THE IMPACT OF CEO ATTRIBUTES ON FIRM-LEVEL CLIMATE-CHANGE DISCLOSURE: EVIDENCE FROM UNITED STATES

A thesis submitted by

Hussein Ahmad Ali Daradkeh
(BSBF, MBA, MSF)

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ABSTRACT

This thesis examines the association between corporate governance traits (i.e. CEO power, CEO-director ties and managerial ability) and the extent of firm-level climate change disclosure. Using a sample of 3,512 U.S. firm-year observations from 2006–2018, the study finds that firms with more powerful CEOs disclose less climate change information. Furthermore, it finds that CEO–director social ties are positively associated with firm-level climate change disclosure. Finally, firms with more capable managers tend to make more climate change disclosures. Additionally, this research examines the moderating role of internal (e.g., corporate governance) and external monitoring (e.g., financial analysts' coverage) on the relationship between CEO power, CEO-director ties and managerial ability and climate change disclosure. The study finds that the negative and statistically significant relationship between CEO power and climate change disclosure is weakened when firms have higher institutional ownership and followed by a high number of analysts. This relationship is also weakened when firms suffer from low quality internal monitoring. The study also finds that both external monitoring and internal monitoring accentuate the positive impact of CEO–director social ties on climate change disclosure. Finally, the significant positive association between managerial ability and climate change disclosure is weakened when firms suffer from weak corporate governance. The results remain robust using a battery of robustness tests including reverse causality, observable and unobservable selection bias. Further, the study utilises state-level government party ideology as an exogeneous policy shock to address endogeneity. Additional analysis finds that climate change disclosure mediates the relationship between CEO power, CEO-director ties and managerial ability and firm value. Given the growing importance of integrating climate change-related information into a firm's operations and the pressure exerted by various stakeholders, understanding the drivers of climate change disclosures is an important and emerging area of research in the accounting and finance literature. To the best of our knowledge, this is the first study to examine any link between managerial ability and climate change disclosures. Considering the recent pressure imposed on companies by regulatory authorities for more climate change disclosures, the study's findings have important implications for regulators, policy makers, investors, financial analysts, researchers and firms.

CERTIFICATION OF THESIS

I *Hussein Ahmad Ali Daradkeh* declare that the PhD Thesis entitled *“the impact of CEO attributes on firm-level climate-change disclosure: evidence from United States”* is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes.

This Thesis is the work of *Hussein Ahmad Ali Daradkeh* except where otherwise acknowledged, with the majority of the contribution to the papers presented as a Thesis by Publication undertaken by the student. The work is original and has not previously been submitted for any other award, except where acknowledged.

Date: 19/5/2023

Endorsed by:

Associate Professor Syed Shams
Principal Supervisor

Senior Lecturer Dr. Sudipta Bose
Associate Supervisor

Student and supervisors’ signatures of endorsement are held at the University.

STATEMENT OF CONTRIBUTION

Three papers produced from this thesis are joint works by the authors identified below. The details of the co-authors' contributions are as follows:

Paper 1:
Daradkeh, H., Shams, S., Bose, S., & Gunasekarage, A. (2023). Does managerial ability matter for corporate climate change disclosures?. *Corporate Governance: An International Review*, *31*(1), 83-104.

This paper has been published in the Corporate Governance: An International Review journal and presented in the Financial Markets and Corporate Governance Conference (FMCG) (2021).

Hussein Daradkeh contributed 70% to this paper. Collectively Syed Shams, Sudipta Bose and Abeyratna Gunasekarage contributed the remainder.

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This paper received a Review and Resubmit decision from The Financial Review journal. Additionally, it has been accepted for presentation in Accounting and Finance Association of Australia and New Zealand (AFAANZ) (2023).

Hussein Daradkeh contributed 70% to this paper. Collectively Syed Shams, Sudipta Bose and Abeyratna Gunasekarage contributed the remainder.

Paper 3:

Daradkeh, H., Shams, S., & Bose, S. (2023). Impact of CEO Power on Corporate Climate Change Disclosure: Evidence from the United States. Journal of Business Ethics.

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Hussein Daradkeh contributed 70% to this paper. Collectively Syed Shams and Sudipta Bose contributed the remainder.

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"In the name of **Allah**, the most gracious, the most merciful"

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ABBREVIATIONS

2SLS	Two-Stage Least Squares
AFAANZ	Accounting and Finance Association of Australia and New Zealand
BIND	Board Independence
BSF	Bachelor of Science in Banking and Finance
BSIZE	Board Size
CAPIN	Capital Intensity
CCDS	Climate Change Disclosure Score
CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CPG	Corporate Philanthropic Giving
CPS	CEO Pay Slice
CSR	Corporate Social Responsibility
E-Index	Entrenchment Index
EIU	Economist Intelligence Unit
ESG	Environmental, Social, and Governance
FAGE	Firm Age
FIN	New Financing
FLI	Forward-Looking Information
FMCG	Financial Markets and Corporate Governance
FOREIGN	Foreign Operations
H1	Hypothesis 1
H1a	Hypothesis 1a
H1b	Hypothesis 1b
H2	Hypothesis 2
H2a	Hypothesis 2a
H2b	Hypothesis 2b
I/B/E/S	Institutional Brokers' Estimate Systems
ICBF	International Conference in Banking and Financial

IPCC	Intergovernmental Panel on Climate Change
IPO	Initial Public Offering
IV	Instrumental Variable
LEV	Leverage
LITG	Litigation Risk
MABILITY	Managerial Ability
MB	Market-to-Book Value
MBA	Master of Business Administration
MSF	Master of Science in Finance
NEW	Asset Newness
OLS	Ordinary Least Squares
PROPDISC	Proportion of Disclosure
PSM	Propensity Score Matching
RBV	Resource-Based View
ROA	Return on Assets
ROE	Return on Equity
S&P	Standard & Poor
SGROWTH	Sales Growth
SIZE	Firm Size
TCFD	Task Force on Climate-Related Financial Disclosures
TRI	Toxics Release Inventory
UK	United Kingdom
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US/USA	United States/United States of America
VIF	Variance Inflation Factor

CHAPTER 1 : INTRODUCTION

The unprecedented and interdependent crises of climate change and biodiversity loss pose an existential threat to people, prosperity, security, and nature.

——Carbis Bay G7 Summit communiqué, 2021, p. 13

1.1 Background and motivation

The world is facing serious environmental problems affecting human health and wellbeing. The two most pressing environmental challenges facing the world now are global warming and associated climate change. Managing climate change risk is one of the main concerns for a sustainable economy (United Nations [UN], 2020; World Bank, 2010). This is a risk that companies are now facing because of catastrophic climate change-related disasters (Task Force on Climate-Related Financial Disclosures [TCFD], 2017). Companies currently face a number of additional risks as a result of climate change, including physical risk (such as situations of extreme drought), regulatory risk (such as changes in government and related agency emission-related policies) and transitional risk (such as climate-related innovations that can be problematic for some industries; Javadi & Masum, 2021). Global warming has a major impact on water and food supply and is increasing sea levels, resulting in multiple disasters around the world (Amran et al., 2014).

The danger associated with climate change caused by greenhouse gas (GHG) emissions is a substantial problem (Intergovernmental Panel on Climate Change [IPCC], 2019). According to the IPCC (2014), the continued survival of humans in the contemporary world is threatened by climate change. For instance, the Economist Intelligence Unit [EIU] (2015) estimates that the present value of the loss of manageable financial assets worldwide from climate change is US$4.2 trillion, which equates to a loss of almost 3% from the world's current stock of manageable financial assets valued at US$143 trillion.[1] Furthermore, according to the Swiss Re Group, one of the biggest insurers in the world, the global economy will lose US$23 trillion by 2050

[1] https://impact.economist.com/perspectives/sites/default/files/The%20cost%20of%20inaction_0.pdf

as a result of crop losses, disease outbreaks and coastal areas being submerged by rapidly rising sea levels caused by climate change.[2] In addition, BlackRock, one of the biggest asset management companies in the world, has made the decision to include climate change in all of its investments because of the risks connected with a rapid rise in global temperatures.[3] The IPCC states that the increase in the global average temperature is a result of human activities that increase GHG.

Therefore, investors and regulators have been giving much attention to climate change disclosures (Ben-Amar & Mcllkenny, 2015). Companies are now under more pressure from their stakeholders to take action to reduce their contribution to climate change and extend the scope of their climate change disclosures (Okereke & Russel, 2010; Reid & Toffel, 2009).[4] This is evidenced by the formation of the TCFD and the Carbon Disclosure Project (CDP). Accordingly, organisations are ensuring that their activities are ‘environmentally friendly’ (Ben-Amar et al., 2017; Cotter & Najah, 2012; Ihlen & Roper, 2014; Lee et al., 2015;). Therefore, organisations are disclosing their efforts to mitigate their effects on climate change, through a variety of channels such as sustainability reports, annual reports and/or CDP responses.

Previous studies (e.g., Eccles et al., 2011; Griffin et al., 2017; Ioannou & Serafeim, 2015) find that capital market participants (e.g., investors and analysts) consider environmental and social disclosures in their valuations. Moreover, investors consider voluntary disclosure of climate change information as a value-creation tool (Cotter & Najah, 2012). Therefore, climate change is now considered an important business concern and corporations have begun to consider climate change-related issues in the making of their strategic management plans (Kolk & Pinkse, 2005). This was especially after the enforcement of the international treaty of the Kyoto Protocol (2005) (Freedman & Jaggi, 2005), which extends the 1992 United Nations Framework Convention on Climate Change committing participating nations to reduce carbon emissions. Therefore, firms are expected to disclose further information regarding their

[2] https://www.nytimes.com/2021/04/22/climate/climate-change-economy.html

[3] https://www.npr.org/2020/01/14/796252481/worlds-largest-asset-manager-puts-climate-at-the-center-of-its-investment-strate

[4] In this thesis, I refer to both carbon disclosures and greenhouse gas (GHG) disclosures as climate change disclosures. Some researchers refer to climate change disclosures as carbon disclosures (e.g., Bui et al., 2020) while others refer to them as GHG disclosures (e.g., Liao et al., 2015; Tauringana & Chithambo, 2015) and to the transparency of GHG disclosures (e.g., Peters & Romi, 2014).

policies on climate change and respective plans to reduce their impact on climate change (Lee et al., 2015).

Understanding the determinants of climate change disclosures has emerged as an important field of study in the accounting and finance literature given the rising relevance of incorporating climate change-related information into a firm's operations and the pressure exerted by various stakeholders. The literature documents several firm-level factors that influence companies' climate change disclosures (Ben-Amar et al., 2017; Bui et al., 2020; Liao et al., 2015; Tauringana & Chithambo, 2015). These researchers find that companies with stronger climate governance (Bui et al., 2020), environmental committees (Liao et al., 2015; Peters & Romi, 2014), larger boards (Liao et al., 2015; Tauringana & Chithambo, 2015) and gender-diverse boards (Ben-Amar et al., 2017; Haque, 2017; Liao et al., 2015) make more extensive climate change disclosures. Although recent research has helped to develop an understanding of the various firm-level determinants of climate change disclosures, evidence is lacking on whether climate change disclosures are affected by managerial ability, CEO–director social ties and CEO power. This research aims to investigate the relationship between managerial ability, two prominent CEO attributes—CEO–director social ties and CEO power—and climate change disclosure.

Climate change disclosure is affected by numerous factors including industry, country regulations, rating agency requirements and stakeholders (Ben-Amar et al., 2017; Brammer & Pavelin, 2006; Cotter & Najah, 2012; Hackston & Milne, 1996; Liao et al., 2015; Tauringana & Chithambo, 2015). For example, Ben-Amar et al. (2017) find that gender diversity increases the quantity of climate change disclosure. Brammer and Pavelin (2006) find that larger, less indebted companies with dispersed ownership characteristics are significantly more likely to make voluntary environmental disclosures. Cotter and Najah (2012) find the extent and quality of climate change disclosures are positively influenced by institutional investors. Moreover, it is evident that company size and industry (Hackston & Milne, 1996), gender diversity, board independence, the existence of an environmental committee (Liao et al., 2015) and government regulations (Tauringana & Chithambo, 2015) impact climate change disclosure. Another important factor that affects firms' climate change disclosure is CEOs and their attributes (Lewis et al., 2014). Researchers examining the relationship between CEO attributes and firms' disclosure find that CEO attributes have a significant impact on the disclosure policies of corporations and that this impact differs according to each attribute (Donnelly & Mulcahy, 2008; Hribar & Yang, 2016; McCarthy et al., 2017; Muttakin et al., 2018). Thus, researchers are isolating CEO attributes and observing the effect of each on environmental disclosure separately (Lewis et al., 2014). The current study specifically focuses on the importance of managerial ability and the CEO's personal attributes—including social connections created with the company's directors by the chief executive officer (CEO) (hereafter, 'CEO–director social ties')—and CEO power for climate change disclosure.

1.2 Research objectives and questions

Climate change is considered a key cause of physical, economic and social risk by the global community (Eleftheriadis & Anagnostopoulou, 2015). Major news agencies (e.g., *Financial Post*, *The New York Times*, *CBS News*, *Politico*, *Reuters*, *Economia*) have been covering the issues of institutional pressure and risks associated with climate change.[5] Therefore, firms need to disclose their environmental targets, risks and performance because distributing information is part of the managerial decision-making process. The outcome of this decision-making process is more likely to be accepted by affected stakeholders if they have been included in the process through communication of information relevant to their interests (Solomon & Lewis, 2002). Hence, investors and regulators have been paying close attention to disclosures related to climate change (Ben-Amar & Mcllkenny, 2015). Companies are now under increased pressure from their stakeholders to reduce their climate impacts while also broadening the scope of their climate change disclosures (Okereke & Russel, 2010; Reid & Toffel, 2009). To that end, firms are publicly sharing their efforts to reduce their contributions to climate change via a range of platforms, including sustainability reports, annual reports and/or CDP responses (Amran et al., 2014). Furthermore, disclosing climate change information is a process of communication that aims to satisfy stakeholders' views and expectations of the firm's environmental responsibility (Gray et al., 2009).

[5] Climate Change Poses Major Risks to Financial Markets, Regulator Warns
Investors Say Facebook, Tesla and many other companies are hiding climate impact
Democrats want companies to disclose their climate risks and fossil fuel industry is worried
Listed companies face mandatory climate risk disclosure

Disclosing information provides organisations with significant legal, competitive, strategic and financial advantages (Gray et al., 2009). Sharing information with external stakeholders reduces informational asymmetry between the firm and its stakeholders (Bui et al., 2020). Corporate disclosures are often seen as a way to influence the opinions of external stakeholders about the firm's future. Moreover, disclosures have often been seen as a preventative measure to mitigate future unfavourable outcomes concerning a firm's contributions to climate change (Brammer & Pavelin, 2006). Hence, CEOs are driven to make climate change disclosures because doing otherwise may limit their discretion regarding potential future investment possibilities. The literature highlights the importance of climate change disclosures in preserving firms' legitimacy marked by growing interest in firms' operational impacts on climate (Li et al., 2018). Therefore, by establishing its legitimacy, a firm mitigates its regulatory risks and protects its reputation in regard to environmental recklessness.

Determinants of climate change disclosure are gaining rapid attention from various scholars (e.g., Ben-Amar et al., 2017; Brammer & Pavelin, 2006; Cotter & Najah, 2012; Hackston & Milne, 1996; Liao et al., 2015; Tauringana & Chithambo, 2015). However, most of their studies focus on the influence of firm and financial characteristics on climate change disclosures, with few focusing on the CEO's impact. For example, some studies find that a CEO's education, tenure, age and duality have an impact on climate change disclosure (Lewis et al., 2014; Oware & Awunyo-Vitor, 2021). The literature sheds light on the influence of managerial ability (Baik et al., 2018; Bamber et al., 2010; Chatjuthamard et al., 2016; Chen & Chen, 2020; Cui et al., 2019; García-Sánchez et al., 2020; Krishnan & Wang, 2015; Peters & Romi, 2014; Sun, 2017; Yuan et al., 2019), CEO–director social ties (Fu, 2011; Hoitash, 2011; Jang et al., 2019; Ramón-Llorens et al., 2019; Zou et al., 2019) and CEO power (Cho et al., 2015; Chu et al., 2022; García-Sánchez et al., 2020; Harper & Sun, 2019; Jiraporn & Chintrakarn, 2013; Li et al., 2016; Muttakin et al., 2018; Rashid et al., 2020; Sheikh, 2019; Sun et al., 2022; Withisuphakorn & Jiraporn, 2015) on firms' information environment and disclosure. However, studies have not examined the relationship between managerial ability, some specific CEO personal attributes (CEO–director social ties and CEO power) and climate change disclosure.

Therefore, this research is motivated to focus on empirically examining the factors that affect environmental disclosure by examining, specifically, the impact of managerial ability, CEO–director social ties and CEO power, on climate change disclosure. This research will fill a gap in the literature on corporate governance, CEO attributes and climate change disclosure by answering the following research questions:

1. Does managerial ability influence firm-level climate change disclosures?
2. Do CEO–director social ties influence firm-level climate change disclosures?
3. Does CEO power influence firm-level climate change disclosures?

While addressing the above research questions, this thesis examines the influence of internal monitoring (governance quality) and external monitoring (analysts following) on the relationship between managerial ability, CEO–director social ties and CEO power, and climate change disclosure. Additionally, this research examines whether climate change disclosure plays a mediating role in this relationship.

1.3 Conceptual framework and underlying hypotheses

Each of three papers presented in this thesis includes a section that discusses the arguments and presents a detailed view of the hypothesis development for this study. However, the current section presents the conceptual framework and underlying hypotheses of the thesis's three papers. Based on relevant literature, the current study posits a conceptual framework for each paper linking managerial ability and CEO attributes with climate change disclosure; and the role of internal and external monitoring on the relationship between managerial ability and CEO attributes, and climate change disclosure. Finally, analyse the role of climate change disclosure in moderating the association between managerial ability and CEO attributes' and firm value.

Figure 1.1 presents the first paper's conceptual framework and hypotheses. In this paper, the independent variable is managerial ability, calculated using Demerjian et al.'s (2012) measure. Furthermore, the paper uses climate change disclosure as the dependent variable. Hypothesis 1 (H1) examines the relationship between managerial ability and climate change disclosure, and Hypothesis 2 (H2) examines the moderating role of internal monitoring (governance quality) on the relationship between managerial ability and climate change disclosure.

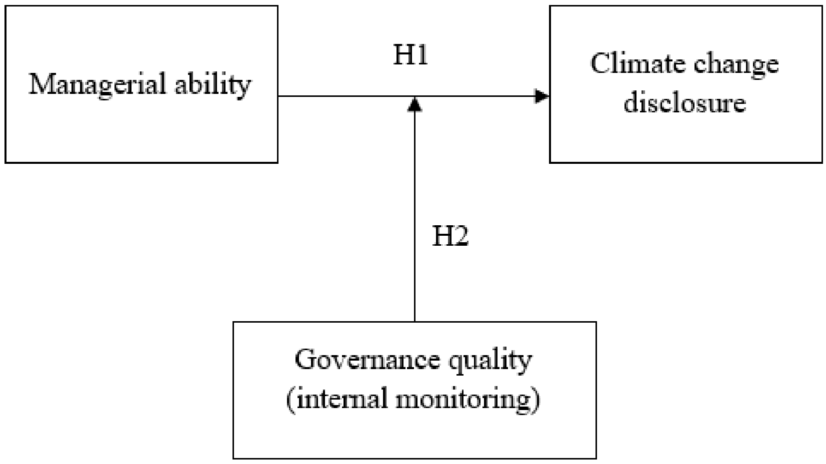

Figure 1.1. Conceptual framework and underlying hypotheses for the first paper

Source: developed by the author

Figure 1.2 presents the second paper's conceptual framework and hypotheses. In this paper the independent variable is CEO–director social ties, measured following Khedmati et al. (2020).[6] Similar to the first paper, climate change disclosure is used as the dependent variable. Hypothesis 1 (H1) examines the influence of CEO–director social ties on climate change disclosure. Hypothesis 2a (H2a) examines the moderating role of internal monitoring (governance quality) in the relationship between CEO–director social ties and climate change disclosure.[7] Finally, Hypothesis 2b (H2b) examines the moderation role of external monitoring (analysts following)[8] in the relationship between CEO–director social ties and climate change disclosure.

[6] Section 4.4.3 provides a comprehensive explanation on the measure of CEO–director social ties.
[7] Section 4.4.2 provides a comprehensive explanation on the measure of corporate governance quality.
[8] Analysts following represents the number of analysts following/covering a firm.

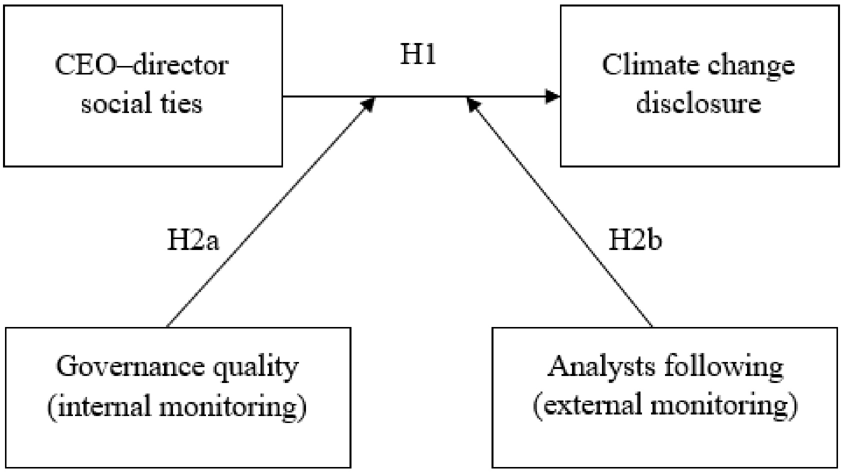

Figure 1.2. Conceptual framework and underlying hypotheses for the second paper

Source: Developed by the author

Finally, Figure 1.3 presents the third paper's conceptual framework and hypotheses. In this paper the independent variable is CEO power, measured using an index that includes the following dimensions: the CEO's duality, tenure, education, equity ownership and age. Like in the first and second papers, climate change disclosure is used as the dependent variable.[9] Hypothesis 1 (H1) examines the influence of CEO power on climate change disclosure. Hypothesis 1a (H1a) and Hypothesis 1b (H1b) examine the moderating role of internal monitoring (governance quality) and external monitoring (analysts following), respectively, on the relationship between CEO power and climate change disclosure.

[9] Section 4.3.3 provides a comprehensive explanation on the measure of CEO power.

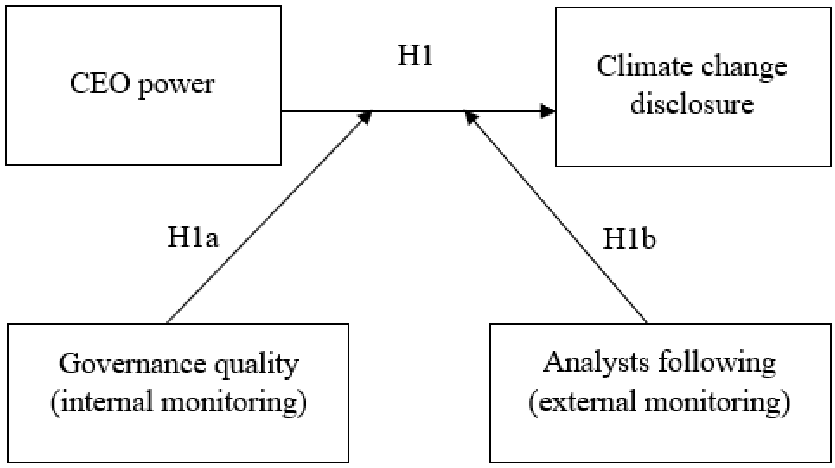

Figure 1.3. Conceptual framework and underlying hypotheses for the third paper

Source: developed by the author

1.4 Overview of findings

1.4.1 Findings of the first paper

This study uses the ordinary least squares (OLS) regression method to investigate the relationship between managerial ability and the extent of firm-level climate change disclosures, and the moderating role of corporate governance in this relationship. Using a sample of 2,298 firm–year observations from the United States (US) for the period 2005–19, I find that firms with more capable managers tend to make more climate change disclosures. Additionally, the study uses firm fixed-effect regression, propensity score matching (PSM) analysis, Heckman's (1979) two-stage analysis, instrumental variable analysis (2SLS) and alternative measures of climate change disclosures to address omitted time-invariant variable bias, observable heterogeneity bias, sample selection bias and reverse causality endogeneity problems, finding that the main results remain robust. The significant positive association between managerial capability and climate change disclosure is weakened when firms suffer from weak corporate governance. Additional investigation demonstrates that the relationship between managerial ability and firm value is mediated by climate change disclosures.

1.4.2 Findings of the second paper

This study uses the OLS regression method to examine the association between CEO–director social ties and the extent of firm-level climate change disclosure. I find that CEO–director social ties are positively associated with firm-level climate change disclosure, using data from 1,007 US firm–year observations spanning the years 2006–18. The results of this study are robust as shown using a battery of robustness tests including reverse causality, observable and unobservable selection bias, and alternative measures of climate change disclosure. Moreover, the state-level government party ideology is used as an exogeneous policy shock to address endogeneity. I also find that the beneficial effects of CEO–director social ties on climate change disclosure are intensified by both internal monitoring (e.g., corporate governance) and external monitoring (e.g., financial analysts' coverage). Additional investigation reveals that the association between CEO–director social ties and firm value is mediated by climate change disclosure.

1.4.3 Findings of the third paper

This paper uses the OLS regression method to examine the way CEO power affects firm-level climate change disclosure, as well as how internal monitoring (e.g., corporate governance) and external monitoring (e.g., financial analysts' coverage) affects this relationship. Using a sample of 3,512 US firm–year observations for the period 2006–18, I find that firms with more powerful CEOs release less information on climate change. The study utilises entropy balancing analysis, Heckman's (1979) two-stage analysis, firm fixed-effects regressions and instrumental variable analysis (2SLS) to test for reverse causality as well as observable and unobservable selection bias, finding that the main results remain robust. Moreover, when firms have increased institutional ownership, are followed by more analysts and suffer from poor internal monitoring, the negative and statistically significant association between CEO power and climate change disclosure is weakened. Through further investigation, I discover that the connection between CEO power and firm value is mediated by climate change disclosure.

1.5 Research contributions and significance

The current study makes several contributions to the literature. First, given that the TCFD recommends that companies demonstrate their resilience in the strategies implemented and operations undertaken to meet the challenge posed by global warming,[10] this thesis makes a timely contribution by analysing how capable CEOs, their social ties and power contribute to the wider community's aspirations. Second, the thesis contributes to the literature on factors influencing firms' climate change disclosures. While previous studies concentrate on variables such as size, leverage, profitability, shareholder resolutions and institutional ownership (Bui et al., 2020; Cotter & Najah, 2012; Freedman & Jaggi, 2005; Reid & Toffel, 2009), evidence on how managerial ability, CEO–director social ties and CEO power influences climate change disclosures is markedly absent. Third, the thesis contributes to the literature on managerial ability, CEO–director social ties and CEO power by investigating their influence on firm-level disclosure of non-financial information. Most previous studies on managerial ability analyse how this variable shapes a firm's financial performance (Bonsall et al., 2017; Holcomb et al., 2009; Koester et al., 2017); however, only a few studies examine the role played by managerial ability in the area of corporate social performance (e.g., Yuan et al., 2019). Furthermore, the literature on CEO–director social ties focuses on their impact on a firm's financial aspects, such as labour investment efficiency, firm value and initial public offerings (IPOs; Chahine & Goergen, 2013; Fan et al., 2019; Khedmati et al., 2020). Few studies focus on CEO–director social ties in the context of corporate social performance (Zou et al., 2019). Moreover, some studies on CEO power analyse its influence on a firm's information environment and corporate social responsibility (CSR) disclosure (Li et al., 2018; Muttakin et al., 2018; Withisuphakorn & Jiraporn, 2015) but not on its climate change disclosure. Finally, the thesis contributes to the firm valuation literature by showing the important mediating role played by climate change disclosures in the association between the three deterministic variables analysed in the thesis—managerial ability, CEO–director social ties and CEO power—and firm valuation. Taken together, the findings have important implications for regulators, policy makers, investors, financial analysts, researchers and firms, given the recent impetus for climate change disclosures.

[10] Source: Task Force on Climate-Related Financial Disclosures (TCFD, 2017).

1.6 Structure of the thesis

The reminder of the thesis is organised as follows. Chapter 2 presents a summary of the relevant literature. Chapter 3 presents the first paper, titled 'Does managerial ability matter for corporate climate change disclosures?'. Chapter 4 presents the second paper, titled 'Impact of CEO–director social ties on climate change disclosure: Evidence from the United States'. Chapter 5 presents the third paper, titled 'Impact of CEO power on corporate climate change disclosure: Evidence from the United States'.

Finally, Chapter 6 presents a summary of the overall findings. It highlights the significant implications for regulators, policy makers, researchers, investors, analysts and company management, given the current regulatory pressure on companies to disclose more information about climate change. Additionally, it presents the study limitations of all three papers and provides insights for future research.

CHAPTER 2 : LITERATURE REVIEW

2.1. Chapter overview

This chapter starts with an overview (Section 2.1) , followed with an introduction summarising the current study literature review process (Section 2.2). Section 2.3 discusses the literature of CEO attributes on firm's performance, while Section 2.3.1, 2.3.2 and 2.3.3 discusses the literature of managerial ability, CEO–director social ties and CEO power, respectively, on firm's performance. Section 2.4 presents the literature covering the influence of CEO attributes on firm's information environment, while sections 2.4.1, 2.4.2 and 2.4.3 discusses the literature of managerial ability, CEO–director social ties and CEO power, respectively, on firm's information environment. Section 2.5 present the literature of the determinants of climate change disclosure and Section 2.6 concludes the chapter and identify the knowledge gap in the literature.

2.2. Introduction

This section summarises the literature related to the current research. Figure 2.1 presents a summary of the literature review process. First, I review the accounting and finance literature to identify scholarly articles that discuss the influence of CEO attributes on firms' decisions and performance. Then I proceed to identify articles that focus on the impact of managerial ability, CEO–director social ties and CEO power on various aspects of firms. Eventually, I narrow the search down to literature discussing the influence of managerial ability, CEO–director social ties and CEO power on firms' information environment and disclosures. The literature review concludes that there is a significant impact of the CEO's managerial ability, CEO–director social ties and CEO power on various aspects of firms, and a knowledge gap on the influence of these attributes on climate change disclosure. In each of the three papers, I also review the relevant literature that helped in the development of hypotheses.

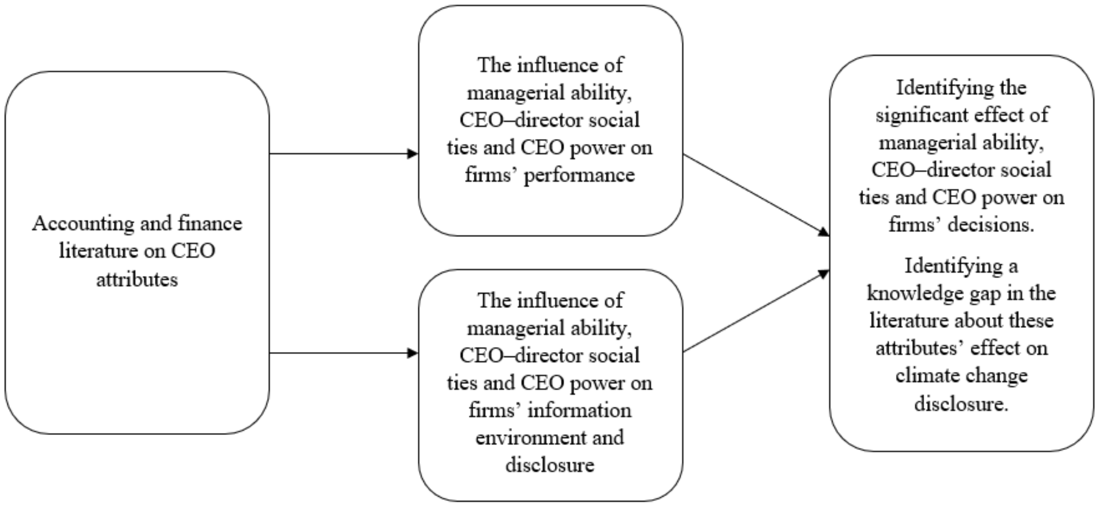

Figure 2.1. Process of reviewing relevant literature and identifying a knowledge gap

Source: developed by the author

2.3. Influence of CEO attributes on firm performance

The CEO is a highly important part of a company, with major responsibility for managing the firm and making critical decisions, in addition to being the firm's public face. Therefore, the relationship between CEO attributes and different aspects of firms has been highly researched. For instance, several studies investigate the impact of CEO attributes on firm performance.

2.3.1. Influence of CEO gender, age, humility, overconfidence and narcissism on firm performance

Wei et al. (2018) examine the effects of CEO attributes including tenure; education; political connectedness; and celebrity status, on corporate philanthropic giving (CPG) strategies in the form of donation amount; timeliness; and disclosure, in emerging markets. The study finds a strong relationship between CPG and CEO attributes. Wolfers (2006) examines the relationship between the director's gender and a firm's long-term stock return, focusing on the underestimated role of females in senior management, finding a systematic change in the returns of holding stock for female-managed corporations. Moreover, Peni (2014) focuses on the effects of CEO attributes on firm performance, using a cross-sectional panel regression to test for the relationship between CEOs attributes, chairperson and the performance of the firm. The study finds a relationship between gender, and both chairperson and firm performance; this relationship is positive when the CEO is female. It also finds an effect of CEO age on firm performance. Similarly, Lin et al. (2014) examines the relationship between CEO attributes and internal control quality, and finds that the age of the CEO influences the level of internal control quality; that is, a CEO's age affects their behaviour in response to the *Sarbanes–Oxley Act* (SOX) section 404 internal control requirements. Additionally, the literature sheds some light on the influence of CEO humility on firm performance. For example, Ou et al. (2018) introduce a model to interpret the relationship between CEO humility and corporate performance. They find a positive effect of CEO humility on firm performance via top management team integration, supporting the important role of CEO humility and its outcomes for corporate activities and results.

The literature also provides evidence on the influence of CEO overconfidence and narcissism on firm performance. Habib and Hossain's (2013) literature review on the effect of different attributes of CEOs and chief financial officers (CFOs) on accounting information finds that overconfident CEOs are innovators; however they are undesirable the boards and stakeholders as they tend to participate in risky financial activities. Another study that supports this finding is that of Beber and Fabbri (2012), which aims to understand the effect of a CEO's personal beliefs and individual attributes on the firm, finding that overconfident CEOs take more risks. Additionally, Ho et al. (2016) investigate the effect of CEO overconfidence and the heterogeneity in banks' risk-taking behaviours in thriving markets versus during a financial crisis. The sample for their study consists of data collected from American banks between 1994 and 2009, a period encompassing both the 1998 Russian Financial Crisis and the 2008 Global Financial Crisis. They find that CEO overconfidence increases the level of exposure of banks, which is usually more profitable to shareholders but not corporations or CEOs. Therefore, although overconfidence plays a major role in CEOs' risky behaviour when making financial decisions, this could positively impact firm performance. Olsen and Stekelberg (2016) discuss the relationship between a CEO's narcissistic personality and their corporation's decision to participate in tax shelters. The researchers find that a CEO's narcissistic personality positively interacts with the possibility of their firm engaging with a tax shelter.

2.3.2. Influence of CEO ability on firm performance

The CEO's ability is also found to have an impact on corporate performance and success (Chen et al., 2015). For instance, Chen et al. (2015) examine the influence of managerial ability on corporate innovative success and find a positive relationship between innovative productivity and managerial ability; this relationship is weaker for older or long-serving CEOs. Also, they find a positive relationship between the equity market and its view of managers' ability, as equity markets show signs of appreciation for better-skilled managers who can bring innovative ideas to life.

According to the predictions of upper echelon theory, organisational outcomes are significantly influenced by managerial ability, which encapsulates a diverse set of characteristics possessed by corporate managers (Hambrick, 2007; Hambrick & Mason, 1984). Collectively, managerial ability encompasses a set of skills possessed by managers together with their understanding of technology, industry trends and the experiential progress made by executives through their career. Therefore, managerial ability critically depends on a manager's understanding of the dynamics of the market in which they operate; strategies implemented by their organisation; competent understanding of the products marketed and the competition encountered by their firm; and their ability to adapt to advances in modern technology (Sun, 2017). Managers with such capabilities are veterans who develop expertise in their specific field; become aware of and are efficient and knowledgeable about their domain; and consequently achieve the goal of maximising shareholders' wealth while accumulating other financial and non-financial gains for their organisations (Coff, 1997).

The literature discusses how the heterogeneity in abilities of CEOs is essentially linked to the financial performance of an organisation (Bertrand & Schoar, 2003; Gabaix & Landier, 2008; Hermalin & Weisbach, 1998; Murphy & Zabojnik, 2004; Silva 2010). Bamber et al. (2010) study the difference between organisational performance and the traits and capabilities of the managerial team of an organisation. They conclude that the individual aspects of a manager's expertise are influential on the performance of an organisation. Strategic management abilities are also related positively to the performance of acquired or venture capital trades (Kaplan et al., 2012).

Moreover, Chemmanur and Paeglis (2005) show that organisations with an experienced and well-versed strategic team have better performance in terms of IPOs, including issuance and closure of shares and dividends. It is considered that a well-reputed manager tends to convincingly convey the intrinsic value of the organisation to third parties, including stakeholders. In addition, based on the theory of Titman and Trueman (1986), Silva (2010) documents a positive relationship between the capabilities of a manager and corporate capital flows. He finds that more able managers engage more in risky projects and their capabilities increase the probability of success in risky projects.

Baik et al. (2011) debate the accuracy of management forecasts of earnings as well as the domain expertise of the manager. Krishnan and Wang (2015) establish the existence of a negative relationship between the capabilities of a manager with audit fees and the going-concern's audit notion. It is evident in the findings of the study that managerial abilities play a significant role in the judgmental behaviour and efficiency of the auditor. Sun (2017) suggests that better capabilities and reputations of managers can help prevent or at least reduce goodwill impairment losses. Armstrong et al. (2015) show that managerial abilities and better rates of taxes are significantly linked. Research further reveals that reputable managers are less involved in activities related to avoidance of tax than are mediocre managers or those with fewer capabilities. The income tax payments of an organisation have a negative relationship with managerial abilities (Koester et al., 2017). Furthermore, Koester et al. (2017) concluded that better management of resources leads to better management of taxation-related transactions (Koester et al., 2017). Furthermore, Titman and Trueman (1986) suggest an analytical model that explains managerial abilities and the existence of variation in the disclosure and accuracy of managers' earnings forecasts.

Demerjian et al. (2012) argue that capable managers have a better understanding of technology and its use; can work effectively in accordance with industrial trends; accurately predict demand for their product; make effective decisions related to investments in high-value projects, and are capable of managing staff and employees efficiently and effectively. They further identify a positive relationship between the abilities of a manager and the performance of the organisation. There is a strong negative relationship between the co-occurrence of restatements and error in the provision of bad debt. Moreover, more able managers appear to utilise equity issuance proceeds more effectively. Their capabilities also lead to more efficient earnings and attractive financial plans for stakeholders.

2.3.3. Influence of CEO–director social ties on firm performance

In their investigation, Fracassi and Tate (2012) find that an increase in CEO–director ties leads to an increase in value-destroying acquisitions. Likewise, Fan et al. (2019) document a negative relationship between firm value and CEO–board friendship. They further find that an increase in board advising requirements weakens the negative effect of CEO–board friendship ties on firm value, suggesting that social ties between CEOs and directors leads to an increased flow of information. In contrast, board monitoring needs strengthen the negative relationship. Similarly, Schmidt (2015) finds that when the potential value of board advice is high, CEO–board social ties are related to higher bidder announcement returns; however, when monitoring needs are high, CEO–board social ties are related to lower returns. Khedmati et al. (2019) find a negative relationship between CEO–director ties and labour investment efficiency; in particular, CEOs with strong relationships with board members are associated with inefficient labour investment. They also find that this positive relationship is stronger in firms that rely more on skilled labour and are financially constrained; and that inefficient labour investment exacerbates labour cost stickiness. Khedmati et al.'s (2019) findings support the view that strong CEO–director ties lead to ineffective monitoring, intensifying the problem of inefficient labour investment; such ties can destroy shareholder value.

Motivated by the arguments that 'as family–board ties can address manager–owner conflicts of interests, they can also give rise to minority-shareholder expropriation and/or private benefits of control. likewise, social ties can either create value or lead to entrenchment and excessive managerial power', Chahine and Goergen (2013) find that IPO performance is positively related to the strength of social ties between CEOs and directors, but negatively related to the strength of family ties. Furthermore, they document an influence of board independence on IPO pricing and post-IPO operating performance after controlling for social ties. Finally, they suggest that the association between IPO performance and ties depends on whether these ties are with inside or outside directors. Westphal (1999) provides evidence contradicting the assumption that board independence from management improves board effectiveness in managing firms. That study provides evidence that an increase in CEO–director social ties increases the frequency of advice and counsel interactions between CEOs and directors, leading to higher board involvement and firm performance. Moreover, using a sample of Fortune 100 firms throughout 1996–2005, Hwang and Kim (2009) investigate the influence of CEO–director friendship ties. They find that 87% of boards are conventionally independent but only 62% are conventionally and socially independent. Furthermore, firms whose boards are conventionally and socially independent award a significantly lower level of compensation, exhibit stronger pay-performance sensitivity and exhibit stronger turnover-performance sensitivity than firms whose boards are only conventionally independent. Also, Wu (2008) find that CEO–board social ties curvilinearly influence the performance of new product introductions.

Cohen et al. (2022) examine whether knowledge of such ties affects investors' assessments of audit committee independence, competence and effectiveness, and, ultimately, investment decisions. Their study findings suggest that investors' knowledge of ties between the CEO and audit committee members significantly influences investors' assessments of audit committee effectiveness and investment decisions. In particular, investors consider that audit committees are independent and effective, and make more favourable investment decisions when no ties are present than when there are ties (social or professional) between audit committee members and the CEO. Furthermore, audit committees with professional ties are viewed as more independent, competent and effective than those with social ties. Furthermore, Bruynseels and Cardinaels (2014) find that CEO–director social ties negatively influence audit committee oversight quality. They find that firms with such ties purchase fewer audit services and engage more in earnings management. They also suggest that auditors are less likely to issue going-concern opinions or to report internal control weaknesses when friendship ties are present. Conversely, social ties formed through 'advice networks' do not seem to hamper the quality of audit committee oversight.

Yin et al. (2020) examine the effects of CEO–board social ties on accounting conservatism, finding a negative relationship. Their study suggests that an increase in CEO–board social ties hinders the board's monitoring function and encourages a CEO's tendency to adopt fewer conservative principles for their gains. Furthermore, they find a moderating effect of the internal control system on the relationship between CEO–director ties and accounting conservatism, suggesting that the internal control system managed by the board could be the facilitator via which the CEO engages in fewer conservative principles.

Krishnan et al. (2011) examines the association between CEO–director social ties and earnings management, finding that CEO–board ties positively affect earnings management. Likewise, Rose et al. (2014) investigate the influence of CEO–director friendship ties on earnings management. They find that friendship ties cause directors to be more willing to approve reductions in research and development (R&D) expenses that cause earnings to rise enough to meet the CEO’s minimum bonus target more often than when the directors and CEO are not friends.

Khanna et al. (2015) examine the relationship between CEO–director ties and corporate fraud, finding that appointment-based CEO–director ties increase corporate fraud, and reduce the potential for fraud detection. Moreover, such ties reduce the expected cost of fraud as boards will cover fraudulent activities, making CEO dismissal less likely upon discovery, and reducing the coordination costs of carrying out illegal activity. Furthermore, they find that CEO–board ties resulting from past employment, education, club memberships have insignificant effects on fraud.

2.3.4. Influence of CEO power on firm performance

Using empirical methods to test their hypothesis, Cheikh and Zarai (2008) investigate the link between CEO power and the performance of highly rated firms. Their research finds a highly validated positive relationship between CEO power and the financial success of organisations, as well as a positive but insignificant relationship between CEO power and firms’ accounting performance. Han et al. (2016) study the relationship between powerful CEOs and industry circumstances, particularly during an economic downturn, and find that powerful CEOs' discrete actions may have a favourable impact, particularly when the sector is in decline. Furthermore, Breit et al. (2019) examine how powerful CEOs affect labour productivity. They find that CEO power and labour productivity are positively correlated, and that powerful CEOs are better at managing labour expenses. Moreover, researchers examine how CEO power affects a company's non-financial success. For instance, Li et al. (2018) find that companies that provide CSR information and are headed by powerful CEOs are more likely to engage in CSR activities.

CEO power can have a negative consequence for firms, as powerful CEOs are more likely to engage in personally beneficial investments at the expense of shareholders (Dunn, 2004). Bebchuk et al. (2011) examine how CEO power affects a company's financial and accounting performance. They find that CEO power is negatively associated with firm value, and lead to lower accounting profitability and lower stock returns. Additionally, companies managed by powerful CEOs are less sensitive to CEO turnover and have a greater likelihood of awarding their CEO a lucky option grant at the lowest price of the month. Morse et al. (2011) examine the probability that a powerful CEO will manipulate how CEO performance is measured to influence their incentive payment. Using a sample from US data, they find that powerful CEOs rig their incentive contracts to influence their compensation in relation to performance sensitivity. Abernethy et al. (2015) investigate the influence of powerful CEOs on firms' decisions to adjust their compensation systems, reflecting regulatory requirements and stakeholder pressure. They find that powerful CEOs influence firms' decisions regarding their compensation contracts and that firms run by powerful CEOs set easily achievable performance targets for their CEOs. Moreover, powerful CEOs do not use or adopt relative performance assessment, and they engage in opportunistic behaviour and avoid risky projects (Dikolli et al., 2018).

Liu and Jiraporn (2010) examine the impact of powerful CEOs on bond yields and ratings, in a US sample. They find that companies managed by powerful CEOs have lower credit ratings and provide greater yields on their bonds than do companies led by less powerful CEOs. These findings, according to the authors, are supported by the information environment that a powerful CEO has established, which makes it difficult for bondholders to monitor the firm's management and influence them to increase bond yields. Additionally, CEO power affects the capital structure of the company; for instance, Jiraporn et al. (2012) discover that powerful CEOs employ less debt to finance the operations of their companies. Additionally, the authors provide evidence that the negative influence of capital structure on firm performance is more significant for firms managed by powerful CEOs.

2.4. Influence of CEO attributes on firms' information environment and disclosures

Some studies examine the relationship between CEO characteristics and disclosures, including forward-looking information (FLI) disclosures; CDP; and financial disclosures. For instance, Alqatamin et al. (2017), studying the impact of CEO characteristics including age, gender and overconfidence on FLI disclosures find a strong positive relationship between overconfidence and gender, and FLI disclosures; however CEO age has a strong negative relationship with FLI disclosures. The effect of CEO characteristics on disclosures is also highlighted in Lewis et al.'s (2014) study of US firms. Their research assumes that CEO characteristics, including education and tenure, affect the possibility of the firm voluntarily releasing environmental data. They find that companies led by newly hired CEOs or CEOs with a Master of Business Administration (MBA) respond more to the CDP than do firms led by lawyers. In a recent study, Buchholz et al. (2018) investigate how to relate the narcissism of CEO to the abnormal optimistic tone used in financial disclosures, proposing a connection between CEOs' narcissism and optimistic financial reporting based on the upper echelons theory. They find a strong positive relationship between CEO narcissism and employing an abnormal optimistic tone in financial disclosures.

2.4.1. Influence of CEO ability on firms' information environment and disclosures

Bamber et al. (2010) study the difference between the organisational practices of voluntary disclosures and the traits and capabilities of the managerial team of an organisation. They conclude that the individual aspects of a manager's expertise are influential in terms of financial reporting and practices related to disclosure. Moreover, based on the upper echelons theory, the literature documents an influence of managerial ability on CSR strategies (Chatjuthamard et al., 2016; Yuan et al., 2019). For example, García-Sánchez and Martínez-Ferrero (2019) find that more able managers invest more in social and environmental practices, and that better managerial ability leads to increased engagement in socially responsible investments. Furthermore, Chatjuthamard et al. (2016) find that an increase in managerial ability leads to more CSR investments. Similarly, Baik et al. (2018) document that an increase in managerial ability leads to an increase in CSR ratings. García-Sánchez et al. (2020) find that greater managerial ability enhances both socially responsible performance and the relevance of CSR disclosures. Moreover, Chen and Chen (2020) suggest a positive relationship between managerial ability and firms' accuracy regarding environmental capital expenditure. Yuan et al. (2019) documents a positive relationship between managerial ability and CSR performance, and that firms' CSR performance increases with managerial ability. Specifically, firms with more able managers are engaged more in socially responsible activities and fewer socially irresponsible activities, and are engaged more in stakeholder CSR rather than third-party CSR. Krishnan and Wang (2015) document a positive relationship between managerial ability and financial reporting, suggesting that managerial ability is more informative.

Moreover, more able managers improve firms' environmental performance, as they reduce Toxic Release Inventory (TRI) chemical releases (Sun, 2017), and García-Sánchez et al. (2020) document a positive relationship between managerial ability and firms' sustainability disclosures. Likewise, Peters and Romi (2014) find a positive relationship between managerial ability and disclosure of GHG emissions because more able managers are better at meeting stakeholders' demands for disclosing environmental information. More able managers influence the voluntary disclosure of information, which leads to a positive association between CEOs' managerial ability and voluntary disclosure (Cui et al., 2019).

2.4.2. Influence of CEO–director social ties on firms' information environment and disclosures

Jang et al. (2019) examine the effects of CEO–board social ties on the relationship between CSR and firm performance. Using a sample of 318 Korean firms between 2012 and 2015 they find that CEO–board social ties negatively impact the relationship between CSR and firm performance.

Ramón-Llorens et al. (2019) investigate the influence of the professional, technical and relational background (human and social capital) of outside directors on promoting firm CSR disclosure. They find that not all outside directors matter in CSR disclosure and that those classified as support specialists promote CSR disclosure. However, they also show that directors with previous experience as politicians affect CSR disclosure negatively, probably because of their interests in safeguarding their reputation within the company; avoiding public scrutiny; and protecting their political connections. Also, Ramón-Llorens et al.'s analysis including interaction effects reveals that powerful CEOs have the incentive to promote CSR-related strategies and to convince business experts and support specialist directors to enhance profitable sustainability strategies and transparency in CSR disclosure. Nevertheless, the powerful CEO effect is not sufficient to compensate for the negative role of political directors in CSR reporting.

Zou et al. (2019) examine the association between board social ties and the level of environmental responsibility undertaken by firms in China, by categorising board social ties into three types based on the three isomorphic forces in the institutional field (coercive, normative and mimetic). Their results provide empirical evidence that ties that are linked to coercive and normative forces (i.e., political organisations and universities) are related to a higher level of environmental responsibility; however, those that are linked to mimetic forces (i.e., industrial peers) have a negative association with environmental responsibility, which is mitigated by CEO power.

Hoitash (2011) examines whether independent directors who have social ties to management can effectively perform their duty of monitoring management on behalf of shareholders. Using social network analysis, Hoitash finds that social ties are associated with higher managerial compensation and that these results are driven by social ties that include members of the compensation committee. Furthermore, Hoitash provides evidence that financial reporting quality is improved when social ties exist. In particular, the likelihood of material weaknesses in internal controls and the likelihood of financial restatements are lower in companies with social ties. Moreover, the improved quality of financial reporting is observed only when social ties include members of the audit committee. Hoitash's findings suggest that socially tied independent directors should disqualify themselves from serving on compensation committees where social independence is essential. However, in tasks where collaboration with management is essential, directors with social links to each other can be of added value to shareholders.

Fu (2011) examine the effects of CEO–director ties on firms' voluntary financial disclosure practices, proxied by management earnings guidance. Fu (2011) finds a significant negative relationship between the likelihood of management earnings forecasts and the extent of outside directors' connection to the CEO. Moreover, firms with boards with fewer connections are less likely to issue precise forecasts, although the forecasts issued are more accurate and less optimistically biased. Together, these findings suggest that pre-existing social connections among outside directors are associated with lower financial disclosure quality, implying that social network ties between the CEO and outside board members weaken the monitoring effectiveness of the board.

2.4.3. Influence of CEO power on firms' information environment and disclosures

Evidence from earlier research shows that CEO power has a detrimental impact on CSR. Jiraporn and Chintrakarn (2013), for instance, investigate how powerful CEOs perceive CSR investments by using the CEO pay slice (CPS) as a proxy for CEO power. They find that when the CEO is more powerful, there is a higher level of CSR participation. However, once a CEO gains significant power, they tend to become more entrenched and stop making investments in CSR. The authors also identify a point at which more powerful CEOs begin to dramatically reduce their CSR spending. When confronted with stakeholder expectations for long-term environmentally friendly development rather than short-term financial gains, powerful CEOs pressure their company's management to implement CSR decoupling (Cho et al., 2015). Li et al. (2016) examines the influence of CEO power on companies' choices to invest in CSR. Their results imply that companies with powerful CEOs have a propensity to spend less and participate less in CSR initiatives. The research of Sheikh (2019) also demonstrates a conflict between powerful CEOs and CSR. Additionally, Harper and Sun (2019) use a sample of US enterprises to study the impact of CEO power on CSR performance and discover a negative and substantial correlation between CEO power and CSR performance. Harper and Sun's findings (2019) are supported by data presented by Chu et al. (2022); however their results point to a stronger inverse link between CEO power and CSR performance when powerful CEOs are young.

Among the sparse research investigating CEO power and firms' information environment, Withisuphakorn and Jiraporn (2015) examine the influence of CEO power on stock price informativeness. The authors conclude that CEO power has a negative impact on stock price informativeness. They argue that this is because strong CEOs foster an atmosphere where information is difficult to discover. García-Sánchez et al. (2020) investigate how CEO power affects the adoption of integrated reporting. They discover a conflict between the sharing of integrated information and powerful

CEOs. In their research into the impact of powerful CEOs on the reading difficulty of corporate annual reports, Sun et al. (2022) find that companies led by powerful CEOs publish annual reports that are challenging to read. Additionally, Muttakin et al. (2018) investigate how CEO power affects CSR disclosure. Using a power index that includes a CEO's duality, ownership, tenure and family status to measure CEO power, they find CEO power to be negatively correlated with CSR disclosure. Rashid et al. (2020), using a sample of Bangladeshi companies, also find a negative correlation between CEO power and CSR disclosure.

2.5. Determinants of climate change disclosure

Amran et al. (2014) examine the effect of company attributes and corporate governance on climate change disclosure. Their sample includes firms from 13 developed and emerging countries in the Asia-Pacific region operating in 10 industries. Regarding the company's attributes and climate change, they find a positive relationship between industry and climate change disclosure. Specifically, when the firm belongs to a carbon-intensive industry, it declares more climate change information. They also find a positive relationship between firms adopting environmental management systems and making climate change disclosures. However, they find a negative relationship between firm size and climate change disclosure. Regarding corporate governance, they show evidence of a negative influence of board size and CEO duality on climate change disclosure, but a positive influence of non-executive directors on climate change disclosure. Moreover, Ben-Amar and McIlkenny (2015) find a positive relationship between board effectiveness and climate change disclosure.

Additionally, research sheds light on the relationship between firms' financial characteristics and climate change disclosure. For instance, Andrikopoulos and Kriklani (2013) find a positive relationship between firm size and climate change disclosure, but a negative relationship between firm leverage and profitability, and climate change disclosure in firms listed in the Copenhagen Stock Exchange. Conversely, Eleftheriadis and Anagnostopoulou (2015) find a positive relationship between firm size and climate change disclosure, but no significant influence of firm leverage and profitability on climate change disclosure in firms listed in the Athens Stock Exchange.

Several studies examine the impact of gender diversity as a characteristic of the board of directors, on carbon disclosure, which involves releasing information regarding the environmental impact of corporations (Kim & Lyon, 2011). For instance, Liao et al. (2015) examine the influence of board of directors' characteristics on GHG emissions voluntary disclosure in a CDP report. They find a positive relationship between GHG information disclosure, the level of disclosure and gender diversity for the board of directors. They also find that the board of directors has a strong tendency to be ecologically transparent if it has a large environmental committee with active directors. Similarly, Hossain et al. (2017) examine the relationship between gender diversity on the board of directors and the CDP index, finding a positive relationship between gender diversity and carbon disclosure. Furthermore, Ben-Amar et al. (2017) examine the influence of the proportion of females on the board of directors on companies' willingness to increase climate change and GHG reporting to respond to pressure from stakeholder groups. The results of the study are consistent with critical mass theory as it finds that the greater the proportion of females on the board of directors, the higher the likelihood of voluntary disclosure.

Other researchers study the impact of effectiveness as a characteristic of the board of directors, on carbon disclosure; for example, Ben-Amar and McIlkenny (2015) examine the relationship between the board of directors' effectiveness and voluntary disclosure in regard to climate change. The researchers find a significant positive relationship between the board of directors' effectiveness, the company's tendency to respond to the CDP survey, and the quality of its carbon disclosure.

2.6. Conclusion

To summarise, researchers have been studying the impact of different CEO attributes on various aspects of firms, finding evidence of a significant influence of CEO attributes on firm performance. However, to my knowledge, only a few studies have examined the relationship between CEO attributes and climate change disclosure; therefore, further research should be undertaken to fill this gap in the literature. Accordingly, the research reported in this thesis investigates the effects of three CEO attributes—managerial ability, CEO–director social ties and CEO power—on climate change disclosure.

CHAPTER 3 : PAPER 1

Does Managerial Ability Matter for Corporate Climate Change Disclosures?

3.1. Chapter overview

This chapter introduces the first paper of the current thesis, which examines the impact of managerial ability on firm-level climate change disclosure, and the moderating role of corporate governance. The chapter provides an overview of its contents in section 3.1. Following the University of Southern Queensland guidelines, each page of the article is uploaded as a photo, beginning with the title and abstract page and ending with Appendix A. The article itself starts with an introduction in section 1, followed by section 2, which discusses related literature and hypothesis development. Section 3 presents the research methodology, while section 4 presents the empirical results. Additional analysis is presented in section 5, and section 6 concludes the article.

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Does managerial ability matter for corporate climate change disclosures?

Hussein Daradkeh[1] | Syed Shams[1] | Sudipta Bose[2] | Abeyratna Gunasekarage[3]

[1]School of Commerce, University of Southern Queensland, Brisbane, Queensland, Australia
[2]Discipline of Accounting and Finance, Newcastle Business School, University of Newcastle, Sydney, New South Wales, Australia
[3]Department of Banking and Finance, Monash Business School, Monash University, Melbourne, Victoria, Australia

Correspondence
Sudipta Bose, Discipline of Accounting and Finance, Newcastle Business School, University of Newcastle, Sydney, NSW 2000, Australia.
Email: sudipta.bose@newcastle.edu.au

Abstract

Research Question/Issue: This study examines the association between managerial ability and the extent of firm-level climate change disclosures and the moderating role of corporate governance in this association.

Research Findings/Insights: Results based on a sample of 2298 firm-year observations from the United States (US) from 2005 to 2019 suggest that firms with more capable managers tend to make more climate change disclosures. This significant positive association is weakened when firms suffer from weak corporate governance. These findings remain robust after addressing omitted time-invariant variable bias, observable heterogeneity bias, sample selection bias, and reverse causality and when using alternative climate change disclosure proxies. Further analysis shows that climate change disclosures have a mediating role in the association between managerial ability and firm valuation.

Theoretical/Academic Implications: Given the growing importance of integrating climate change-related information into a firm's operations and the pressure exerted by various stakeholders, understanding the drivers of climate change disclosures has emerged as an important area of research in the accounting and finance literature. To the best of our knowledge, this is the first study to examine any link between managerial ability and climate change disclosures.

Practitioner/Policy Implications: Considering the recent pressure imposed on companies by regulatory authorities for more climate change disclosures, our study's findings have important implications for regulators, policy makers, investors, financial analysts, researchers, and firms.

KEYWORDS
climate change disclosures, firm value, governance, managerial ability

1 | INTRODUCTION

Over the past two decades, climate change and global warming have emerged as the most imminent global environmental issues. One of a sustainable economy's biggest challenges is managing climate change risk (United Nations [UN], 2020; World Bank, 2010), a risk that organizations are confronting today owing to extreme climate change-related events (Task Force on Climate-Related Financial Disclosures [TCFD], 2017). According to the Intergovernmental Panel on Climate Change (IPCC) (2014), climate change threatens the existence of mankind in the modern world. Consequently, companies are continuously pressured by various stakeholders to disclose information on their activities that affect climate change. This is evidenced by the formation of the Task Force on Climate-Related Financial Disclosure (TCFD) and the Carbon Disclosure Project (CDP). Given the growing importance of integrating climate change-related information into a firm's operations and the pressure exerted by various stakeholders, understanding the drivers of climate change disclosures has emerged as an important area of research in the accounting and finance literature. Previous studies suggest several of the firm-level factors that drive firms' climate change disclosures (Ben-Amar et al., 2017; Bui et al., 2020; Liao et al., 2015; Tauringana & Chithambo, 2015).[1] These researchers argue that more extensive climate change disclosures are made by firms with stronger climate governance (Bui et al., 2020), environmental committees (Liao et al., 2015; Peters & Romi, 2014), larger boards (Liao et al., 2015; Tauringana & Chithambo, 2015), and gender-diverse boards (Ben-Amar et al., 2017; Haque, 2017; Liao et al., 2015).

Although extant research helps to develop an understanding of the various firm-level determinants of climate change disclosures, evidence is lacking on whether climate change disclosures are affected by managerial ability. Managerial ability reflects the knowledge, skills, and experience possessed by the team that manages the firm and the efficiency displayed by managers in transforming corporate resources to revenue (Demerjian et al., 2012). Managers who are more capable are in a better position to understand advancements in technology and industry trends, to correctly project future product demands, to select and implement projects that generate higher returns, and to improve resources productivity, as well as being efficient in managing their employees. Finkelstein (1992) argues that top managers are entrusted with the power to deal with both internal and external uncertainty. Uncertainty is an integral part of climate change issues (Stern, 2008). The interview evidence presented by Kumarasiri and Gunasekarage (2017) reveals that, while perceiving climate change risk as a threat (both financial and reputational), company managers believed that climate change risk presented them with opportunities to develop new renewable energy sources, introduce low carbon products, and support their customers in managing their emissions.

Existing evidence on managerial ability reveals that the more capable managers lead their companies to success during crisis periods through efficient utilization of resources, making use of low-cost debt financing and grabbing investment opportunities available in the market (Andreou et al., 2017; Lee et al., 2018). Grenadier (2002) contends that investments made during periods of severe uncertainty can create strategic advantages in an imperfect setting by enabling companies to acquire growth opportunities, thereby increasing their market share. Therefore, capable managers should be in a position to manage climate change risk by implementing climate change risk management policies while making use of any advantages arising from uncertainty associated with climate change issues. From the legitimacy theory perspective, an organization exists only if the society confers upon the organization the state of legitimacy (Deegan, 2002) and managers use social and environmental disclosures as a means to counter legitimacy threats (Deegan, 2019). The increased stakeholder demand for the disclosure of climate change information (Ben-Amar et al., 2017; Bui et al., 2020; Clarkson et al., 2015; Kolk et al., 2008) can be viewed as societal pressure in this legitimization process. Together with their desire to maintain the social license to operate, capable managers' ability to manage the uncertainty associated with climate change while making use of the opportunities presented by the same scenario can consequently create a link between managerial ability and firms' climate change disclosures.

Therefore, the main objective of our study is to investigate whether managerial ability influences the disclosure of climate change information at the firm-level. As prior studies show that firms' climate change disclosures are influenced by corporate governance mechanisms (Bui et al., 2020), we examine the moderating role played by corporate governance mechanism in the association between managerial ability and climate change disclosures. Furthermore, we examine the mediating role of climate change disclosures in the association between managerial ability and firm valuation, given the inconclusive findings of this association.

Using a sample of 2298 firm-year observations for the period 2005–2019, we examine the association between managerial ability and the extent of firm-level climate change disclosures and the moderating role of corporate governance in this association. We estimate and measure managerial ability using a modified version of Demerjian et al.'s (2012) firm efficiency model by adding board size, board independence, and Chief Executive Officer (CEO) duality as additional control variables, along with six firm characteristics (firm size, market share, firm age, positive free cash flow, complex multisegment, and international operations). We measure the level of climate change disclosure with the CDP climate change disclosure score. To estimate the regression models, we use the ordinary least squares (OLS) regression method. As our findings may be affected by observable and unobservable selection bias, we employ propensity score matching (PSM) analysis and Heckman's (1979) two-stage analysis. We undertake several robustness analyses, including firm fixed-effect regression, instrumental variable (IV) analysis, and quasi-experimental analysis. We also examine the mediating role of climate change disclosures in the association between managerial ability and firm valuation.

We find that managerial ability has a positive and significant influence on the level of climate change disclosures of firms in our sample. This finding supports the view that capable managers have less career concerns and, thus, are motivated to disclose more climate change information. We also find that the above influence is weakened if firms have weak corporate governance. Our findings remain robust after addressing the omitted time-invariant variable bias using firm fixed effects, observable selection bias using PSM analysis, unobservable selection bias using Heckman's (1979) two-stage analysis, and endogeneity concerns by implementing two-stage analysis with IVs and quasi-experimental analysis. We also find that climate change disclosures have a mediating role in the association between managerial ability and firm valuation.

Our study makes several contributions to the existing literature. Firstly, as the TCFD recommends that companies demonstrate their resilience in the strategies implemented and operations undertaken to meet the challenge posed by global warming,[2] we make a timely contribution by analyzing how capable managers contribute to the wider community's aspirations. Secondly, we contribute to the literature on factors that influence firms' climate change disclosures. While previous studies concentrate on variables, such as size, leverage, profitability, shareholder resolutions, and institutional ownership (Bui et al., 2020; Cotter & Najah, 2012; Freedman & Jaggi, 2005; Reid & Toffel, 2009), evidence on how managerial capability influences climate change disclosures is markedly absent. Thirdly, we contribute to the literature on managerial ability by investigating its influence on firm-level disclosure of nonfinancial information. Most prior studies analyze how managerial ability shapes the firm's financial performance (Bertrand & Schoar, 2003; Bonsall et al., 2017; Holcomb et al., 2009; Koester et al., 2017); however, only a few studies examine the role that managerial ability plays in the area of corporate social performance (e.g., Yuan et al., 2019). Fourthly, we consider the influence of a powerful corporate governance mechanism (weak governance, as proxied by managerial entrenchment) to discover whether this variable moderates the main relationship revealed in the study. Finally, we contribute to the firm valuation literature by showing the important mediating role played by climate change disclosures in the association between managerial ability and firm valuation. Taken together, our findings have important implications for regulators, policy makers, investors, financial analysts, researchers, and firms, given the recent impetus for climate change disclosures.

The remainder of the paper proceeds as follows. Section 2 presents the review of the relevant literature and the development of the research hypotheses. Section 3 outlines the methodology employed in the study. Section 4 discusses the empirical findings, while Section 5 presents the outcomes of several additional analyses. The last section (Section 6) concludes the paper.

2 | LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 | Managerial ability and climate change disclosures

According to the predictions of upper echelons theory, organizational outcomes are significantly influenced by managerial ability, a term which encapsulates a diversified set of characteristics possessed by corporate managers (Hambrick, 2007). Collectively, managerial ability encompasses a set of managerial skills, together with managers' understanding of technology and industry trends and the experiential progress made throughout their careers. Therefore, managerial ability critically depends on managers' understanding of the dynamics of the market in which they operate, the strategies implemented by their firms, a competent understanding of their firms' products and the competition encountered by their firms, and their ability to adapt to advancements in modern technology (Demerjian et al., 2012; Sun, 2017). Managers with these capabilities develop expertise and become veterans in their specific field. They are aware of their domain, as well as being efficient and knowledgeable, and, consequently, achieve the goal of maximizing shareholders' wealth while accumulating other financial and non-financial gains for their firms (Demerjian et al., 2013; Holcomb et al., 2009).

Corporate executives make a significant contribution to the firm's strategic decisions (Hambrick, 2007). One of the key characteristics that influences these strategic decisions is managerial career concern. Holmstrom (1999) argues that a manager's worry about his or her future career may affect incentives to exert effort or make choices on the job, while Holmstrom (1982) notes that these career concerns could distort decisions made by managers. Narayanan (1985) finds that when managers are motivated to improve their reputation, they have the incentive to make suboptimal decisions that boost the firm's short-term profits, to which their remuneration is attached, at the expense of shareholders' long-term interests. Graham et al. (2005) find similar evidence that managers motivated by career prospects forsake long-term value to increase short-term profits. Due to the inherent uncertainty involved in climate change issues (Stern, 2008), any investment in climate change risk management requires a long-term commitment by managers, with these projects being risky investments that do not generally provide quick pay-offs (Krueger et al., 2020). Therefore, one could conjecture that career-concerned managers have an aversion to invest in climate change projects.

However, the argument that managerial career concerns lead to short termism in decision making may only be applicable to less capable managers. The reason is that managers with a high level of ability earn better assessments, both within their own firm and from the labor market, and therefore are in high demand from competing firms (Ali et al., 2019; Fee & Hadlock, 2003). Fee and Hadlock (2003) find that top executives in well-performing firms are likely to be hired with offers of better remuneration packages by competing firms, while Rajgopal et al. (2006) find that CEO talent is correlated with explicit recognition of CEOs by external parties and with these CEOs receiving offers of appointment from outside their firm. Yuan et al. (2019) argue that the more able managers do not suffer from short-term career concerns due to their belief that their abilities will reward them with future career prospects. Bertrand and Schoar (2003) find manager fixed effects to be important determinants of a wide range of corporate decisions: in particular, managers who hold an MBA degree appear to follow more aggressive strategies. Several studies have established a strong link between managerial ability and corporate social responsibility (CSR)[3] investments for which returns are uncertain and take a longer time to come to fruition (Chatjuthamard et al., 2016; Yuan et al., 2019). The more capable managers can use these CSR initiatives strategically to increase the value of their firms by, for example, reducing the amount of labor-related litigation, improving the loyalty of customers and the quality of products, gaining recognition among community members, and promoting the morale of their employees (Bénabou & Tirole, 2010). Climate change projects are highly uncertain projects that require a long-term commitment from management. Managerial ability mitigates short termism arising from career concerns, thereby motivating more capable managers to invest in long-term strategic investments, such as climate change risk management projects. It is also argued that the market uses voluntary disclosures as a signal of superior managerial ability (Ferreira & Rezende, 2007). Climate change disclosures are considered voluntary actions (Bui et al., 2020; Cotter & Najah, 2012), with voluntary disclosures influenced by managerial characteristics (Bamber et al., 2010). Based on this evidence, it can be conjectured that managerial ability has a positive influence on both investments in climate risk management projects and disclosure of climate change information. We therefore propose and test the following hypothesis in alternative form:

H1. : *A positive association exists between managerial ability and climate change disclosures.*

2.2 | Managerial ability and climate change disclosures: Moderating role of corporate governance

Managers of firms with weak corporate governance could pursue their own personal objectives at the expense of shareholders' wealth (Elyasiani & Zhang, 2015; Shleifer & Vishny, 1989). Studies associate weak corporate governance with negligence of stakeholder demands, reduction of CSR activities, and weak climate change and environmental policies (Hill & Jones, 1992; Jo & Harjoto, 2012). Hill and Jones (1992) document evidence that managers of firms with weak corporate governance make strategic decisions to reduce stakeholder power, with this affecting corporate efficiency negatively. While Ferreira and Laux (2007) contend that weak corporate governance leads to a drop in the transparent disclosure of information to capital markets and external parties, Armstrong et al. (2012) suggest that firms with weak corporate governance withhold adverse financial information without releasing it to the outside world. Ulupinar (2018) finds that entrenched managers use nonpublic information privy only to themselves to pressure analysts and investment banks to create biased optimistic research as they seek to cover up their value-destroying actions. Aggarwal and Dow (2012) find that weakly governed firms pursue short-term investments; therefore, they may not favor activities addressing climate change and that are environmentally friendly if these activities are stakeholder-focused and/or long-term investments with high initial costs, greater uncertainty, and no quick pay-offs. Similarly, Jo and Harjoto (2012) find that weak governance has a negative influence on the decision to engage in CSR activities, with Cong and Freedman (2011) finding that good governance has a positive influence on pollution disclosures. Based on this evidence, it can be contended that weak governance curtails the motivation of capable managers to disclose information including that relating to climate change. Therefore, we propose and test the following hypothesis in alternative form:

H2. : *The positive association between managerial ability and climate change disclosures is weaker for firms with weak governance.*

3 | RESEARCH METHODOLOGY

3.1 | Sample and data

Our initial sample includes all US firms that responded to the CDP questionnaire from 2004 to 2019. We select 2004 as the initial year as the CDP started to report climate change disclosure data from that year.[4] The managerial ability data were available only up to 2018. Due to our lead–lag approach to analysis, the climate change disclosure data covered from 2005 to 2019, while the data for managerial ability and other independent variables were for the period from 2004 to 2018. Table 1, Panel A, shows that 5406 firm-year observations were in our initial sample. However, 958 observations were excluded as they were from financial firms and another 1182 observations were dropped due to the unavailability of managerial ability data. A further 968 observations were disregarded as they lacked the necessary data for the control variables used in the regression models (see Section 3.4 for the analytical models used in the current study). This screening process provided us with a usable sample of 412 unique firms with 2298 firm-year observations.

Table 1, Panels B and C, shows industry and yearly distributions of the firms in our sample, respectively. The computer industry contributes the highest percentage of observations (17.49%); however, a fair distribution can be observed of firms in our sample across a wide variety of industries. The highest number of observations is shown in 2018 followed by 2019, while the lowest number is in 2005.

We use the following sources to collect the necessary data: climate change disclosure data from the CDP database, financial data from the Compustat North America database, stock prices from the CRSP database, and corporate governance data from the Institutional Shareholder Services (ISS) (previously, Risk Metrics) database.

3.2 | Measures of climate change disclosures

We measure the extent of climate change disclosures using the CDP climate change score. Every year, CDP (an independent global not-for-profit organization running the global environmental disclosure system) collects firms' responses through questionnaires regarding their activities to address climate change and translates these responses into scores. The CDP scoring system is considered one of the most credible ratings in the world (GlobeScan & SustainAbility, 2014).[5] Furthermore, this score is also reported in the Key Stats and Ratio section of Google Finance.[6] These climate change disclosure scores encapsulate a large spectrum of climate change

TABLE 1 Sample selection and distribution

Panel A: sample selection	
Climate change score data available from CDP (2005–2019)	5406
Less: Exclusion of financial firms due to nonavailability of managerial ability score	(958)
Less: Firms having nonavailable managerial ability score	(1182)
Less: Firms dropped due to insufficient control variables	(968)
Final test sample from 2005 to 2019	**2298**

Panel B: Industry-wise distribution of sample firms		
Name of industry	Number of firms	% of sample
Mining/construction	59	2.57
Food	186	8.09
Textiles/printing/publishing	145	6.31
Chemicals	151	6.57
Pharmaceuticals	108	4.70
Extractive	140	6.09
Manufacturing: rubber/glass/etc.	38	1.65
Manufacturing: metal	49	2.13
Manufacturing: machinery	85	3.70
Manufacturing: electrical equipment	57	2.48
Manufacturing: transport equipment	110	4.79
Manufacturing: instruments	162	7.05
Manufacturing: miscellaneous	26	1.13
Computers	402	17.49
Transportation	173	7.53
Retail: wholesale	65	2.83
Retail: miscellaneous	181	7.88
Retail: restaurant	31	1.35
Services	103	4.48
Others	27	1.17
Total sample	**2298**	**100**

Panel C: Year-wise distribution of sample firms		
Year	Number of firms	% of sample
2005	42	1.83
2006	45	1.96
2007	95	4.13
2008	121	5.27
2009	134	5.83
2010	148	6.44
2011	158	6.88
2012	158	6.88
2013	147	6.40
2014	203	8.83
2015	190	8.27
2016	182	7.92
2017	199	8.66
2018	246	10.70
2019	230	10.01
Total	2298	100

(Continues)

TABLE 1 (Continued)

Abbreviation: CDP, Carbon Disclosure Project.

activities including: firm-level climate governance, climate change-related risk and opportunities, business strategy, climate change-related targets and performance, firms' initiatives for the reduction of carbon emissions, verification of carbon emissions, carbon pricing, and firm-level engagement with value chain partners regarding climate change-related activities (Carbon Disclosure Project [CDP], 2017). Until 2014, CDP allocated a score to each participating firm that ranged from 0 to 100; in 2015, however, the score was replaced with a climate change performance band. This change in reporting practice makes it difficult for us to use the scores and bands as the change occurs during our sample period. Therefore, we convert climate change performance bands for 2015–2019 into scores by assigning values that range from 1 to 8 and convert these scores,[7] together with the CDP scores available for 2005–2014, into percentile ranks. More specifically, following the prior disclosure literature (Barth et al., 2017), we compute the percentile rank of climate change disclosures as: (firm rank−1)/(number of firms−1). The percentile ranks for climate change disclosure range between 0 for the lowest ranked firm and 1 for the highest ranked firm. Additionally, we use the propensity to respond to the CDP climate change questionnaire (*CDP*) as an alternative proxy to measure firm-level climate change disclosure to assess the robustness of our findings. More specifically, we develop an indicator variable for climate change disclosure that takes the value of 1 if the firm responds to the CDP climate change questionnaire and allows its response to be publicly available and 0 otherwise.

3.3 | Measures of managerial ability

We measure managerial ability following Demerjian et al. (2012). To evaluate the relative efficacy of managers in converting resource inputs into outputs, Demerjian et al. (2012) use data envelopment analysis (DEA) to estimate firm efficiency within industries, comparing the sales generated by each firm, conditional on five stock variables ("net property," "plant and equipment," "net operating leases," "net research and development," "purchased goodwill," and "other intangible assets") and two flow variables ("cost of inventory" and "selling, general, and administrative [SG&A] expenses") as inputs.

Demerjian et al. (2012) regress firm efficiency on influential firm characteristics (firm size, market share, positive free cash flow, firm age, complex multisegment, and international operations) and use the residual term generated from this regression as the element reflecting managerial ability. They argue that the managerial ability measure according to this approach is based on the idea that more capable managers have a better understanding of technology and industry trends, more reliably predict product demand, invest in higher-value projects, and more effectively manage employees than their less capable counterparts. This managerial ability measure is widely used in empirical studies due to its superior power to capture managerial ability (e.g., Bonsall et al., 2017; Demerjian et al., 2013).

However, in the current study, we use a modified version of Demerjian et al.'s (2012) model by adding some board characteristics in estimating the firm-level managerial ability score. If not controlled for, the effect of these variables will be captured by the residual term of the model, thus distorting the managerial ability measure.[8] Therefore, we include board size, board independence, and CEO duality as additional control variables in the model in addition to the six firm characteristics used by Demerjian et al. (2012). More specifically, we estimate the following Tobit regression model by applying Fama and French's (1997) industry classifications:

$$\begin{aligned}\textit{Firm Efficiency}_{i,t} = {} & \beta_0 + \beta_1 Ln(\textit{TotalAssets}_{i,t}) + \beta_2 \textit{Market Share}_{i,t} \\ & + \beta_3 \textit{Positive Free Cash Flow Indicator}_{i,t} \\ & + \beta_4 Ln(\textit{Firm Age}_{i,t}) \\ & + \beta_5 \textit{Business Segment Concentration}_{i,t} \\ & + \beta_6 \textit{Foreign Currency Indicator}_{i,t} + \beta_7 Ln(\textit{Board Size}_{i,t}) \\ & + \beta_8 \textit{Board Independence}_{i,t} + \beta_9 \textit{CEO Duality}_{i,t} \\ & + \textit{Year Indicators}_t + \varepsilon \end{aligned} \tag{1}$$

where *Firm Efficiency* is the efficiency measure generated by Demerjian et al. (2012) using the DEA process; *Ln (Total Assets)* is the natural logarithm of total assets; *Market Share* is the percentage of sales revenues earned by the firm within its industry; *Positive Free Cash Flow Indicator* is an indicator variable that takes the value of 1 if the firm has positive free cash flow, and 0 otherwise[9]; *Ln (Firm Age)* is the natural logarithm of the firm's age (i.e., the number of years that the firm has been listed on Compustat); *Business Segment Concentration* is the ratio of individual business segment sales to total sales, summed across all business segments; *Foreign Currency Indicator* is an indicator variable that takes the value of 1 if the firm has nonzero value for foreign currency adjustment; *Ln (Board Size)* is the natural logarithm of the total number of board members; *Board Independence* is the ratio of independent board members to total board members; and *CEO duality* is an indicator variable that takes the value of 1 if the CEO and chairperson is the same person, and 0 otherwise. The residual term obtained by estimating regression Equation (1) is our measure of managerial ability (*MABILITY*). To assess the robustness of our findings, we also use the managerial ability score computed by Demerjian et al. (2012).

3.4 | Measure of corporate governance

We measure corporate governance using the entrenchment index (or E-Index) following prior studies (e.g., Bebchuk et al., 2013; Li & Li, 2018). The E-Index comprises six entrenchment provisions: staggered boards, poison pills, golden parachutes, supermajority requirements for charter amendments, supermajority requirements for bylaw amendments, and supermajority requirements for mergers. Therefore, the maximum value that E-Index can have is six (6), while the minimum value is zero (0). A higher E-Index value indicates weaker governance, while a lower value indicates stronger governance. We use the entrenchment index (*EINDEX*) to divide firms into two groups based on the yearly median *EINDEX* as the cut-off point. Accordingly, *HIGH_EINDEX* takes the value of 1 if the firm's *EINDEX* is greater than or equal to the yearly median *EINDEX* value and 0 otherwise; *HIGH_EINDEX* = 1 indicates weaker corporate governance, while *HIGH_EINDEX* = 0 indicates stronger corporate governance.

3.5 | Empirical models

We employ the following lead-lag regression model to test Hypothesis 1 (H1):

$$\begin{aligned}CCDS_{i,t+1} = {} & \beta_0 + \beta_1 MABILITY_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 MB_{i,t} + \beta_4 LEV_{i,t} \\ & + \beta_5 SGROWTH_{i,t} + \beta_6 FIN_{i,t} + \beta_7 LITG_{i,t} + \beta_8 ROA_{i,t} \\ & + \beta_9 CAPIN_{i,t} + \beta_{10} ENV\_STR_{i,t} + \beta_{11} ENV\_CON_{i,t} \\ & + \sum INDUSTRY_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{2}$$

where *CCDS* is the percentile rank of the climate change disclosure score and *MABILITY* is the managerial ability score, as discussed in Section 3.3. To support our Hypothesis 1 (H1), we expect a positive and significant coefficient for the *MABILITY* variable.

To test Hypothesis 2 (H2), we represent weak governance with the categorical variable *HIGH_EINDEX* (defined in Section 3.4), adding this variable and its interaction with the *MABILITY* variable to Equation (2) and estimate the following model:

$$\begin{aligned}CCDS_{i,t+1} = {} & \beta_0 + \beta_1 MABILITY_{i,t} + \beta_2 MABILITY_{i,t} \times HIGH\_EINDEX_{i,t} \\ & + \beta_3 HIGH\_EINDEX_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 MB_{i,t} + \beta_6 LEV_{i,t} \\ & + \beta_7 SGROWTH_{i,t} + \beta_8 FIN_{i,t} + \beta_9 LITG_{i,t} + \beta_{10} ROA_{i,t} \\ & + \beta_{11} CAPIN_{i,t} + \beta_{12} ENV\_STR_{i,t} + \beta_{13} ENV\_CON_{i,t} \\ & + \sum INDUSTRY_{i,t} + \sum YEAR + \varepsilon_{i,t}\end{aligned} \tag{3}$$

To support our Hypothesis 2 (H2), we expect a negative and significant coefficient for the *MABILITY*×*HIGH_EINDEX* variable.

3.6 | Control variables

We include several control variables in Equations (2) and (3) for reasons explained below. We control for firm size (*SIZE*) as larger firms have a greater tendency to disclose more climate change information, as they have additional resources for measuring and reporting carbon emissions (Ben-Amar et al., 2017; Bose et al., 2018; Bose, Khan, et al., 2021). We include financial leverage (*LEV*) to capture the influence of capital structure on the firm's disclosure policy. While some studies find that higher financial leverage leads to more frequent disclosures (Debreceny & Rahman, 2005), other studies find that highly leveraged firms experience a reduction in climate change-related activities due to their firm's tightened financial position and the pressure exerted by debtholders to take a short-term perspective in investment decisions (Haque, 2017; Tauringana & Chithambo, 2015). Following Haque (2017), we control for capital intensity (*CAPIN*), profitability (*ROA*), and market-to-book ratio (*BM*). Haque (2017) suggests that firms with higher capital intensity (*CAPIN*) and asset newness utilize cleaner and more energy efficient technologies, thus achieving energy efficiency and better carbon performance. Moreover, while highly profitable (*ROA*) firms can possess economic resources to act more proactively in social and environmental matters, firms with high market-to-book ratios (*MB*) are expected to have more potential investment opportunities and, therefore, are likely to have better environmental performance that results in long-term competitive advantage. Bui et al. (2020) find that litigation-prone firms are subject to increased public and stakeholder scrutiny and, thus, are likely to pursue extensive disclosures to manage their credibility and the risk to their legitimacy. We therefore use a dummy variable to control for firms that operate in highly litigious industries (*LITG*). We control for sales growth (*SGROWTH*) as it increases a firm's disclosure ranking (Jiao, 2011) while being an influential factor in shaping the firm's environmental policy (Carrión-Flores & Innes, 2010). Firms that approach the markets for new financing tend to expand their coverage of voluntary environmental disclosures in advance (Clarkson et al., 2008; Dhaliwal et al., 2011). We therefore control for new financing (*FIN*) in the above model. In addition, we control for the firm's environmental strengths (*ENV_STR*) and environmental concerns (*ENV_CON*) as these two characteristics could influence the disclosure of the firm's climate change information (Matsumura et al., 2014). Finally, we control for industry and year effects to account for influences stemming from industry and time-period specific factors. Appendix A provides the definitions of all the variables used in Equations (2) and (3).

We employ the OLS regression method to estimate the above models. Robust standard errors clustered at the firm-level are applied to address heteroscedasticity and serial correlation in all these models.

4 | EMPIRICAL RESULTS

4.1 | Descriptive statistics

The descriptive statistics are reported in Table 2, Panel A. The mean (median) of managerial ability (*MABILITY*) for firms in our sample is 0.171 (0.123) which is consistent with Demerjian et al. (2013). The average (median) climate change disclosure score (*CCDS*) is 0.637 (0.643). Furthermore, the average entrenchment index (*EINDEX*) score, measuring weak governance, is 3.702. The average market capitalization of firms in our sample is US$38.91 billion (the natural logarithm of market capitalization is 9.778), thus implying that our sample contains relatively large firms. The financial leverage of 27.20% implies that an average firm in our sample uses debt capital to finance about a quarter of its assets base. As reflected by sales growth (*SGROWTH*) of 5.70% and the market-to-book (*MB*) value of 5.402, the sample comprises growing firms that possess future growth opportunities valued by the market. This is further assured by the positive figure reported for average capital intensity (*CAPIN*). The mean (median) value of the new financing variable (*FIN*) is −0.016 (−0.024), implying that these firms reduce debt or repurchase shares more than they raise new financing. Their ability to generate the required funds internally can be justified on the basis of their profitability performance, as reflected by the *ROA* of 6.80%. Furthermore, about 32.30% of firms in our sample operate in highly litigious industries (*LITG*). The mean values of their environmental strengths (*ENV_STR*) and environmental concerns (*ENV_CON*) are 0.178 and 0.060, respectively.

As shown in Table 2, Panel B, we split the sample into two groups, one of high managerial ability firms (*HIGH_MABILITY*) and the other of low managerial ability firms (*LOW_MABILITY*), using the industry-year median as the cut-off point and compare mean/median values of the above variables between the two groups. We find that high managerial ability firms report a significantly higher *CCDS* score and lower managerial entrenchment. Furthermore, firms in that group are larger in size, more profitable, have faster growth, are less capital intensive, and are more environmentally concerned than firms in the low managerial ability group.

4.2 | Regression results

In this section, we report the outputs generated by estimating Equations (2) and (3) which are designed to test H1 and H2. Table 3 presents the results. The coefficients for *MABILITY* are positive in both Models 1 and 2 (0.220 and 0.162, respectively) and statistically significant at the 1% level, implying that managerial ability has a significant positive impact on firm-level climate change disclosures. Clearly, firms with more capable managers tend to make a higher level of climate change disclosures. Considering the *MABILITY* coefficient in Model 2, we infer that if managerial ability increases by one standard deviation (coefficient = 0.231 in Table 2), the percentile ranking of climate change disclosure increases by 3.70% (0.231 × 0.162). These findings therefore provide strong support for H1.

Hypothesis 2 (H2) predicts that the positive effect of managerial ability on climate change disclosures is weaker for firms with weak governance mechanisms. This hypothesis is tested by estimating Equation (3), with the results reported in Table 3, Model 3. In this model, our variable of interest is *MABILITY*×*HIGH_EINDEX* which captures the interactive influence of managerial ability and weak governance on climate change disclosures. This variable captures the difference in the effects of managerial ability on climate change disclosures between firms with weak governance mechanisms (i.e., highly entrenched boards) and those with strong governance

TABLE 2 Descriptive statistics

Panel A: descriptive statistics						
	Observations	Mean	Std. dev.	Median	First quartile	Third quartile
CCDS	2298	0.637	0.252	0.643	0.444	0.846
MABILITY	2298	0.171	0.231	0.123	−0.003	0.325
EINDEX	1713	3.702	1.066	4.000	3.000	4.000
HIGH_EINDEX	1713	0.633	0.482	1.000	0.000	1.000
SIZE	2298	9.778	1.284	9.696	8.952	10.589
MB	2298	5.402	53.129	3.007	1.917	4.866
LEV	2298	0.272	0.164	0.251	0.161	0.364
SGROWTH	2298	0.057	0.168	0.049	−0.009	0.112
FIN	2298	−0.016	0.107	−0.024	−0.057	0.008
LITG	2298	0.323	0.468	0.000	0.000	1.000
ROA	2298	0.068	0.070	0.067	0.039	0.101
CAPIN	2298	0.078	0.126	0.042	0.027	0.069
ENV_STR	2298	0.178	0.184	0.143	0.063	0.250
ENV_CON	2298	0.060	0.131	0.000	0.000	0.000

Panel B: mean and median tests						
	HIGH_MABILITY (*N* = 1211)		*LOW_MABILITY* (*N* = 1222)		Mean test	Median test
	Mean	Median	Mean	Median	(p-value)	(p-value)
CCDS	0.683	0.708	0.591	0.600	0.000***	0.000***
HIGH_EINDEX	0.589	1.000	0.676	1.000	0.000***	0.000***
SIZE	10.022	9.886	9.537	9.491	0.000***	0.000***
MB	5.935	3.196	4.874	2.867	0.633	0.000***
LEV	0.260	0.237	0.284	0.262	0.000***	0.000***
SGROWTH	0.067	0.053	0.048	0.043	0.008***	0.002***
FIN	−0.022	−0.027	−0.009	−0.019	0.003***	0.000***
LITG	0.336	0.000	0.311	0.000	0.198	0.198
ROA	0.081	0.075	0.055	0.060	0.000***	0.000***
CAPIN	0.073	0.043	0.083	0.041	0.046**	0.632
ENV_STR	0.172	0.143	0.184	0.143	0.140	0.624
ENV_CON	0.066	0.000	0.054	0.000	0.031**	0.368

Note: This table reports descriptive statistics for the variables used in the study. All variables are defined in Appendix A.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance at 10% level.

mechanisms (i.e., low entrenched boards). The coefficient for the *MABILITY* variable captures the above effect for strongly governed firms. Consistent with our expectation, the *MABILITY*×*HIGH_EINDEX* variable enters the model with a negative coefficient which is significant at the 1% level (coefficient = −0.242, *p*-value < 0.01), revealing that the average increase in climate change disclosures led by managerial ability is lower for firms with weak governance mechanisms. In economic terms, a one standard deviation increase in managerial ability leads to a 5.08% (0.233 × 0.218) increase in the percentile ranking of climate change disclosures for better governed firms, while a similar increase in managerial ability leads to a decrease of 0.56% (0.233 × (−0.242 + 0.218)) in the percentile ranking of climate change disclosures for poorly governed firms.[10] Accordingly, support is found for H2 with its proposal that poor governance weakens the positive relationship between managerial ability and climate change disclosure. This finding suggests that firms with entrenched boards are less likely to be active in climate change risk mitigation actions, leading them to have a weak relationship between managerial ability and climate change disclosures.

Turning to control variables, we find that climate change disclosures are positively associated with firm size (*SIZE*), litigation risk (*LITG*), capital expenditures (*CAPIN*), and environmental strengths

TABLE 3 Regression results of association between managerial ability and climate change disclosures

	Dependent variable = *CCDS*		
	Model (1)	Model (2)	Model (3)
MABILITY	0.220***	0.162***	0.218***
	(7.020)	(5.187)	(5.971)
MABILITY×HIGH_EINDEX			−0.242***
			(−4.727)
HIGH_EINDEX			0.009
			(0.573)
SIZE		0.052***	0.039***
		(6.214)	(5.083)
MB		−0.000	0.000
		(−0.396)	(0.791)
LEV		0.026	−0.003
		(0.439)	(−0.061)
SGROWTH		0.008	0.053*
		(0.234)	(1.676)
FIN		0.052	0.074
		(1.070)	(1.512)
LITG		0.167**	0.133**
		(2.474)	(2.228)
ROA		0.103	0.015
		(0.936)	(0.164)
CAPIN		0.115*	0.127**
		(1.700)	(2.414)
ENV_STR		0.125***	0.113**
		(2.597)	(2.220)
ENV_CON		−0.025	−0.007
		(−0.341)	(−0.095)
Intercept	0.687***	0.042	0.037
	(10.609)	(0.325)	(0.218)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	2298	2298	1713
R-squared	0.056	0.139	0.132

Note: This table reports the regression results for the association between managerial ability and climate change disclosures. Models (1) and (2) present the regression output of Equation (2), respectively, while Model (3) presents regression outputs for Equation (3). Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. All variables are defined in Appendix A.

Abbreviation: CCDS, climate change disclosure score.

***Statistical significance at 1% level.

**Statistical significance at 5% level.

*Statistical significance 10% level.

performance (*ENV_STR*). These findings are consistent with the evidence revealed in prior studies (Bui et al., 2020; Jiao, 2011; Reid & Toffel, 2009).

4.3 | Firm fixed-effect regressions

Controlling for several firm-specific variables that could be related to climate change disclosures may not be successful in addressing the omitted time-invariant variable bias due to unknown firm characteristics. Therefore, firm fixed-effect regressions are used to mitigate this omitted time-invariant variable concern. Firm fixed-effect regressions remove the cross-sectional variation and analyze only the variation within a firm over time; they also remove the influence of omitted time-invariant firm characteristics that could potentially cause a spurious correlation between climate change disclosures and managerial ability (Kim et al., 2020).

Table 4 reports the firm fixed-effect regression output. In Model 1, the coefficient for *MABILITY* is positive and statistically significant (coefficient = 0.097, *p*-value < 0.01). In Model 2, the coefficient for *MABILITY×HIGH_EINDEX* is negative and significant (coefficient = −0.115, *p*-value < 0.10). Even though the magnitudes of these coefficient values are smaller than those reported in Table 3, probably due to the removal of possible omitted time-invariant variable bias, the firm fixed-effect regression results corroborate the evidence reported in the previous section. More importantly, the study's main findings do not appear to be significantly affected by time-invariant variable bias.

4.4 | PSM analysis

The relationship between managerial ability and climate change disclosures may be affected by observable heterogeneity bias (Lennox et al., 2012) and functional misspecification bias (Shipman et al., 2017). To mitigate this bias, we apply PSM analysis. For this purpose, we split the sample into two groups, namely, high *MABILITY* (*HIGH_MABILITY*) score firms and low *MABILITY* (*LOW_MABILITY*) score firms, using, as the cut-off point, the industry median *MABILITY* in a given year. We then create a dummy variable assigning the value of 1 to those in the former group and 0 to those in the latter group and estimate a logistic model (first-stage model) using this categorical variable as the dependent variable. We use the propensity scores obtained from the first-stage logistic regression model to select the optimal match, based on the caliper matching, in an attempt to control for the differences in characteristics between firms with high *MABILITY* scores (treatment group) and those with low *MABILITY* scores (control group). This is done to ensure that each high *MABILITY* firm is paired with a low *MABILITY* firm in the same industry and year to have the lowest difference in propensity scores. We employ the caliper matching method in this process and matching within a caliper of 3%.

Table 5 reports the findings. In Panel A, the first-stage regression estimates reveal that several firm-specific characteristics, namely, firm size, leverage, growth, litigation, and profitability play significant roles in determining the probability of a firm having high-ability managers. Panel B reveals that none of the deterministic variables differs between the treatment group and control group in a statistically

TABLE 4 Firm fixed-effect regression results of association between managerial ability and climate change disclosures

	Dependent variable = *CCDS*	
	Model (1)	Model (2)
MABILITY	0.097***	0.111***
	(3.164)	(2.889)
MABILITY×HIGH_EINDEX		−0.115*
		(−1.681)
HIGH_EINDEX		−0.030
		(−1.404)
SIZE	0.026	0.018
	(1.475)	(1.042)
MB	0.000	0.000
	(0.715)	(1.142)
LEV	0.132	0.076
	(1.514)	(0.694)
SGROWTH	−0.007	0.005
	(−0.205)	(0.123)
FIN	0.041	0.023
	(0.806)	(0.378)
ROA	0.025	−0.020
	(0.247)	(−0.172)
CAPIN	0.019	0.089
	(0.179)	(1.046)
ENV_STR	0.044	0.026
	(0.853)	(0.463)
ENV_CON	0.053	−0.000
	(0.598)	(−0.002)
Intercept	0.371**	0.390**
	(2.075)	(2.122)
Year fixed effects	Yes	Yes
Industry fixed effects	No	No
Observations	2298	1713
R-squared	0.560	0.530

Note: This table reports the firm fixed-effect regression results for Equations (2) and (3). Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. All variables are defined in Appendix A.
Abbreviation: CCDS, climate change disclosure score.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance 10% level.

significant fashion. In Panel C, the regression model estimated on the propensity score-matched samples produces results similar to those reported in Table 3. The coefficient for *HIGH_MABILITY* is positive and statistically significant (coefficient = 0.052, *p*-value < 0.01) in Model 1, and the coefficient for *HIGH_MABILITY×HIGH_EINDEX* is negative and statistically significant (coefficient = −0.077, *p*-value <0.01) in Model 2. Therefore, the PSM analysis results confirm our main findings regarding the significant positive relationship between

TABLE 5 Propensity score matching (PSM) analysis

Panel A: first-stage logistic regression results			
	Coefficient	*z*-stat	*p*-value
SIZE	0.293	6.370	0.000***
MB	0.000	0.080	0.939
LEV	−0.697	−2.160	0.030**
SGROWTH	0.874	2.750	0.006***
FIN	−0.428	−0.950	0.345
LITG	1.713	3.090	0.002***
ROA	4.779	5.580	0.000***
CAPIN	−0.298	−0.610	0.543
ENV_STR	−0.268	−0.810	0.418
ENV_CON	0.698	1.490	0.137
Intercept	−3.694	−5.050	0.000***
Year fixed effects		Yes	
Industry fixed effects		Yes	
Observations		2298	
Pseudo *R*-squared		0.085	
Log likelihood		−1457.69	

Panel B: mean test between treatment and control groups			
	HIGH_MABILITY (treatment)	*LOW_MABILITY* (control)	*t*-test (*p*-value)
SIZE	9.771	9.778	0.895
MB	4.061	5.583	0.547
LEV	0.274	0.274	0.984
SGROWTH	0.057	0.057	0.911
FIN	−0.014	−0.014	0.908
LITG	0.302	0.313	0.638
ROA	0.068	0.067	0.738
CAPIN	0.077	0.075	0.654
ENV_STR	0.180	0.181	0.910
ENV_CON	0.061	0.060	0.842

Panel C: second-stage regression results of association between climate change disclosures and managerial ability		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
HIGH_MABILITY	0.052***	0.000
	(3.510)	(0.020)
HIGH_MABILITY×HIGH_EINDEX		−0.077***
		(−3.022)
HIGH_EINDEX		−0.103***
		(−4.769)
SIZE	0.047***	0.046***
	(4.657)	(4.380)
MB	−0.000	−0.000
	(−0.599)	(−0.620)

(Continues)

TABLE 5 (Continued)

Panel C: second-stage regression results of association between climate change disclosures and managerial ability		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
LEV	−0.008	−0.007
	(−0.127)	(−0.123)
SGROWTH	0.018	0.033
	(0.404)	(0.721)
FIN	0.048	0.046
	(0.865)	(0.817)
LITG	0.142***	0.141***
	(3.262)	(3.099)
ROA	0.096	0.043
	(0.673)	(0.313)
CAPIN	0.078	0.098
	(0.968)	(1.217)
ENV_STR	0.152***	0.148***
	(2.846)	(2.723)
ENV_CON	−0.006	0.004
	(−0.077)	(0.046)
Intercept	0.118	0.220
	(0.878)	(1.534)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	1720	1677
R-squared	0.102	0.122

Note: This table presents the results of the propensity score matching (PSM) analysis. Panel A reports the first-stage regression results where the *MABILITY* categorical variable is regressed on several firm-specific characteristics. Panel B tests the differences in firm characteristics between treatment (*HIGH_MABILITY*) and control (*LOW_MABILITY*) group of firms. Panel C reports the regression models estimated on propensity score-matched samples. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses in Panel C. All variables are defined in Appendix A.
Abbreviation: CCDS, climate change disclosure score.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance 10% level.

managerial ability and climate change disclosures and the moderating role of corporate governance mechanisms in this association.

4.5 | Heckman's (1979) two-stage analysis

Although we address the observable differences between the treatment and control firms using PSM, our sample may demonstrate a systematic bias if firms that voluntarily respond to the CDP climate change questionnaire differ systematically from those that do not respond. More specifically, factors affecting a firm's CDP disclosure decisions may be correlated with climate change disclosures. To correct for this possible sample selection bias, we employ Heckman's (1979) two-stage selection model.[11] In the first stage (selection model), we develop a model for a firm's decision to respond to the CDP questionnaire by augmenting our sample with firms that were sent the CDP questionnaire but did not respond over our sample period. To be specific, we develop the following probit regression model (first-stage model):

$$\begin{aligned} Pr(DISC\_CDP=1)_{i,t} = {} & \beta_0 + \beta_1 PROPDISC_{i,t} + \beta_2 CDP\_LAG_{i,t} + \beta_3 SIZE_{i,t} \\ & + \beta_4 MB_{i,t} + \beta_5 LEV_{i,t} + \beta_6 SGROWTH_{i,t} + \beta_7 FIN_{i,t} \\ & + \beta_8 LITG_{i,t} + \beta_9 ROA_{i,t} + \beta_{10} CAPIN_{i,t} \\ & + \beta_{11} ENV\_STR_{i,t} + \beta_{12} ENV\_CON + \sum Year_{i,t} \\ & + \sum Industry_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{4}$$

where $DISC\_CDP = 1$, the dependent variable, is an indicator variable that takes the value of 1 if the firm responds to the CDP questionnaire and 0 otherwise. Lennox et al. (2012) emphasize the importance of imposing "exclusion restrictions" when applying Heckman (1979) procedure. This is because the lack of "exclusion restrictions" in the selection model can produce biased coefficients in the second-stage model due to multicollinearity. The exclusion restriction requires the inclusion of at least one variable in the selection model (first stage) that is conceptually excluded from the second-stage model. To satisfy the exclusion restriction, we include two variables in the first-stage model in addition to including several control variables following prior studies (Bose, Minnick, et al., 2021; Matsumura et al., 2014). These two variables are as follows: *PROPDISC* (the proportion of firms in an industry that respond to the CDP questionnaire) and *CDP_LAG* (a firm's response to the CDP questionnaire in the previous year). The objective of including *PROPDISC* is to capture industry pressure; if more firms in an industry respond to the CDP questionnaire, nonresponding firms come under greater pressure to respond to the CDP to minimize the negative perceptions of external capital providers (Bose, Minnick, et al., 2021; Matsumura et al., 2014). Furthermore, we include *CDP_LAG* in Equation (4) as a firm's decision to respond to the CDP questionnaire tends to be sticky. We predict positive signs on the coefficients of both variables, *PROPDISC* and *CDP_LAG*. Appendix A provides the definition of these variables. We generate the inverse Mills ratio (*IMR*) from the first-stage model and include it in the second-stage models as stated in Equations (2) and (3) to account for selection bias.

Table 6 presents the results. Panel A reports the first-stage regression results, with the coefficients for *PROPDISC* and *CDP_LAG* both positive (3.238 and 2.307, respectively) and significant at the 1% level. The model has a pseudo-R^2 value of 56.90% and partial R^2 values (unreported) for *PROPDISC* and *CDP_LAG* of 3.22% and 32.13%, respectively, which are statistically significant at a 1% level, suggesting that *PROPDISC* and *CDP_LAG* are reasonably exogenous variables. In Panel B, which reports the second-stage regression results, the coefficient for *MABILITY* is positive and statistically significant (coefficient = 0.183, *p*-value < 0.01) in Model 1, while the coefficient for *MABILITY*×*HIGH_EINDEX* is negative and statistically

TABLE 6 Heckman's (1979) two-stage analysis

Panel A: Heckman's (1979) First-stage probit regression results

	Dependent variable = *CDP response*		
	Coefficient	*z*-stat	*p*-value
PROPDISC	3.238	9.896	0.000***
CDP_LAG	2.307	24.931	0.000***
SIZE	0.236	7.026	0.000***
MB	−0.001	−0.300	0.764
LEV	−0.176	−0.797	0.426
SGROWTH	−0.286	−1.544	0.123
FIN	−0.301	−1.200	0.230
LITG	−0.030	−0.122	0.903
ROA	0.140	0.355	0.723
CAPIN	−0.359	−1.645	0.100*
ENV_STR	1.420	5.171	0.000***
ENV_CON	−1.011	−2.781	0.005***
Intercept	−4.979	−10.430	0.000***
Year fixed effects		Yes	
Industry fixed effects		Yes	
Observations		3603	
Pseudo *R*-squared		0.569	
Log likelihood		−913.83	

Panel B: Heckman's (1979) second-stage regression results

	Dependent variable = *CCDS*	
	Model (1)	Model (2)
MABILITY	0.183***	0.236***
	(5.732)	(6.405)
MABILITY×*HIGH_EINDEX*		−0.240***
		(−4.700)
HIGH_EINDEX		0.008
		(0.519)
SIZE	0.055***	0.038***
	(6.162)	(4.739)
MB	−0.000	0.000
	(−0.378)	(0.774)
LEV	0.029	−0.011
	(0.482)	(−0.209)
SGROWTH	0.021	0.086**
	(0.524)	(2.166)
FIN	0.054	0.064
	(1.065)	(1.262)
LITG	0.144**	0.113*
	(2.033)	(1.821)
ROA	0.101	−0.016
	(0.894)	(−0.174)
CAPIN	0.123	0.145**
	(1.618)	(2.377)
ENV_STR	0.121**	0.112**
	(2.524)	(2.154)
ENV_CON	−0.078	−0.040
	(−0.985)	(−0.547)
IMR	−0.013	−0.025
	(−0.831)	(−1.646)
Intercept	0.009	−0.039
	(0.073)	(−0.243)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	2119	1603
R-squared	0.155	0.151

Note: This table presents the results of Heckman (1979) two-stage analysis. Panel A reports Heckman (1979) first-stage regression results. Panel B reports Heckman (1979) second-stage regression results. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses in Panel B. All variables are defined in Appendix A.

Abbreviations: CCDS, climate change disclosure score; CDP, Carbon Disclosure Project.

***Statistical significance at 1% level.

**Statistical significance at 5% level.

*Statistical significance 10% level.

significant (coefficient = −0.240, *p*-value < 0.01) in Model 2. However, the coefficient for *IMR* is not statistically significant, which suggests that sample selection bias is not a significant concern.[12]

4.6 | Instrumental variable (IV) analysis

The potential endogenous relationship between managerial ability and climate change disclosures can be a concern in our regression models. Even though we expect managerial ability to influence climate change disclosures, the possibility exists that the more capable managers are attracted to firms that have a higher level of climate change disclosures, hence, bringing a reverse causality to the relationship. We employ IV-based two-stage least squares (2SLS) regressions to overcome concerns that our results may be affected by reverse causality. The IV-based 2SLS technique is advanced as a suitable regression approach for assessing the possible reverse causality inherent in the main model (Wooldridge, 2010). This approach requires the identification of an IV that is (or IVs that are) highly correlated to a firm's managerial ability but without influencing climate change disclosures except through managerial ability. Following Demerjian et al. (2020), we use the average industry-adjusted managerial ability in the same county where a firm is headquartered (*MABILITY_AVG*) as the instrument to identify the first-stage equation. Demerjian et al. (2020, p. 432) argue that "firms operating in geographic areas with a greater supply of high-ability managers are more likely to have these high-ability managers in their networks and are thus, ceteris paribus, more likely to employ a high-ability manager." We, therefore, expect *MABILITY_AVG* to be positively correlated with our endogenous variable, *MABILITY*. However, it is very unlikely that the average ability of managers within a region would influence firm-level climate change disclosures. Thus, we believe that the essential requirements of the instrument are satisfied.

Table 7 reports the 2SLS regression results. In Model 1, the coefficient for *MABILITY_AVG*, as expected, is positive and statistically significant (coefficient = 0.793, *p*-value < 0.01). Furthermore, Shea's partial R^2 value is 26.10%, while the partial *F*-statistic is 896.15 in the first-stage model. Based on the analysis by Stock et al. (2002), this high value for the *F*-statistic suggests that our instrument is not weak. Additionally, the Durbin–Wu–Hausman test is statistically significant (in the second-stage model), thus suggesting that managerial ability has an endogenous relationship with climate change disclosures. Overall, these test statistics suggest that our instruments fulfill the conditions of exogeneity and relevance. More importantly, the coefficient for the *MABILITY_PREDICTED* variable is negative and statistically significant (coefficient = 0.090, *p*-value < 0.05) in Model 2, thus corroborating our main findings. Therefore, our 2SLS regression output provides further assurance of the main evidence revealed in our study on the influence of managerial ability on climate change disclosures.[13]

TABLE 7 Two-stage least squares (2SLS) regression results

	First stage DV = *MABILITY* Model (1)	Second stage DV=*CCDS* Model (2)
MABILITY_PREDICTED		0.090**
		(2.074)
SIZE	0.009***	0.054***
	(2.600)	(10.704)
MB	0.001	−0.000
	(1.020)	(−0.359)
LEV	−0.032	0.018
	(−1.290)	(0.497)
SGROWTH	0.054*	0.015
	(1.980)	(0.520)
FIN	0.015	0.050
	(0.320)	(1.141)
LITG	0.005	0.008
	(0.250)	(0.560)
ROA	−0.022	0.173***
	(−0.400)	(4.787)
CAPIN	0.087*	0.111
	(1.870)	(1.378)
ENV_STR	0.104***	0.121**
	(3.480)	(2.421)
ENV_CON	0.076*	0.124***
	(1.760)	(3.259)
MABILITY_AVG	0.793***	−0.009
	(29.910)	(−0.185)
Intercept	−0.032	−0.021
	(−0.500)	(−0.246)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	2298	2298
R-squared	0.381	0.135
Durbin–Wu–Hausman statistic (test of endogeneity)		3.30*
Shea's partial R^2	0.261	
Weak instrument test: partial *F*-statistic	896.15	

Note: This table presents the results of two-stage least squares (2SLS) regression results. Model (1) shows the first-stage regression results. Model (2) shows the second-stage regression results. All variables are defined in Appendix A.

***Statistical significance at 1% level.

**Statistical significance at 5% level.

*Statistical significance 10% level.

5 | ADDITIONAL ANALYSES

5.1 | Quasi-experimental analysis: Significance of "blue" and "red" states

As firms provide climate change disclosures to meet stakeholder demands and expectations, we further examine whether the external pressures faced by firms for climate change disclosures have any influence on the association between firm-level managerial ability and climate change disclosures. Studies find that firm-level social and environmental disclosures are affected by the preferences of the communities in which firms are located (Deng et al., 2013; Di Giuli & Kostovetsky, 2014). In the context of the United States, prior studies argue that firms operating in states that are controlled by the Democratic Party are more likely to have good social responsibility ratings, as Democratic Party voters prefer more emphasis on social and environmental issues (e.g., Deng et al., 2013; Di Giuli & Kostovetsky, 2014).

To test this phenomenon, we split the firms in our sample into two groups based on whether their headquarters are located in states controlled by the Democratic Party (Blue) or Republican Party (Red) and estimate regressions for these two groups separately. The regression results are reported in Table 8. In Models 1 and 2, the *MABILITY* coefficient is significant for the Blue group. This confirms the positive relationship between managerial ability and climate change disclosures for firms headquartered in Democratic Party-controlled states; that is, the pressure exerted by Democratic Party governments pushes the more able managers to disclose more climate change information. Similarly, we find that coefficients for the interaction variable,

TABLE 8 Regression results of association between managerial ability and climate change disclosures: democratic party states versus republican party states

	Dependent variable = CCDS			
	Blue Model (1)	Red Model (2)	Blue Model (3)	Red Model (4)
MABILITY	0.180***	0.108*	0.245***	0.046
	(4.973)	(1.914)	(5.828)	(0.721)
MABILITY×HIGH_EINDEX			−0.262***	−0.042
			(−4.410)	(−0.549)
HIGH_EINDEX			0.015	−0.046**
			(0.828)	(−2.100)
SIZE	0.046***	0.066***	0.030***	0.050***
	(3.940)	(5.582)	(2.775)	(4.749)
MB	−0.000	0.000	0.000	0.001
	(−1.086)	(0.949)	(0.479)	(1.579)
LEV	−0.059	0.146*	−0.063	0.017
	(−0.758)	(1.729)	(−1.078)	(0.219)
SGROWTH	0.022	0.022	0.069	0.044
	(0.494)	(0.543)	(1.598)	(1.113)
FIN	0.082	−0.024	0.076	0.031
	(1.460)	(−0.329)	(1.286)	(0.370)
LITG	0.127	0.238***	0.101	0.230***
	(1.411)	(3.152)	(1.253)	(3.436)
ROA	0.126	0.056	0.027	−0.061
	(0.714)	(0.508)	(0.181)	(−0.618)
CAPIN	0.735***	0.079	0.675***	0.106**
	(4.130)	(1.343)	(3.674)	(2.249)
ENV_STR	0.114**	0.153*	0.111**	0.172*
	(2.077)	(1.659)	(1.995)	(1.869)
ENV_CON	0.019	−0.204**	−0.002	−0.038
	(0.207)	(−2.073)	(−0.024)	(−0.396)
Intercept	−0.023	0.081	−0.113	0.235
	(−0.136)	(0.509)	(−0.500)	(1.188)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	1488	810	1080	633
R-squared	0.166	0.209	0.172	0.189
Test of equality of coefficients	31.11***		35.14***	

Note: This table presents the regression results of the association between managerial ability and climate change disclosures separately for firms headquartered in Democratic Party (Blue) states and those headquartered in Republican Party (Red) states. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. All variables are defined in Appendix A.

Abbreviation: CCDS, climate change disclosure score.

***Statistical significance at 1% level.

**Statistical significance at 5% level.

*Statistical significance 10% level.

MABILITY×HIGH_EINDEX, are highly significant for firms headquartered in Democratic Party-controlled states while it is statistically insignificant for firms headquartered in Republican Party-controlled states. It appears that our main conclusions are more applicable to firms headquartered in states controlled by Democratic Party governments.

5.2 | Alternative measures of climate change disclosures

In our main analysis, we use climate change disclosure scores as a measure of climate change disclosures to capture the quality and comprehensiveness of firm-level climate change disclosures. In this section, we use the propensity of a firm to respond to the CDP questionnaire as an alternative proxy of climate change disclosures. More specifically, we augment our sample by adding firms that were sent the CDP questionnaire but did not respond over our sample period. Therefore, our dependent variable is an indicator variable that takes the value of 1 if a firm participates in the CDP questionnaire and 0 otherwise, and consequently, we estimate a logistic regression model.

Table 9, Panel A, reports the regression results. Model 1 reports the regression results of the association between managerial ability and the propensity to respond to the CDP climate change questionnaire, while Model 2 reports the moderating role of corporate governance in this association. In Model 1, the coefficient for *MABILITY* is positive and statistically significant (coefficient = 4.480, p-value < 0.01), suggesting that firms with a higher managerial ability score have a higher propensity to respond to the CDP climate change questionnaire. In Model 2, the coefficient for *MABILITY×HIGH_EINDEX* is negative and statistically significant (coefficient = −2.677, p-value < 0.01), suggesting that the positive association between the managerial ability score and the propensity to respond to the CDP climate change questionnaire is less pronounced for firms with weak corporate governance. Overall, our main findings remain robust to the use of this alternative proxy of climate change disclosures.

In this study, we assign a percentile rank of climate change disclosures to each firm by using the CDP scores (2005–2014) and CDP bands (2015–2019). We use the available CDP scores and CDP bands for the above respective periods as alternative measures of climate change disclosures and estimate baseline regression models. The findings are presented in Table 9, with Panel B reporting the regression results using CDP scores for 2005–2014 and Panel C reporting the regression results using CDP bands for 2015–2019. Our findings hold for each of these classification schemes; therefore, the main findings remain robust to the use of these alternative climate change disclosure measures.

In Table 9, Panel D, we use Demerjian et al.'s (2012) measure of managerial ability (i.e., excluding the board governance variables as additional controls in Equation (1)) and estimate Equations (2) and (3). We find that the *MABILITY* coefficient is positive and significant in Model 1 (coefficient = 0.096, p-value < 0.05), while the *MABILITY×HIGH_EINDEX* coefficient is negative and significant (coefficient = −0.094, p-value < 0.01) confirming the insensitivity of our main findings to the use of the original managerial ability measure of Demerjian et al. (2012).

5.3 | Managerial ability, climate change disclosures, and firm valuation: The mediation effect

The evidence thus far suggests that firms with higher managerial ability have higher climate change disclosures. Prior studies show that the more capable managers are positively associated with firm value (e.g., Yung & Chen, 2018). Moreover, Demerjian et al. (2013) find that managerial ability improves a firm's operating performance. Conversely, Mishra (2014) argues that more able managers have greater mobility in the job market, with their personal goals different from

TABLE 9 Additional analyses of association between managerial ability and climate change disclosures

Panel A: Regression results based on the propensity to respond CDP climate change questionnaire		
	Dependent variable = *CDP_RESPOND*	
	Model (1)	Model (2)
MABILITY	4.480***	5.974***
	(9.270)	(7.812)
MABILITY×HIGH_EINDEX		−2.677***
		(−3.062)
HIGH_EINDEX		0.214
		(1.386)
Intercept	−4.784***	−3.784**
	(−3.514)	(−2.311)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	4130	3067
Pseudo R-squared	0.278	0.235
Panel B: Regression results based on CDP scores for the period 2005–2014		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
MABILITY	8.069***	10.654***
	(3.871)	(4.257)
MABILITY×HIGH_EINDEX		−6.025*
		(−1.796)
HIGH_EINDEX		−0.950
		(−0.831)
Intercept	19.682**	25.707***
	(2.500)	(2.968)
Control variables	Yes	Yes
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	1251	922
R-squared	0.505	0.580
Panel C: Regression results based on CDP bands for the period 2015–2019		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
MABILITY	0.720***	1.079***
	(3.055)	(4.008)
MABILITY×HIGH_EINDEX		−1.432***
		(−3.644)
HIGH_EINDEX		−0.008
		(−0.071)
Intercept	1.192	1.802**
	(1.316)	(2.137)

(Continues)

TABLE 9 (Continued)

Panel C: Regression results based on CDP bands for the period 2015–2019		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
Control variables	Yes	Yes
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	1047	791
R-squared	0.441	0.486
Panel D: Regression results using the managerial ability score developed by Demerjian et al. (2012)		
	Dependent variable = *CCDS*	
	Model (1)	Model (2)
MABILITY	0.096**	0.096**
	(1.995)	(2.102)
MABILITY×*HIGH_EINDEX*		−0.094*
		(−1.814)
HIGH_EINDEX		−0.008
		(−0.703)
Intercept	0.049	0.073
	(0.390)	(0.625)
Control variables	Yes	Yes
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	2298	1713
R-squared	0.124	0.091

Note: This table presents the regression results for several additional analyses. Panel A shows the regression results using firms' propensity to respond CDP questionnaire as a proxy for climate change disclosures. Panel B uses CDP scores over the period 2005–2014, while Panel C uses CDP performance bands over the period 2015–2019. Panel D presents the regression results using the managerial ability score computed by Demerjian et al. (2012) as a proxy for managerial ability. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. All variables are defined in Appendix A.

Abbreviations: CCDS, climate change disclosure score; CDP, Carbon Disclosure Project.

***Statistical significance at 1% level.

**Statistical significance at 5% level.

*Statistical significance 10% level.

those of shareholders; thus, these managers engage in more risk-taking activities that are detrimental to shareholders' wealth. Therefore, our study next examines the mediating role of climate change disclosures in the association between managerial ability and firm valuation. We develop the following set of equations to conduct our mediation test:

$$TOBINQ_{i,t} = \beta_0 + \beta_1 MABILITY_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \tag{5.1}$$

$$CCDS_{i,t} = \gamma_0 + \gamma_1 MABILITY_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \tag{5.2}$$

$$TOBINQ_{i,t} = \omega_0 + \omega_1 MABILITY_{i,t} + \omega_2 CCDS_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \tag{5.3}$$

where *TOBINQ* is Tobin's Q, measured as the sum of the market value of common equity plus the book value of total debt scaled by total assets (Bose et al., 2017; Bose, Khan, et al., 2021). We use Tobin's Q as a measure of firm value. Appendix A provides the definition of all variables.

We begin with Equation (5.1) to examine the overall effect of *MABILITY* on a firm's *TOBINQ*, denoted by coefficient β_1. The effect of *MABILITY* on *CCDS* is captured by γ_1 in Equation (5.2), whereas ω_1 in Equation (5.3) denotes the direct effect of *MABILITY* on *TOBINQ* after controlling for the mediator variable, *CCDS*. We consider *CCDS* as a mediator following Baron and Kenny (1986) and Wen and Ye (2014) if (a) *MABILITY* is significantly related to *TOBINQ* ($\beta_1 \neq 0$) in Equation (5.1), (b) *MABILITY* is significantly related to *CCDS* ($\gamma_1 \neq 0$) in Equation (5.2), and (c) *CCDS* is significantly related to *TOBINQ* after controlling for *MABILITY* ($\omega_1 \neq 0$) in Equation (5.3).[14] Once the relationships are established, it is essential to test whether the average causal mediation effect is statistically significant. We use the bootstrapped Sobel–Goodman test (Preacher & Hayes, 2004) to analyze whether a mediator carries the influence of the treatment variable to a dependent variable. This test is useful as we simultaneously run three equations, Equations (5.1) to (5.3), to assess the potential links between the variables of interest: *MABILITY*, *CCDS*, and *TOBINQ*. Figure 1 shows the procedure for the mediation test.

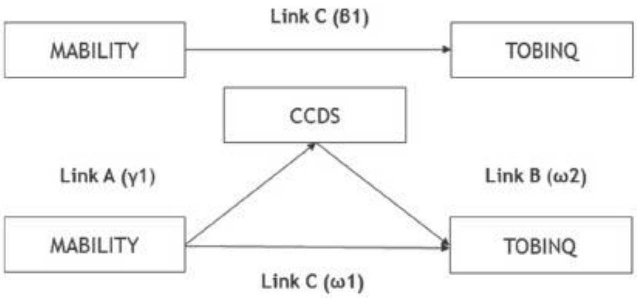

FIGURE 1 Paths between climate change disclosure score (CCDS), managerial ability, and firm value

TABLE 10 Mediation regression results of association between managerial ability, climate change disclosures, and firm value

	DV = *TOBINQ* Model (1)	DV = *CCDS* Model (2)	DV = *TOBINQ* Model (3)
MABILITY	0.239*	0.182***	0.187
	(1.890)	(5.440)	(1.470)
CCDS			0.288***
			(3.130)
SIZE	0.174***	0.521***	0.159***
	(7.400)	(8.390)	(6.650)
LEV	0.818***	0.080*	0.795***
	(4.970)	(1.840)	(4.840)
SGROWTH	0.163	0.004	0.162
	(1.070)	(0.090)	(1.070)
FIN	−0.594**	0.066	−0.614**
	(−2.480)	(1.050)	(−2.570)
LITG	0.678***	0.185***	0.624***
	(3.550)	(3.680)	(3.260)
ROA	5.940***	0.320***	5.848***
	(14.780)	(3.020)	(14.550)
CAPIN	−0.546***	0.205***	−0.605**
	(−3.440)	(2.940)	(−2.280)
ENV_STR	−0.586***	−0.185***	−0.639***
	(−3.440)	(−2.730)	(−3.740)
ENV_CON	−0.892***	−0.009	−0.838***
	(−3.460)	(−0.160)	(−3.250)
Intercept	0.143	−0.247**	0.214
	(0.370)	(−2.430)	(0.560)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	1737	1737	1737
R-squared	0.379	0.161	0.383
Mediating effects			
Indirect effect - *CCDS*×*MABILITY*		0.053***	
z-statistic for indirect effect - *CCDS*×*MABILITY*		(2.716)	
Direct effect		0.187	
Total effect		0.239	
% of the total mediated effect		21.86%	

Note: This table presents the regression results on the mediation role of climate change disclosures in the association between managerial ability and firm valuation. The mediation effect test statistics are reported in the bottom section of the table. All variables are defined in Appendix A.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance 10% level.

We report the regression results in Table 10. Model 1 shows that the coefficient for *MABILITY* is positive and statistically significant when the dependent variable is firm value (*TOBINQ*), suggesting that firms with a higher managerial ability are awarded higher valuations by the market. In Model 2, as also observed in Table 4, when an OLS model was estimated, the coefficient for *MABILITY* is positive and statistically significant, suggesting that firms with a higher managerial ability make a higher level of climate change disclosures. However, in Model 3, the coefficient for *MABILITY* is statistically insignificant, while the coefficient for *CCDS* is significant at a 1% level when the dependent variable is firm value (*TOBINQ*). These findings support full mediation: Once the influence of *CCDS* is controlled for, the influence of *MABILITY* on firm valuation disappears.

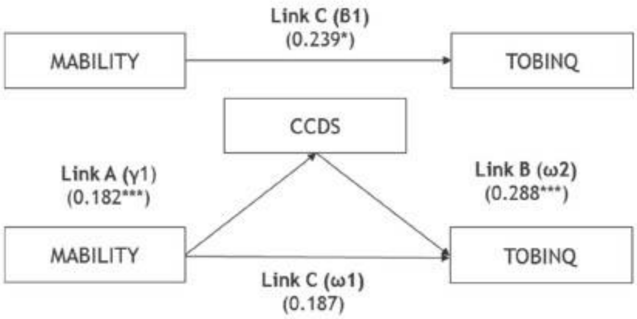

FIGURE 2 Paths between climate change disclosure score (CCDS), managerial ability, and firm value

We report the mediation-related statistics at the bottom of Table 10. These statistics suggest that the direct and total effects of *CCDS* on firm value are 0.187 and 0.239, respectively, giving rise to a mediation effect (i.e., indirect effect) of 0.053. As revealed by the reported z-statistic, this mediation effect is statistically significant; the mediated portion of firm value attributed to *CCDS* is 21.86% of the total effect. We also graphically present the results in Figure 2. In summary, the mediation analysis provides evidence that climate change disclosures are the channel through which managerial ability affects firm value.

6 | CONCLUSION

In this study, we investigate the association between managerial ability and firm-level climate change disclosures. We find that firms with more capable managers make a higher level of climate change disclosures. Furthermore, the positive association between managerial ability and climate change disclosures is weakened when the firm suffers from weak corporate governance. Our results remain robust to addressing omitted time-invariant variable bias, observable heterogeneity bias, sample selection bias, and reverse causality and to separation of firms in the sample into different groups based on disclosure characteristics. We also find evidence that climate change disclosures have a significant mediating influence on the association between managerial ability and firm valuation.

Our findings suggest that more able managers are less concerned about the short-term performance of their firms and tend to engage in climate change activities that require long-term commitments from management and are beneficial to a wider group of stakeholders. Thus, our findings provide insights into an important internal mechanism of the firm—managerial ability—that could play a significant role not only in disclosing climate change information but also in preparing firms to manage the risk of climate change, a threat to the existence of mankind. The study's findings are timely given the importance placed by the TCFD on climate change actions by firms, with firms expected to demonstrate the resilience of their strategies and operations under different scenarios of future global warming. Our study is a US-based study; future research covering diverse jurisdictions would enrich the debate by providing new evidence on the association between managerial ability and climate change disclosures. Future research could explore the underlying mechanisms through which managerial ability affects climate change disclosures.

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DATA AVAILABILITY STATEMENT

All data are publicly available from the sources mentioned in the paper.

ORCID

Hussein Daradkeh https://orcid.org/0000-0002-7595-8470
Syed Shams https://orcid.org/0000-0001-9209-0418
Sudipta Bose https://orcid.org/0000-0002-3895-2416
Abeyratna Gunasekarage https://orcid.org/0000-0003-4934-881X

NOTES

[1] In this study, we refer to carbon disclosures and greenhouse gas disclosures as climate change disclosures. Some researchers refer to climate change disclosures as carbon disclosures (e.g., Bui et al., 2020), while some refer to them as greenhouse gas (GHG) disclosures (e.g., Liao et al., 2015; Tauringana & Chithambo, 2015) and to the transparency of GHG disclosures (e.g., Peters & Romi, 2014).

[2] Source: Task Force on Climate-Related Financial Disclosures (TCFD) (2017).

[3] The term "corporate social responsibility (CSR)" refers to the engagement of an organization in areas where the benefit is mainly accrued by society. This includes taking responsibility for actions for protection of the environment, contribution to the community, relationship with customers, issues with labor, and diversification of employment (Cho & Lee, 2019).

[4] CDP2005 corresponds to the financial year 2004, while CDP2020 corresponds to the financial year 2019.

5 After surveying 702 qualified sustainability experts across 70 countries, GlobeScan and SustainAbility (2014) report that the CDP rating is the most credible environmental disclosure rating system globally. See https://globescan.com/wp-content/uploads/2017/07/Rate_the_Raters_2013-Polling_the_Experts-GlobeScan_SustainAbility-3.pdf (accessed on 20 September 2021).

6 For example, see https://www.google.com/finance/quote/BHP:ASX (accessed on 20 September 2021).

7 The CDP provides eight performance bands (i.e., A, A-, B, B-, C, C-, D, and D-) based on firms' disclosure of climate change information. We assign 8 for performance band A, 7 for A-, 6 for B, 5 for B-, 4 for C, 3 for C-, 2 for D, and 1 for D-, respectively.

8 We thank an anonymous reviewer for suggesting the re-computation of managerial ability scores after controlling for the effect of board governance variables.

9 Free cash flow is defined as earnings before depreciation and amortization less the change in working capital (receivables + inventory + other current assets + other current liabilities − trade accounts payable) less capital expenditures. See Demerjian et al. (2012) for more details about the calculation.

10 The standard deviation of managerial ability (*MABILITY*) is 0.233 for Model (3) sample.

11 We thank an anonymous reviewer for suggesting the analysis of the self-selection bias.

12 An alternative explanation for the insignificant *IMR* is that our selection model is misspecified. Nevertheless, we further calculate the Variance Inflation Factor (VIF) for *IMR* to confirm that the insignificant coefficient for *IMR* is not caused by multicollinearity. The unreported VIF for *IMR* is 1.19 and 1.18 in Model (1) and Model (2), respectively, thus indicating that multicollinearity is not an issue.

13 We run only Equation (2) using two-stage instrumental variable analysis where we instrumented *MABILITY* through using *MABILITY_AVG* as an instrumental variable. We do not estimate Equation (3) using this approach because if we do so using the instrumented *MABILITY* and include *MABILITY*×*HIGH_EINDEX* in the second-stage regression the coefficient for *MABILITY*×*HIGH_EINDEX* does not capture the influence of instrumented *MABILITY*.

14 A variable acts as a mediator if the following criteria are met: (i) the treatment (managerial ability) is significantly associated with the mediator (climate change disclosures); (ii) the treatment (managerial ability) is significantly associated with the dependent variable (firm value) in the absence of the mediator (climate change disclosures); and (iii) the mediator (climate change disclosures) has a significant unique effect on the dependent variable, and when this mediation effect is controlled for, the effect that the treatment variable (managerial ability) has on the dependent variable (firm value) is weakened. If the treatment (managerial ability) is no longer significant when the mediator (climate change disclosures) is controlled for, the findings support full mediation. If the treatment (managerial ability) is still significant when the mediator (climate change disclosures) is controlled for, the finding supports partial mediation.

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AUTHOR BIOGRAPHIES

Mr Hussein Daradkeh is a PhD candidate at the University of Southern Queensland, Australia. Mr Daradkeh was awarded M.Sc. in Finance from George Washington University, USA, and MBA specialized in International Finance from Virginia International University, USA. His research interests include corporate governance, corporate disclosure, climate change, and financial technology. He has published a book chapter titled "From one crisis to another: Impact of COVID-19 pandemic on Peer-to-peer lending market." He has also presented his scholarly articles at various conferences, including the Financial Markets and Corporate Governance (FMCG) 2021 conference.

Dr Syed Shams is an Associate Professor in Finance at the University of Southern Queensland, Australia. He has published more than 30 research articles in a range of highly respected journals and a book chapter. His publications have appeared in reputable journals, including in the Journal of Corporate Finance, Journal of Business Research, Corporate Governance: An International Review, International Review of Financial Analysis, Accounting & Finance, Australian Journal of Management, and Pacific-Basin Finance Journal. His broad research interests include corporate finance, corporate governance, mergers and acquisitions, corporate sustainability, and corporate disclosure. He is actively involved in the supervision of PhD students and support of earlier career researchers.

Dr Sudipta Bose is a Senior Lecturer in Accounting at the University of Newcastle. Dr Bose was awarded his PhD in Accounting from the School of Accounting, UNSW Sydney. His research interests include capital market, cost of equity capital, climate change disclosures, carbon emissions and assurance, integrated reporting, sustainability reporting and assurance, and corporate governance. Dr Bose has published his scholarly articles in the

Journal of Corporate Finance, Accounting, Auditing & Accountability Journal, British Accounting Review, Abacus, Accounting & Finance, Corporate Governance: An International Review, Critical Perspectives on Accounting, Journal of Business Ethics, Journal of Contemporary Accounting and Economics, Managerial Auditing, Asia Pacific Journal of Management, and Journal of Banking and Finance Law and Practice.

Dr Abeyratna (Abey) Gunasekarage is a Senior Lecturer in Finance at the Department of Banking and Finance, Monash University, Australia. Abey received his BSc Honors from the University of Sri Jayewardenepura, Sri Lanka, and MAcc & PhD from the University of Dundee, UK. Abey's research interests include dividend policy, mergers and acquisitions, financial markets, bank performance, corporate governance, and emissions management. Abey has published more than 40 scholarly articles in reputable journals such as Accounting and Finance, British Accounting Review, International Review of Economics and Finance, Journal of Contemporary Accounting and Economics, and Pacific-Basin Finance Journal.

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APPENDIX A: VARIABLE DESCRIPTIONS

Notation	Variable name	Definition
CCDS	Climate change disclosure score	Percentile rank of climate change disclosure score/band.
MABILITY	Managerial ability	The managerial ability score estimated using a modified version of Demerjian et al. (2012).
HIGH_EINDEX	Managerial entrenchment index score	An indicator variable that takes the value of 1 if a firm's *EINDEX* score is greater than the year median score of EINDEX, and 0 otherwise. The *EINDEX* is the entrenchment index constructed according to Bebchuk et al. (2009).
SIZE	Firm size	Natural logarithm of the market value of equity at the beginning of the year.
MB	Market-to-book value	The market value of equity divided by the book value of equity.
LEV	Leverage	The ratio of total debt to total assets.
SGROWTH	Sales growth	The changes in sales divided by the prior year's sales.
FIN	New financing	Amount of debt or equity capital raised by the firm in a given year, divided by total assets at the beginning of that year. It is calculated as the issuance of common stock and preferred shares minus the purchase of common stock and preferred shares, plus the issuance of long-term debt minus the payment of long-term debt.
LITG	Litigation risk	An indicator variable that takes the value of 1 if the firm operates in a high-litigation industry (standard industrial classification [SIC] codes of 2833–2836, 3570–3577, 3600–3674, 5200–5961, and 7370) and 0 otherwise.
ROA	Return on assets	The ratio of income before extraordinary items to total assets at the beginning of the year.
CAPIN	Capital intensity	The ratio of capital spending to total sales at the beginning of the year
ENV_STR	Environmental strengths	The percentage of the total number of raw environmental strengths scaled by the total number of items of environmental strengths for a firm reported by the MSCI ESG database.
ENV_CON	Environmental concerns	The percentage of the total number of raw environmental concerns scaled by the total number of items of environmental concerns for a firm reported by the MSCI ESG database.
DISC_CDP	CDP response	An indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire and 0 otherwise.
PROPDISC	Proportion of disclosure	Measured as the proportion of firms in an industry that respond to the CDP questionnaire.
CDP_LAG	Previous year CDP disclosure	An indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire in the previous year and 0 otherwise.
TOBINQ	Firm value	The sum of the market value of common equity plus the book value of total debt scaled by total assets

3.2. Links and implications

This study sheds light on the drivers of climate change disclosure by examining the influence of executive management. The results demonstrate that firms with capable managers tend to make more climate change disclosures, and these disclosures have a positive impact on firm valuation. However, the association between managerial ability and climate change disclosure is weakened when firms suffer from weak corporate governance.

Building on these findings, the next study will investigate the impact of CEO–director social ties on climate change disclosure in U.S. firms. Specifically, it will examine how CEO attributes, such as social ties with directors, influence the level of climate change disclosure. The current study provides a strong foundation for this research direction by establishing climate change disclosure as an independent variable.

In addition, the next study will explore the moderating influence of internal and external monitoring on the relationship between CEO–director social ties and climate change disclosure. This investigation will shed further light on the mechanisms underlying the influence of social ties on climate change disclosure and provide insights into the role of monitoring in enhancing or constraining the effectiveness of climate change disclosure. Overall, this research aims to contribute to the literature on corporate social responsibility and sustainability by providing a more comprehensive understanding of the drivers of climate change disclosure.

CHAPTER 4 : PAPER 2

Impact of CEO–Director Social Ties on Climate Change Disclosure: Evidence from the United States

4.1 Chapter overview

This chapter presents the second paper of the thesis, which investigates the relationship between CEO-director social ties and firm-level climate change disclosure, along with the moderating role of internal and external monitoring.

Section 4.2 provides an introduction into the article and its key objectives. Section 4.3 reviews the relevant literature and presents the hypotheses developed for the study. Section 4.4 describes the research methodology, including the sample selection process, data collection, and analytical techniques used in the study.

Section 4.5 presents the empirical results of the study, including the relationship between CEO-director social ties and climate change disclosure, and the moderating effects of internal and external monitoring. Section 4.6 provides additional analysis of the results to further investigate the relationship between the variables.

Section 4.7 concludes the article by summarising the key findings and their implications for future research and practice. Section 4.8 discusses the connection between this paper and the next chapter, which will focus on a different determinant of climate change disclosure in firms.

Impact of CEO–Director Social Ties on Climate Change Disclosure: Evidence from the United States

Hussein Daradkeh[11]

School of Business
University of Southern Queensland
Brisbane, Qld 4300, Australia
Telephone: +61 (4) 1184 1317
Email: hussein.daradkeh@usq.edu.au

Syed Shams

School of Business
University of Southern Queensland
Brisbane, Qld 4300, Australia
Telephone: +61 (7) 3470 4551
Email: syed.shams@usq.edu.au

Sudipta Bose

Discipline of Accounting and Finance
Newcastle Business School
University of Newcastle
Sydney, NSW 2000, Australia
Tel: +61 (2) 8262 6406
Email: sudipta.bose@newcastle.edu.au

Abeyratna Gunasekarage

Department of Banking and Finance
Monash Business School
Monash University
Melbourne, Vic 3800, Australia
Tel: +61 (3) 9904 7249
Email: abeyratna.gunasekarage@monash.edu

[11] Corresponding author: Hussein Daradkeh, Discipline of Finance, School of Business, University of Southern Queensland, Springfield, QLD 4300, Australia. Email: hussein.daradkeh@usq.edu.au Tel: +61 (4) 1184 1317

Impact of CEO–Director Social Ties on Climate Change Disclosure: Evidence from the United States

Abstract

This study examines the association between CEO–director social ties and firm-level climate change disclosure. We find that CEO–director social ties are positively associated with firm-level climate change disclosure. We also find that better external monitoring and internal monitoring accentuate the positive impact of CEO–director social ties on climate change disclosure. Our results remain robust using a battery of robustness tests. Our study's findings have significant implications for regulators, policy makers, researchers, investors, analysts and company management, given the current regulatory pressure on companies to disclose more information about climate change.

Keywords: Climate change disclosure; CEO–director social ties; Governance; Firm value

JEL Classifications: G34, M41,

Data availability: All data are publicly available as stated in the paper.

"The unprecedented and interdependent crises of climate change and biodiversity loss pose an existential threat to people, prosperity, security, and nature."

(Carbis Bay G7 Summit communiqué, 2021, p. 13).

4.2. INTRODUCTION

Over the past two decades, climate change and global warming have been identified as among the most urgent environmental issues in the world (United Nations [UN], 2020). Currently, companies face several additional risks due to climate change, including physical risk (e.g., extreme drought circumstances), regulatory risk (e.g., changes in emissions-related policies of the government and related agencies) and transitional risk (e.g., climate-related innovations which can be troubling for some industries) (Javadi & Masum, 2021). For example, the Economist Intelligence Unit [EIU] (2015) estimates that the present value of the loss of manageable financial assets worldwide from climate change would be US$4.2 trillion which equates to a loss of nearly 3% from the world's current stock of manageable financial assets valued at US$143 trillion.[12] Consequently, companies have come under increasing pressure from their stakeholders to engage in activities to reduce their climate change footprint, while increasing the extent of their climate change disclosures (Okereke & Russel, 2010; Reid & Toffel, 2009). Accordingly, companies are disclosing their efforts to minimise the impact of climate change, with this information disclosed through different channels including sustainability reports, annual reports and/or responses to CDP (previously, Carbon Disclosure Project). Given the growing importance of the climate change issue and the pressure exerted by various stakeholders, understanding the firm-level drivers of climate change disclosure has become an emerging issue in the literature. Prior studies document that firms with stronger climate governance (Bui et al., 2020); greater managerial ability (Daradkeh et al., 2022); larger boards (Liao et al., 2015; Tauringana & Chithambo, 2015); gender-diverse boards (Ben-Amar et al., 2017; Haque, 2017; Liao et al., 2015); and environmental committees (Liao et al., 2015; Peters & Romi, 2014) provide higher level of climate change disclosures.[13] However,

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[12] https://impact.economist.com/perspectives/sites/default/files/The%20cost%20of%20inaction_0.pdf

[13] In this study, we refer to carbon disclosures and greenhouse gas (GHG) disclosures as climate change disclosures. Some researchers refer to climate change disclosures as carbon disclosures (e.g.,

the social connections created with the company's directors by the Chief Executive Officer (CEO) (hereafter, "CEO–director social ties") constitute another important aspect of corporate governance. The extant literature lacks evidence on the potential effect of CEO–director social ties on a company's climate change disclosures, with our study aiming to fill this gap in the knowledge.

As the main governing body of a company and responsible for protecting the interests of all stakeholders, the board of directors is responsible for the company's risk management and disclosure of information, including climate change information (Prado-Lorenzo & García-Sánchez, 2010). As climate change risk-related actions require highly uncertain strategic decisions that demand a long-term commitment, leadership from top management is an essential factor (Hoffman, 2007, Walls & Berrone, 2017). In this context, the strength of CEO–director social ties can play a critical role in climate change initiatives to ensure a unified effort from the board of directors. However, the understanding of the influence of CEO–director social ties on climate change disclosure is limited. An investigation of the extent of this influence can therefore be of interest to many firm stakeholders.

The nexus between CEO–director social ties and climate change disclosure can be explained by two opposing theories. Firstly, from an agency theory perspective (Fama & Jensen, 1983), social relationships between the CEO and directors are viewed as detrimental to the company as they interfere with the board's capacity to serve as a reliable internal governance mechanism (Fracassi & Tate, 2012). As a result, these social connections may make it difficult for the board to effectively oversee the CEO as it is rare that directors with these connections will challenge the CEO at a meeting (Nguyen, 2012). According to Guedj and Barnea (2009), social connections between the CEO and directors not only "soften" the monitoring mechanism for the CEO but also provide him/her with more negotiation power with the board for extra private benefits, such as pay and tenure. Independent directors, with social connections to the CEO, will feel obligated to support the CEO's preferred strategic choices (Wade et al., 1990). Additionally, as Janis (1972) claims, when CEOs and directors form close bonds, this may increase the possibility of "groupthink" when

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Bui et al., 2020), while some refer to them as greenhouse gas (GHG) disclosures (e.g., Liao et al., 2015; Tauringana & Chithambo, 2015) and others to the transparency of GHG disclosures (e.g., Peters & Romi, 2014).

making the company’s business decisions. As a result, CEO–director social relationships undermine the effectiveness of strategic decision making as CEOs, with these relationships, may keep their board of directors mostly inactive and inert, thus undermining the board’s independence (Wade et al., 1990). Consequently, CEO–director social ties could adversely affect the boards’ responsibility to disclose information, including information related to climate change. Secondly, from the perspectives of friendly boards (Adams & Ferreira, 2007); collaborative frameworks (Westphal, 1999); and the resource-based view (RBV) (Shrader & Siegel, 2007), CEO–director social ties could enhance climate change disclosure as these ties could reduce conflicts within the board. This would facilitate the effective exchange of information (Cao et al., 2015; McPherson et al., 2001; Shane & Cable, 2002), with the trust and cooperation from these ties encouraging directors and CEOs to make a collaborative effort to obtain climate change information which they have the responsibility to disclose (Ben-Amar & McIlkenny, 2015; Cohen et al., 2002; Fuente et al., 2017; Hoitash, 2011; Nowak & McCabe, 2003; Prado-Lorenzo & García-Sánchez, 2010). Additionally, prior research offers a wealth of evidence supporting the beneficial effects of boards, executives, and executive compensation on ESG and CSR practises (see, for example, Borghesi et al., 2014; Ikram et al., 2019; Iliev & Roth, 2020; McCarthy et al., 2017). As a result, CEOs and directors often have identical goals for ESG and CSR. Social ties boost friendship and trust, resulting in an efficient information flow between CEOs and directors (McPherson et al., 2001). Also, they encourage greater collaboration between the board and top management for activities where their objectives are compatible, which will lead to better results (Westphal, 1999). As a result, when CEOs and directors have preferences connected to ESG, their social ties may aid in the implementation of improved ESG-type policies.

Therefore, the main objective of our study is to examine the association between CEO–director social ties and the extent of firm-level climate change disclosure. Furthermore, prior studies show both internal and external monitoring mechanisms affect firms’ climate change disclosures (Bui et al., 2020). Hence. we examine the moderating role played by internal and external governance mechanisms in the association between CEO–director social ties and climate change disclosure. Additionally, we examine the role of climate change disclosure as an underlying channel through which climate change disclosure enhances firm valuation.

Using a sample of 1,007 firm-year observations from United States (US) firms that responded to the CDP questionnaire from 2006–2018, we examine the impact of CEO–director social ties on climate change disclosure. Our main results suggest that CEO–director social ties positively influence climate change disclosure. Moreover, our findings on the role of analysts following and governance quality reveal that the positive relationship between CEO–director social ties and climate change disclosure is strengthened by a higher number of analysts following. At the same time, the relationship is hindered by poor governance. To check for endogeneity problems, we employ two-stage least squares (2SLS) analysis with the instrumental variable approach, firm fixed-effect regressions and propensity score matched (PSM) samples, discovering that our findings remain valid.

Our study makes several contributions to the literature. Firstly, it contributes to the body of literature examining the determinants of climate change disclosure by documenting evidence of the influence of the characteristics of boards of directors on climate change disclosure. Previous literature on boards of directors' characteristics finds that climate change disclosure is influenced by strong climate governance, board size, gender-diverse boards, the presence of environmental committees and board effectiveness (Ben-Amar & McIlkenny, 2015; Bui et al., 2020; Liao et al., 2015). Nevertheless, we found evidence that CEO–director social ties positively affect climate change disclosure. Secondly, previous literature focuses on the influence of CEO–director social ties on a firm's financial aspects, such as labour investment efficiency, firm value and initial public offerings (IPOs) (Chahine & Goergen, 2013; Fan et al., 2019; Khedmati et al., 2020). At the same time, only a few studies have focused on CEO–director social ties in the context of corporate social performance. Thirdly, we provide evidence of the contribution of CEO–director social ties to the wider community, as well as to meeting stakeholders' demands for corporate environmental responsibility by increasing the level of disclosure of climate change information. Fourthly, our study shows that both external monitoring (proxied by analysts following) and internal monitoring (proxied by governance quality) affect the positive relationship between CEO–director social ties and climate change disclosure. Fifthly, our results contribute to the literature on boards of directors' two tasks, monitoring and advising, and examine the impact of the board's social relationships with management on its capacity to effectively carry out these tasks. Finally, we add to the literature by demonstrating the moderating function of climate change disclosure in the relationship between CEO–director social ties and firm value. Given the current push for climate change disclosure, our study's results have significant implications for regulators, policy makers, investors, financial analysts, academics and businesses.

The remainder of the paper proceeds as follows. Section 2 presents the review of the relevant literature and the development of the hypotheses. Section 3 discusses the methodology employed in the study. Section 4 discusses the findings, while Section 5 presents the discussion of several additional analyses. The last section (Section 6) concludes the paper.

4.3. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

4.3.1 Literature review

According to Fracassi and Tate (2012), CEOs and directors on the board are considered to be socially connected if they have one or more of the following three connections. Firstly, the CEO and directors have previously worked together as employees or directors in the same organisation. Secondly, they have personal ties that go beyond their profession, such as shared memberships at country clubs, attendance at business roundtable meetings or trusteeships for non-profit organisations. Thirdly, they have received their Master of Business Administration (MBA) degrees from the same program.

Agency theory emphasises how crucial independence is to the board's monitoring responsibility (Fama & Jensen, 1983). According to this theory, management would "abuse" its social connections to persuade the board to comply with its demands. However, research shows that social links between independent board members and management may enhance the amount of cooperation and information exchange between them (Hoitash, 2011), with this view building on theoretical frameworks on advice seeking and social ties in companies (Adams & Ferreira, 2007; Westphal, 1999). These studies reveal that social ties, such as friendship and trust, may promote rather than hinder board engagement in managing a company and, as a result, may boost board effectiveness. Thus, these connections may improve shareholders' welfare. Together, these ideas show that interactions between management and independent board members may have both positive and negative effects. Social exchange theory explains why social network ties are linked to environmental disclosure (Zhou et al., 2021). For example, an individual with strong social network ties with others in an organisation is likely to share his/her past experience with other organisations through his/her own initiative. In other words, employees who highly value social network ties are likely to present a favourable image of their organisation to stakeholders. They could deliver on an organisation's accountability towards various stakeholders by disclosing strategic environmental information that extends beyond the requirements specified by their organisation. Consequently, employees who establish close social network ties with others in the organisation create an atmosphere that stimulates employees to work collaboratively when disclosing environmental information to stakeholders and shareholders.

Furthermore, the resource-based view (RBV) considers CEO–director social ties as a competitive advantage for the firm (Shrader & Siegel, 2007). Social ties are a source of value as they influence the firm's strategy and decision making (Leana & Van Buren, 1999; Pennings et al., 1998). Accordingly, boards of directors are regarded as providers of resources as it is their responsibility to provide advice to CEOs on a firm's strategy and managerial issues (Wu, 2008). Moreover, Fan et al. (2019) hypothesises that social ties can allow for better board involvement in decision making, leading to increased firm value. Social relationships between CEOs and boards of directors foster transparency and trust, paving the way for information sharing (Adams & Ferreira, 2007; Cao et al., 2015; Hoitash, 2011; Westphal, 1999). This leads to effective decision making and improved monitoring by the board of directors, consequently increasing shareholders' value (Adams & Ferreira, 2007; Duchin & Sosyura, 2013; Hwang & Kim, 2009). According to Milbourn et al. (2001), managers with career or reputation concerns will invest in successful projects that create value for the firm, thus helping these managers to develop a reputation. Accordingly, a CEO with career concerns or who is trying to build a reputation will allow for more board involvement by utilising social ties as a channel for exchanging information and advice.

In addition to monitoring management, boards are tasked with giving management guidance and counsel (Salancik & Pfeffer, 1978). However, most accounting and auditing research is mainly concerned with agency theory (Fama & Jensen, 1983) and the board's monitoring function. This one-sided perspective is criticised by Cohen et al. (2008) who contend that additional duties of the board of directors should be considered. The authors show that when auditors evaluate control risk, they consider additional board of director functions (apart from monitoring) and allocate a lower control risk to firms in situations where the board can help management to operate the company. Cohen et al. (2007) provide evidence to support this claim. In line with this view, it is proposed in the board collaboration model (Westphal, 1999) that having personal connections is related to greater firm performance when the board carries out certain tasks. This idea contends that social characteristics, such as trust and friendship, may encourage board engagement and effectiveness in managing a corporation rather than inhibiting the corporation. This idea is based on theoretical frameworks on advice seeking and social relationships in companies. The same connection is also implied by Adams and Ferreira (2007) who demonstrate that, when the board and management's views are aligned, the board offers higher-quality guidance that produces favourable results.

Several studies examine the influence of CEO–director social ties on various firm outcomes. Using several network links between CEOs and directors to build an aggregate metric of connectivity for Standard & Poor (S&P) 1500 companies, Fracassi and Tate (2012) explore how board independence and business value are impacted by CEO–director social relationships. The authors find that a more powerful CEO is more likely to nominate new directors with prior network links to that CEO, thereby compromising the independence of the board. When directors with links to the CEO leave the board, company value (represented by Tobin's Q) increases by 9.3% from the year prior to the departure to two years after the departure. Using a sample of France's top publicly listed firms, Nguyen (2012) studies the influence of CEO–director relationships on board oversight and business governance. The author finds that, when a CEO and many board members share social circles, the CEO is less likely to be fired for bad performance. Even if the CEO is driven out of the firm, he/she is more likely to find new and rewarding work. This outcome is not attributable to the CEO's skills or to the superior knowledge of the board that he/she led, with the main reason behind this reward indicated as being the network ties of the CEO with other directors. Similarly, Liu (2014) finds that CEO connectivity significantly increases their turnover probability as these ties expand the external employment options available to them. Fan et al. (2019) find that both the breadth and depth of board–CEO friendship relationships (represented by the fraction of directors with friendship ties to a CEO and the number of friendships ties the CEO has with the board of directors, respectively) have negative and significant influences on company value, although the breadth ties seem to have a greater impact. Yin et al. (2020) report that an increase in CEO–board social ties hinders the board's monitoring function and encourages a CEO's tendency to adopt fewer conservative principles for his/her personal gain. Studies of both Krishnan et al. (2011) and Rose et al. (2014) find evidence that firms with CEO–board social ties tend to engage in more earnings management exercises. Khanna et al. (2015) reveal evidence that CEO–director social ties increase corporate fraud while decreasing the potential of fraud detection. Khedmati et al. (2020) find that CEOs with strong relationships with board members are associated with inefficient labour investment, while CEO–director social ties lead to ineffective monitoring that causes the intensified problem of inefficient labour investment, leading to a reduction in shareholders' wealth.

However, numerous studies find positive outcomes associated with CEO–director social ties. Chahine and Goergen (2013) find that IPO performance is positively related to the strength of social ties between CEOs and directors, but this association is conditional on whether these directors are internal or external. Westphal (1999) provides evidence that an increase in CEO–director social ties increases the frequency of advice and counsel interactions between CEOs and directors, leading to higher levels of board involvement and firm performance. Hwang and Kim (2009) find that 87% of boards are conventionally independent (i.e., with no financial or familial ties to the CEO), while 62% are conventionally and socially independent (i.e., with no financial, familial or social ties). Firms with conventionally and socially independent boards award a significantly lower amount of compensation to their CEOs, exhibit stronger pay–sensitivity and show stronger turnover–performance sensitivity than firms with only conventionally independent boards. Schmidt (2015) finds an asymmetric influence of CEO–director social ties on announcement period returns earned by acquirers: the social ties are positively associated with announcement returns when the potential value of board advice is high but are negatively associated when monitoring needs are high. Cao et al. (2015) find that the increased information flow from CEO–board social ties leads to increased value for shareholders, while Hoitash (2011) finds that financial reporting is improved when social ties exist between CEOs and boards of directors.

A branch of this research examines the influence of CEO–director social ties on a firm's CSR activities. Jang et al. (2019), who examine the effects of CEO–board social ties on the relationship between CSR and firm performance of Korean firms, find that these social links hinder the association between CSR and firm performance. Zou et al. (2019) examine the association between board social ties and the level of environmental responsibility undertaken by firms in China by categorising board social ties into the three types of isomorphic forces in the institutional field (coercive, normative and mimetic). They reveal evidence that social ties linked to coercive and normative forces (i.e., political organisations and universities) lead to a firm having a higher level of environmental responsibility; however, social ties linked to mimetic forces (i.e., industry peers) have a negative association with environmental responsibility.

4.3.2 Hypotheses development

The existing literature provides two contrasting views regarding the influence on a firm's decisions of social ties between the CEO and independent board members. On the one hand, the agency theory view is that CEO–director social ties are harmful to the firm as they compromise the board's ability to function as an effective internal governance mechanism (Fracassi & Tate, 2012). These social ties may inhibit the board from adequately monitoring the CEO as it is unlikely for directors with these ties to oppose the CEO in the boardroom (Nguyen, 2012). Guedj and Barnea (2009) find that CEO–director social ties not only "soften" the mechanism that monitors CEOs, but also increase CEOs' negotiating leverage with the board for additional private advantages, such as salary and tenure. Independent directors with links to CEOs will feel socially compelled to back the preferred strategic decisions of these CEOs (Wade et al., 1990). Also, Janis (1972) finds that when CEOs and directors build intimate links, this may promote the likelihood of "groupthink" in the boardroom when deciding the firm's business policies. Thus, CEO–director social ties reduce the efficacy of strategic decision making, as CEOs will keep their boards of directors mainly passive and uninvolved, leading to the boards' lack of independence (Wade et al., 1990).

On the other hand, friendly board theory (Adams & Ferreira, 2007) and the collaboration theoretical framework (Westphal, 1999) propose that CEO–director social ties increase collaboration and information sharing between a CEO and the firm's board members, therefore building trust and friendships within the board. These relationships encourage the board's involvement in managing the firm, leading to increased board effectiveness. McPherson et al. (2001) and Shane and Cable (2002) show that social ties, formed via previous employment or other non-business activities, develop friendship and mutual trust between the linked individuals, leading to effective information flow between them. Cao et al. (2015) contend that social interactions might reduce conflicts between independent directors and CEOs, making them more willing to share information. Furthermore, social ties give rise to more frequent social encounters among board members, creating more opportunities for CEOs and independent board members to exchange information (McPherson et al., 2001).

The board of directors is responsible for the disclosure of CSR and climate change information (Ben-Amar & McIlkenny, 2015; Fuente et al., 2017; Prado-Lorenzo & García-Sánchez, 2010). Hence, the decision to disclose this information is heavily influenced by the board of directors. According to Carter and Lorsch (2003), independent directors spend an average of 100 hours yearly on their board responsibilities. However, this average does not enable them to obtain insightful information and knowledge about the company's operations; therefore, they often rely on CEOs for information (Hoitash, 2011). Moreover, independent board members believe that CEOs has control over the flow of information (Nowak & McCabe, 2003). Cohen et al. (2002) find that a firm's management will not be governed unless they want this to happen. Social ties are found to improve trust and cooperation between independent board members and CEOs, allowing for greater information exchange and a higher level of governance (Hoitash, 2011).

Climate change projects are inherently unpredictable strategic choices that need a long-term commitment from top executives (Elsayih et al., 2021). They have implications for the firm's climate change activities (Prado-Lorenzo & García-Sánchez, 2010), with stakeholders paying significant attention to the climate change implications of corporate strategies and operations in their investment decisions (Liao et al., 2015). According to social science and management studies, CEO–director social ties are a crucial attribute, helping firms in their strategic decision making (Engelberg et al., 2013). A highly connected CEO may have access to network knowledge necessary for launching strategic CSR initiatives (such as climate change projects) and stakeholders may be eager to support these efforts (Edmans, 2011). Moreover, previous literature provides a wide range of evidence on the positive influence of boards, executives and executive compensation on ESG and CSR practices (see, for example, Borghesi et al., 2014; Ikram et al., 2019; McCarthy et al., 2017). Hence, in many instances, CEOs and directors share similar objectives with regard to ESG and CSR. Social ties increase trust and friendship, leading to an effective information flow between CEOs and directors (McPherson et al., 2001). They also promote a higher degree of cooperation between the board and executive management for tasks when they have similar goals, which will result in better outcomes (Westphal, 1999). Consequently, when CEOs and directors have ESG-related preferences, their social ties can help implement better ESG-type policies. Therefore, one can expect CEO–director social ties to have an influence on disclosures made by firms on their climate change initiatives. Even though existing studies investigate how some board characteristics influence climate change disclosure, to the best of the authors' knowledge, no study has investigated whether CEO–director social ties, specifically, have an impact on climate change disclosure. To examine this issue in the current study, we test the following hypothesis:

H1: *CEO–director social ties have a positive influence on voluntary climate change disclosures made by a firm.*

4.3.3 Moderating roles of internal and external monitoring

Internal monitoring (governance quality) and external monitoring (analysts following) are considered to be important factors that influence a firm's information environment. For example, weak internal monitoring, according to Ferreira and Laux (2007), is the reason for a decrease in information disclosed to financial markets and external parties. According to Armstrong et al. (2012), companies with poor internal monitoring decline to release financial information. Weak internal monitoring allows CEOs to chase their personal objectives, regardless of shareholders' benefits (Elyasiani & Zhang, 2015; Shleifer & Vishny, 1989). Additionally, research reveals that weak internal monitoring is linked to an ineffective climate change and environmental policy as well as to a decline in CSR initiatives (Jo & Harjoto, 2012). In contrast, Cong and Freedman (2011) find that strong internal monitoring leads to more pollution disclosure. Moreover, in the presence of strong internal governance, it is predicted that CEOs would use their social ties to meet stakeholder demands by, for example, disclosing climate change information. Based on these arguments, we predict that strong internal monitoring can have a moderating effect on the positive relationship between CEO–director social ties and climate change disclosure. Accordingly, we suggest the following hypothesis:

H2a: *The positive association between CEO–director social ties and climate change disclosure is stronger (weaker) for firms with a better (poor) corporate governance.*

The number of analysts following (external monitoring) is considered to be a strong third-party monitoring mechanism, serving as a motivational tool for CEOs to encourage them to undertake value-creating decisions, thereby aligning the interests of CEOs with those of shareholders (Jiraporn, Chintrakarn, & Kim, 2012). An increased number of analysts following a firm leads to a better information environment and limits managerial actions that suppress negative information (Jiraporn et al., 2012). Accordingly, Yu (2008) finds that an increase in the number of analysts following a firm results in a decrease in earnings management. Aerts, Cormier and Magnan (2008) contend that the number of analysts following a firm reflects the firm’s information accessibility and moderates the relationship between environmental disclosure and the consensus analysts’ forecasts. Given these findings, we expect CEOs of firms followed by more analysts to utilise their social ties with the board to provide better quality information, including the voluntary disclosure of climate change information. Accordingly, we propose the following hypothesis:

H2b: *The positive association between CEO–director social ties and climate change disclosure is stronger for firms followed by a higher number of analysts.*

4.4. RESEARCH METHODOLOGY

4.4.1 Sample and data

The initial sample of our study comprises all United States (US) firms that participated in the CDP (formerly Carbon Disclosure Project) questionnaire survey from CDP2007–CDP2019. We select CDP2007 as the first year of the sample period as climate change disclosure data are only available from that year, with the sample period ending in CDP2019, the final year of data collection. We obtain climate change disclosure data from the CDP database; firm-level financial and stock market data from Worldscope and DataStream databases; non-financial data from the Refinitiv ESG database; corporate governance data from the BoardEx database; and financial analysts’ data from the Institutional Brokers' Estimate Systems (I/B/E/S) database. Our study excludes 917 firm-year observations which cannot be merged among the databases; 1,220 firm-year observations due to the non-availability of CEO–director social ties data; and 582 firm-year observations due to the non-availability of corporate governance data. The final sample size is 1,007 firm-year observations covering the period from CDP2007–CDP2019. Table 4.1, Panel A provides the sample selection procedure.

Table 4.1. Sample selection and distribution

Panel A: Sample Selection	
Climate change score data available from CDP (2007–2019)	3,726
Less: Firms dropped due to not merging with Compustat database	(917)
Less: Firms having non-available CEO social ties data	(1,220)
Less: Firms dropped due to insufficient control variables	(582)
Final Test Sample from 2007–2019	**1,007**

Panel B: Industry and Year Distribution of Firms in the Sample

Name of Industry	**Number of Observations**	**% Of Sample**	**Year**	**Observations**	**% Of Sample**
Mining/Construction	21	2.09	2007	30	2.98
Food	65	6.45	2008	34	3.38
Textiles/Print/Publishing	37	3.67	2009	55	5.46
Chemicals	14	1.39	2010	92	9.14
Pharmaceuticals	65	6.45	2011	70	6.95
Extractive	27	2.68	2012	81	8.04
Manufacturing: Rubber/glass/, etc.	17	1.69	2013	77	7.65
Manufacturing: Metal	8	0.79	2014	91	9.04
Manufacturing: Machinery	38	3.77	2015	83	8.24
Manufacturing: Electrical Equipment	8	0.79	2016	83	8.24
Manufacturing: Transport Equipment	34	3.38	2017	112	11.12
Manufacturing: Instruments	80	7.94	2018	104	10.33
Manufacturing: Miscellaneous	16	1.59	2019	95	9.43
Transportation	226	22.44		**1,007**	**100**
Utilities	59	5.86			
Retail: Restaurant	51	5.06			
Retail: Wholesale	32	3.18			
Retail: Miscellaneous	90	8.94			
Retail: Restaurant	6	0.60			
Financial	80	7.94			
Insurance/Real Estate	3	0.30			
Services	18	1.79			
Others	12	1.19			
Total Sample	**1,007**	**100**			

Table 4.1, Panel B provides the distribution of firm-year observations by industry and year. Our sample is dominated by firm-year observations from firms operating in the transportation industry (22.44%), followed by the retail (miscellaneous) industry (8.94%), with the lowest number of firm-year observations (0.30%) being from firms in the insurance/real estate industry. While the number of observations remains below 5% in 2006 and 2007, the firm-year observations for the remaining years of the sample period are between 5% and 11%.

4.4.2 Measure of climate change disclosure

In this study, we measure climate change disclosure using the CDP climate change disclosure scores. As an international, non-profit and independent organisation, CDP manages the reporting of environmental information, gathering questionnaire responses annually from businesses on their climate change initiatives and converting these responses into ratings. These ratings are globally regarded as the most reliable (GlobeScan & SustainAbility, 2014). Moreover, Google Finance incorporates these ratings in their Key Statistics and Ratio sections. The CDP climate change disclosure score includes several climate change activities, such as: a firm's climate management risks and opportunities arising from climate change; corporate strategies; environmental performance and objectives; corporate strategies to decrease carbon emissions; carbon footprint verification; carbon pricing; and a firm's involvement with its stakeholders on climate change issues. Every participating company was given a score between 0 and 100 by CDP between 2006 and 2014. However, from 2015, CDP swapped its scoring system with a performance band. In our study, we could not utilise the scores and bands together as the change in scoring technique took place within the time frame of our sample period. The climate change performance bands for 2015–2018 are thus given values ranging from 1–8, and these scores, along with the CDP ratings available for 2006–2019, are then transformed into percentile rankings. In particular, we follow Barth et al. (2017) by constructing the following climate change disclosure percentile rank: (firm rank - 1)/(number of firms - 1), resulting in a range from 0–1, with 0 being the lowest-rated company and 1 being the highest-rated company. Moreover, to assess the robustness of our findings, the likelihood of responding to the CDP's questionnaire survey on climate change was used as a proxy to capture the extent of a firm's climate change disclosure. More specifically, if the company responds to the CDP survey and makes its answers publicly accessible, we create a climate change disclosure indicator variable with a value of 1, and if not, we assign a value of 0.

4.4.3 Measures of CEO–director social ties

We measure CEO–director social ties using the context of social ties created by education, employment (current and past) and friendships, following Khedmati et al. (2020). We obtain these data from the BoardEx database which provides information on the qualifications, institutions attended and graduation dates of CEOs and directors. This database also provides former and present positions held by CEOs and directors, including the name of each company, the position held, the individual's role, and the start and end dates of the role. A distinctive feature of the BoardEx database is that it provides information about non-professional groups to which individuals belong, such as social clubs, country clubs and charities (Khedmati et al., 2020).

Education ties (*TieEdu*) arise when both a director and a company's CEO are graduates from the same educational institution. When a company's CEO and a director serve concurrently as directors on the board of another company, this is referred to as present employment ties (*TieEmppresent*). Similarly, when a director and a CEO both previously worked for the same company regardless of their position, this is referred to as having past employment ties (*TieEmppast*). Finally, a director and a CEO of a firm may also have friendship ties (*TieOther*) if they are both members of the same charity, country club, social club or other non-profit organisation, either currently or in the past. In the main regression analysis, we employ the aggregate measure of CEO–director social ties (*SOCIAL_TIE*). This is determined as the percentage of independent directors who have at least one connection to the CEO, based on their shared backgrounds in terms of employment, education or other social relationships. In our additional analyses, we divide the aggregate measure (*SOCIAL_TIE*) into several categories of social ties, that is, from education, previous or present employment, and other 'friendship' activities.

4.4.4 Empirical models

We employ the following lead–lag regression model to test Hypothesis 1 (H1):

$$\begin{aligned} CCDS_{i,t+1} = {} & \beta_0 + \beta_1 \, SOCIAL\_TIE_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 MB_{i,t} + \beta_4 LEV_{i,t} + \beta_5 SGROWTH_{i,t} + \\ & \beta_6 FIN_{i,t} + \beta_7 FOREIGN_{i,t} + \beta_8 LITG_{i,t} + \beta_9 FAGE_{i,t} + \beta_{10} ROA_{i,t} + \beta_{11} CAPIN_{i,t} + \\ & \beta_{12} NEW_{i,t} + \beta_{13} ENV\_STR_{i,t} + \beta_{14} ENV\_CON_{i,t} + \beta_{15} BSIZE_{i,t} + \beta_{16} BIND_{i,t} \\ & + \beta_{17} CEO\_DUAL_{i,t} + \sum INDUSTRYi,t + \sum YEARi,t + \varepsilon_{i,t} \qquad (1) \end{aligned}$$

where *CCDS* is the percentile rank of climate change disclosure, while *SOCIAL_TIE* represents CEO–director social ties. To support Hypothesis 1 (H1), we expect a positive and statistically significant coefficient for *SOCIAL_TIE*.

Following prior studies, we control for several variables in Equation (1). We control for firm size *(SIZE)*, as larger firms divulge more climate change information due to their access to more resources for measuring and reporting climate change information (Ben-Amar et al., 2017). Prior studies find that firms with newer assets and greater capital intensity utilise technology that is greener and more energy efficient, resulting in increased efficiency in energy usage and lower carbon emissions (Haque, 2017). Therefore, we control for asset newness *(NEW)* and capital intensity *(CAPIN)*. Furthermore, companies with high profitability (*ROA*) have the financial resources to be more proactive about environmental issues. Moreover, a firm's high market-to-book ratio (*MB*) is assumed to attract more investment opportunities, resulting in a better environmental performance in the long run. Therefore, we control for profitability, capital intensity, market-to-book ratio and asset newness.

Andrikopoulos and Kriklani (2005) demonstrate that greater financial results in a higher level of climate change disclosure. In contrast, Haque (2017) finds that, as a consequence of constrained financial conditions and debtholder pressure to make short-term investment choices, highly leveraged firms limit their climate change-related activity. We therefore include financial leverage (*LEV*) as a control variable. Litigation-prone companies face higher regulatory and stakeholder monitoring. Therefore, these firms are more inclined to provide a higher level of disclosure to protect their reputation and legitimacy (Bui et al., 2020). Therefore, we control for litigation risk (*LITG*). While Jiao (2011) finds that sales growth improves a firm's disclosure ranking, Carrión-Flores and Innes (2010) report a relationship between sales growth and a firm's environmental policy. Thus, our study includes sales growth (*SGROWTH*) as a control variable. Firms approaching markets for new financing, together with those that operate in foreign countries, tend to increase their voluntary disclosure of environmental information (Clarkson et al., 2008; Dhaliwal et al., 2011). Thus, we control for new financing (*FIN*) and foreign operations (*FOREIGN*). Older firms have more incentives to disclose more green information (Bose et al., 2018); we therefore include firm age (*FAGE*) as a control variable.

Matsumura et al. (2014) find that environmental concerns (*ENV_CON*) and environmental strengths (*ENV_STR*) affect a company's climate change disclosure, motivating out study to control for these two variables in our model. Pucheta-Martínez and Gallego-Álvarez (2019) find that CEO duality increases the number of environmental disclosures. We therefore use CEO duality (*CEO_DUAL*) as a control variable. While Liao et al. (2015) report that independent boards are found to disclose more environmental information, Samaha et al. (2015) find a positive and statistically significant influence of board size on a firm's voluntary disclosures. Therefore, we control for board size (*BSIZE*) and board independence (*BIND*) in our model. Finally, to account for the influences of industry-specific and time period-specific characteristics, we control for industry and year effects. All variables used in Equation (1) are defined in the Appendix.

We estimate our model using the ordinary least squares (OLS) regression approach. Heteroscedasticity and serial correlation are accounted for in our model by using robust standard errors clustered at the firm level. We control for industry and year fixed effects in all models.

4.5. EMPIRICAL RESULTS

4.5.1 Descriptive statistics

Table 4.2 provides descriptive statistics for the variables used in Equation (1). The mean (median) value of the percentile rank of climate change disclosure score *(CCDS)* is 0.376 (0.319). The average (median) value of CEO–director social ties (*SOCIAL_TIE*) is 0.187 (0.143), suggesting that, on average, 18.7% of independent directors in firms in our sample have at least one connection with the firm's CEO in relation to education, employment or other activities. The average (median) value of firm size *(SIZE)*, measured by the natural logarithm of market capitalisation, of 9.566 (9.646) implies an average total market capitalisation of US$31.61 billion (unreported), indicating that our sample includes relatively large firms. The average (median) value of leverage *(LEV)* is 0.270 (0.245), indicating that firms in our sample have, on average, 27% debt in their capital structure.

Furthermore, firms in our sample are profitable with valuable growth opportunities, as the average values of market-to-book ratio *(MB)*, sales growth (*SGROWTH*) and return on assets (*ROA*) are 3.788%, 5.80% and 7.30%, respectively. Both the mean and median values of external financing (*FIN*) are close to zero (-0.014 and -0.023, respectively), suggesting that firms in our sample mainly rely on internally generated funds to finance new projects. The average firm age *(FAGE)* is 3.495, implying that firms in our sample have, on average, been operating for 37.68 years. The mean value of capital intensity (*CAPIN*) is 0.50% of total sales revenue. For asset newness (*NEW*), the percentage is 48.80% of gross property, plant and equipment, providing further evidence that these firms invest in capital-intensive projects and new assets on an ongoing basis. About 79.40% of our firm-year observations are from firms with foreign operations (*FOREIGN*), while about 30.80% of firm-year observations are from firms operating in litigated industries, that are thus prone to litigation risk (*LITG*).

The average values of firms' performance in environmental strengths (*ENV_STR*) and environmental concerns (*ENV_CON*) are 0.093 and 0.023, respectively. The average value of board size (*BSIZE*), measured as the natural logarithm of total board members, is 2.380, implying that the average number of directors on a board is 10.87 (unreported). About 82.40% of board directors are independent (*BIND*), while 51.50% of firms have CEO duality (*CEO_DUAL*).

Table 4.2. Descriptive statistics

Panel A: Descriptive statistics						
	Observations	**Mean**	**Std. Dev.**	**Median**	**1st Quartile**	**3rd Quartile**
CCDS	1,007	0.376	0.261	0.319	0.154	0.538
SOCIAL_TIE	1,007	0.187	0.180	0.143	0.000	0.286
SIZE	1,007	9.566	1.036	9.646	8.998	10.399
MB	1,007	3.788	7.083	3.002	1.864	4.748
LEV	1,007	0.270	0.204	0.245	0.130	0.370
SGROWTH	1,007	0.058	0.166	0.043	-0.016	0.110
FIN	1,007	-0.014	0.150	-0.023	-0.060	0.013
FOREIGN	1,007	0.794	0.404	1.000	1.000	1.000
LITG	1,007	0.308	0.462	0.000	0.000	1.000
FAGE	1,007	3.495	0.543	3.555	3.091	4.060
ROA	1,007	0.073	0.078	0.072	0.037	0.113
CAPIN	1,007	0.005	0.009	0.002	0.001	0.005
NEW	1,007	0.488	0.139	0.466	0.390	0.584
ENV_STR	1,007	0.093	0.086	0.071	0.000	0.200
ENV_CON	1,007	0.023	0.051	0.000	0.000	0.000
BSIZE	746	2.380	0.185	2.398	2.303	2.485
BIND	746	0.824	0.240	0.786	0.727	0.833
CEO_DUAL	746	0.515	0.500	1.000	0.000	1.000

Panel B: Mean and median tests						
	HIGH_SOCIAL_TIE		***LOW_SOCIAL_TIE***		**Mean test (*p*-value)**	**Median test (*p*-value)**
	Mean	**Median**	**Mean**	**Median**		
CCDS	0.445	0.404	0.311	0.273	0.000	0.000
SIZE	9.805	9.942	9.343	9.436	0.000	0.000
MB	3.531	3.032	4.030	2.980	0.264	0.845
LEV	0.301	0.280	0.240	0.220	0.000	0.000
SGROWTH	0.062	0.043	0.055	0.042	0.544	0.896
FIN	-0.006	-0.017	-0.021	-0.030	0.011	0.034
FOREIGN	0.813	1.000	0.777	1.000	0.156	0.155
LITG	0.314	0.000	0.302	0.000	0.674	0.674
FAGE	3.563	3.829	3.431	3.434	0.001	0.000
ROA	0.072	0.071	0.074	0.072	0.712	0.367
CAPIN	0.003	0.001	0.006	0.003	0.000	0.000
NEW	0.508	0.485	0.469	0.449	0.000	0.000
ENV_STR	0.103	0.133	0.083	0.069	0.000	0.000
ENV_CON	0.034	0.000	0.013	0.000	0.000	0.000
BSIZE	2.410	2.485	2.353	2.303	0.000	0.000
BIND	0.818	0.800	0.829	0.778	0.528	0.008
CEO_DUAL	0.603	1.000	0.433	0.000	0.000	0.000

This table reports descriptive statistics for the variables used in the study. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

Table 4.2, Panel B provides results of the mean and median tests of variables used in Equation (1), based on CEO–director social ties. Firms in our sample are divided into two groups, based on the industry-year adjusted median value of CEO–director social ties as the cut-off point: these groups are (1) firms with higher CEO–director social ties (*HIGH_SOCIAL_TIE*) and (2) those with lower CEO–director social ties (*LOW_SOCIAL_TIE*). The results suggest that firms with higher CEO–director social ties have a higher climate change score *(CCDS)*; are larger *(SIZE)*; have higher leverage *(LEV)*; have higher external financing *(FIN)*; are of long-standing in the market *(FAGE)*; have lower capital intensity *(CAPIN)*; have higher asset newness *(NEW)*; have higher performance in environmental strengths *(ENV_STR)* and concerns *(ENV_CON)*; have a larger board size *(BSIZE)*; have higher board independence *(BIND)*; and have CEO duality *(CEO_DUAL)*. The median tests produce similar results.

4.5.2 Regression results

Hypothesis 1 (H1) predicts that CEO–director social ties are positively associated with climate change disclosure. Table 4.3 reports the regression results, with Model (1) showing the regression results of *CCDS* on *SOCIAL_TIE* without including any control variables, while Models (3) and (4) show the regression results of the full model both without and with corporate governance control variables, respectively. Model (2) only shows the regression results of the control variables. As shown in Table 4.3, the coefficients of *SOCIAL_TIE* are positive and statistically significant at the 1% level in Models (1), (3) and (4), indicating the CEO–director social ties are positively associated with climate change disclosure. Hence, our H1 is supported. This finding can be interpreted to mean that firms with a higher level of CEO–director social ties provide a higher level of climate change disclosure. In terms of the economic significance, based on the coefficient from Model (4), we infer that an increase of one standard deviation in CEO–director social ties increases the percentile ranking of climate change disclosure by 6.10% (0.187×0.325).

Table 4.3. Regression results between climate change disclosure and CEO–director social ties

	Dependent variable=*CCDS*			
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
SOCIAL_TIE	0.378***		0.297***	0.325***
	(9.482)		(7.347)	(6.776)
SIZE		0.060***	0.054***	0.024
		(5.094)	(4.628)	(1.619)
MB		0.001	0.001	-0.000
		(0.679)	(0.716)	(-0.260)
LEV		0.054	0.023	0.075
		(1.102)	(0.482)	(1.412)
SGROWTH		-0.131**	-0.135***	-0.096
		(-2.485)	(-2.614)	(-1.623)
FIN		-0.067	-0.051	-0.098*
		(-1.298)	(-1.004)	(-1.771)
FOREIGN		0.062**	0.060**	0.061*
		(2.313)	(2.303)	(1.958)
LITG		0.050	0.024	0.069*
		(1.299)	(0.655)	(1.655)
FAGE		0.010	0.000	0.026
		(0.560)	(0.007)	(1.332)
ROA		-0.133	-0.105	-0.136
		(-1.287)	(-1.060)	(-1.004)
CAPIN		2.228*	2.482**	5.531**
		(1.913)	(2.195)	(1.999)
NEW		0.048	0.044	0.136
		(0.610)	(0.582)	(1.528)
ENV_STR		0.481***	0.468***	0.351***
		(4.486)	(4.426)	(2.925)
ENV_CON		0.162	0.015	0.151
		(0.862)	(0.081)	(0.762)
BSIZE		—	—	0.091
				(1.544)
BIND		—	—	-0.046
				(-1.230)
CEO_DUAL		—	—	0.012
				(0.657)
Intercept	0.309***	-0.395***	-0.346***	-0.538**
	(4.864)	(-3.006)	(-2.615)	(-2.539)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	1007	1007	1007	746
R^2	0.160	0.203	0.234	0.257
Adjusted-R^2	0.130	0.164	0.196	0.204

This table reports the regression results for the association between CEO–director social ties and climate change disclosure. Model (1) presents the regression output of Equation (1) while Models (2) and (3), respectively, present regression outputs for Equations (2) and (3). Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

Regarding control variables, we find that the coefficients of *FOREIGN, CAPIN* and *ENV_STR* are statistically significant in both Models (3) and (4), suggesting that firms with foreign operations, higher capital intensity and higher performance in environmental strengths provide a higher level of climate change disclosure. Furthermore, we find the coefficients of *SIZE* and *SGROWTH* are positive and statistically significant in Model (3), suggesting that larger firms and firms with higher growth provide a higher level of climate change disclosure. Overall, we find that firms with a higher level of CEO–director social ties provide a higher level of climate change disclosure.

4.5.3 Firm fixed-effect regressions

Omitted time-invariant variable bias resulting from unknown firm characteristics may not be successfully addressed by controlling for several firm-specific variables that could be related to climate change disclosure. To address this issue with the omitted time-invariant variable, we employ firm fixed-effect regressions which eliminate cross-sectional variation and focus only on variation within a firm over time. These regressions also eliminate the influence of omitted time-invariant firm characteristics that might otherwise lead to a spurious correlation between climate change disclosure and CEO–director social ties (Kim et al., 2020).

Table 4.4. Firm fixed-effect regression results of association between CEO–director social ties and climate change disclosure

	Dependent variable=*CCDS*	
	Model (1)	**Model (2)**
SOCIAL_TIE	0.249***	0.261***
	(4.125)	(3.773)
SIZE	0.017	-0.012
	(0.763)	(-0.487)
MB	0.001	0.000
	(0.811)	(0.310)
LEV	0.171*	0.174*
	(1.906)	(1.727)
SGROWTH	-0.049	-0.069
	(-1.064)	(-1.276)
FIN	-0.114	-0.084
	(-1.186)	(-0.754)
FOREIGN	-0.082**	-0.052
	(-2.065)	(-0.963)
FAGE	0.191**	0.270***
	(2.034)	(2.666)
ROA	0.094	0.217
	(0.859)	(1.618)
CAPIN	-2.920*	-0.959
	(-1.654)	(-0.285)
NEW	0.109	0.098
	(0.823)	(0.641)
ENV_STR	0.207*	0.283**
	(1.835)	(2.188)
ENV_CON	-0.042	-0.011
	(-0.222)	(-0.052)
BSIZE	—	0.016
		(0.239)
BIND	—	-0.244**
		(-2.501)
CEO_DUAL	—	-0.016
		(-0.704)
Intercept	-0.530	-0.454
	(-1.303)	(-0.971)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	1007	746
R^2	0.729	0.714

This table reports the firm fixed-effect regression results for Equations (1)–(3). Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

We report the firm fixed-effects regression results in Table 4.4. In Models (1) and (2), the coefficients of *SOCIAL_TIE* are positive and statistically significant at the 1% level of significance. While the removal of possible omitted time-invariant variable bias has produced slightly smaller coefficients than those reported in Table 4.3, the results of the firm fixed-effect regressions confirm our main results, as reported in Section 4.2. Hence, firm fixed-effect regressions do not affect the association between CEO–director social ties and climate change disclosure.

4.5.4 Propensity score matching (PSM) analysis

The empirical association between CEO–director social ties and climate change disclosure may be affected by observable heterogeneity bias (Lennox et al., 2012) and functional misspecification bias (Shipman et al., 2017). To address both types of bias, we apply propensity score matching (PSM) analysis. For this purpose, we identify our control sample comprising firms with firm-year observations with comparatively lower levels of climate change disclosure that do not differ significantly in terms of their observable characteristics from firms in our treatment sample, which comprises firms with higher levels of climate change disclosure. We use the industry-year adjusted median value of CEO–director social ties as the cut-off point. We then assign the value of 1 to treatment firms *(HIGH_SOCIAL_TIE)* and 0 to control firms *(LOW_SOCIAL_TIE)* and estimate a logistic model (first-stage model) using this categorical variable as the dependent variable. To control for differences in firm characteristics between firms with *HIGH_SOCIAL_TIE* (treatment group) and those with *LOW_SOCIAL_TIE* (control group), we use the propensity scores derived from the first-stage logistic regression model to identify the optimal match based on caliper matching within a caliper of 1%. This ensures that each *HIGH_SOCIAL_TIE* firm is paired with a *LOW_SOCIAL_TIE* firm in the same industry and year in order to have the smallest difference in propensity scores.

The results are shown in Table 4.5, with Panel A reporting the first-stage logistic regression results. These results suggest that firm size, leverage, foreign operations, performance in environmental strengths, litigation risk, board size and CEO duality positively influence the likelihood that a firm will have strong social ties between its CEO and independent board members. Furthermore, as shown in Table 4.5, Panel B, none of the firm-specific characteristics used in the first-stage regression are statistically significant between the treatment group and control group. Table 4.5, Panel C reports the second-stage regression results using the PSM sample. The coefficient of *HIGH_SOCIAL_TIE* is positive and statistically significant, suggesting that CEO–director social ties are positively associated with climate change disclosure, thus corroborating our main findings.

Table 4.5. Propensity score matching (PSM) analysis

Panel A: First-stage logistic regression results

	Coefficient	***z*-stat**	***p*-value**
SIZE	0.547	3.650	0.000
MB	0.001	0.100	0.919
LEV	2.240	3.670	0.000
SGROWTH	-0.023	-0.030	0.973
FIN	-1.036	-1.400	0.161
FOREIGN	0.745	2.430	0.015
LITG	1.538	3.440	0.001
FAGE	0.309	1.540	0.124
ROA	-0.022	-0.020	0.987
CAPIN	32.010	1.430	0.151
NEW	0.551	0.640	0.520
ENV_STR	2.635	2.090	0.037
ENV_CON	1.333	0.670	0.504
BSIZE	1.441	2.410	0.016
BIND	-0.140	-0.370	0.713
CEO_DUAL	0.502	2.600	0.009
Intercept	-13.644	-5.520	0.000
Year Fixed Effects		Yes	
Industry Fixed Effects		Yes	
Observations		739	
Pseudo R^2		0.209	
Log likelihood		-404.917	

Panel B: Mean test between treatment and control groups

	***HIGH_SOCIAL_TIE* (Treatment)**	***LOW_SOCIAL_TIE* (Control)**	***t*-test (*p*-value)**
SIZE	9.534	9.474	0.483
MB	3.785	4.086	0.685
LEV	0.270	0.284	0.450
SGROWTH	0.060	0.067	0.624
FIN	-0.018	-0.012	0.587
FOREIGN	0.780	0.771	0.813
LITG	0.205	0.224	0.631
FAGE	3.465	3.477	0.830
ROA	0.073	0.076	0.673
CAPIN	0.004	0.004	0.094
NEW	0.496	0.494	0.847
ENV_STR	0.098	0.096	0.852
ENV_CON	0.028	0.025	0.698
BSIZE	2.371	2.368	0.902
BIND	0.837	0.823	0.573
CEO_DUAL	0.512	0.483	0.555

Table 4.5. *Continued*

Panel C: Second-stage regression results of association between CEO–director social ties and climate change disclosure

	Dependent variable=*CCDS*	
	Model (1)	**Model (2)**
HIGH_SOCIAL_TIE	0.073***	0.073***
	(2.940)	(2.964)
SIZE	0.014	0.013
	(0.566)	(0.508)
MB	-0.001	-0.001
	(-0.429)	(-0.300)
LEV	0.025	0.035
	(0.349)	(0.492)
SGROWTH	-0.065	-0.044
	(-0.793)	(-0.552)
FIN	0.000	0.000
	(0.526)	(0.472)
FOREIGN	-0.021	-0.037
	(-0.404)	(-0.691)
LITG	0.017	0.055
	(0.224)	(0.802)
FAGE	0.038	0.016
	(1.472)	(0.627)
ROA	-0.022	-0.023
	(-0.136)	(-0.139)
CAPIN	0.892	2.001
	(0.241)	(0.514)
NEW	0.212	0.166
	(1.540)	(1.196)
ENV_STR	0.181	0.177
	(0.986)	(0.985)
ENV_CON	0.585**	0.505*
	(2.038)	(1.788)
BSIZE	—	0.216**
		(2.457)
BIND	—	-0.045
		(-0.782)
CEO_DUAL	—	0.014
		(0.546)
Intercept	-0.087	-0.533
	(-0.322)	(-1.541)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	410	410
R^2	0.236	0.254

This table presents the results of the propensity score matching (PSM) analysis. Panel A reports the first-stage regression results in which the SOCIAL_TIE categorical variable is regressed on several firm-specific characteristics. Panel B tests the differences in firm characteristics between the treatment group (HIGH SOCIAL_TIE) and control group (LOW SOCIAL_TIE) of firms. Panel C reports the regression models estimated on propensity score-matched samples. Robust two-tailed t-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

4.5.5 Heckman's (1979) two-stage analysis

While propensity score matching (PSM) analysis addresses observable selection bias between treatment and control firms, our sample may be subject to systematic bias if firms that voluntarily respond to the CDP climate change questionnaire differ systematically from those that do not respond. To address potential sample selection bias, we employ Heckman's (1979) two-stage selection model. In the first stage (the selection model), we create a model for a firm's decision to respond to the CDP questionnaire by augmenting our sample with firms that were sent the questionnaire but did not respond during our sample period. More specifically, we develop the following first-stage probit regression model:

$$
\begin{aligned}
Pr(DISC\_CDP=1)_{i,,t} = \beta_0 &+ \beta_1 PROPDISC_{i,t} + \beta_2 CDP\_LAG_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 MB_{i,t} \\
&+ \beta_5 LEV_{i,t} + \beta_6 SGROWTH_{i,t} + \beta_7 FIN_{i,t} + \beta_8 LITG_{i,t} + \beta_9 ROA_{i,t} \\
&+ \beta_{10} CAPEX_{i,t} + \beta_{11} ENV\_STR_{i,t} + \beta_{12} ENV\_CON + \sum Year_{i,t} + \\
&\sum Industry_{i,t} + \varepsilon_{i,t} \qquad (2)
\end{aligned}
$$

where *DISC_CDP* is the dependent variable, measured as an indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire and 0 otherwise. In addition to controlling for several variables following prior studies (Matsumura et al., 2014) in the first-stage model, we include two variables to satisfy the criteria for exclusion restrictions: *PROPDISC* (the percentage of firms in an industry that respond to the CDP questionnaire) and a firm's response to the CDP questionnaire in the previous year (*CDP_LAG)*. The rationale for the selection of *PROPDISC* is that it captures industry pressure: when more firms in a particular industry respond to the CDP questionnaire, firms that do not respond face increasing pressure to do so to alleviate concerns from various stakeholders (Matsumura et al., 2014). Furthermore, firms' response to the CDP questionnaire tends to be sticky. Hence, we select firms that respond to the CDP questionnaire in the previous year (*CDP_LAG)* as an additional variable. We expect a positive coefficient on both the *PROPDISC* and *CDP_LAG* variables. To account for selection bias, we generate the inverse Mills ratio *(IMR*) from the first-stage model and include it in the second-stage models, as specified in Equation (1).

Table 4.6. Heckman's (1979) two-stage analysis

Panel A: Heckman's (1979) first-stage probit regression results

	Dependent variable=*CDP Response*		
	Coefficient	***z*-stat**	***p*-value**
PROPDISC	3.282	10.054	0.000
CDP_LAG	2.276	24.484	0.000
SIZE	0.223	6.511	0.000
MB	0.000	-0.390	0.696
LEV	-0.153	-0.692	0.489
SGROWTH	-0.152	-0.836	0.403
FIN	-0.254	-0.989	0.323
FOREIGN	0.185	2.439	0.015
LITG	0.013	0.056	0.955
FAGE	0.154	2.841	0.004
ROA	0.060	0.151	0.880
CAPIN	-0.101	-0.454	0.650
NEW	-0.349	-1.356	0.175
ENV_STR	1.324	4.808	0.000
ENV_CON	-1.107	-2.997	0.003
Intercept	-5.375	-10.077	0.000
Year Fixed Effects		Yes	
Industry Fixed Effects		Yes	
Observations		3,603	
Pseudo R^2		0.573	
Log likelihood		-905.97	

Table 4.6. *Continued*

Panel B: Heckman's (1979) second-stage regression results		
	Dependent variable=*CCDS*	
	Model (1)	**Model (2)**
SOCIAL_TIE	0.263***	0.313***
	(5.690)	(5.796)
SIZE	0.034**	-0.028*
	(2.428)	(-1.740)
MB	0.001	0.000
	(0.978)	(0.256)
LEV	-0.031	0.061
	(-0.600)	(1.081)
SGROWTH	-0.112*	-0.051
	(-1.831)	(-0.804)
FIN	-0.051	-0.029
	(-0.543)	(-0.280)
FOREIGN	0.070**	0.086**
	(2.224)	(2.263)
LITG	0.021	0.043
	(0.482)	(1.113)
FAGE	-0.029	0.001
	(-1.387)	(0.027)
ROA	0.139	0.255*
	(1.017)	(1.734)
CAPIN	2.298*	2.572
	(1.776)	(1.038)
NEW	0.017	0.156
	(0.183)	(1.538)
ENV_STR	0.494***	0.277**
	(4.080)	(2.118)
ENV_CON	0.237	0.265
	(1.188)	(1.265)
BSIZE	—	0.107*
		(1.699)
BIND	—	-0.062
		(-1.139)
CEO_DUAL	—	0.021
		(1.054)
IMR	-0.046**	-0.046**
	(-2.097)	(-1.998)
Intercept	-0.127	-0.009
	(-0.818)	(-0.038)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	735	555
R^2	0.269	0.308

This table presents the results of Heckman's (1979) two-stage analysis. Panel A reports Heckman's (1979) first-stage regression results. Panel B reports Heckman's (1979) second-stage regression results. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

Table 4.6, Panel A shows the first-stage regression results with positive and statistically significant coefficients for *PROPDISC* and *CDP_LAG*. The model has a pseudo-R^2 value of 57.30% and partial R^2 values of 4.56% and 41.65% for *PROPDISC* and *CDP_LAG*, respectively, which are statistically significant at the 1% level. This indicates that the two exclusion restrictions are appropriate exogenous variables to satisfy the exclusion restrictions criteria. As shown in Table 4.6, Panel B, the coefficient of *SOCIAL_TIE* is positive and statistically significant (coefficient = 0.263, p-value<0.01), thus corroborating the study's main findings. In Models (1) and (2), the coefficients of *IMR* are statistically significant, suggesting that our findings hold after accounting for sample selection bias. Overall, we find that CEO–director social ties are positively associated with climate change disclosure.

4.5.6 Instrumental variable analysis

In our regression models, the possible endogenous relationship between climate change disclosure and CEO–director social ties may be a source of concern. Although we find that CEO–director social ties affect climate change disclosure, it is possible that socially connected CEOs prefer to work with firms that have a higher level of climate change disclosure, with this possibly creating reverse causality. We use instrumental variable (IV)-based two-stage least squares (2SLS) regression analysis to address the reverse causality concerns. Wooldridge (2010) suggests that the IV-based 2SLS method is an appropriate regression technique for addressing reverse causality. This method requires the employment of instrumental variables (IVs), related to a firm's CEO–director social ties, but that do not influence climate change disclosure other than via these social ties.

In most cases, CEO–director social ties are maintained over time (Bruynseels & Cardinaels, 2014; Carcello et al., 2011). Therefore, following prior studies (Bruynseels & Cardinaels, 2014; Khedmati et al., 2020), we use social ties from employment (*TieEmp*) and social ties from other activities (*TieOther*) as instrumental variables as most of our results are based on CEO–director social ties from employment and other activities. Table 4.7 reports the 2SLS regression results. In Model 1, the coefficients for *TIE_EMP* and *TIE_OTHER* are positive and statistically significant (coefficient = 0.832, p-value < 0.01; coefficient = 0.888, p-value < 0.01, respectively). Furthermore, in the first-stage model, Shea's partial R^2 value is 27.30%, while the partial F-statistic is 1098.05. Based on analysis by Stock et al. (2002), the F-statistic's high value suggests that our instrument is not weak. Additionally, in the second-stage model, the Durbin–Wu–Hausman test result is statistically significant, thus suggesting that CEO–director social ties has an endogenous relationship with climate change disclosure. Overall, these test results suggest that our instruments fulfil the conditions of exogeneity and relevance. Importantly, the coefficient for the *SOCIAL_TIE_PREDICTED* variable is positive and statistically significant (coefficient = 0.272, p-value < 0.01) in Model (2), thus corroborating our main findings. Therefore, our 2SLS regression output provides further assurance of the main evidence revealed in our study on the influence of CEO–director social ties on climate change disclosure.

Table 4.7. Two-stage least squares (2SLS) regression results

	First Stage	Second Stage
	DV=*SOCIAL_TIE*	DV=*CCDS*
	Model (1)	Model (2)
SOCIAL_TIE_PREDICTED	—	0.272***
		(6.569)
SIZE	0.004**	0.054***
	(2.065)	(4.784)
MB	0.000	0.001
	(0.063)	(0.732)
LEV	0.017**	0.026
	(1.971)	(0.548)
SGROWTH	0.005	-0.135***
	(0.552)	(-2.674)
FIN	-0.021**	-0.052
	(-2.010)	(-1.056)
FOREIGN	0.004	0.060**
	(1.197)	(2.363)
LITG	0.011*	0.026
	(1.843)	(0.728)
FAGE	0.001	0.001
	(0.186)	(0.055)
ROA	0.008	-0.107
	(0.496)	(-1.109)
CAPIN	0.136	2.461**
	(0.675)	(2.228)
NEW	0.024**	0.044
	(2.063)	(0.600)
ENV_STR	0.019	0.469***
	(0.954)	(4.550)
ENV_CON	-0.107***	0.027
	(-2.898)	(0.151)
TIE_EMP	0.832***	—
	(35.621)	
TIE_OTHER	0.888***	—
	(46.202)	
Intercept	0.028	-0.431***
	(1.171)	(-3.216)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	1007	1007
R^2		0.234
Instrument diagnostics tests:		3.235*
Durbin–Wu–Hausman statistic (Test of endogeneity)		
Kleibergen–Paap rk LM statistic (Under-identification test)		249.856***
Kleibergen–Paap Wald F statistic (Weak identification test)		1260.137
Hansen J statistic (Over-identification test)		3.690
		(*p*-value>0.05)

This table presents the results of two-stage least squares (2SLS) regression results. Model (1) shows the first-stage regression results. Model (2) shows the second-stage regression results. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix. DV=dependent variable.

4.6. ADDITIONAL ANALYSES

4.6.1 Quasi-experimental analysis: Significance of 'Blue' and 'Red' US states

Although stakeholders' demands and expectations drive the disclosure of climate change information, community preferences in the geographical location where firms are located are found in the previous literature to have an influence on firms' social and environmental disclosures. For example, prior studies (e.g., Deng et al., 2013; Di Giuli & Kostovetsky, 2014) find that firms with a higher level of CSR performance are more likely to be headquartered in states governed by the US Democratic Party, thus reflecting Democratic Party voters' increased concerns about social and environmental problems. Therefore, if CEO–director social ties drive climate change disclosure, we expect this relationship to be stronger in firms headquartered in US states governed by the Democratic Party. To test this phenomenon, we separate companies in our sample into two categories depending on where their headquarters are located: Democratic Party states (Blue group) and Republican Party states (Red group). The regression model is then individually estimated for each group.

In Table 4.8, Model (1) was estimated for the Blue group, with the *SOCIAL_TIE* variable generating a positive coefficient which is significant at the 1% level (coefficient = 0.343; *p*-value = 0.00). However, the same variable generates an insignificant coefficient in Model (2) which was estimated for the Red group. These findings demonstrate that Blue state-based firms are more likely than Red state-based firms to benefit from the positive impact of CEO–director social connections on climate change disclosure.

Table 4.8. Regression results of association between CEO–director social ties and climate change performance: US Democratic Party states (Blue) vs. US Republican Party states (Red)

	Dependent variable=*CCDS*	
	BLUE	RED
	Model (1)	**Model (2)**
SOCIAL_TIE	0.343***	0.151
	(6.007)	(1.239)
SIZE	0.008	0.065**
	(0.427)	(2.348)
MB	-0.001	-0.000
	(-0.509)	(-0.152)
LEV	0.090	-0.074
	(1.381)	(-0.472)
SGROWTH	-0.038	-0.141
	(-0.565)	(-1.629)
FIN	-0.143**	0.138
	(-2.284)	(0.691)
FOREIGN	0.058	-0.043
	(1.530)	(-0.826)
LITG	0.138***	-0.042
	(2.827)	(-0.395)
FAGE	0.008	-0.051
	(0.347)	(-0.941)
ROA	0.027	-0.042
	(0.155)	(-0.134)
CAPIN	5.995**	10.907
	(2.137)	(1.116)
NEW	0.004	0.227
	(0.035)	(0.824)
ENV_STR	0.150	-0.073
	(0.963)	(-0.353)
ENV_CON	0.481*	-0.161
	(1.914)	(-0.429)
BSIZE	0.104	0.396***
	(1.433)	(4.672)
BIND	-0.025	-0.153*
	(-0.488)	(-1.865)
CEO_DUAL	0.031	-0.039
	(1.306)	(-1.081)
Intercept	-0.337	-1.252***
	(-1.408)	(-3.090)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	445	168
R^2	0.290	0.513
Test of equality of coefficients	42.49***	

This table presents the regression results of the association between CEO–director social ties and climate change disclosure separately for firms headquartered in US Democratic Party (Blue) states and those headquartered in US Republican Party (Red) states. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

4.6.2 Moderating roles of internal and external monitoring

Our study's Hypothesis 2a (H2a) predicts that the positive relationship between CEO–director social ties and climate change disclosure is weaker for firms with poor corporate governance. We use the Entrenchment Index (E-Index) (*EINDEX*) to proxy for corporate governance to capture the quality of a firm's internal monitoring. We calculate the E-Index values using Bebchuk et al.'s (2013) model which consists of staggered boards, poison pills, golden parachutes, and supermajority requirements for charter amendments, bylaw amendments and mergers, with the E-Index having values between 0 and 6. A higher E-Index value suggests weaker governance, while a lower value suggests stronger governance. The *EINDEX* variable is used to separate firms into two groups, with the yearly median *EINDEX* value as the cut-off point. As a result, *HIGH_EINDEX* is 1 if the firm's *EINDEX* value is greater than or equal to the yearly median *EINDEX* value, and 0 otherwise; *HIGH_EINDEX*=1 indicates poor corporate governance, while *HIGH_EINDEX*=0 shows strong corporate governance. We then estimate Equation (1), adding *HIGH_EINDEX* and the interaction term between CEO–director social ties and E-Index (*SOCIAL_TIE*×*HIGH_EINDEX*) as additional variables. This interaction term captures the difference in the effects of CEO–director social ties on climate change disclosure between firms with weak governance mechanisms (i.e., highly entrenched boards) and those with strong governance mechanisms (i.e., low entrenched boards). As reported in Table 4.9, Model (1), the coefficient for the *SOCIAL_TIE*×*HIGH_EINDEX* variable is negative (-0.264) which is significant at the 5% level.

These findings suggest that weak internal governance weakens the positive effects of CEO–director social ties on climate change disclosure, while strong internal governance strengthens the positive influence of CEO–director social ties on climate change disclosure.

Table 4.9 Roles of internal and external monitoring mechanisms

	Dependent variable=CCDS	
	Model (1)	Model (2)
SOCIAL_TIE	0.130	0.447***
	(1.548)	(7.107)
SOCIAL_TIE×HIGH_ANALYST	0.196**	—
	(2.188)	
ANALYST	0.038	—
	(1.546)	
SOCIAL_TIE×HIGH_EINDEX	—	-0.264***
		(-3.597)
EINDEX	—	-0.059***
		(-2.707)
SIZE	0.042***	0.055***
	(3.452)	(4.814)
MB	0.001	0.001
	(0.622)	(0.587)
LEV	0.010	0.029
	(0.202)	(0.622)
SGROWTH	-0.127**	-0.115**
	(-2.457)	(-2.257)
FIN	-0.039	-0.065
	(-0.759)	(-1.276)
FOREIGN	0.062**	0.064**
	(2.394)	(2.576)
LITG	0.012	0.020
	(0.336)	(0.545)
FAGE	0.009	-0.009
	(0.494)	(-0.492)
ROA	-0.094	-0.143
	(-0.939)	(-1.460)
CAPIN	2.317**	2.562**
	(2.097)	(2.307)
NEW	0.041	0.044
	(0.540)	(0.616)
ENV_STR	0.488***	0.431***
	(4.653)	(4.125)
ENV_CON	-0.024	0.012
	(-0.134)	(0.070)
Intercept	-0.299**	-0.252*
	(-2.244)	(-1.899)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	1007	1007
R^2	0.244	0.278

This table presents the regression results for the roles of internal and external monitoring mechanisms. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

Our study's Hypothesis 2b (H2b) predicts that the positive relationship between CEO–director social ties and climate change disclosure is stronger for firms followed by a greater number of analysts. We use analysts following to proxy for corporate governance to capture the quality of a firm's external monitoring. We measure *HIGH_ANALYST* as an indicator variable that takes the value of 1 if the total number of analysts following a firm is greater than or equal to the yearly median, and 0 otherwise. Our variable of interest is the interaction term *(SOCIAL_TIE×HIGH_ANALYST)* between CEO–director social ties and a high number of analysts following (a firm). This term captures the difference in the effects of CEO–director social ties on climate change disclosure between firms with a low number of analysts following (the firm) and those with a high number of analysts following (the firm); the coefficient for *SOCIAL_TIE* captures the impact of CEO–director social ties on climate change disclosure by firms with a low number of analysts following. The coefficient for the *SOCIAL_TIE×HIGH_ANALYST* interaction term is positive and significant at the 5% level (coefficient = 0.196, p-value < 0.05) (as reported in Table 4.9, Model [1]), indicating that the average increase in the level of climate change disclosure led by CEO–director social ties is greater for firms with a higher number of analysts following. Therefore, the positive effect of CEO–director social ties on climate change disclosure is stronger for firms that are subject to a higher level of external monitoring.

4.6.3 Alternative measures of climate change disclosures

In our main analysis, we use climate change disclosure scores as a measure of climate change disclosures to capture the quality and comprehensiveness of firm-level climate change disclosures. However, our CDP measure could be capturing the effect of an omitted, correlated variable associated with the firm's decision to respond to the CDP questionnaire rather than the firm's environmental awareness. Therefore, we use the following proxies to address these concerns. First, GHG emissions scopes (scopes 1, scope 2 and scope 3) (see Appendix B for scope definition) can be a representation of firms' environmental-related disclosures (Depoers et al., 2016; Jung et al., 2018). Second, firms' engagement with GHG emissions assurance can reflect their level of commitment towards climate change and their efforts to reduce their impact on the climate (Cohen & Simentt, 2015; Zhou et al., 2016). Third, propensity to voluntarily disclose carbon information, the quality and comprehensiveness of these disclosures is greater when CEOs' compensation contracts are better aligned with stakeholder interests, suggesting higher disclosures of climate change information (Luo et al., 2021). Therefore, in this section, we use GHG emissions scopes, CEOs' incentives (compensation contracts) and assurance of GHG emissions as an alternative proxy for climate change disclosure.

Table 4.10, Panel A reports the regression results. Model 1, 2 and 3 reports the regression results of the relationship between CEO–director social ties and the three scopes of GHG emissions. The coefficients in these Models are positive and statistically significant, suggesting that CEO–director social ties increase firm's engagement in climate change disclosure. Model 4 reports the regression results of the relationship between CEO–director social ties and GHG emissions assurance. The coefficient of *SOCIAL_TIE* is positive and statistically significant, suggesting the CEO–director social ties positively influence firm's decision to engage with assurance bodies in relation to their climate change disclosures. Finally, Model 5 reports the regression results of the relationship between CEO–director social ties and climate incentives awarded to the CEO. We find that *SOCIAL_TIE* coefficient is positive and statistically significant (coefficient = 1.655, *p*-value < 0.01), suggesting CEO–director social ties lead to a better climate incentive awarded to the CEO when they engage in climate change disclosures. Overall, our main findings remain robust to the use of this alternative proxy of climate change disclosures.

Table 4.10. Regression results of association between CEO power and alternative proxies for climate change disclosure

Panel A: Regression results between items of climate-change disclosures and CEO's social ties					
	DV= Scope1_dum	**DV= Scope2_dum**	**DV= Scope3_dum**	**DV= GHG_Assurance**	**DV= Climate_incentives**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
SOCIAL_TIE	1.139*	1.134*	1.509**	1.612**	1.655***
	(1.831)	(1.856)	(2.405)	(2.264)	(2.972)
Intercept	-1.648	-2.088	-2.059	-6.066**	-4.614**
	(-0.683)	(-0.872)	(-0.717)	(-2.016)	(-2.181)
Control variables	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	726	726	718	718	739
Pseudo-R^2	0.154	0.148	0.235	0.353	0.210

Panel B: Regression results between climate-change disclosures and CEO's social ties			
	DV=$CCDS_{t+2}$	**DV=$CCDS_{t+3}$**	**DV=$CCDS_{t+4}$**
	Model (1)	**Model (2)**	**Model (3)**
SOCIAL_TIE	0.106**	0.257***	0.216***
	(2.520)	(4.983)	(4.071)
Intercept	-0.397**	-0.785***	-0.369**
	(-2.449)	(-4.627)	(-2.200)
Control variables	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
observations	762	647	586
R^2	0.199	0.282	0.254

This table presents the regression results of the association between CEO-director ties and alternative proxies of climate change disclosures. Moreover, it presents the results of the association between CEO-director ties and climate change disclosure at different years of the social connection. Robust two-tailed t-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance levels at 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix A.

Table 4.10, Panel B reports the regression results of the relationship between CEO–director social ties and climate change disclosure at different ages of the established social connection. Models 1, 2 and 3 reports a positive and statistically significant coefficients of *SOCIAL_TIE*, (coefficient = 0.106, p-value < 0.05), (coefficient = 0.257, p-value < 0.01) and (coefficient = 0.216, p-value < 0.01), respectively. However, we notice that the coefficients in Models 2 and 3 are significantly higher than the coefficient reported in Model 1, suggesting that when CEO–director social ties are older, they have a greater impact on firm's level climate change disclosure.

4.6.4 CEO–director social ties, climate change disclosure and firm value: Mediation effect

As suggested by our study's results to this point, firms with a higher level of CEO–director social ties disclose a higher level of climate change information. Previous studies find that CEO–director social ties are negatively associated with firm value (e.g., Fan et al., 2019; Fracassi & Tate, 2012). The strength of social ties between the CEO and board directors affects a firm's value as greater ties reduce the board's willingness to punish the CEO, destroying the firm's value when the interests of the CEO and shareholders are not aligned (Schmidt, 2015). As a result, these CEOs undertake projects with greater risk that further reduce shareholders' value. This section investigates whether CEO–director social ties and firm value are mediated in any way by the disclosure of climate change information. To carry out our mediation test, we create the following series of equations:

$$TOBINQ_{i,t} = \beta_0 + \beta_1 SOCIAL\_TIE_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.1)$$

$$CCDS_{i,t} = \gamma_0 + \gamma_1 SOCIAL\_TIE_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.2)$$

$$TOBINQ_{i,t} = \omega_0 + \omega_1 SOCIAL\_TIE_{i,t} + \omega_2 CCDS_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.3)$$

where *TOBINQ* is the measure of firm value, calculated as the sum of the book value of total assets plus the market value of equity minus the book value of equity divided by total assets. The Appendix provides definitions of the other variables.

We start by looking at Equation (3) where the coefficient β_1 represents the total impact of *SOCIAL_TIE* on a firm's *TOBINQ*. In Equation (4), γ_1 represents the influence of *SOCIAL_TIE* on *CCDS*; whereas ω_1 in Equation (5) represents the direct effect of *SOCIAL_TIE* on *TOBINQ* after controlling for *CCDS*, the mediator variable. If *SOCIAL_TIE* is significantly related to *TOBINQ* ($\beta_1 \neq 0$) in Equation (3); if *SOCIAL_TIE* is significantly related to *CCDS* ($\gamma_1 \neq 0$) in Equation (4); and if *CCDS* is significantly related to *TOBINQ* ($\omega_2 \neq 0$) after controlling for *SOCIAL_TIE*, then we consider *CCDS* to be a mediator, following Baron and Kenny (1986) and Wen and Ye (2014).[14] It is crucial to determine if the average causal mediation effect is statistically significant after the links have been established. To determine whether a mediator transmits the effect of the treatment variable to a dependent variable, we employ the bootstrapped Sobel–Goodman test (Preacher & Hayes, 2004). When we concurrently run Equations (3)–(5), this test is helpful for analysing any possible relationships between the variables of interest, *SOCIAL_TIE*, *CCDS* and *TOBINQ*. Figure 4.1 shows the procedure for the mediation test.

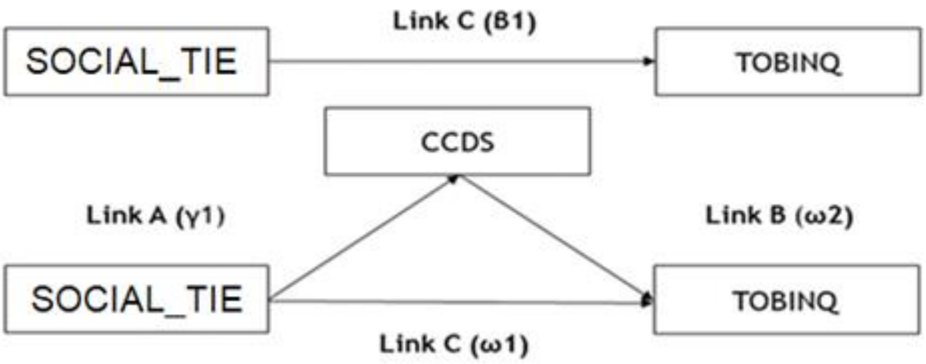

Figure 4.1. Paths between CCDS, CEO-director social ties and firm value.

Source: developed by the author

Table 4.11 presents the regression results. Model (1) provides a positive and statistically significant coefficient for *SOCIAL_TIE* when firm value (*TOBINQ*) is the dependent variable, suggesting that firms with a higher level of CEO–director social ties have higher firm value. Furthermore, Model (2) presents a positive and statistically significant coefficient for *SOCIAL_TIE*, as was also shown in Table 4.3. This finding

[14] When all three of the following conditions are satisfied, a variable is considered to be a mediator. Firstly, CEO–director social ties (the treatment) are strongly correlated with climate change disclosure (the mediator); secondly, CEO–director social ties (the treatment) are strongly correlated with firm value (the dependent variable) in the absence of climate change disclosure (the mediator); and, thirdly, climate change disclosure (the mediator) has a significantly unique effect on firm value (the dependent variable) and, when controlling for the mediation effect, the impact of CEO–director social ties (treatment variable) on firm value (dependent variable) is weakened. The result supports partial mediation if climate change disclosure (the mediator) is still significant after controlling for CEO–director social ties (the treatment).

suggests that firms with CEO–director social ties disclose more climate change information. Additionally, the coefficient for *SOCIAL_TIE* is positive and statistically significant when the dependent variable in Model (3) is firm value (*TOBINQ*), while the coefficient for *CCDS* is significant at the 1% level. These findings support partial mediation. The mediation analysis provides evidence that climate change disclosures (*CCDS*) are the channel through which CEO–director social ties (*SOCIAL_TIE*) affects firm value (*TOBINQ*).

Table 4.11. Mediation regression results of association between CEO–director social ties, climate change disclosure and firm value

	DV=*TOBINQ*	DV=*CCDS*	DV=*TOBINQ*
	Model (1)	**Model (2)**	**Model (3)**
SOCIAL_TIE	1.052***	0.367***	0.755***
	(4.280)	(7.150)	(3.002)
CCDS			0.809***
			(4.362)
SIZE	0.218***	0.062***	0.167***
	(3.800)	(5.200)	(2.899)
LEV	-0.087	-0.001	-0.086
	(-0.290)	(-0.010)	(-0.296)
SGROWTH	0.326	-0.035	0.354
	(1.090)	(-0.550)	(1.201)
FIN	-0.948***	-0.082	-0.882**
	(-2.640)	(-1.090)	(-2.487)
FOREIGN	0.251*	0.074***	0.191
	(1.890)	(2.660)	(1.449)
LITG	-0.275*	0.039	-0.307*
	(-1.680)	(1.150)	(-1.902)
FAGE	-0.379	0.012	-0.389***
	(-4.100)	(0.630)	(-4.267)
ROA	3.393***	-0.059	3.441***
	(5.900)	(-0.490)	(6.068)
CAPIN	27.035***	4.108***	23.711***
	(4.980)	(3.620)	(4.388)
NEW	0.052	-0.077	0.114
	(0.130)	(-0.930)	(0.291)
ENV_STR	0.895	0.333***	0.626
	(1.630)	(2.900)	(1.146)
ENV_CON	-0.315	-0.086	-0.245
	(-0.320)	(-0.420)	(-0.252)
Intercept	2.824***	-0.570***	3.285***
	(3.220)	(-3.110)	(3.773)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	695	695	695
R^2	0.354	0.295	0.372
Mediating effects (Bootstrapped)			
Indirect effect: *CCDS*×*SOCIAL_TIE*		0.297***	
z-statistic for indirect effect: *CCDS*×*SOCIAL_TIE*		(3.460)	
Direct effect		0.755	
Total effect		1.052	
% of total mediated effect		28.20%	

This table presents the regression results for the mediation role of climate change disclosure in the association between CEO–director social ties and firm value. The mediation effect test statistics are reported in the bottom section of the table. Robust two-tailed *t*-statistics are presented in parentheses. Superscript ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in the Appendix.

At the bottom of Table 4.11, we provide mediation-related statistics. These suggest that the direct and total effects of *CCDS* on firm value are estimated to be 0.755 and 1.052, respectively. The result is a mediation effect (i.e., indirect effect) which is equal to 0.297. The reported *z*-statistic suggests that the mediated portion of firm value related to *CCDS* is 28.20% of the total effect, showing that this mediation effect is statistically significant. In Figure 4.2, we visually display the outcomes. In conclusion, the mediation analysis shows that CEO–director social ties have an impact on firm value via the channel of climate change disclosure.

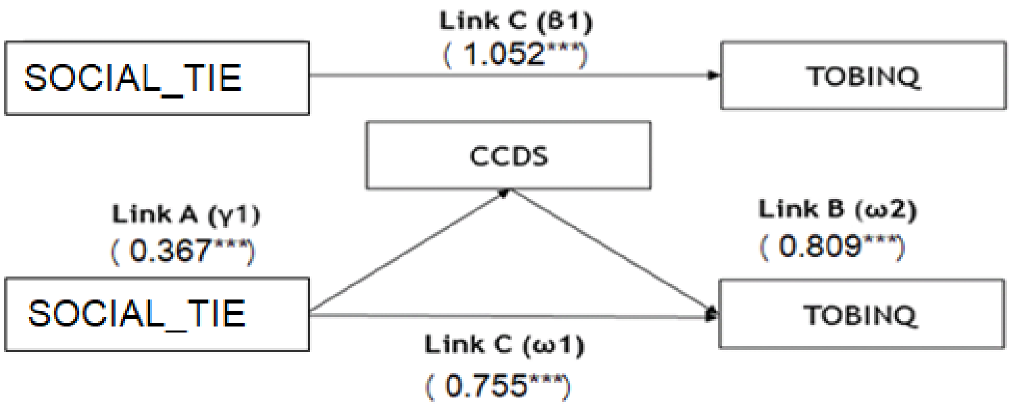

Figure 4.2. Paths between CCDS, CEO-director social ties and firm value.

Source: developed by the author

4.7. CONCLUSION

In this study, we look at the relationship between firm-level climate change disclosure and social ties between the CEO and board directors. We discover that companies with CEO–director social ties provide more information on climate change. Additionally, when a company has poor corporate governance, the positive correlation between CEO–director social ties and climate change disclosure is less; conversely, the positive correlation is greater when a company has a larger number of analysts following (the company). After adjusting for sample selection bias, observable heterogeneity bias, omitted time-invariant variable bias and reverse causality, as well as grouping the selected companies according to their disclosure characteristics, our results remain accurate. We also reveal data suggesting that climate change disclosure acts as a mediating factor between CEO–director social ties and firm value.

Our study makes several contributions to the literature. Firstly, it contributes to the body of literature examining the determinants of climate change disclosure by finding evidence of the influence of the characteristics of boards of directors on climate change disclosure. Previous studies in the literature on characteristics of boards of directors find that strong climate governance, board size, gender-diverse boards, the presence of environmental committees and board effectiveness (Ben-Amar & Mcllkenny, 2015; Bui et al., 2020; Liao et al., 2015) influence climate change disclosure. Nevertheless, no evidence is found of how CEO–director social ties affect climate change disclosure. Secondly, in line with theories which claim that social ties between managers and independent directors increase board performance (Adams & Ferreira, 2007; Westphal, 1999), we find that CEO–director social ties increase firm-level climate change disclosure. The emphasis of earlier research is on how CEO–director social ties affect the organisation's financial elements, for instance, initial public offerings (IPOs), labour investment efficiency and firm value (Chahine & Goergen, 2013; Fan et al., 2019; Khedmati et al., 2020). At the same time, only a few studies have looked at CEO–director social ties in the context of corporate social performance. Thirdly, we demonstrate how CEO–director social ties contribute to wider society and how growing numbers of climate change disclosures satisfy stakeholder demands for corporate environmental responsibility. Fourthly, we investigate whether the positive association between CEO–director social ties and climate change disclosure is impacted by an external monitoring mechanism (analysts following [a firm]) and an internal monitoring mechanism (governance quality). Fifthly, our findings add to the literature on two responsibilities of the board of directors (monitoring and advising) and explore how social ties between board directors and management affect the board's capacity to successfully carry out these responsibilities. Finally, we add to the literature by demonstrating how the association between CEO–director social ties and firm value is moderated by climate change disclosure. Our findings have important ramifications for regulators, legislators, investors, financial analysts, academia and companies, given the current drive for climate change disclosure.

Our study provides insight into a fundamental internal mechanism of the firm, CEO–director interaction (i.e., social ties), which may be essential in assisting companies to share knowledge about the threat of climate change which also poses a threat to human life. The study's results are pertinent, given the weight assigned to corporate climate change measures by the Task Force on Climate-Related Financial Disclosures (TCFD) (2017), with corporations required to show the adaptability of their plans and operations under various future global warming scenarios. As our analysis is in the context of a US-based study, future research across several countries would add to the discussion by providing fresh data on the association between CEO–director social ties and climate change disclosure. Future studies may examine the underlying processes by which CEO–director social ties influence climate change disclosure.

Our research has certain limitations. It should be highlighted that, as this study solely focuses on the US setting, other countries may have quite different associations between CEO–director social ties and climate change disclosure. Future studies might examine the association between CEO–director social ties and climate change disclosure in a global context. Future research could also examine the moderating effect on capital market outcomes, including the cost of equity, given that prior research notes that environmental performance lowers the cost of equity, even though the current study demonstrates the moderating role of CEO–director social ties in the climate change disclosure–financial performance relationship. In addition, research could look at the social ties between CEOs and board directors working together on environmental committees and how these social ties might affect climate change disclosure.

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Appendix A

Variable descriptions

Variable		Definition
CCDS	Climate change disclosure score	Percentile rank of climate change disclosure score/band.
SOCIAL_TIE	CEO–director social ties	The proportion of independent directors who share at least one connection with the CEO based on education, employment or other friendship activities (Khedmati et al., 2020).
HIGH_ANALYST	Analysts following	An indicator variable that takes the value of 1 if a firm's total number of analysts following the firm is greater than the year median of analysts following, and 0 otherwise.
HIGH_EINDEX	Managerial Entrenchment Index	An indicator variable that takes the value of 1 if a firm's E-Index score is greater than the year median score of E-Index, and 0 otherwise. The E-Index is the Entrenchment Index constructed according to Bebchuk et al. (2009).
MB	Market-to-book value	The market value of equity divided by the book value of equity.
LEV	Leverage	The ratio of total debt to total assets.
SGROWTH	Sales growth	The change in sales divided by the prior year's sales.
FIN	New financing	Amount of debt or equity capital raised by a firm in a given year divided by total assets at the beginning of that year. It is calculated as the issuance of common stock and preferred shares minus the purchase of common stock and preferred shares, plus the issuance of long-term debt minus the payment of long-term debt.
FOREIGN	Foreign operations	An indicator variable that takes the value of 1 if a firm reports foreign income, and 0 otherwise.
LITG	Litigation risk	An indicator variable that takes the value of 1 if a firm operates in a high-litigation industry (Standard Industrial Classification [SIC] codes of 2833–2836, 3570–3577, 3600–3674, 5200–5961 and 7370), and 0 otherwise.
FAGE	Firm age	Natural logarithm of the number of years since the firm appeared in the Compustat database.
ROA	Return on assets	The ratio of income before extraordinary items to total assets at the beginning of the year.
CAPIN	Capital intensity	The ratio of capital spending to total sales at the beginning of the year.
NEW	Asset newness	The ratio of net property, plant and equipment to gross property, plant and equipment at the beginning of the year.
ENV_STR	Environmental strengths	The total number of environmental strengths for a firm, as reported by the MSCI ESG database.
ENV_CON	Environmental concerns	The total number of environmental concerns for a firm, as reported by the MSCI ESG database.
BSIZE	Board size	The number of directors on the board (from BoardEx).
BIND	Board independence	Percentage of independent board members, calculated by the number of independent directors divided by the number of directors on the board.
CEO_DUAL	CEO duality	A dummy variable equal to 1 if the CEO is also the chair of the board.

Appendix B

The CDP scope breakdown follows the recommendations of the GHG Protocol.

Emission scope	Definition
Scope 1	Direct GHG emissions from sources that the firm owns or controls, such as combustion in boilers or furnaces that are within its ownership or control.
Scope 2	Indirect GHG emissions from the production of the company's purchased electricity, heat, or steam.
Scope 3	Emissions are a result of the firm's operations, but they come from sources that the company does not own or control, such as employee business travel or contracted out commercial activities.

4.8. Links and implications

The current study provides important insights into the influence of CEO–director social ties on climate change disclosure, and how internal and external monitoring can affect this relationship. The next study aims to build on these findings by exploring the impact of CEO power on climate change disclosure in U.S. firms and investigating the moderating role of monitoring. This research direction is important as it will further our understanding of the drivers of climate change disclosure and provide insights into the effectiveness of monitoring in enhancing or constraining such disclosures. Overall, this research contributes to the literature on corporate social responsibility and sustainability by providing a more comprehensive understanding of the factors that influence climate change disclosure, and how these disclosures can be effectively monitored and improved.

CHAPTER 5 : PAPER 3

Impact of CEO Power on Corporate Climate Change Disclosure: Evidence from the United States

5.1. Chapter overview

This chapter presents the third paper of the current thesis, which investigates the impact of CEO power on firm-level climate change disclosure, and the moderating role of internal and external monitoring on this relationship. It begins with an overview of the chapter's contents in Section 5.1. Section 5.2 introduces the article and its research objectives. Section 5.3 provides a comprehensive review of the literature and develops the research hypotheses. Section 5.4 presents the research methodology adopted to test the hypotheses. Section 5.5 discusses the empirical results, while Section 5.6 presents additional analyses to validate the findings. Finally, Section 5.7 concludes the article by summarising the main contributions, limitations, and future research directions.

Impact of CEO Power on Corporate Climate Change Disclosure: Evidence from the United States

Hussein Daradkeh[15]
School of Business
University of Southern Queensland
Brisbane, Qld 4300, Australia
Telephone: +61 (4) 1184 1317
Email: hussein.daradkeh@usq.edu.au

Syed Shams
School of Business
University of Southern Queensland
Brisbane, Qld 4300, Australia
Telephone: +61 (7) 3470 4551
Email: syed.shams@usq.edu.au

Sudipta Bose
Discipline of Accounting and Finance
Newcastle Business School
University of Newcastle
Sydney, NSW 2000, Australia
Tel: +61 (2) 8262 6406
Email: sudipta.bose@newcastle.edu.au

[15] Corresponding author: Hussein Daradkeh, Discipline of Finance, School of Business, University of Southern Queensland, Springfield, Qld 4300, Australia. Email: hussein.daradkeh@usq.edu.au Tel: +61 (4) 1184 1317

Impact of CEO Power on Corporate Climate Change Disclosure: Evidence from the United States

Abstract

We examine the relationship between CEO power and corporate climate change disclosure, and the moderating role of internal and external monitoring in this relationship. Using a sample of 3,512 United States (US) firm-year observations from 2006–2018, firms with more powerful CEOs are found to disclose less climate change information. This negative statistically significant relationship is weakened when firms have higher institutional ownership, are followed by a larger number of analysts and when firms suffer from low-quality internal monitoring. Our results remain robust through a battery of robustness tests on reverse causality, and observable and unobservable selection bias. Through additional analysis, we find that climate change disclosure mediates the relationship between CEO power and firm value. Our study's findings have significant implications for regulators, policy makers, researchers, investors, analysts and companies' management, given the current regulatory pressure on companies to disclose more information about climate change.

KEYWORDS: CEO power; Climate change disclosures; Governance; Firm value

JEL Classifications: G34, M41

Data availability: All data are publicly available from the sources mentioned in the paper.

5.2. INTRODUCTION

The dangers of climate change caused by greenhouse gas (GHG) emissions are a substantial problem (Intergovernmental Panel on Climate Change [IPCC], 2019). Politicians are being driven by growing environmental concern among the general public and various groups of stakeholders to look for strategies to incentivise businesses to cut emissions. According to the Economist Intelligence Unit (EIU) (2015), over the course of the next 10 years, climate change will cause the global stock market to lose between US$4.2 trillion and US$43 trillion in shareholder value. Moreover, the Swiss Re Group (one of the world's largest providers of insurance to other insurance companies) predicts that the world's economy will lose US$23 trillion by 2050 due to crop losses, the spread of disease and coastal areas being consumed by the rapid increase of sea levels[16], owing to climate change. Furthermore, BlackRock, one of the world's largest asset management firms, has decided to incorporate climate change in all its investments due to risks associated with rapid change in the world's temperature.[17] According to the IPCC (2019), GHG emissions are to blame for the risk of global warming and climate change, and businesses must control their emissions to avoid significant risks, such as increased regulation, higher taxes, higher clean-up and compliance costs, and reputational damage (Eccles et al., 2012). However, corporate strategies may differ significantly, ranging from proactive methods demanding businesses develop certain competencies to reactive ones simply complying with laws and satisfying regulatory criteria (Hart, 1995). Hence, information on a firm's plans, activities and influence on GHG emissions is essential for stakeholders' choices (Liao et al., 2015). In the absence of specific public policy requirements, some businesses choose to voluntarily publish their GHG emissions data. While the importance of corporate governance and Chief Executive Officer (CEO) characteristics in corporate social responsibility (CSR) is well acknowledged (Manner, 2010; Michelon & Parbonetti, 2012), little research has been conducted on how these factors affect climate change disclosure[18] (Terjesen et al., 2009). Hence,

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[16] https://www.nytimes.com/2021/04/22/climate/climate-change-economy.html

[17] https://www.npr.org/2020/01/14/796252481/worlds-largest-asset-manager-puts-climate-at-the-center-of-its-investment-strate

[18] In this study, we refer to carbon disclosure and greenhouse gas (GHG) disclosure as climate change disclosure. Some researchers refer to climate change disclosure as carbon disclosure (e.g., Bui et al., 2020), while some use the term 'greenhouse gas (GHG) disclosure' (e.g., Liao et al., 2015; Tauringana & Chithambo, 2015) and others refer to the transparency of GHG disclosure (e.g., Peters & Romi, 2014).

the current study fills this gap by examining the relationship between CEO power and climate change disclosure.

Corporations are disclosing their efforts to mitigate the effects of climate change and are doing so via a variety of channels, such as sustainability reports, annual reports and/or CDP (previously Carbon Disclosure Project) responses. Gaining an understanding of the firm-level determinants of climate change disclosure is emerging as a topic in the literature due to the rising relevance of the climate change problem and the pressure being applied by numerous stakeholders. Prior studies investigate stronger climate governance (Bui et al., 2020); managerial ability (Daradkeh et al., 2023); larger boards (Liao et al., 2015; Tauringana & Chithambo, 2015); gender-diverse boards (Ben-Amar et al., 2017; Haque, 2017; Liao et al., 2015); environmental committees (Liao et al., 2015; Peters & Romi, 2014); and CEOs' education and tenure (Lewis et al., 2014). Moreover, CEO power is another important aspect of corporate governance with its influence on firm-level climate change disclosure not having been measured: our study also aims to fill this gap in the knowledge.

The previous literature sheds light on the influence of CEO power on corporations' information environment and disclosure. For example, Li et al. (2018) find that CEO power increases CSR disclosure, while Muttakin et al. (2018) and Rashid et al. (2020) find that CEO power decreases CSR information. Additionally, Withisuphakorn and Jiraporn (2015) find that powerful CEOs foster an environment of opaque information, causing a negative impact on stock price informativeness. Furthermore, Garcia-Sanchez et al. (2020) find a negative relationship between powerful CEOs and the disclosure of integrated information. Similarly, Sun et al. (2022) find that firms run by powerful CEOs release difficult-to-read annual reports. Although previous literature provides evidence of CEO power's influence on a firm's information environment and disclosure, no studies to date examine the influence of CEO power on climate change disclosure specifically. Hence, the aim of this study is to understand the influence that CEO power has over climate change disclosure.

Two opposing arguments can predict the direction of the relationship between CEO power and climate change disclosure. On the one hand, CEO power may have various good effects on climate change disclosure. Firstly, according to stakeholder theory, CEOs will participate in disclosure activities to satisfy the needs of their firm's stakeholders, therefore including disclosure practices in the company/firm's business model (Freeman, 2010). Moreover, according to Ben-Amar and McIlkenny (2015), environmental disclosure is seen as a company commitment to work towards social equality, environmental integrity and economic prosperity—all of which are expectations of different stakeholders. Also, in accordance with stakeholder theory, environmental disclosure rewards CEOs with the attention that their initiatives generate and elevates them to model business leader status. Therefore, powerful CEOs seeking to expand their relationships with other stakeholder groups, such as political and environmental organisations, would participate in procedures of greater transparency to appease these groups (Rashid et al., 2020). According to Li et al. (2018), a CEO's power and legitimacy will increase due to exposure. Therefore, we believe that CEO power will lead to increased climate change disclosure.

On the other hand, CEO power may have a detrimental impact on climate change disclosure in several ways. Firstly, CEO's power has an impact on the board's oversight functions and choices regarding non-financial disclosure (Muttakin et al., 2018). This is due to their influence on board's composition and decision-making capacity (Fiegener et al., 2000); selection of their executive teams (Westphal & Zajac, 1995); and non-executive directors' tendency to avoid confrontation with powerful CEOs. Thus, we believe that CEO power may result in fewer climate change disclosures. Secondly, Powerful CEOs constrain boards of directors' capacity to invest in CSR and to disclose relevant information regarding CSR practices. This is justified by Muttakin et al. (2018) findings that a powerful CEO make decisions that disregard stakeholders' interests. Powerful CEOs are often shielded from reinforcing and controlling variables, such as boards of directors, the managerial labour market and/or the corporate control market, by virtue of their position (Fama & Jensen, 1983). Rather than serving the objectives of stakeholders or shareholders, entrenched CEO power structures may be used to further CEO's personal goals (Pucheta-Martínez & Gallego-Álvarez, 2021). If CSR policies are unrelated to the interests of powerful CEOs, then they may not be incentivised to invest in CSR initiatives, such as spending on CSR disclosures (McWilliams et al., 2006), therefore CEO power will lead to a decreased level of climate change disclosure. Finally, powerful CEOs would release less climate change information as additional information would not further increase their power (Jiraporn & Chintrakarn, 2013).

Using a sample of 3,512 firm-year observations from United States (US) firms that responded to the CDP questionnaire from 2005–2019, we examine the effect of CEO power on climate change disclosure. Our main results reveal that CEO power is negatively correlated with climate change disclosure. Moreover, in our additional analyses of the role of external and internal monitoring on the relationship between CEO power and climate change disclosure, we find that an increase in the quality of external monitoring and a decrease in internal monitoring weaken the negative effect of CEO power on climate change disclosure. Furthermore, we examine the role of climate change disclosure as a mediator variable on the relationship between CEO power and firm value. Our evidence suggests that climate change disclosure intensifies the negative influence of CEO power on firm value. To check for endogeneity problems, we employ two-stage least squares (2SLS) analysis with instrumental factors, firm fixed-effect regressions and entropy balancing analysis. The analysis results verify that our findings remain valid.

Our study makes several contributions to the literature. Firstly, it contributes to the body of literature examining the determinants of climate change disclosure by finding evidence that it is influenced by CEO characteristics. Previous literature on CEO characteristics provides evidence that climate change disclosure is influenced by a CEO's educational degree, tenure, managerial ability, age and duality (Daradkeh et al., 2023; Lewis et al., 2014). However, evidence is found in the current study of how CEO power influences climate change disclosure. Secondly, the previous literature focuses on the influence of CEO power on a firm's information environment and CSR disclosure (Li et al., 2018; Muttakin et al., 2018; Withisuphakorn & Jiraporn, 2015) but not on its climate change disclosure. Thirdly, we provide evidence of the potentially destructive effect of powerful CEOs on firms' investment decisions, especially ones that relate to environmental investments. Fourthly, we study the impact of external monitoring (proxied by analysts' following and institutional ownership) and internal monitoring (proxied by governance quality) to see if these factors affect the negative relationship between CEO power and climate change disclosure. Finally, we add to the literature by demonstrating the moderating function of climate change disclosure in the relationship between CEO power and firm value. Given the current push towards climate change disclosure, our results have significant implications for regulators, policy makers, investors, financial analysts, academics and businesses.

The remainder of the paper proceeds as follows. Section 2 presents the review of the relevant literature and the development of the research hypotheses. Section 3 outlines the methodology employed in the study. Section 4 discusses the empirical findings, while Section 5 presents the outcomes of several additional analyses. The last section (Section 6) concludes the paper.

5.3. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

5.3.1. Literature review

The Chief Executive Officer (CEO) is a highly important role in a firm, with major responsibility for managing the firm and making critical decisions, as well as being the firm's public face. Therefore, the relationship between CEO characteristics and different aspects of the firm is extensively researched. For instance, several studies investigate the impact of CEO characteristics on forward-looking information (FLI) disclosures (see e.g., Alqatamin et al., 2017); on disclosures to the CDP (see e.g., Lewis et al., 2014); and on financial disclosures (see e.g., Buchholz et al., 2018). In the current research, we focus on the influence of CEO power on climate change disclosure.

Previous literature provides opposing findings of CEO power's influence on firms' decisions and performance. On the one hand, CEO power can have a positive and favourable effect on firms run by powerful CEOs. According to Keltner et al. (2003), powerful people (such as CEOs) are more likely to take action to get what they want as they are less likely to be constrained by social norms. Furthermore, Klein et al. (2004) conclude that CEOs with more power are better at creating centralised social networks which provide them with the opportunity to access important information, including private information, and to learn better managerial practices. Previous literature examines the influence of CEO power on firms' information disclosure. For example, Li et al. (2018) find that firms engaging in the release of CSR information and run by powerful CEOs are more likely to participate in CSR activities.

On the other hand, CEO power can have a negative consequence on firms managed by powerful CEOs. Arguably, CEO power increases agency problems, as powerful CEOs are more likely to engage in personally beneficial investments at the expense of shareholders (Dunn, 2004).

Previous literature provides evidence of the negative influence of CEO power on corporate social responsibility (CSR). For example, Jiraporn and Chintrakarn (2013) use the CEO pay slice (CPS) as a proxy for CEO power and explore how powerful CEOs view CSR investments. They find that when the CEO is relatively less powerful, an increase in CEO power leads to more CSR engagement. However, as the CEO becomes substantially more powerful, he/she is more entrenched and no longer invests more in corporate social responsibility (CSR). Furthermore, the authors propose a threshold beyond which more powerful CEOs significantly reduce CSR investments. Similarly. Previous literature provides evidence of the negative impact of CEO power on CSR investments and performance (Chu et al., 2022; Harper & Sun, 2019; Li et al., 2016; Sheikh, 2019). Furthermore, powerful CEOs force their firm's management to practise CSR decoupling when faced with stakeholders' demands for long-term environmentally friendly growth rather than short-term financial benefits (Cho et al., 2015).

Among the sparse literature investigating CEO power and firms' information environment, Withisuphakorn and Jiraporn (2015) investigate the influence of CEO power on stock price informativeness. The authors find that CEO power has a negative influence on stock price informativeness, with this justified by the fact that powerful CEOs create an opaque information environment. Garcia-Sanchez et al. (2020) examine the impact of CEO power on the adoption of integrated reporting. They find a negative relationship between powerful CEOs and the disclosure of integrated information. Sun et al. (2022) study the influence of powerful CEOs on the reading difficulty of corporate annual reports, finding that firms run by powerful CEOs release difficult-to-read annual reports. Furthermore, Muttakin et al. (2018) investigate the influence of CEO power on CSR disclosure. Using a power index that includes a CEO's duality, ownership, tenure and family status to measure CEO power, they find CEO power to be negatively correlated with CSR disclosure. Likewise, Rashid et al. (2020), using a sample of Bangladeshi firms, find that CEO power is negatively correlated with CSR disclosure.

5.3.2 Hypotheses development

> "CEO dominance indicates how much decision-making power is concentrated in the hands of the CEO" (Liu & Jiraporn, 2010).

The term 'CEO power' is an indication of the CEO's decision-making authority and its concentration within the CEO's hands. This concentration of power may positively or negatively influence a firm's decision to engage in climate change disclosure. The influence of a CEO's power on a firm's disclosure practices can be examined in the light of stakeholder and agency theories.

On one hand, CEO power can positively affect climate change disclosure in several ways. Stakeholder theory suggests that CEOs will engage in disclosure activities to meet the demands of the firm's stakeholders, therefore incorporating disclosure practices in the firm's business model (Freeman, 2010). Moreover, Ben-Amar and McIlkenny (2015) suggest that environmental disclosure is considered a firm's commitment to pursue environmental integrity and social equity, together with the economic prosperity expected by various stakeholders. Furthermore, in the light of stakeholder theory, environmental disclosure rewards CEOs with the publicity created by these activities and promotes them as good corporate citizens. Hence, powerful CEOs who are seeking to build connections with different stakeholder groups, such as political and environmental groups, to strengthen their power will engage more in disclosure practices to satisfy these groups (Rashid et al., 2020). Li et al. (2018) provide evidence that this type of publicity contributes to CEOs' power and legitimacy. Therefore, we predict that CEO power will increase climate change disclosure.

On the other hand, CEO power can negatively affect climate change disclosure in various ways. Firstly, Ben-Amar and McIlkenny (2015) state that it is the responsibility of the board of directors to monitor the firm and disclose CSR and climate change information. Fiegener et al. (2000) find that CEO power affects a board's composition and decision-making ability. Moreover, powerful CEOs increase their domination and influence over the firm by expanding executive teams with other managers who share their views (Westphal & Zajac, 1995). Therefore, powerful CEOs are supported and protected by these teams, allowing them to ignore the board of directors' directives and shareholders' best interests (Miller, 1991). Additionally, powerful CEOs can easily influence non-executive directors to accept managerial decisions, as a non-executive director generally avoids conflict with a powerful CEO (Li et al., 2016). Therefore, CEO power can be a source of influence inhibiting a board's monitoring role and influencing a board's non-financial disclosure decisions (Muttakin et al., 2018). Hence, we predict that CEO power can decrease the level of climate change disclosure.

Secondly, Muttakin et al. (2018) find that a powerful CEO may make choices that neglect stakeholders' interests which could lead to low levels of social engagement and, therefore, have an impact on how the firm discloses information. As emphasised by Weisbach (1988), CEO power may be utilised to promote the CEO's self-interest, instead of the interests of shareholders or stakeholders. Agency theory (Jensen & Meckling, 1976) explains the potential impact of CEO power resulting from the CEO's control over corporate objectives, such as CSR reporting. Powerful CEOs are often protected by their position from reinforcing and controlling factors, such as boards of directors, the managerial labour market and/or the corporate control market (Fama & Jensen, 1983). Entrenched CEO power structures may be utilised to enhance personal interests rather than those of stakeholders or shareholders (Pucheta-Martínez & Gallego-Álvarez, 2021). Powerful CEOs may not be encouraged to invest in CSR activities, such as CSR disclosure, if these policies are not connected to their own interests (McWilliams et al., 2006). Therefore, CEO power limits the board's ability to invest in CSR and to provide pertinent information about CSR practices. Hence, we predict that CEO power decreases the level of climate change disclosure.

Finally, CEOs, to increase their power, use environmental disclosure to please various stakeholder groups (Jiraporn & Chintrakarn, 2013). However, in accordance with stakeholder theory, at a certain level, a powerful CEO will disclose less climate change information as further disclosure will not contribute more to their power. Similarly, Harper and Sun (2019) suggest that when CEOs gain power, they may not always behave in the best interests of stakeholders and shareholders. The authors observe a substantial and adverse relationship between CEO power and CSR activities, demonstrating that companies with more powerful CEOs participated in less CSR activity. Therefore, based on these arguments, this study predicts that CEO power may have a negative impact on firm-level climate change disclosure. Hence, the study proposes the following hypothesis:

H1: *Firms with a higher level of CEO power are less likely to disclose climate change information.*

5.3.3. Moderating roles of internal and external monitoring

As previously mentioned, it is the responsibility of the board of directors to monitor the firm and to disclose CSR and climate change information (Ben-Amar & McIlkenny, 2015). However, the previous literature and arguments discuss how CEO power may negatively influence the monitoring capabilities of the board of directors and their decision to disclose the firm's social behaviour information (see Muttakin et al., 2018). Therefore, we examine the influence of external monitoring (proxied by analysts' following and institutional ownership) and internal monitoring (proxied by the Entrenchment Index [E-Index] score) on the relationship between CEO power and climate change disclosure.

We predict that external monitoring may have an inhibiting influence on the hypothesised negative relationship between CEO power and climate change disclosure. Firstly, Carleton et al. (1998) provide evidence that a large proportion of institutional ownership persuades management to engage in investments that benefit all stakeholders via private meetings and negotiations between institutional investors and management. Large institutional investors bring more expertise and power that can influence a firm's management (Cubbin & Leech, 1983). Similarly, Bathala (1996) finds that large institutional investors reduce a CEO's influence over the board of directors. Large institutional investors provide the expertise necessary to monitor the firm and reduce a CEO's influence on board decisions, in matters such as the CEO's compensation (Khan, al. 2005).

Secondly, large institutional investors are a body of professional investors who can analyse a firm's information in a way that could increase the firm's performance. They own a large proportion of the firm's shares; therefore, they have the incentive to protect their investment by enhanced monitoring and the power to discipline a CEO due to their voting power and influence over the board of directors (Lin & Fu, 2017). Moreover, large institutional investors develop strategies for a firm that benefit shareholders, reducing agency problems and improving the firm's performance (Saleh et al., 2022).

Thirdly, Boone and White's (2015) study provides evidence that large institutional investors pressure firms' boards and management to increase their public information releases. As large institutional investors manage large and diverse portfolios, it becomes costly for them to demand private information for each firm in which they invest. Thus, the authors suggest that large institutional investors exert pressure seeking the release of more information to reduce their monitoring costs. Large institutional investors create a better information environment, leading to an increased level of voluntary disclosure (Lin et al., 2018).

Fourthly, a firm's value is improved by the number of analysts following by enhancing the monitoring of the firm's activities, resulting in reduced agency problems between CEOs and investors (Jensen & Meckling, 1976). Although monitoring by analysts' following is not considered direct monitoring of a firm's activities, it is the result of private information collection, analysis and production that may expose misappropriation of a firm's resources by management (Lang et al., 2004). Moreover, analysts are a professional body with the necessary skills to collect and analyse data on a firm's operations to produce appropriate forecasts about the targeted firm, therefore leading to increased transparency about the firm's operations (Chava et al., 2010). The increased transparency makes it more difficult for the CEO to hide his/her decisions, especially decisions that could harm shareholders' wealth (Lang et al., 2004).

Finally, analysts, when examining a firm's investment decisions and opinions, may persuade the board of directors to monitor the CEO's decisions (Jung et al., 2012). Monitoring is enhanced by analysts' following which exerts pressure on the board of directors to replace the CEO if the firm has poor performance (Farrell & Whidbee, 2002).Relying on the previous arguments and the favourable influence of external monitoring represented by institutional ownership and analysts' following, we predict that external monitoring will reduce the negative influence of CEO power on climate change disclosure. Hence, we propose the following hypothesis:

H1a: *In the presence of a high level of external monitoring, the negative relationship between CEO power and climate change disclosure is weaker.*

Furthermore, we examine the moderating influence of internal monitoring on the hypothesised negative relationship between CEO power and climate change disclosure. We use the Entrenchment Index (E-Index) score as a proxy for internal monitoring. The E-Index, constructed by Bebchuk et al. (2009), indicates the level of a firm's board entrenchment. The score on the E-Index ranges from 0–6, with 0 representing an un-entrenched board and 6 representing a highly entrenched board. Previous literature provides evidence that entrenched boards may have a negative influence on the firm. For example, Manne (1965) suggests that entrenched boards decrease shareholders' power over the CEO by eliminating their disciplinary option of a forced turnover. Moreover, a high E-Index score is negatively related to information disclosures (Ferreira & Laux, 2007) and, in some cases, can allow a firm's management to refuse to disclose financial information (Armstrong et al., 2012). Elyasiani and Zhang (2015) find that weak internal monitoring provides a firm's management with the opportunity to pursue their own goals, such as engaging in investments that increase management's own wealth or engaging in investment opportunities that increase management's power and entrenchment.

Moreover, lack of monitoring due to highly entrenched boards may provide the opportunity for CEOs to seek their own goals (Elyasiani & Zhang, 2015). A CEO might seek to increase their power and legitimacy using environmental disclosures (Jiraporn & Chintrakarn, 2013; Li et al., 2018). Therefore, in the absence of an effective internal monitoring system, a CEO may choose to increase their own power and legitimacy by disclosing more climate change information. Relying on the previous arguments and the favourable outcomes that might be a result of entrenched boards, we predict that a high E-Index score will reduce the negative influence of CEO power on climate change disclosure. Hence, we propose the following hypothesis:

H1b: *In the presence of a high E-index score, the negative relationship between CEO power and climate change disclosure is weaker.*

5.4. RESEARCH METHODOLOGY

5.4.1. Sample and data

The current study's sample includes all firms covered by the CDP database from CDP2005–CDP2019. Our study's sample period starts from CDP 2007 as CDP started reporting climate change data from 2005, while CDP2019 is the latest period of data collection. We collect climate change ratings data from the CDP database; CEO power and corporate governance data from BoardEx; financial data from Compustat North

America, stock price data from CRSP; and analysts' coverage data from the Institutional Brokers' Estimate Systems (I/B/E/S) database. Our initial sample begins with 5,406 firm-year observations. However, it was reduced when merged with other databases, resulting in a final sample of 3,512 firm-year observations spanning the period from CDP2005–CDP2019. Table 5.1, Panel A summarises the sample selection procedure.

Table 5.1. Sample selection and distribution

Panel A: Sample Selection					
Climate change score data available from CDP (2005–2019)					5,406
Less: Firms dropped due to not merging with Compustat database					(882)
Less: Firms having non-available CEO power data					4,524
Less: Firms dropped due to insufficient control variables					(1012)
Final Test Sample from 2005–2019					**3,512**
Panel B: Industry and Year Distribution of Firms in Sample					
Name of Industry	**Observations**	**% of Sample**	**Year**	**Observations**	**% of Sample**
Mining/Construction	66	1.88	2005	81	2.31
Food	226	6.44	2006	85	2.42
Textiles/Print/Publishing	140	3.99	2007	155	4.41
Chemicals	168	4.78	2008	213	6.06
Pharmaceuticals	167	4.76	2019	216	6.15
Extractive	202	5.75	2010	238	6.78
Manufacturing: Rubber/glass/, etc.	49	1.40	2011	233	6.63
Manufacturing: Metal	54	1.54	2012	231	6.58
Manufacturing: Machinery	105	2.99	2013	240	6.83
Manufacturing: Electrical Equipment	63	1.79	2014	283	8.06
Manufacturing: Transport Equipment	122	3.47	2015	287	8.17
Manufacturing: Instruments	194	5.52	2016	279	7.94
Manufacturing: Miscellaneous	24	0.68	2017	289	8.23
Transportation	521	14.83	2018	355	10.11
Utilities	245	6.98	2019	327	9.31
Retail: Restaurant	323	9.20		**3,512**	**100**
Retail: Wholesale	73	2.08			
Retail: Miscellaneous	208	5.92			
Retail: Restaurant	43	1.22			
Financial	311	8.86			
Insurance/Real Estate	36	1.03			
Services	140	3.99			
Others	32	0.91			
Total Sample	**3,512**	**100**			

Table 5.1, Panel B provides the distribution of firm-year observations by industry and year. We notice that the transportation industry contributes the largest number of observations to our sample (521 observations, 14.83% of the total sample). Meanwhile, the manufacturing: miscellaneous industry had the least number of observations (24 observations, 0.68% of the total sample). Furthermore, we notice that the percentage of observations in each year remains between 6.06% and 10.11% during our sample period, except for 2005, 2006 and 2007.

5.4.2. Measures of climate change disclosure

Our study employs the CDP carbon disclosure score as a proxy for climate change disclosure. Aiming to mitigate the risks stemming from environmental disclosure, CDP creates dialogue and promotes information sharing between firms (Wilhelm, 2013). Furthermore, GlobeScan and SustainAbility (2014) suggest that the CDP carbon disclosure score is the most creditable environmental ranking scheme, when compared to other ranking schemes such as the Dow Jones Sustainability Index and FTSE4Good Index Series. To accomplish this, CDP works in partnership with firms and institutional investors to maintain its environmental disclosure system. This system collects and discloses information about the greenhouse gas (GHG) emissions of thousands of the largest companies in the world, including those listed on prestigious stock exchanges, such as the FTSE 350 and the S&P 500. The information provided by firms via the CDP questionnaire can be divided into three categories: firstly, climate change management; secondly, opportunities and concerns associated with climate change; and, thirdly, emissions methodology, data, energy, emissions performance and emissions trading.

While some questions in the CDP questionnaire are binary, most call for qualitative and narrative responses which are then evaluated using content analysis, in accordance with the established CDP scoring methodology (Bui et al., 2020). This methodology assigns a score from 0–100 for each participating company. However, CDP stopped using this scoring system in CDP2015 and, from CDP2016, started using a ratings band by assigning a band for participating firms ranging from 1–8. As our sample period stretches from 2007–2019, we could not utilise the scores and bands together. Therefore, we developed a climate change disclosure percentile rank similar to that of Barth et al. (2017). Using the following equation:

(firm rank - 1)/(number of firms - 1)

the result received ranges from 0–1, with 0 representing the lowest ranked firms, while 1 represents the highest ranked firms. Furthermore, the probability of responding to the CDP questionnaire was used as a proxy for a firm's climate change disclosure in our robustness check.

5.4.3. Measures of CEO power

The accounting and finance literature do not agree on a specific definition of CEO power. For example, Bebchuk et al. (2011) use the CEO's pay slice (CPS) as a proxy for CEO power, while Finkelstein's (1992) power index includes four dimensions: CEO's equity ownership, and prestige, expert and structural power. Furthermore, Jackling and Johl (2009) created a different index, arguing that CEO power stems from the CEO's family status, tenure, equity ownership and duality. Therefore, inspired by Finkelstein's (1992) argument, that CEO power should be measured as an index as it stems from different sources, we develop a CEO power index that includes the following dimensions: CEO's duality, tenure, education, equity ownership and age.

A CEO who also serves as the chair of the board may have a greater influence over the board (Cannella & Shen, 2001). A CEO serving as a chairperson has the power to decide the agenda items of board meetings, therefore controlling what can be brought to the board directors' attention (Muttakin et al., 2018). Furthermore, CEO duality may lead to the lack of independence in the board room, as the chairperson has a high level of influence on the choice of new board directors (Muttakin et al., 2018). Therefore, we develop a dummy variable for CEO duality that takes the value of 1 if the CEO is also the chairman of the board, and 0 otherwise.

We include a CEO's tenure in our study's index as CEOs who have held their positions for an extended period of time could suffer from agency problems. The previous literature provides evidence that a long tenure leading to entrenchment causes an increase in CEO power (Ryan & Wiggins, 2004). Hence, we create a dummy variable named CEO tenure that takes the value of 1 if the CEO has a longer tenure than that of the industry–year adjusted median, and 0 otherwise.

We consider a CEO's education in our power index. A CEO's education is measured by whether he/she is the holder of a Bachelor, Master and/or PhD degree.

When higher education and experience are combined, a greater likelihood exists of developing stronger skills in management, with Malmendier and Tate (2008) suggesting that a CEO's education is crucial for corporate decisions. In their study, Bowers and Seashore (1966) find that a manager's higher education leads to advanced technical and managerial skills. Hence, we create a dummy variable called CEO title that takes the value of 1 if a CEO's educational qualifications are higher than those held by other CEOs in the industry in a given year, and 0 otherwise.

A CEO's equity ownership may increase his/her power and influence in the board room, while also representing the CEO's voting power in the firm (Daily & Johnson, 1997). Therefore, we create a dummy variable called CEO ownership that takes the value of 1 if the CEO's equity ownership is higher than the industry–year adjusted median, 0 otherwise.

Finally, we incorporate a CEO's age in the power index. Harjoto and Jo (2009) use a CEO's age as a proxy for a CEO's ability to make decisions and influence the board of directors which suggests a higher level of power. As older CEOs tend to have greater expertise, they have greater power. Thus, we create a dummy variable called CEO age: this takes the value of 1 if a CEO's age is higher than the average age of CEOs in the same industry, and 0 otherwise. We then add together all five CEO power factors and create a composite index by converting the natural logarithm of the total score received by each firm.

5.4.4. Empirical models

We employ the following lead–lag regression model to test H1:

$$CCDS_{i,t+1} = \beta_0 + \beta_1 CEO\_POWER_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 MB_{i,t} + \beta_4 LEV_{i,t} + \beta_5 SGROWTH_{i,t} + \beta_6 FIN_{i,t} + \beta_7 FOREIGN_{i,t} + \beta_8 LITG_{i,t} + \beta_9 FAGE_{i,t} + \beta_{10} ROA_{i,t} + \beta_{11} CAPIN_{i,t} + \beta_{12} NEW_{i,t} + \beta_{13} ENV\_STR_{i,t} + \beta_{14} ENV\_CON_{i,} + \beta_{15} BSIZE_{i,t} + \beta_{16} BIND_{i,t} + \sum INDUSTRYi,t + \sum YEARi,t + \varepsilon_{i,t} \quad (1)$$

where *CCDS* is the percentile rank of climate change disclosure, while *CEO_POWER* is the CEO power variable. If H1 is supported, we expect *CEO_POWER* to have a negative and statistically significant coefficient.

5.4.5. Control variables

We incorporate several control variables in Equation (1), following the prior literature. Firm size (*SIZE*) is considered to be a significant determinant of positive environmental disclosure (Giannarakis et al., 2017). As larger firms are under greater pressure from stakeholders, they tend to disclose more environmental information to inform their stakeholders of their social commitments (Eleftheriadis & Anagnostopoulou, 2015). Therefore, we control for firm size by using the natural logarithm of total assets. Furthermore, we follow Ben-Amar and McIlkenny (2015) by controlling for investment opportunities (proxied by the market-to-book ratio [*MB*]) and growth opportunity (*SGROWTH*), due to their positive influence on environmental disclosure. Additionally, financial leverage leads to a higher level of climate change disclosure. Therefore, we follow Debreceny and Rahman (2005) by controlling for financial leverage (*LEV*).

Financial performance has a positive influence on environmental disclosure (Luo & Tang, 2014). To satisfy stakeholders' demands and receive social acceptance for their lucrative investments, profitable firms tend to provide more environmental disclosures (Castelló & Loxano, 2011). Hence, we control for a firm's profitability (*ROA*) by using return on assets (ROA). Firms seeking external financing (*FIN*) and running operations in foreign countries (*FOREIGN*) have the tendency to disclose more environmental information (Dhaliwal et al., 2011). Hence, we control for new financing and foreign operations. Additionally, we control for firm age (*FAGE*) as older firms disclose more environmental information (Bose et al., 2018).

Following Bui et al. (2020), we control for firms operating in a highly litigated industry (*LITG*). Litigation-prone firms are under high pressure from various stakeholder groups, making them more inclined to use environmental disclosure to control the risk to their reputation and legitimacy. Furthermore, we control for high capital intensity firms (*CAPIN*) and firms with newer assets (*NEW*) to address information asymmetry about their activities and utilise information disclosure to educate their shareholders about their performance (Bui et al., 2020).

Board size (*BSIZE*) and board independence (*BIND*) are considered to be critical control variables, with both influencing the effectiveness of board monitoring of a CEO's decisions (Lee & Chen, 2011). A larger board of directors brings together more diversified and important resources that can more successfully address social concerns (Abeysekera, 2010). Furthermore, previous literature shows that board size and independence influence the volume of voluntary disclosures (Samaha et al., 2015). Therefore, we control for board size and board independence. Moreover, we control for environmental concerns (*ENV_CON*) and environmental strength (*ENV_STR*) as they influence a firm's climate change disclosure (Matsumura et al., 2014).

We estimate our model using the ordinary least squares (OLS) regression approach. The heteroscedasticity and serial correlation are accounted for in our model by using robust standard errors clustered at the firm level. We control for industry and year fixed effects in all models.

5.5. EMPIRICAL RESULTS

5.5.1. Descriptive statistics

Table 5.2 reports descriptive statistics for the variables in our model. The climate change disclosure (*CCDS*) variable has mean and median values of 0.585 and 0.659, respectively. On average, the proportion of powerful CEOs (*CEO_POWER*) in our sample is 50% which is higher than what is reported in Jiraporn and Chintrakarn (2013), Li et al. (2016) and Muttakin et al. (2018). The average firm size (*SIZE*), as measured by the natural logarithm of total assets, is 9.801, suggesting that the average firm in our sample is large. Furthermore, the average firm in our sample has great investment opportunities, revealed through the mean and median values of the market-to-book ratio (*MB*) of 4.634 and 2.774, respectively. The mean value of a firm's leverage is 0.271, implying that the capital structure of the average firm in our sample consists of approximately 27% debt. Growth opportunity (*SGROWTH*) and profitability (*ROA*) have positive mean values of 0.061 and 0.064, respectively, suggesting that firms in our sample are profitable and have the opportunity for growth. Moreover, we notice that the mean and median values of external financing (*FIN*) are -0.012 and -0.017, respectively. The negative external financing values suggest that the average firm in our sample generates its funds internally.

Furthermore, we notice that 70.1% of firms in our sample have foreign operations (*FOREIGN*), while 27.3% of firms in our sample operate in a highly litigated industry (*LITG*). The mean value of firm age (*FAGE*) is 3.513, suggesting that firms in our sample, on average, have been operating for longer than 35 years (details unreported in this paper). The mean value of capital intensity (*CAPIN*) is approximately 0.9% of total sales revenue while, for asset newness (*NEW*), it is 50.4% of gross property, plant and equipment. This provides further evidence that these firms invest on an ongoing basis in capital intensive projects and new assets. The mean value of board size (*BSIZE*) is 2.730, suggesting that the average number of directors on the boards of firms in our sample is approximately 11 (details unreported in this paper), while 61.5% of firms in our sample have independent board directors (*BIND*). Moreover, the average values of performance in environmental strengths (*ENV_STR*) and environmental concerns (*ENV_CON*) is 0.157 and 0.065, respectively.

Table 5.2. Descriptive statistics

Panel A: Descriptive statistics						
	Observations	**Mean**	**Std. Dev.**	**Median**	**1st Quartile**	**3rd Quartile**
CCDS	3,512	0.585	0.314	0.659	0.333	0.841
CEO_POWER	3,512	0.500	0.221	0.400	0.400	0.600
SIZE	3,512	9.801	1.184	9.741	9.014	10.549
MB	3,512	4.634	44.859	2.774	1.722	4.514
LEV	3,512	0.271	0.172	0.254	0.155	0.366
SGROWTH	3,512	0.061	0.245	0.049	-0.009	0.113
FIN	3,512	-0.012	0.104	-0.017	-0.054	0.014
FOREIGN	3,512	0.701	0.458	1.000	0.000	1.000
LITG	3,512	0.273	0.445	0.000	0.000	1.000
FAGE	3,512	3.513	0.655	3.689	3.091	4.078
ROA	3,512	0.064	0.069	0.060	0.029	0.098
CAPIN	3,512	0.088	0.138	0.041	0.024	0.086
NEW	3,512	0.504	0.140	0.486	0.401	0.601
ENV_STR	3,512	0.157	0.175	0.133	0.000	0.214
ENV_CON	3,512	0.065	0.136	0.000	0.000	0.111
BSIZE	3,512	2.730	0.180	2.773	2.639	2.833
BIND	3,512	0.615	0.110	0.625	0.563	0.667

This table reports descriptive statistics for the variables in our baseline model. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. Std. Dev. = standard deviation. All variables are defined in Appendix A.

5.5.2. Correlation matrix

Table 5.3 presents the Pearson's correlation matrix for the study's variables. A significant negative correlation is found between CEO power (*CEO_POWER*) and climate change disclosure (*CCDS*). The *CCDS* variable also has negative correlations with leverage, growth, external financing, capital intensity and board independence, while it is positively correlated with firm size, market-to-book ratio, foreign operations, litigation, firm age, profitability, asset newness, environmental strengths, environmental concerns and board size. Many control variables used in regression models demonstrate significant correlations with each other, with Gujarati and Porter (2009) arguing that a correlation coefficient value below 0.80 does not create the problem of multicollinearity. As the correlation coefficients between control variables have values less than 0.80, it appears that our models do not suffer from the problem of multicollinearity. We also use variance inflation factor (VIF) values to assess the problem of multicollinearity. A VIF value of less than 10 shows that no multicollinearity problem exists between the variables (Gujarati & Porter, 2009). In the current study, the average VIF value is 1.21, with the lowest VIF value being 1.06 and the highest VIF value being 1.47, suggesting that the multicollinearity problem is unlikely to be present in our regression models.

Table 5.3 Correlation matrix

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
CCPS	**[1]**	1.000																
CEO_POWER	**[2]**	-0.040**	1.000															
SIZE	**[3]**	0.212***	0.149***	1.000														
MB	**[4]**	0.019	-0.007	0.021	1.000													
LEV	**[5]**	-0.021	-0.004	-0.066***	0.013	1.000												
SGROWTH	**[6]**	-0.022	-0.016	0.050***	0.007	-0.075***	1.000											
FIN	**[7]**	-0.019	-0.035**	-0.092***	-0.000	0.155***	0.077***	1.000										
FOREIGN	**[8]**	0.025	0.025	0.123***	0.009	-0.056***	0.046***	-0.085***	1.000									
LITG	**[9]**	0.023	-0.006	0.110***	0.021	-0.156***	0.041**	-0.076***	0.143***	1.000								
FAGE	**[10]**	0.046***	0.141***	0.176***	-0.037**	0.065***	-0.092***	-0.027	-0.030*	-0.139***	1.000							
ROA	**[11]**	0.026	0.102***	0.259***	0.042**	-0.106***	0.098***	-0.261***	0.244***	0.113***	-0.036**	1.000						
CAPIN	**[12]**	-0.019	0.011	-0.057***	-0.023	0.067***	-0.005	0.138***	-0.243***	-0.169***	0.007	-0.180***	1.000					
NEW	**[13]**	0.033**	0.023	0.102***	-0.026	0.137***	0.080***	0.132***	-0.340***	-0.121***	0.014	-0.093***	0.391***	1.000				
ENV_STR	**[14]**	0.202***	0.101***	0.181***	-0.014	-0.002	-0.028*	-0.028*	0.122***	0.056***	0.229***	0.058***	-0.061***	-0.042**	1.000			
ENV_CON	**[15]**	0.049***	0.129***	0.193***	-0.023	0.010	-0.047***	0.012	-0.031*	-0.189***	0.252***	-0.046***	0.166***	0.217***	0.231***	1.000		
BSIZE	**[16]**	0.168***	0.127***	0.437***	-0.002	0.020	-0.049***	-0.069***	0.011	-0.071***	0.329***	0.042**	-0.097***	0.079***	0.204***	0.192***	1.000	
BIND	**[17]**	-0.021	0.187***	-0.000	0.025	0.089***	-0.045***	0.039**	0.030*	-0.096***	0.203***	-0.044***	-0.016	-0.026	0.059***	0.115***	-0.009	1.000

This table reports the Pearson correlation matrix for the variables in our baseline model. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

5.5.3. Portfolio analysis

We employ portfolio analysis to develop an initial understanding of the relationship between CEO power and climate change disclosure. In this case, portfolio analysis tests the distribution between climate change disclosure and our selection of control variables across groups of firms based on CEO power. We divide our sample of climate change disclosure into three portfolios using CEO power. It should be noted on Table 5.4 that observations with the lowest levels of CEO power belong to the group of firms in Q1, while observations with the highest levels of CEO power belong to the group of firms operating in Q3.

Table 5.4 reports the results of the portfolio analysis. Table 5.4, Panel A reports a large variation in climate change disclosure for firms in the highest CEO power portfolio, compared to firms in the lower CEO power portfolios. We find that *CCDS* in the highest CEO power portfolio is significantly lower than it is for firms in the lowest CEO power portfolio (i.e., the difference equals 0.04). Therefore, these results support our assumption that higher CEO power leads to a decrease in climate change disclosure. Table 5.4, Panel B reports that firms with the highest level of CEO power have significantly larger firm size (*SIZE*); as well as higher firm age (*FAGE*); profitability (*ROA*); environmental strengths (*ENV_STR*) and environmental concerns (*ENV_CON*); board size (*BSIZE*); and board independence (*BIND*). Additionally, firms in the portfolio with the highest level of CEO power experience lower market-to-book ratio (*MB*), leverage (*LEV*), growth (*SGROWTH*), external financing (*FIN*) and litigation (*LITG*). Hence, the results are within our study's expectations.

Table 5.4. Portfolio analysis

Panel A: *CCDS* for portfolios based on *CEO_POWER*				
	Q1 (Lowest)	**Q2**	**Q3 (Highest)**	**Q3-Q1**
CCPS	0.594	0.590	0.554	-0.040***
Panel B: Firm characteristics for portfolios based on *CEO_POWER*				
	Q1 (Lowest)	**Q2**	**Q3 (Highest)**	**Q3-Q1**
SIZE	9.637	9.906	10.060	0.424***
MB	4.598	5.697	3.052	-1.545
LE	0.269	0.276	0.265	-0.004
SGROWTH	0.065	0.060	0.055	-0.010
FIN	-0.011	-0.011	-0.018	-0.008*
FOREIGN	0.692	0.704	0.721	0.029
LITG	0.283	0.257	0.272	-0.010
FAGE	3.431	3.550	3.664	0.233***
ROA	0.057	0.069	0.072	0.014***
CAPIN	0.088	0.082	0.095	0.007
NEW	0.503	0.507	0.505	0.002
ENV_STR	0.142	0.165	0.183	0.041***
ENV_CON	0.051	0.070	0.093	0.042***
BSIZE	2.706	2.749	2.760	0.055***
BIND	0.596	0.630	0.643	0.048***

This table presents the average climate change disclosure (Panel A) and all control variables in our baseline model (Panel B) in various portfolios sorted by CEO power. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

5.5.4. Baseline regression results

Table 5.5 presents the results of the OLS regression that we use to test H1, our first hypothesis, which predicts that CEO power is negatively related to climate change disclosure. Table 5.5, Model (1) reports the regression results of *CCDS* and firm-level control variables only, while Model (2) reports the results of *CCDS* and CEO power including firm-level control variables only. Finally, Model (3) reports the regression results for the full model including both firm-level and corporate governance control variables. In Models (2) and (3), we notice that *CEO_POWER* coefficients are negative and statistically significant at the 1% level, suggesting that CEO power is negatively correlated with climate change disclosure. Therefore, firms with more powerful CEOs will disclose less climate change information. Thus, HI is supported by the results. In terms of economic significance, using the coefficient from Model (3), we infer that an increase of one standard deviation in CEO power decreases the percentile ranking of climate change disclosure by 5.45% (-0.109×0.50).

Table 5.5. Regression results between climate change disclosure and CEO power

	Dependent variable = ***CCDS***		
	Model (1)	**Model (2)**	**Model (3)**
CEO_POWER		-0.105***	-0.109***
		(-3.536)	(-3.703)
SIZE	0.052***	0.055***	0.047***
	(5.281)	(5.510)	(4.389)
MB	0.000	0.000	0.000
	(1.119)	(1.085)	(1.052)
LEV	0.078	0.077	0.071
	(1.187)	(1.182)	(1.086)
SGROWTH	-0.039**	-0.040***	-0.038***
	(-2.546)	(-2.675)	(-2.632)
FIN	-0.018	-0.015	-0.010
	(-0.314)	(-0.266)	(-0.176)
FOREIGN	0.021	0.020	0.017
	(0.909)	(0.884)	(0.772)
LITG	0.181**	0.175***	0.190***
	(2.574)	(2.627)	(2.827)
FAGE	0.002	0.005	-0.004
	(0.109)	(0.272)	(-0.204)
ROA	-0.055	-0.034	-0.011
	(-0.437)	(-0.270)	(-0.090)
CAPIN	-0.032	-0.030	-0.020
	(-0.389)	(-0.363)	(-0.251)
NEW	0.066	0.057	0.056
	(0.815)	(0.707)	(0.695)
ENV_STR	0.347***	0.350***	0.345***
	(6.302)	(6.409)	(6.357)
ENV_CON	-0.041	-0.035	-0.038
	(-0.559)	(-0.481)	(-0.524)
BSIZE			0.119**
			(2.112)
BIND			0.032
			(0.432)
Intercept	-0.377**	-0.347*	-0.601***
	(-2.142)	(-1.935)	(-2.836)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	3512	3512	3512
R^2	0.169	0.174	0.177
Adjusted-R^2	0.157	0.162	0.165

This table reports the baseline ordinary least squares (OLS) regression results for the relationship between CEO power and climate change disclosure. Model (1) reports the coefficients of firm characteristics' control variables. Model (2) reports the coefficients of CEO power and firm characteristics' control variables only. Model (3) reports the coefficients of CEO power and all control variables in our baseline model. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Regarding the control variables, the coefficients of *SIZE*, *LITg* and *ENV_STR* are positive and statistically significant at the 1% level. These findings suggest that firm size, a highly litigated industry and a firm's environmental strengths increase the level of climate change disclosure. Moreover, we find that the coefficient of *SGROWTH* is negative and statistically significant, implying that the opportunity for growth decreases the level of climate change disclosure. Overall, we find that firms with more powerful CEOs disclose less climate change information.

5.5.5. Entropy balancing analysis

The potentially endogenous relationship between CEO power and climate change disclosure can be a concern in our regression models. Our findings may be affected by an observable heterogeneity bias and functional misspecification bias (Lennox et al., 2012; Shipman et al., 2017). To address these types of bias, we use a multivariate matching method called entropy balancing analysis (Hainmueller, 2012). The propensity score matching (PSM) method is more commonly used to solve endogenous concerns; however, new studies have questioned the validity of PSM due to researcher bias (King & Nielsen, 2019). Therefore, our study utilises entropy balancing analysis as it needs less assumptions from the researcher and removes the need for a researcher's adjustment of a propensity model (McMullin & Schonberger, 2020). Entropy balancing analysis and PSM are similar in balancing the distribution of covariates across treatment and control groups; however, each method uses a different approach in assigning weights to the control group (Ali et al., 2022). For example, entropy balancing analysis determines a continuous weight for all firm-year observations from the control group to equalise the distribution moments (such as averages [means], variances and skewness) for all variables in the treatment and control groups (Ali et al., 2022).

We take the following steps to perform entropy balancing analysis on firms in our sample. Firstly, we divide firms in our sample into two groups (i.e., the treatment group and the control group). Our treatment group *(HIGH_CEO_POWER=1)* consists of firm-year observations with CEO power higher than the sample's median, whereas the control group *(HIGH_CEO_POWER=0*) consists of firm-year observations with CEO power lower than the sample's median. Secondly, we equalise the distribution of the moments (means, variances and skewness) for all control variables in both groups. Finally, we re-estimate our baseline regression using the treatment group. Table 5.6, Panel A reports the descriptive statistics of firm characteristics' control variables, while Panel B reports the descriptive statistics of firm characteristics' and corporate governance control variables. Panel C, Model (1) reports the results of the re-estimation of the baseline regression using the balance of the treatment group but only including firm characteristics' control variables. Panel C, Model (2) then reports the results of the re-estimation of the baseline regression using the balance of the treatment group including both firm characteristics and corporate governance control variables. We find that in both models, that the *HIGH_CEO_POWER* variable returns negative and statistically significant coefficients at the 1% level. Thus, the results of the entropy balancing analysis corroborate our main findings.

Table 5.6. Entropy balancing analysis

Panel A: Descriptive statistics for *CCDS* model variables after entropy balancing						
	Treatment (*HIGH_CEO_POWER*)			**Control (*LOW_CEO_POWER*)**		
	Mean	**Variance**	**Skewness**	**Mean**	**Variance**	**Skewness**
SIZE	9.966	1.310	0.133	9.966	1.310	0.133
MB	4.671	3160.000	6.434	4.671	3160.000	6.434
LEV	0.272	0.026	1.822	0.272	0.026	1.822
SGROWTH	0.058	0.023	2.248	0.058	0.023	2.286
FIN	-0.014	0.008	3.172	-0.014	0.008	3.172
FOREIGN	0.710	0.206	-0.927	0.710	0.206	-0.927
LITG	0.263	0.194	1.077	0.263	0.194	1.077
FAGE	3.594	0.384	-1.011	3.594	0.384	-1.011
ROA	0.070	0.004	-0.545	0.070	0.004	-0.545
CAPIN	0.087	0.015	3.446	0.087	0.015	3.446
NEW	0.506	0.019	0.323	0.506	0.019	0.323
ENV_STR	0.172	0.035	1.480	0.172	0.035	1.480
ENV_CON	0.079	0.022	2.157	0.079	0.022	2.157
Panel B: Descriptive statistics for *CCDS* model variables after entropy balancing						
	Treatment (*HIGH_CEO_POWER*)			**Control (*LOW_CEO_POWER*)**		
	Mean	**Variance**	**Skewness**	**Mean**	**Variance**	**Skewness**
SIZE	9.966	1.310	0.133	9.966	1.310	0.133
MB	4.671	3160.000	6.434	4.671	3160.000	6.434
LEV	0.272	0.026	1.822	0.272	0.026	1.822
SGROWTH	0.058	0.023	2.248	0.058	0.023	2.280
FIN	-0.014	0.008	3.172	-0.014	0.008	3.172
FOREIGN	0.710	0.206	-0.927	0.710	0.206	-0.927
LITG	0.263	0.194	1.077	0.263	0.194	1.077
FAGE	3.594	0.384	-1.011	3.594	0.384	-1.011
ROA	0.070	0.004	-0.545	0.070	0.004	-0.545
CAPIN	0.087	0.015	3.446	0.087	0.015	3.446
NEW	0.506	0.019	0.323	0.506	0.019	0.323
ENV_STR	0.172	0.035	1.480	0.172	0.035	1.480
ENV_CON	0.079	0.022	2.157	0.079	0.022	2.157
BSIZE	2.753	0.024	-1.171	2.753	0.024	-1.171
BIND	0.635	0.008	-0.875	0.635	0.008	-0.875

Table 5.6. *Continued*

Panel C: Second-stage regression results of association between CEO power and climate change disclosure

	Dependent variable = *CCDS*	
	Model (1)	**Model (2)**
CEO_POWER	-0.036***	-0.038***
	(-2.745)	(-2.930)
SIZE	0.056***	0.050***
	(5.461)	(4.466)
MB	0.000*	0.000*
	(1.766)	(1.718)
LEV	0.087	0.082
	(1.255)	(1.171)
SGROWTH	-0.049	-0.046
	(-1.235)	(-1.188)
FIN	0.026	0.028
	(0.399)	(0.440)
FOREIGN	0.021	0.019
	(0.900)	(0.814)
LITG	0.211***	0.225***
	(2.785)	(2.936)
FAGE	0.012	0.005
	(0.649)	(0.270)
ROA	-0.029	-0.005
	(-0.193)	(-0.031)
CAPIN	0.080	0.085
	(0.802)	(0.869)
NEW	0.033	0.030
	(0.400)	(0.361)
ENV_STR	0.314***	0.310***
	(5.751)	(5.693)
ENV_CON	-0.009	-0.014
	(-0.114)	(-0.173)
BSIZE		0.105*
		(1.772)
BIND		0.028
		(0.345)
Intercept	-0.421**	-0.653***
	(-2.214)	(-2.936)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	3512	3512
R^2	0.183	0.185

This table presents the results of the entropy balancing analysis. Panels A and B report the moments for the covariates for the treatment group (i.e., CEO power higher than the sample's median) and control groups (i.e., CEO power lower than the sample's median). Panel C reports the regression based on the entropy balancing method. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

5.5.6. Heckman's (1979) two-stage analysis

As the response by firms to the CDP questionnaire is voluntary, the empirical relationship between CEO power (*CEO_POWER*) and climate change disclosure (*CCDS*) could suffer from self-selection bias. This may occur if firms that choose to voluntarily respond to the CDP questionnaire systematically differ from firms that choose not to respond. We employ Heckman's (1979) two-stage approach to address self-selection bias. In the first stage, we develop a probit regression model to determine a firm's decision to voluntarily respond to the CDP questionnaire by adding firm-year observations to our sample from firms that declined to respond to the CDP questionnaire. We use the following first-stage probit regression model in our selection stage:

$$Pr(DISC\_CDP=1)_{i,t} = \beta_0 + \beta_1 PROPDISC_{i,t} + \beta_2 CDP\_LAG_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 MB_{i,t} + \beta_5 LEV_{i,t} + \beta_6 SGROWTH_{i,t} + \beta_7 FIN_{i,t} + \beta_8 FOREIGN_{i,t} + \beta_9 LITG_{i,t} + \beta_{10} FAGE_{i,t} + \beta_{11} ROA_{i,t} + \beta_{12} CAPIN_{i,t} + \beta_{13} NEW_{i,t} + \beta_{14} ENV\_STR_{i,t} + \beta_{15} ENV\_CON_{i,t} + \sum Year_{i,t} + \sum Industry_{i,t} + \varepsilon_{i,} \quad (2)$$

In the first-stage regression, we use a firm's decision to voluntarily respond to the CDP questionnaire as a dummy variable (*DISC_CDP*) that takes the value of 1 if the firm responds to the CDP questionnaire, and 0 otherwise. We follow Matsumura et al. (2014) by adding two variables (i.e., *PRODISC* and *CDP_LAG*) to satisfy the exclusion restrictions criteria, in addition to variables used in the baseline model. We measure *PRODISC* as the proportion of firms that respond to the CDP questionnaire within an industry, while *CDP_LAG* represents whether the firm responded to the CDP questionnaire in the previous year. Matsumura et al. (2014) include these two variables to measure both industry pressure to respond to the CDP questionnaire and the probability that a firm will respond to the CDP questionnaire again, if it responded the previous year. In the second stage, we proceed with an OLS regression of *CEO_POWER* on *CCDS* including all control variables and the inverse Mills ratio (*IMR*) generated from the first-stage probit regression model.

Table 5.7. Heckman's (1979) two-stage analysis

Panel A: Heckman's (1979) first-stage probit regression results

	Dependent variable = *CCDS*		
	Coefficient	***z*-statistic**	***p*-value**
PROPDISC	2.778	8.284	0.000
CDP_LAG	2.342	34.244	0.000
SIZE	0.157	5.583	0.000
MB	0.000	0.925	0.355
LEV	-0.051	-0.314	0.753
SGROWTH	-0.132	-1.568	0.117
FIN	-0.096	-0.389	0.697
FOREIGN	0.163	2.686	0.007
LITG	-0.152	-0.783	0.434
FAGE	0.074	1.795	0.073
ROA	-0.402	-1.128	0.259
CAPIN	-0.164	-0.907	0.364
NEW	-0.469	-2.308	0.021
ENV_STR	1.571	6.827	0.000
ENV_CON	-0.361	-1.300	0.194
Intercept	-4.088	-8.218	0.000
Year Fixed Effects		Yes	
Industry Fixed Effects		Yes	
Observations		5,487	
Pseudo-R^2		0.556	
Log likelihood		-1595.39	

Table 5.7. *Continued*

Panel B: Heckman's (1979) second-stage regression results

	Dependent variable = *CCPS*	
	Model (1)	**Model (2)**
CEO_POWER	-0.103***	-0.109***
	(-3.288)	(-3.481)
SIZE	0.048***	0.042***
	(4.522)	(3.643)
MB	0.000	0.000
	(1.104)	(1.061)
LEV	0.058	0.050
	(0.841)	(0.713)
SGROWTH	-0.030**	-0.028**
	(-2.173)	(-2.074)
FIN	-0.027	-0.022
	(-0.451)	(-0.382)
FOREIGN	0.010	0.008
	(0.428)	(0.337)
LITG	0.171**	0.188***
	(2.561)	(2.747)
FAGE	-0.008	-0.016
	(-0.428)	(-0.849)
ROA	-0.008	0.014
	(-0.066)	(0.113)
CAPIN	-0.028	-0.020
	(-0.294)	(-0.218)
NEW	0.093	0.091
	(1.148)	(1.124)
ENV_STR	0.295***	0.292***
	(5.329)	(5.307)
ENV_CON	-0.042	-0.046
	(-0.538)	(-0.587)
BSIZE		0.117**
		(1.984)
BIND		0.056
		(0.737)
IMR	-0.071***	-0.067***
	(-4.833)	(-4.546)
Intercept	-0.214	-0.489**
	(-1.154)	(-2.235)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	3200	3200
R^2	0.189	0.192

This table presents the results of Heckman's (1979) two-stage analysis. Panel A reports Heckman's (1979) first-stage regression results. Panel B reports Heckman's (1979) second-stage regression results. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Table 5.7, Panel A reports the results of the first-stage probit regression. We find that the coefficients for both *PROPDISC* and *CDP_LAG* are positive and statistically significant. The model's pseudo-*R*-squared (R^2) value is 55.6%. Moreover, the partial

R^2 values of 7.78% and 20.80% for *PROPDISC* and *CDP_LAG*, respectively, which are statistically significant at the 1% level, indicate that the two exclusion restrictions are appropriate exogenous variables to satisfy the exclusion restrictions criteria (details unreported in this paper). Furthermore, Table 5.7, Panel B reports a negative and statistically significant coefficient at the 1% level for *CEO_POWER*, implying that CEO power negatively influences climate change disclosure. In Models (1) and (2), the *IMR* coefficient is negative and statistically significant at the 1% level, suggesting that our results are robust after addressing self-selection bias.

5.5.7. Firm fixed-effect regressions

Unknown firm characteristics that could be related to climate change disclosure, but that are not successfully controlled for in our baseline model, can create an omitted time-invariant variable bias. To mitigate this concern in our regression models, we use firm fixed-effect regressions. Additionally, firm fixed-effect regressions eliminate cross-sectional variation and focus only on variation within a firm over time (Kim et al., 2020).

Table 5.8. Firm fixed-effects regression results between climate change disclosure and CEO power

	Dependent variable = *CCDS*	
	Model (1)	**Model (2)**
CEO_POWER	-0.073**	-0.072**
	(-2.445)	(-2.352)
SIZE	0.035*	0.035*
	(1.707)	(1.684)
MB	0.000	0.000
	(1.161)	(1.165)
LEV	0.205***	0.204***
	(2.947)	(2.928)
SGROWTH	-0.020*	-0.020*
	(-1.799)	(-1.773)
FIN	0.010	0.011
	(0.193)	(0.200)
FOREIGN	-0.004	-0.004
	(-0.169)	(-0.174)
FAGE	0.208***	0.208***
	(2.972)	(2.946)
ROA	0.214**	0.215**
	(2.081)	(2.094)
CAPIN	-0.026	-0.025
	(-0.293)	(-0.285)
NEW	-0.115	-0.118
	(-0.806)	(-0.829)
ENV_STR	0.094*	0.093*
	(1.952)	(1.946)
ENV_CON	-0.078	-0.079
	(-0.967)	(-0.973)
BSIZE		0.015
		(0.240)
BIND		-0.033
		(-0.286)
Intercept	-0.476*	-0.496
	(-1.666)	(-1.590)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	3512	3512
R^2	0.605	0.605

This table reports the firm fixed-effect regression results. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

We re-estimate our baseline model using firm fixed-effect regression, with the results shown in Table 5.8. Models (1) and (2) report a negative and statistically significant coefficient at the 1% level for *CEO_POWER*. We notice that the *CEO_POWER* coefficients are smaller than those reported in Table 5.5 due to the removal of possible omitted time-invariant variable bias. However, the firm fixed-effect regression results confirm our main findings of a negative relationship between CEO power and climate change disclosure.

5.5.8. Instrumental variable analysis

The regression models to test the relationship between CEO power and climate change disclosure may suffer from a potential endogenous concern. Although we predict that CEO power will decrease climate change disclosure, powerful CEOs may be attracted to firms that disclose less climate change information. This prediction is possible as the previous literature provides evidence that CEOs use environmental disclosure to gain power; however, when a CEO reaches a certain level of power, he/she starts to reduce the disclosure of environmental information (Jiraporn & Chintrakarn, 2013). It is suggested that an already powerful CEO could be attracted to a firm that produces less environmental information as he/she would gain no additional benefit from joining firms that disclose more frequent environmental information. This prediction creates a reverse causality issue; thus, following the previous literature, we use the two-stage least squares (2SLS) approach to address this issue (Ali et al., 2022). Furthermore, Wooldridge (2010) suggests that, to address reverse causality, a 2SLS regression based on an instrumental variable (IV) would be a suitable regression approach. A 2SLS approach requires an instrumental variable (IV) highly correlated to CEO power; however, this does not have a direct effect on climate change disclosure. Following the previous literature, we use CEO dismissal (i.e., a forced turnover, an involuntary turnover), *CEO_DISMISSAL*, as an instrumental variable for CEO power (Sheikh, 2019). The previous literature provides evidence that powerful CEOs can protect themselves from a forced turnover (Pi & Lowe, 2011). Additionally, Onali et al. (2016) used unforced turnover as an instrument for CEO power. This instrument is highly correlated with CEO power but not related to climate change disclosure; hence, *CEO_DISMISSAL* is a valid instrumental variable.

Table 5.9 presents the 2SLS results. Model (1) provides a negative and statistically significant coefficient at the 1% level for *CEO_DISMISSAL*. Moreover, in the first-stage regression model, we notice that Shea's R^2 value is 15.9% and the partial F-statistic is 149.255. The high value for the F-statistic suggests that our instrumental value is not weak (Stock et al., 2002). Furthermore, the second-stage model returns a statistically significant Durbin–Wu–Hausman test suggesting that CEO power has an endogenous relationship with climate change disclosure. Therefore, our choice of instruments satisfies the conditions when testing for exogeneity and relevance. Finally, in Model (2), *CEO_POWER_PREDICTED* returns a negative and statistically significant coefficient at the 1% level, suggesting that the 2SLS approach provides further evidence of CEO power's negative influence on climate change disclosure.

Table 5.9. Two-stage least squares (2SLS) regression results

	First Stage	Second Stage
	DV = *CEO_POWER*	**DV = *CCDS***
	Model (1)	**Model (2)**
CEO_POWER_PREDICTED	—	-0.938***
		(-7.35)
SIZE	0.025***	0.67***
	(6.55)	(9.59)
MB	-0.000	0.000
	(-0.51)	(0.81)
LEV	-0.006	0.60
	(-0.26)	(1.42)
SGROWTH	-0.013	-0.045*
	(-1.23)	(-2.84)
FIN	0.007	0.004
	(0.22)	(0.07)
FOREIGN	-0.009	0.010
	(-0.93)	(0.68)
LITG	-0.024	0.159***
	(-0.64)	(3.46)
FAGE	0.0133*	0.007
	(2.16)	(0.75)
ROA	0.193***	0.175
	(3.57)	(1.82)
CAPIN	0.021	0.002
	(0.64)	(0.04)
NEW	-0.066*	-0.010
	(-2.12)	(-0.20)
ENV_STR	0.294	0.358***
	(1.06)	(8.16)
ENV_CON	0.029	-0.133
	(0.82)	(-0.23)
CEO_DISMISSAL	-0.188***	—
	(-12.22)	
Intercept	-0.216**	-0.657***
	(-2.90)	(-4.67)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	3,512	3,512
R^2	0.159	
Instrument diagnostic tests: Durbin–Wu–Hausman stats (Test of endogeneity)	—	38.480***
Kleibergen–Paap Wald F statistic (Weak identification test)	149.255	—

This table presents the results of two-stage least squares (2SLS) regression results. Model (1) shows the first-stage regression results. Model (2) shows the second-stage regression results. Superscripts ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. DV = dependent variable. All variables are defined in Appendix A

5.5.9. Moderating roles of internal and external monitoring

Hypothesis 1a (H1a) predicts that the negative relationship between CEO power and climate change disclosure is weaker for firms with a higher level of external monitoring. We use institutional ownership and analysts' following as proxies for external monitoring. We create a dummy variable for analysts' following (*HIGH_ANALYST*) that takes the value of 1 if the total number of analysts following a firm is equal to or larger than the sample's yearly median, and 0 otherwise. Similarly, we create a dummy variable *HIGH_INSTOWN* to capture institutional ownership, with this variable taking the value of 1 if the number of institutional owners is equal to or larger than the sample's yearly median, and 0 otherwise.

To capture the effects of CEO power on climate change disclosure for firms with a high number of analysts following and a high level of institutional ownership, the study uses the interaction terms *CEO_POWER*×*HIGH_ANALYST* and *CEO_POWER*×*HIGH_INSTOWN*, respectively. Table 5.10, Models (1) and (2) report positive and statistically significant coefficients at the 1% level for *CEO_POWER*×*HIGH_ANALYST*. Furthermore, the results shown in Models (5) and (6) suggest that firms with a larger number of institutional owners and analysts following disclose more climate change information, by reporting positive and statistically significant coefficients at the 5% level for *CEO_POWER*×*HIGH_INSTOWN*, Thus, the negative effect of CEO power on climate change information is weaker for firms exposed to a higher level of external monitoring.

Table 5.10. Role of internal and external monitoring

	Dependent variable = *CCDS*					
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
CEO_POWER	-0.118***	-0.128***	-0.082**	-0.091**	-0.064	-0.072
	(-3.030)	(-3.313)	(-1.987)	(-2.189)	(-1.446)	(-1.630)
CEO_POWER×HIGH_ANALYST	0.148***	0.161***				
	(3.040)	(3.312)				
HIGH_ANALYST	-0.049	-0.059*				
	(-1.616)	(-1.949)				
CEO_POWER×HIGH_INSTOWN			0.106**	0.113**		
			(2.000)	(2.125)		
HIGH_INSTOWN			-0.074**	-0.080**		
			(-2.270)	(-2.484)		
CEO_POWER×HIGH_EIND					0.102*	0.108**
					(1.929)	(2.023)
HIGH_EIND					-0.068**	-0.079***
					(-2.253)	(-2.615)
SIZE	0.051***	0.044***	0.051***	0.043***	0.050***	0.041***
	(5.043)	(4.018)	(5.187)	(4.005)	(5.156)	(3.892)
MB	0.000	0.000	0.000	0.000	0.000	0.000
	(1.158)	(1.124)	(1.106)	(1.072)	(1.150)	(1.106)
LEV	0.072	0.064	0.058	0.051	0.060	0.052
	(1.114)	(1.002)	(0.887)	(0.787)	(0.915)	(0.799)
SGROWTH	-0.038***	-0.036**	-0.039***	-0.036***	-0.039***	-0.036***
	(-2.631)	(-2.582)	(-2.704)	(-2.654)	(-2.642)	(-2.589)
FIN	-0.013	-0.007	-0.015	-0.009	-0.012	-0.004
	(-0.221)	(-0.119)	(-0.260)	(-0.155)	(-0.209)	(-0.072)
FOREIGN	0.022	0.020	0.025	0.022	0.023	0.021
	(0.992)	(0.886)	(1.064)	(0.968)	(1.032)	(0.921)
LITG	0.167**	0.186***	0.162**	0.179***	0.171***	0.190***
	(2.450)	(2.703)	(2.520)	(2.732)	(2.602)	(2.858)
FAGE	0.004	-0.005	0.001	-0.008	0.005	-0.005
	(0.207)	(-0.298)	(0.038)	(-0.459)	(0.292)	(-0.282)
ROA	-0.017	0.006	-0.029	-0.006	-0.032	-0.005
	(-0.141)	(0.048)	(-0.237)	(-0.052)	(-0.260)	(-0.044)
CAPIN	-0.038	-0.027	-0.051	-0.042	-0.034	-0.022
	(-0.466)	(-0.347)	(-0.632)	(-0.547)	(-0.415)	(-0.277)

Table 5.10. *Continued*

	Dependent variable = *CCDS*					
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
NEW	0.058	0.058	0.055	0.055	0.055	0.054
	(0.740)	(0.738)	(0.694)	(0.692)	(0.685)	(0.670)
ENV_CON	-0.043	-0.044	-0.061	-0.063	-0.041	-0.044
	(-0.604)	(-0.621)	(-0.852)	(-0.875)	(-0.565)	(-0.600)
BSIZE		0.133**		0.128**		0.146***
		(2.429)		(2.268)		(2.669)
BIND		0.023		0.033		0.038
		(0.307)		(0.440)		(0.519)
Intercept	0.018	-0.255	0.131	-0.129	0.076	-0.220
	(0.100)	(-1.255)	(0.763)	(-0.652)	(0.428)	(-1.095)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3438	3438	3429	3429	3390	3390
R^2	0.176	0.179	0.171	0.174	0.168	0.172

This table presents the regression results for the role of internal and external monitoring. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance levels at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

Hypothesis 1b (H1b) predicts that the negative relationship between CEO power and climate change disclosure is weaker for firms with weak internal monitoring. We employ Bebchuck et al.'s (2009) Entrenchment Index (E-index) as a proxy for the quality of internal monitoring. The E-Index comprises six different factors; hence, it can have a score from 0–6. A lower E-Index score suggests stronger governance, while a higher score suggests weaker governance. We create a dummy variable *HIGH_EIND* that takes the value of 1 if the firm's E-Index score is higher than or equal to the sample's yearly median score, and 0 otherwise. Therefore, *HIGH_EIND=1* means that the firm experiences poor governance, while *HIGH_EIND=0* means that the firm is experiencing strong governance.

The interaction term *CEO_POWER×HIGH_EIND* captures the effects of CEO power on climate change disclosure for firms with poor governance. Table 5.10, Models (1) and (2) report positive and statistically significant coefficients at 10% and 5% levels (respectively) for *CEO_POWER×HIGH_EIND*, suggesting that firms with poor governance disclose more climate change information. Thus, the negative effect of CEO power on climate change disclosure is weaker for firms with weak internal monitoring.

5.6. ADDITIONAL ANALYSES AND ROBUSTNESS CHECKS

5.6.1. Quasi-experimental analysis: Significance of 'Blue' and 'Red' states

In addition to stakeholder pressure, prior research shows that community preferences in the area where firms' headquarters are located have an impact on firm-level environmental disclosures. Firms with higher CSR performance are more likely to have their headquarters in US states controlled by the Democratic Party, reflecting the increased concerns of Democrat voters about social and environmental issues (Di Giuli & Kostovetsky, 2014). Therefore, if we assume that CEO power has a negative effect on climate change disclosure, we anticipate that the location of a firm's headquarters might augment or mitigate the negative influence of CEO power on climate change disclosure. Specifically, we predict that if a firm's headquarters are located in a state controlled by the Republican party, CEO power would have a stronger negative effect on climate change disclosure. After allocating the firms in our sample to the Republican (Red) and Democrat (Blue) states, according to the location of their headquarters, our regression model is separately calculated for each group.

Table 5.11 reports the results for each group. In Models (1) and (3), we notice that the coefficients for *CEO_POWER* in Blue states are negative and statistically significant at the 5% level. As shown in Models (2) and (4), the coefficients for *CEO_POWER* in Red states are negative and statistically significant at the 1% level. Although all models return a negative and significant coefficient, the coefficients for firms located in the Red states have significantly higher values than for those located in the Blue states. Therefore, firms with headquarters located in a Red state will have a stronger negative relationship between CEO power and climate change disclosure compared to firms with headquarters located in Blue states.

Table 5.11. Regression results of association between CEO power and climate change disclosure: Democratic Party (Blue) states vs. Republican Party (Red) states

	Dependent variable = *CCDS*			
	BLUE	**RED**	**BLUE**	**RED**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
CEO_POWER	-0.086**	-0.151***	-0.088**	-0.164***
	(-2.296)	(-3.153)	(-2.338)	(-3.468)
SIZE	0.043***	0.077***	0.033**	0.077***
	(3.217)	(4.806)	(2.268)	(4.243)
MB	0.000	0.000	0.000	0.000
	(1.052)	(0.690)	(0.987)	(0.609)
LEV	0.012	0.151*	0.005	0.155*
	(0.148)	(1.886)	(0.068)	(1.942)
SGROWTH	-0.031***	-0.100	-0.028**	-0.097
	(-2.623)	(-1.603)	(-2.412)	(-1.567)
FIN	0.063	-0.091	0.069	-0.098
	(1.005)	(-1.031)	(1.084)	(-1.142)
FOREIGN	0.011	0.108***	0.009	0.105***
	(0.346)	(3.194)	(0.270)	(2.975)
LITG	0.241**	-0.336***	0.262**	-0.312***
	(2.324)	(-3.382)	(2.515)	(-3.126)
FAGE	0.024	-0.026	0.013	-0.033
	(1.076)	(-0.794)	(0.591)	(-0.949)
ROA	0.045	-0.211	0.091	-0.195
	(0.253)	(-1.179)	(0.505)	(-1.081)
CAPIN	0.252	0.088	0.221	0.097
	(1.213)	(0.791)	(1.107)	(0.885)
NEW	0.088	0.046	0.096	0.047
	(0.873)	(0.288)	(0.957)	(0.290)
ENV_STR	0.315***	0.356***	0.307***	0.355***
	(5.167)	(3.014)	(5.038)	(3.013)
ENV_CON	-0.066	-0.052	-0.063	-0.063
	(-0.728)	(-0.540)	(-0.693)	(-0.664)
BSIZE			0.167**	0.028
			(2.490)	(0.262)
BIND			0.060	0.148
			(0.614)	(1.047)
Intercept	-0.234	0.285	-0.597***	0.104
	(-1.382)	(1.428)	(-2.841)	(0.324)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	2229	1026	2229	1026
R^2	0.195	0.299	0.200	0.301

This table presents the regression results of the association between CEO power and climate change disclosure separately for firms headquartered in Democratic Party (Blue) states and those headquartered in Republican Party (Red) states. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance levels at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

5.6.2. Alternative measures of climate change disclosure

In our study's main analysis, we use climate change disclosure scores as a measure of climate change disclosure to capture its quality and comprehensiveness at firm level. However, previous literature finds that GHG emissions' scopes (scope 1, scope 2 and scope 3) (see Appendix B for scope definition) can represent firms' environment-related disclosures (Depoers et al., 2016; Jung et al., 2018). A firm's engagement with the assurance of its GHG emissions can reflect its level of commitment towards climate change and its efforts to reduce its climate change impact (Cohen & Simnett, 2015). Finally, the propensity to voluntarily disclose carbon information and the quality and comprehensiveness of the disclosure are greater when CEOs' compensation contracts are better aligned with stakeholder interests, thus suggesting higher levels of disclosure of climate change information (Luo et al., 2021). Therefore, in this section, we describe the use of alternative measures as proxies[19] for climate change disclosure, with these being GHG emissions' scopes, CEO incentives (i.e., compensation contract) and assurance of GHG emissions.

Table 5.12, Models 2, 3 and 4 report the regression results for the relationship between CEO power and the three scopes of GHG emissions. In Models 2 and 3, *CEO_POWER* has negative and statistically significant coefficients (coefficient = -0.548, p-value < 0.01; coefficient = -0.560, p-value < 0.01, respectively). These results suggest that CEO power negatively impacts on a firm's decision to disclose direct (scope 1) and indirect (scope 2) GHG emissions' information related to its economic activities. In Model 4, the coefficient of *CEO_POWER* is negative but not statistically significant, suggesting that a powerful CEO has a negative impact on a firm's decision to disclose its scope 3 GHG emissions, with these generated in the wider community as a result of the firm's activity. However, the negative influence of CEO power on scope 3 is not as significant as it is on scopes 1 and 2. Finally, Table 5.12, Model 5 reports the regression results of the relationship between CEO power and GHG emissions' assurance. The coefficient of *CEO_POWER* is negative and statistically

[19] The use of these alternative measures as proxies addresses the possible concern that our CDP measure could be capturing the effect of an omitted, correlated variable associated with the firm's decision to respond to the CDP questionnaire rather than the firm's environmental awareness. It also provides confidence that our findings and conclusions are not sensitive to our choice of proxy for climate change disclosure.

significant, suggesting that CEO power negatively impacts on a firm's decision to engage with assurance bodies in relation to it climate change disclosures. Overall, our main findings remain robust to the use of this alternative measure as a proxy for climate change disclosure.

Table 5.12. Regression results of association between CEO power and alternative proxies for climate change disclosure

	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
	incentive_given	scope1_total_dum	scope2_total_dum	scope3_total_dum	assurance
CEO_POWER	-0.492*	-0.548**	-0.560**	-0.157	-0.799**
	(-1.860)	(-1.996)	(-2.086)	(-0.580)	(-2.363)
SIZE	0.196***	-0.132*	-0.151**	-0.412***	0.476***
	(2.734)	(-1.892)	(-2.157)	(-4.765)	(5.120)
MB	-0.000	0.000	0.000	-0.002*	0.000
	(-0.590)	(0.389)	(0.233)	(-1.907)	(0.119)
LEV	-0.299	0.680	0.631	0.299	0.236
	(-0.719)	(1.630)	(1.530)	(0.640)	(0.463)
SGROWTH	-0.101	-0.271	-0.277	-0.151	-0.441
	(-0.328)	(-1.481)	(-1.519)	(-0.949)	(-1.350)
FIN	-0.140	-0.427	-0.462	-0.067	-0.067
	(-0.289)	(-1.026)	(-1.119)	(-0.155)	(-0.143)
FOREIGN	-0.127	0.011	0.044	-0.090	-0.235
	(-0.852)	(0.080)	(0.311)	(-0.504)	(-1.274)
LITG	0.196	0.340	0.312	1.601**	-0.741
	(0.417)	(0.476)	(0.446)	(2.260)	(-1.039)
FAGE	0.281***	0.157	0.142	0.175	-0.141
	(2.622)	(1.462)	(1.317)	(1.341)	(-1.033)
ROAY	0.393	0.344	0.422	0.288	-0.042
	(0.440)	(0.426)	(0.515)	(0.275)	(-0.041)
CAPIN	0.536	0.440	-0.087	-0.230	0.139
	(1.015)	(0.856)	(-0.176)	(-0.450)	(0.219)
NEW	-0.581	-0.337	-0.182	0.874	1.008
	(-0.975)	(-0.641)	(-0.344)	(1.379)	(1.423)
ENV_STR	1.085***	2.064***	2.366***	1.527***	2.302***
	(2.711)	(4.475)	(5.097)	(3.479)	(4.697)
ENV_CON	-1.000*	0.026	-0.982*	-1.785***	1.435**
	(-1.668)	(0.047)	(-1.741)	(-2.809)	(1.999)
BSIZE	1.202***	0.691*	0.834**	1.955***	0.705
	(3.118)	(1.846)	(2.273)	(4.422)	(1.468)
BIND	0.047	-0.056	-0.083	-0.343	-0.058
	(0.091)	(-0.108)	(-0.163)	(-0.608)	(-0.090)
Intercept	-5.058***	-0.929	-0.953	-2.851**	-26.462***
	(-3.949)	(-0.688)	(-0.671)	(-2.238)	(-16.197)
Observations	3512	3504	3419	3214	3427

This table presents the regression results of the association between CEO power and alternative proxies of climate change disclosure. Robust two-tailed *t*-statistics clustered by firm are presented in parentheses. Superscripts ***, ** and * indicate statistical significance levels at 1%, 5% and 10% levels, respectively. All variables are defined in Appendix A.

5.6.3. CEO power, climate change disclosure and firm valuation: Mediation effect

The current study provides evidence of the negative relationship between CEO power and climate change disclosure. Previous literature provides evidence that CEO power is correlated with higher firm value (Lee & Chen, 2015). However, a powerful CEO may engage in a value destruction investment if it has personal beneficial returns, thus destroying shareholders' wealth (Jiraporn & Chintrakarn, 2013). Our study therefore examines the influence of firm value as a mediating variable on the relationship between CEO power and climate change disclosure. To carry out our mediation test, we create the following series of equations:

$$TOBINQ_{i,t} = \beta_0 + \beta_1 CEO\_POWER_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.1)$$

$$CCDS_{i,t} = \gamma_0 + \gamma_1 CEO\_POWER_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.2)$$

$$TOBINQ_{i,t} = \omega_0 + \omega_1 CEO\_POWER_{i,t} + \omega_2 CCDS_{i,t} + \sum Controls_{i,t} + \sum YEAR_{i,t} + \sum INDUSTRY_{i,t} + \varepsilon_{i,t} \quad (3.3)$$

We use *TOBINQ* as a proxy for firm value. Following Bose et al. (2018), *TOBINQ* is measured using the following formula:

$$TOBINQ = \sum \frac{market\ value\ of\ equity + book\ value\ of\ total\ debt}{\text{total assets}}$$

Starting with Equation (3.1), the coefficient of β_1 represents the total impact of *CEO_POWER* on a firm's *TOBINQ*. In Equation (3.2), γ_1 represents the influence of *CEO_POWER* on *CCDS*, while ω_1 in Equation (3.3) represents the direct effect of *CEO_POWER* on *TOBINQ*, after controlling for the mediator variable, *CCDS*. We follow Wen and Ye's (2014) assumption by considering *CCDS* as a mediator variable. Wen and Ye (2014) suggest that when all three of the following conditions are satisfied, a variable is considered to be a mediator: firstly, CEO power (the treatment) is strongly correlated with climate change disclosure (the mediator); secondly, CEO power (the treatment) is strongly correlated with firm value (the dependent variable) in the absence of climate change disclosure (the mediator); and thirdly, climate change disclosure (the mediator) has a significantly unique effect on firm value (the dependent variable) and, when controlling for the mediation effect, the impact of CEO power (treatment variable) on firm value (dependent variable) is weakened. The result supports partial mediation if climate change disclosure (the mediator) is still significant after controlling for CEO power (the treatment).

Therefore, if *CEO_POWER* is significantly related to *TOBINQ* ($\beta_1 \neq 0$) in Equation (3.1); if *CEO_POWER* is significantly related to *CCDS* ($\gamma_1 \neq 0$) in Equation (3.2); and if *CCDS* is significantly related to *TOBINQ* ($\omega_2 \neq 0$) after controlling for *CEO_POWER* in Equation (3.3), then we consider *CCDS* to be a mediator. It is crucial to determine if the average causal mediation effect is statistically significant after the links have been established. To determine whether a mediator transmits the effect of the treatment variable to a dependent variable, we employ the bootstrapped Sobel–Goodman test (Preacher & Hayes, 2004). This test is helpful when we concurrently run Equations (3.1)–(3.3) to analyse any possible relationships between the study's variables of interest, *CEO_POWER*, *CCDS* and *TOBINQ*. Figure 5.1 presents the procedure for the mediation test.

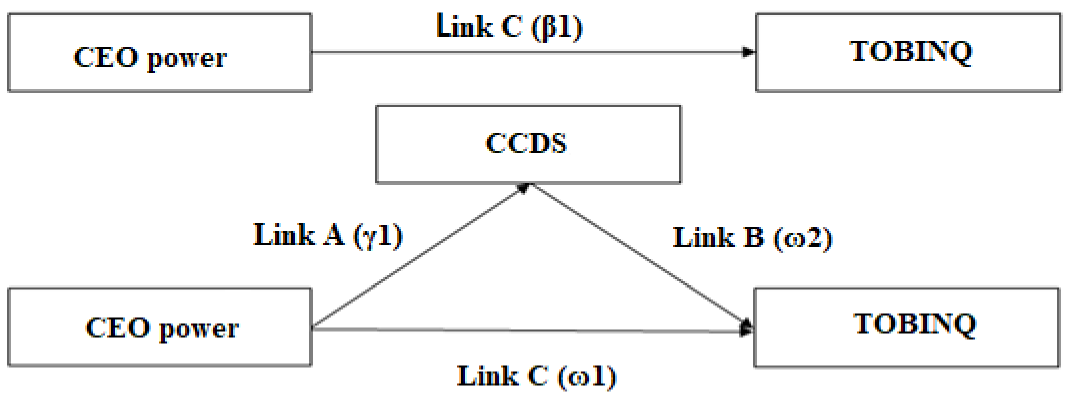

Figure 5.1. Paths between CCDS, CEO power and firm value.

Source: developed by the author

Table 5.13 reports the regression results. Model (1) provides a negative and statistically significant coefficient at the 1% level for *CEO_POWER* when firm value (*TOBINQ*) is the dependent variable, suggesting that firms with higher CEO power have lower firm value. Furthermore, Model (2) presents a negative and statistically significant coefficient at the 1% level for *CEO_POWER*, as in our baseline model findings. This finding suggests that firms with powerful CEOs provide less climate change information. Additionally, in Model (3), the coefficient for *CEO_POWER* is negative and statistically significant at the 1% level when the dependent variable is firm value (*TOBINQ*), while the coefficient for *CCDS* is negative and significant at the 5% level. These findings support partial mediation as *CEO_POWER*'s impact on firm value persists even after controlling for *CCDS*'s impact.

Table 5.13. Mediation regression results of association between CEO power, climate change disclosure and firm value

	DV = *TOBINQ*	DV = *CCDS*	DV = *TOBINQ*
	Model (1)	**Model (2)**	**Model (3)**
CEO_POWER	-0.234***	-0.109***	-0.247***
	(-2.940)	(-4.650)	(-3.096)
CCDS			-0.119**
			(-2.070)
SIZE	0.221***	0.047***	0.226***
	(11.460)	(8.340)	(11.644)
MB	0.001***	0.001	0.001***
	(2.590)	(1.430)	(2.643)
LEV	0.604***	0.071**	0.613***
	(5.320)	(2.120)	(5.396)
SGROWTH	0.115	-0.038*	0.111
	(1.640)	(-1.810)	(1.581)
FIN	-0.590***	-0.010	-0.591***
	(-3.460)	(-0.200)	(-3.469)
FOREIGN	-0.183***	0.017	-0.181***
	(-4.050)	(1.310)	(-4.008)
LITG	0.579***	0.190***	0.602***
	(3.740)	(4.160)	(3.882)
FAGE	-0.154***	-0.004	-0.154***
	(-5.050)	(-0.400)	(-5.071)
ROA	6.159***	-0.011	6.158***
	(22.090)	(-0.140)	(22.099)
CAPIN	-0.368**	-0.020	-0.370**
	(-2.290)	(-0.420)	(-2.301)
NEW	-0.426***	0.056	-0.419***
	(-2.800)	(1.240)	(-2.756)
ENV_STR	-0.550***	0.345***	-0.509***
	(-4.250)	(9.030)	(-3.891)
ENV_CON	-0.494***	-0.038	-0.499***
	(-2.980)	(-0.780)	(-3.012)
BSIZE	-0.456***	0.119***	-0.442***
	(-3.980)	(3.530)	(-3.854)
BIND	-0.449***	0.032	-0.445***
	(-2.800)	(0.680)	(-2.782)
Intercept	2.215***	-0.601***	2.143***
	(5.620)	(-5.160)	(5.423)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	3,512	3,512	3,512
R^2	0.373	0.177	0.373
Mediating effects (Bootstrapped)			
Indirect effect – *CCPS×CEO_POWER*		0.013*	
z-statistic for indirect effect – *CCDS×SOCIAL_TIE*		(1.929)	
Direct effect		-0.247	
Total effect		0.013	
% of the total mediated effect		-5.57%	

This table presents the regression results of the mediation role of climate change performance in the association between CEO power and firm valuation. The mediation effect test statistics are reported in the bottom section of the table. Robust two-tailed *t*-statistics are presented in parentheses. Superscripts ***, ** and * indicate statistical significance levels at 1%, 5% and 10% levels, respectively. DV = dependent variable. All variables are defined in Appendix A.

Table 5.13 provides mediation-related statistics which suggest that the direct and total effects of *CCDS* on firm value are estimated to be 1.3%. This results in a mediation effect (i.e., indirect effect) equal to 1.3%. The reported *z*-statistic suggests that the mediated portion of firm value related to *CCDS* is -5.57% of the total effect, showing that this mediation effect is statistically significant. In Figure 5.2, the outcomes as also presented visually. In summary, the mediation analysis shows that CEO power has an impact on firm value via the channel of climate change disclosure.

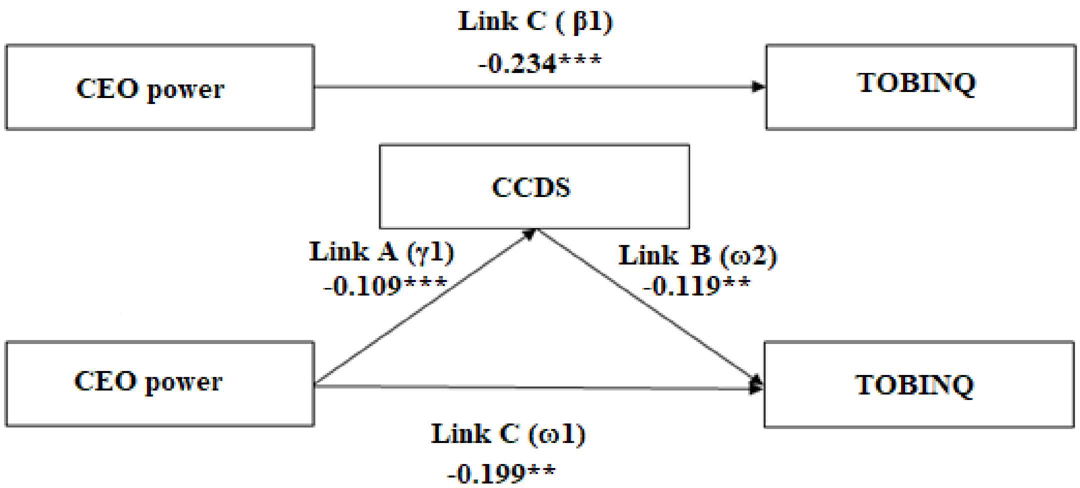

Figure 5.2. Paths between CCDS, CEO power and firm value.

Source: developed by the author

5.7. CONCLUSION

This study investigates the influence of CEO power on climate change disclosure in all US firms that responded to the CDP questionnaire from 2006–2018. We find that CEO power is negatively correlated with climate change disclosure, suggesting that CEO power reduces the extent of firm-level climate change disclosure. Furthermore, we find evidence of the impact of internal monitoring (proxied by the E-Index score) and external monitoring (proxied by institutional ownership and analysts' following) on the relationship between CEO power and climate change disclosure. Our findings suggest that a high level of institutional ownership, a high number of analysts following and low-quality internal governance inhibit the relationship between CEO power and climate change disclosure, by reducing CEO power's negative effect. Additionally, we investigate the influence of climate change disclosure as a moderating variable in the relationship between CEO power and firm value, finding that this relationship is moderated by climate change disclosure.

However, our current study suffers from a few limitations. Firstly, firms in our sample are from the US only. Compiling an international sample could provide more insightful evidence. Secondly, future research could examine the cost of equity as a moderating variable in the relationship between CEO power and climate change disclosure as previous research suggests that environmental performance lowers the cost of equity (Gupta, 2018).

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Appendix A: Descriptions of variables

Variable	Variable in full	Definition
CCDS	Climate change disclosure score	Percentile rank of climate change disclosure score/band.
CEO_POWER	CEO power	The CEO power index is computed based on the CEO's duality, CEO's tenure, CEO's title (i.e., education qualification), CEO's age and CEO's equity shareholdings. The CEO's duality is measured as a dummy variable that takes the value of 1 if the CEO serves as the chairman of the board, and 0 otherwise. The CEO's tenure, title, age and equity shareholdings are dummy variables that take the value of 1 if the firm's observation is higher than the sample's median, and 0 otherwise. We then add together all five variables and create a composite index of CEO power by converting the natural logarithm of the total score received by each firm.
HIGH_ANALYST	Analysts' coverage	An indicator variable that takes the value of 1 if a firm's total number of analysts following is greater than the year's median of analysts' coverage, and 0 otherwise.
HIGH_EINDEX	Managerial Entrenchment Index (E-Index) score	An indicator variable that takes the value of 1 if a firm's E-Index score is greater than the year's median E-Index score, and 0 otherwise. The E-Index is the Entrenchment Index constructed by Bebchuk et al. (2009).
HIGH_INSTOWN	Institutional ownership	The percentage of shareholdings by institutional investors. *HIGH_INSTOWN* is an indicator variable that takes the value of 1 if a firm's institutional ownership is greater than the year's median institutional ownership of firms in the sample, and 0 otherwise.
SIZE	Firm size	The natural logarithm of the market value of equity at the beginning of the year.
MB	Market-to-book value	The market value of equity divided by the book value of equity.
LEV	Leverage	The ratio of total debt to total assets.
SGROWTH	Firm's growth	The percentage change in annual revenue.
FIN	New financing	The amount of debt or equity capital raised by the firm in a given year, divided by total assets at the beginning of that year. It is calculated as the issuance of common stock and preferred shares minus the purchase of common stock and preferred shares, plus the issuance of long-term debt minus the payment of long-term debt.
LITG	Litigation risk	An indicator variable that takes the value of 1 if the firm operates in a high-litigation industry (Standard Industrial Classification [SIC] codes of 2833–2836, 3570–3577, 3600–3674, 5200–5961 and 7370), and 0 otherwise.
FOREIGN	Foreign operations	An indicator variable that takes the value of 1 if a firm reports foreign income, and 0 otherwise.
FFAGE	Firm age	The natural logarithm of the number of years since the firm appeared in the Compustat database.
NEW	Asset newness	The ratio of net property, plant and equipment to gross property, plant and equipment at the beginning of the year.

ROA	Return on assets	The ratio of income before extraordinary items to total assets at the beginning of the year.
CAPIN	Capital intensity	The ratio of capital spending to total sales at the beginning of the year.
ENV_STR	Environmental strengths	The percentage of the total number of raw environmental strengths scaled by the total number of items of environmental strengths for a firm reported by the MSCI environmental, social and governance (ESG) database.
ENV_CON	Environmental concerns	The percentage of the total number of raw environmental concerns scaled by the total number of items of environmental concerns for a firm reported by the MSCI ESG database.
BIND	Board independence	Percentage of independent directors on the board.
BSIZE	Board size	The natural logarithm of the total number of directors on the board.
DISC_CDP	CDP response	An indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire, and 0 otherwise.
PROPDISC	Proportion of disclosure	Measured as the proportion of firms in an industry that respond to the CDP questionnaire.
CDP_LAG	Previous year CDP disclosure	An indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire in the previous year, and 0 otherwise.
scope1_total_dum	CDP GHG Scope 1	An indicator variable that takes a value of 1 if the firm produce Scope 1 emissions, and 0 otherwise.
scope2_total_dum	CDP GHG Scope 2	An indicator variable that takes a value of 1 if the firm produce Scope 2 emissions, and 0 otherwise.
scope3_total_dum	DCP GHG Scope 3	An indicator variable that takes a value of 1 if the firm produce Scope 3 emissions, and 0 otherwise.
TOBINQ	Firm value	The sum of the market value of common equity plus the book value of total debt scaled by total assets

Appendix B: CDP GHG scope breakdown following GHG Protocol recommendations

Emissions' scope	Definition
Scope 1	Direct GHG emissions from sources that the firm owns or controls, such as combustion in boilers or furnaces that are within its ownership or control.
Scope 2	Indirect GHG emissions from the production of the company's purchased electricity, heat or steam.
Scope 3	Emissions are a result of the firm's operations, but they come from sources that the company does not own or control, such as employee business travel or contracted-out commercial activities.

CHAPTER 6 : DISCUSSION AND CONCLUSIONS

6.1 Chapter overview

This chapter concludes the thesis by discussing the research findings, implications, limitations and direction for future research. The current chapter consist of the following sections: Section 6.2 that presents a summary of the research findings and robustness checks of each article. Section 6.3 provides the implications of this research. Finally, Section 6.4 presents the limitations of the current study and some direction for future research.

6.2 Summary of findings

This section provides a short summary of the research questions, research design, and methodology used in the study. Furthermore, it presents the key findings and the outcomes of the robustness tests. The next three subsections separately present a synopsis of each article of this thesis.

6.2.1 Findings of the first paper

The first paper reports on the determinants of climate change disclosure and the influence of managerial ability on firms' decisions. Specifically, this study examines the influence of managerial ability on climate change disclosure and the influence of governance quality on the aforementioned relationship. Initially, this study included all United States (US) firms that responded to the CDP (previously, Carbon Disclosure Project) questionnaire from 2004–2019. However, after an exclusion process, the study uses a sample of 412 unique firms with 2,298 firm-year observations between 2007–2019.[20]

This study uses descriptive statistics to provide some insights into the sample's variables. The first paper shows that the mean (median) of managerial ability (*MABILITY*) for firms in the study's sample of 0.171 (0.123), which is similar to Demerjian et al. (2013). Furthermore, the mean (median) of climate change disclosure score (*CCDS*) is 0.637 (0.643). Using the industry-year median as the cut-off point and comparing mean/median values, the study's sample is split into two groups one of high managerial ability firms *(HIGH_MABILITY)* and the other of low managerial

[20] Section 2.3.1 provides a comprehensive explanation of our sample collection, screening and exclusion process.

ability firms *(LOW_MABILITY)*. Table 3.2, Panel A reports that firms with high managerial ability firms *(HIGH_MABILITY)* report significantly higher *CCDS* score. Therefore, it provides initial evidence on the influence of managerial ability on climate change disclosure.

This study uses ordinary least squares (OLS) regression method to test H1 and H2.[21] The results of the first paper presents a positive and significant coefficient for *MABILITY* (coefficient = 0.220, p-value < 0.01), (coefficient = 0.162, p-value < 0.01), respectively. Suggesting that managerial ability have an influence on firm-level climate change disclosures. Specifically, firms with more capable managers disclose more climate change information. These findings provide strong support for H1. Furthermore, the results of the first paper indicates a negative and statistically significant coefficient (coefficient = -0.242, p-value < 0.01), suggesting that weak governance mechanisms hinder the positive relationship between managerial ability and climate change disclosures. These findings provide strong support for H2.

Additionally, the study uses firm fixed-effect regression, propensity score matching (PSM) analysis, Heckman's (1979) two-stage analysis, instrumental variable analysis (2SLS) and alternative measures of climate change disclosures to address omitted time-invariant variable bias, observable heterogeneity bias, sample selection bias and reverse causality endogeneity problems. The coefficients of the variables of interest suggest that the results remain robust and are in support of the baseline regression model and proposed hypothesis. Additional analysis suggest that the study's findings are more applicable to firms headquartered in states controlled by Democratic Party governments. Furthermore, climate change disclosure plays a mediating role in the relationship between managerial ability and firm value.

6.2.2 Findings of the second paper

The second paper reports on the determinants of climate change disclosure and the role of CEO–director social ties on firms' decision to disclose climate change related information. Specifically, this study examines the influence of CEO–director social ties on climate change disclosure and the influence of internal governance (e.g.,

[21] Robust standard errors clustered at the firm level are applied to address heteroscedasticity and serial correlation in all these models.

governance quality) and external monitoring (e.g., analysts following) on the aforementioned relationship. Initially, this study included all United States (US) firms that responded to the CDP (previously, Carbon Disclosure Project) questionnaire from 2007–2019. However, after an exclusion process, the study uses a sample of 1,007 firm-year observations.[22]

Table 4.2 presents the descriptive statistics for the variables used in Equation (4.1). Panel A reports mean (median) values of climate change disclosure score *(CCDS)* of 0.376 (0.319). While the average (median) value of CEO–director social ties (*SOCIAL_TIE*) is 0.187 (0.143), suggesting that, on average, 18.7% of independent directors in firms in this study's sample have at least one connection with the firm's CEO by education, employment or other activities. Furthermore, Panel B provides results of the mean and median tests of variables used in Equation (1), based on CEO–director social ties. Firms in our sample are divided into two groups, based on the industry-year adjusted median value of CEO–director social ties as the cut-off point: these groups are (1) firms with higher CEO–director social ties (*HIGH_SOCIAL_TIE*) and (2) those with lower CEO–director social ties (*LOW_SOCIAL_TIE*). The results suggest that firms with higher CEO–director social ties have a higher climate change score *(CCDS)*, providing initial evidence on the influence of CEO–director social ties on climate change disclosure.

This study uses ordinary least squares (OLS) regression method to estimate the Equations (4.1) which is designed to test H1.[23] Table 4.3, Models (1), (2) and (3) presents a positive and significant coefficient for *SOCIAL_TIE*. CEO–director social ties are positively associated with climate change disclosure. Hence, our H1 is supported. Table 4.9 presents the results of the OLS regression used to test for H2a and H2b. Model 2 report the coefficient for the *SOCIAL_TIE×HIGH_EINDEX* variable (-0.264) which is significant at the 1% level. Suggesting that weak internal governance weakens the positive effects of CEO–director social ties on climate change disclosure, while strong internal governance strengthens the positive influence of CEO–director

[22] Section 3.3.1 provides a comprehensive explanation of our sample collection, screening and exclusion process.

[23] Robust standard errors clustered at the firm level are applied to address heteroscedasticity and serial correlation in all these models. Furthermore, industry and year fixed effects are controlled for in all models.

social ties on climate change disclosure. Furthermore, Table 4.9, Model (1) reports the coefficient for the *SOCIAL_TIE×HIGH_ANALYST* interaction term. The coefficient is positive and significant at the 5% level (coefficient = 0.196, p-value < 0.05), indicating that the average increase in the level of climate change disclosure led by CEO–director social ties is greater for firms with a higher number of analysts following. Therefore, the positive effect of CEO–director social ties on climate change disclosure is stronger for firms that are subject to a higher level of external monitoring. These findings are in support of H2a and H2b.

The results of this study remain robust using a battery of robustness tests including reverse causality, observable and unobservable selection bias and alternative measures of climate change disclosure. Moreover, the state-level government party ideology is used as an exogeneous policy shock to address endogeneity. Additional analysis finds that climate change disclosure mediates the relationship between CEO–director social ties and firm value.

6.2.3 Findings of the third paper

The third paper examine the relationship between CEO power and corporate climate change disclosure. Moreover, it examines the moderating role of internal monitoring (e.g., governance quality) and external monitoring (e.g., analysts following and institutional ownership) in relationship between CEO power and climate change disclosure. Initially, this study included all United States (US) firms that responded to the CDP (previously, Carbon Disclosure Project) questionnaire from 2007–2019. However, after an exclusion process, the study uses a sample of 3,512 firm-year observations.[24]

Using descriptive statistics to provide insights into the sample's variables. Table 5.2, Panel A reports a mean (median) of climate change disclosure (*CCDS*) variable of 0.585 and 0.659, respectively. Furthermore, on average, the proportion of powerful CEOs (*CEO_POWER*) in our sample is 50% which is higher than what is reported in Jiraporn and Chintrakarn (2013), Li et al. (2016) and Muttakin et al. (2018). Next, the study utilises Pearson's correlation coefficients and variance inflation factor (VIF) values to examine the fit of the model. The average VIF value is 1.21, with the lowest

[24] Section 4.3.1 provides a comprehensive explanation of our sample collection, screening and exclusion process.

VIF value being 1.06 and the highest VIF value being 1.47, suggesting that the multicollinearity problem is unlikely to be present in our regression models. Furthermore, the study employs portfolio analysis to develop an initial understanding of the relationship between CEO power and climate change disclosure. Table 5.4, Panel A reports a large variation in climate change disclosure for firms in the highest CEO power portfolio, compared to firms in the lower CEO power portfolios. Specifically, *CCDS* in the highest CEO power portfolio is significantly lower than it is for firms in the lowest CEO power portfolio (i.e., the difference equals 0.04). Therefore, these results support assumption of H1.

Table 5.5 presents the results of the OLS regression that we use to test H1. Models (2) and (3) indicate that *CEO_POWER* coefficients are negative and statistically significant at the 1% level, suggesting that CEO power is negatively correlated with climate change disclosure. Therefore, firms with more powerful CEOs will disclose less climate change information. Thus, H1 is supported by the results. Furthermore, Table 5.10 reports the results of OLS regression used to evaluate H1a and H1b. Models (1) and (2) report positive and statistically significant coefficients at the 1% level for *CEO_POWER*×*HIGH_ANALYST*. Furthermore, the results shown in Models (5) and (6) suggest that firms with a larger number of institutional owners and analysts following disclose more climate change information, by reporting positive and statistically significant coefficients at the 5% level for *CEO_POWER*×*HIGH_INSTOWN*, Thus, the negative effect of CEO power on climate change information is weaker for firms exposed to a higher level of external monitoring. Therefore, these results support assumption of H1a. Table 5.10, Models (1) and (2) report positive and statistically significant coefficients at 10% and 5% levels (respectively) for *CEO_POWER*×*HIGH_EIND*, suggesting that firms with poor governance disclose more climate change information. Thus, the negative effect of CEO power on climate change disclosure is weaker for firms with weak internal monitoring. Therefore, these results support assumption of H1b.

The study utilises entropy balancing analysis, Heckman’s (1979) two-stage analysis, firm fixed-effects regressions and instrumental variable analysis (2SLS) to test for reverse causality, and observable and unobservable selection bias. Through additional analysis, the study find that climate change disclosure mediates the relationship between CEO power and firm value.

6.3 Implications

This section presents the implications of the thesis; however, the implications of each research question are discussed separately in each article. This research provides significant theoretical/academic and practitioner/policy implication. The results of the first paper show that more able managers are less concerned regarding the short-term goals of their firms and are likely to participate in climate change initiatives that involve long-term commitments from management and are advantageous to a larger set of stakeholders. Thus, these results provide insight into a key internal function of the company, managerial ability, which may be crucial not only to disseminating information concerning climate change but also for preparing organisations to handle the danger of this existential threat to humanity. The study's results are significant given the weight assigned to corporate climate change strategies by the Task Force on Climate-Related Financial Disclosures (TCFD), with corporations required to show the adaptability of their strategies and operations under various future scenarios of global warming.

Furthermore, the results of the second paper shed light on another key organisational internal mechanism, CEO-director social ties, which may be crucial in helping organisations communicate information about the threat posed by climate change. The results of this article expand the literature on the determinants of climate change disclosure by providing evidence on the relationship between CEO–director social ties and climate change disclosure. The results demonstrate how CEO–director social ties contribute to wider society and how growing numbers of climate change disclosures satisfy stakeholder demands for corporate environmental responsibility. Moreover, these findings add to the literature on two responsibilities of the board of directors (monitoring and advising) and explore how social ties between board directors and management affect the board’s capacity to successfully carry out these responsibilities.

Finally, the results of the third paper have significant implications for regulators, policy makers, researchers, investors, analysts and companies’ management, given the current regulatory pressure on companies to disclose more information about climate change. This paper expanded on the agency theory literature by providing evidence on powerful CEOs ignoring stakeholders demands and pursuing their own goals, leading to a decrease in firms’ value. These results provide an insight into an example of internal firm functions that can lead to a decrease in firms’ disclosures (e.g., climate change disclosure).

6.4 Limitations and future research

The current research is a US-based study: future research covering diverse jurisdictions (e.g., Europe, Asia-Pacific) would enrich the debate by providing new evidence on the association between managerial ability, CEO–director social ties and CEO power and climate change disclosures. Additionally, future research could explore the underlying mechanisms through which managerial ability, CEO–director social ties and CEO power affects climate change disclosures. The current research demonstrate that climate change disclosure mediates the relationship between managerial ability, CEO–director social ties and CEO power and firm value. Therefore, future research could also examine the moderating effect on capital market outcomes, including the cost of equity, given that prior research notes that environmental performance lowers the cost of equity (Gupta, 2018).

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