIGE	0.0106	0.0047	0.0006**	0.0657
	(1.57)	(1.36)	(2.01)	(1.25)
INTERNAL MONITORING	-0.0010**	-0.0003**	-0.0001**	-0.0110**
	(-2.26)	(-2.25)	(-2.23)	(-2.04)
CEOPOWER_PRESTIGE * INTERNAL MONITORING	-0.0084*	-0.0039*	-0.0003*	-0.0641*
	(-1.86)	(-1.76)	(-1.78)	(-1.73)
CONSTANT	0.0609*	0.0365*	0.0036**	0.4137
	(1.86)	(1.92)	(2.10)	(1.53)
Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
F-stat	12.95	14.83	7.05	12.38
Prob	0.0000	0.0000	0.0000	0.0000
R2	0.4909	0.5247	0.3443	0.4797
N	1,473	1,473	1,473	1,473

This table presents the regression results of the interaction between CEO power and the carbon-intensive industry variable (Panel A), extreme weather variable (Panel B) and internal control variable (Panel C) on carbon emissions. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Table 10: CEO power, carbon emissions, and firm performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LEAD1ROA	TOTALEMISSIONS	LEAD1ROA	SCOPE1	LEAD1ROA	SCOPE2	LEAD1ROA	NEC	LEAD1ROA
CEOPOWER	0.0014*	-0.0045**	0.0012	-0.0025**	0.0012	-0.0001	0.0012	-0.0377**	0.0012
	(1.67)	(-2.34)	(1.52)	(-2.35)	(1.52)	(-1.51)	(1.50)	(-2.28)	(1.51)
EMISSIONS			-0.0357**						
			(-2.05)						
SCOPE1					-0.0654**				
					(-1.87)				
SCOPE2							-1.2943**		
							(-2.70)		
NEC									-0.0044*
									(-1.72)
LNBOARDSIZE	0.0095**	0.0140	0.0100**	0.0078	0.0100**	0.0007	0.0104**	0.1186	0.0100**
	(2.01)	(1.38)	(2.12)	(1.39)	(2.12)	(1.36)	(2.23)	(1.41)	(2.13)
BOARDINDEPENDENCE	0.0086	0.0038	0.0087	0.0035	0.0088	-0.0005	0.0079	0.0313	0.0087
	(1.58)	(0.50)	(1.61)	(0.85)	(1.62)	(-1.10)	(1.47)	(0.47)	(1.61)
LNTOTALASSETS	0.0002	-0.0222***	-0.0006	-0.0126***	-0.0006	-0.0008**	-0.0008	-0.1929***	-0.0007
	(0.11)	(-2.87)	(-0.33)	(-2.89)	(-0.35)	(-2.54)	(-0.48)	(-2.90)	(-0.36)
LEVERAGE	-0.0008	0.0557	0.0012	0.0317	0.0013	0.0005	-0.0002	0.4778	0.0013
	(-0.08)	(1.21)	(0.13)	(1.18)	(0.14)	(0.60)	(-0.02)	(1.23)	(0.14)
MVBV	0.0010	0.0030	0.0011	0.0017	0.0011	-0.0001	0.0010	0.0257	0.0011
	(1.33)	(1.36)	(1.50)	(1.34)	(1.51)	(-0.13)	(1.34)	(1.39)	(1.50)
GROWTH	0.0183**	-0.0053	0.0181**	-0.0019	0.0182**	0.0019	0.0207***	-0.0167	0.0182**
	(2.33)	(-0.22)	(2.30)	(-0.14)	(2.32)	(1.15)	(2.64)	(-0.08)	(2.33)
CASHHOLDINGS	0.0642***	0.0628	0.0664***	0.0283	0.0661***	0.0040	0.0693***	0.5639	0.0667***
	(3.43)	(1.00)	(3.73)	(0.82)	(3.73)	(1.06)	(4.10)	(1.03)	(3.77)
CAPEXASOFTA	-0.0273	0.2303	-0.0191	0.1320	-0.0187	0.0160***	-0.0066	2.0166	-0.0185
	(-1.10)	(1.36)	(-0.69)	(1.32)	(-0.66)	(2.60)	(-0.29)	(1.42)	(-0.67)
NEWFINANCING	-0.0001	-0.0005	-0.0001	-0.0003	-0.0001	0.0001	0.0001	-0.0033	-0.0001
	(-0.01)	(-0.36)	(-0.02)	(-0.31)	(-0.02)	(0.18)	(0.02)	(-0.25)	(-0.02)
ASSETSNEWNESS	-0.0103	0.0760**	-0.0076	0.0409**	-0.0076	0.0014	-0.0085	0.6539**	-0.0075
	(-0.99)	(2.24)	(-0.75)	(2.08)	(-0.76)	(0.75)	(-0.86)	(2.12)	(-0.74)
LNFIRMAGE	0.0003	0.0059	0.0006	0.0037*	0.0006	0.0001	0.0005	0.0550*	0.0006
	(0.25)	(1.62)	(0.41)	(1.75)	(0.43)	(0.65)	(0.35)	(1.71)	(0.44)
LITIGATIONRISK	0.0005	0.0016	0.0005	0.0011	0.0005	0.0006	0.0013	0.0175	0.0005
	(0.06)	(0.09)	(0.07)	(0.11)	(0.07)	(0.86)	(0.17)	(0.11)	(0.07)
CONSTANT	0.0212	0.0617*	0.0234	0.0338*	0.0234	0.0034*	0.0256	0.5197*	0.0235

	(1.20)	(1.72)	(1.31)	(1.67)	(1.31)	(1.89)	(1.44)	(1.71)	(1.31)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.3279	0.5257	0.3313	0.5850	0.3313	0.3252	0.3391	0.5154	0.3317
N	1,237	1,237	1,237	1,237	1,237	1,237	1,237	1,237	1,237
Mediation statistics									
Direct effect		0.0012							
Indirect effect		0.0002							
Total effect (direct + indirect)		0.0014							
z-statistic for indirect effect		1.930		1.855		1.954		1.879	
p-value		0.054		0.064		0.049		0.060	

This table reports the regression results on the mediation role of carbon emissions in the association between CEO power and firm performance in Panel A. Panel B reports the mediation effect test statistics. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. The superscripts ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix B.

Appendix A: Profiles of sustainability managers

Sustainability manager Number	Code	Profile
Sustainability manager 1	SM1	Currently, SM1 holds the position of Corporate Sustainability Manager of a multinational company operating in the Diversified Metals and Mining sector, a position they have held for more than 11 years. During their career spanning over 20 years, SM1 has held a number of senior management positions and gathered vast experience in climate change risk management and sustainability management.
Sustainability manager 2	SM2	Currently, SM2 holds the position of Environment and Sustainability Manager of a company operating in the industrials sector, a position they have held for seven months. During their career spanning over 10 years, SM2 has held a number of senior management positions in a number of companies including those in the areas of environment and sustainability.
Sustainability manager 3	SM3	Currently, SM3 holds the position of Vice President, Group Sustainability of a company operating in the communication services sector, a position they have held for nearly two years. During their career spanning over 25 years, SM3 has held various senior management positions in telecommunications and information technology companies including those relating to sustainability and social responsibility.
Sustainability manager 4	SM4	Currently, SM4 holds the position of National Sustainability Manager of a company operating in the Diversified Metals and Mining sector, a position they have held for nearly six months. During their career spanning over six years, SM4 has held a number of senior management positions in a number of companies including those in relation to sustainability.
Sustainability manager 5	SM5	Currently, SM5 holds the position of Environmental Services Manager of a company operating in the energy sector, a position they have held for nearly six years. During their career spanning over 20 years, SM5 has held a number of senior management positions in a number of companies of which most are in the area of environmental management.
Sustainability manager 6	SM6	Currently, SM6 holds the position of National Environmental Manager of a company operating in the industrials sector, a position they have held for nearly six years. During their career spanning over 15 years, SM6 has held a number of senior management positions in a number of companies in the areas of environment science and environmental management.
Sustainability manager 7	SM7	Currently, SM7 holds the position of Environment Manager of a company operating in the energy sector, a position they have held for nearly 18 months. During their career spanning over 15 years, SM7 has held a number of senior positions in the area of environmental management in two leading energy companies.
Sustainability manager 8	SM8	Currently, SM8 holds the position of Sustainability Manager of a company operating in the industrials sector, a position they have held for seven months. During their career spanning over 15 years, SM8 has held senior management positions in a number of companies including those in the areas of sustainability and climate change and worked as a consultant in corporate social responsibility.
Sustainability manager 9	SM9	Currently, SM9 holds the position of Head of Sustainability of a company operating in the energy sector, a position they have held for one year. During their career spanning over 20 years, SM9 has held senior management positions in a number of companies and government institutions, including those in the areas of environmental management and sustainability.

Appendix B: Definitions of variables

Variable	Code	Definition
Carbon emissions measures		
Total emissions released	TOTALEMISSIONS	Total emissions released in million, scaled by sales.
Scope 1 emissions released	SCOPE1	Direct emissions from owned or controlled sources in million, scaled by sales.
Scope 2 emissions released	SCOPE2	Indirect emissions from the generation of purchased energy in million, scaled by sales.
Net energy consumed	NEC	Net energy consumed in million, scaled by sales.
CEO power index, dimensional power indices and CEO power components		
CEO power index	CEOPOWER	A sum of the seven dichotomous variables created to capture four dimensions of CEO power (structural, ownership, expertise, and prestige). Note: The dichotomous variables are created by assigning a value of one for observations whose values are equal or above the industry-year median, and zero otherwise.
Structural power score	STRUCTURALPOWERSCORE	The score generated by adding the two dichotomous variables used to capture the structural power.
Ownership power score	OWNERSHIPPOWERSCORE	The score generated by the dichotomous variable used to capture the ownership power.
Expert power score	EXPERTPOWERSCORE	The score generated by adding the two dichotomous variables used to capture the expert power.
Prestige power score	PRESTIGEPOWERSCORE	The score generated by adding the two dichotomous variables used to capture the prestige power.
CEO pay slice	CEOPAYSLICE	The CEO total compensation divided by the total compensation of the top five executives, including the CEO. Note: Compensation is the reported total pay, which consists of the salary, bonus, superannuation, non-pecuniary benefits, shares and stock options. We exclude the final pay-out received by directors at the termination of their employment in calculating this CPS measure.
CEO duality	CEODUALITY	A dummy variable that takes the value of 1 if a CEO is also the chairperson, and zero otherwise.
CEO’s equity ownership	CEOOWNERSHIP	The percentage of equity shares owned by the CEO.
CEO’s tenure	CEOTENURE	The number of years of service as the CEO in the firm.
CEO’s prior executive experience in the firm	CEOPRIORPOSITIONS	A dummy variable that takes the value of 1 if the CEO held an executive position in the firm in the three years prior to becoming the CEO, and zero otherwise.
CEO’s other concurrent directorships	CEOOTHERDIRECTORSHIPS	A dummy variable that takes the value of 1 if the CEO holds directorships in other companies, and zero otherwise.
CEO’s qualifications	CEOQUALIFICATIONS	A dummy variable that takes the value of 1 if a CEO holds a higher degree(s) (i.e., masters, MBA, doctorate), and zero otherwise.
Governance characteristics		
Board size	LNBOARDSIZE	Logarithm of the total number of directors of the firm.
Board independence	BOARDINDEP	The percentage of independent directors on the board.
Financial characteristics		
Firm size	LNTOTALASSETS	Logarithm of firm’s total assets.
Return on assets	ROA	Income before extraordinary items scaled by the book value of assets.
Leverage	LEVERAGE	Short-term debt plus current portion of long-term debt plus long-term debt divided by total assets.
Market-to-book value	MVBV	Market value of assets divided by the book value of assets.
Growth	SALESGROWTH	Sales in the current year divided by sales in the previous year minus 1.
Cash holdings	CASHHOLDINGS	Total cash and equivalent divided by total assets.
Capital expenditure	CAPEX	Capital expenditure incurred to acquire, upgrade, and maintain physical assets, divided by total assets.
New financing	NEWFINANCING	The amount of debt and equity capital raised by the firm each year divided by the total assets at the beginning of that year.
Assets newness	ASSETSNEWNESS	Net property, plant and equipment (PPE), divided by gross PPE.
Firm age	LNFIRMAGE	Logarithm of firm age.
Litigation risk	LITIGATIONRISK	A dummy variable that takes the value of 1 if the company belongs to a high-litigation-risk industry, and zero otherwise.