

Ownership structure and climate-related corporate reporting

Abstract

We investigate the impacts of various types of corporate ownership structures (i.e., institutional, government, and managerial ownership) on climate-related corporate reporting as reflected in the levels of voluntary carbon disclosure. Using a sample of S&P 500 companies from 2015 to 2020 across both environmentally sensitive and non-environmentally sensitive industries, we find that diverse ownership structures have distinct impacts and preferences in corporate carbon disclosure. Specifically, government ownership is likely to promote transparency of carbon information. In contrast, the ownership held by institutional investors (total, short-term, and long-term), managers (i.e., CEOs, directors), and block-holders are negatively associated with the proactive greenhouse gas disclosure. We also find evidence that climate governance quality plays a positive moderating role in the relationship between two ownership types (i.e., long-term institutional investors and block-holder) and a firm's climate-related corporate reporting. Our findings offer some practical insights for managers, regulators, and policymakers to focus on the configuration of corporate ownership in the context of improving green practices.

Key words: *corporate ownership; climate change; institutional ownership; state ownership; managerial ownership; ownership concentration*

1. Introduction

The Paris Agreement¹, which is a landmark in the multilateral climate change process, has led to a vast and rapid investment in carbon-related initiatives covering monitoring, verification, and public reporting (Ferreira et al., 2019). Consequently, multiple stakeholders (e.g., investors, customers, analysts, governments, and communities) are increasingly concerned about non-financial information disclosure regarding global warming impacts, carbon emissions, relevant strategic risks, and opportunities to reveal the level of corporate accountability and long-term sustainable growth (Chithambo et al., 2021). As a result, the commitment to climate change reporting has become a crucial indicator for firms involved in the current global economic competition, encouraging firms to contribute to carbon practices to meet various stakeholders' aspirations (Al Amosh and Khatib, 2021).

Our study examines whether and to what extent different categories of ownership (i.e., institutional, state, managerial, and block-holders ownership) exert influences on climate-related corporate reporting as reflected in the levels of the voluntary carbon (greenhouse gas) disclosures. We complement the two growing streams of literature on the determinants of climate change reporting. The *first* research focuses mainly on the board characteristics (e.g., size, independence, diversity, CEO duality) (see Liao et al., 2015; Rudyanto, 2017; Buerthey, 2021), while the *second* one is concerned with other firm-specific indicators such as financial performance, leverage, and capital expenditure (Yin et al., 2019; Karim et al., 2021). To the best of our knowledge, there is *little* effort on climate change reporting stimulated by the pressures from various types of corporate ownership. The absence of this factor in current studies is surprising because ownership types are one of the key signals that represent a firm's identity (Calza et al., 2016). We aim to explore the link between this crucial governance variable and the emerging behavior of firms to publicly disclose carbon information (which implies a change of attitude towards green practices).

Our selected ownership (i.e., long-term and short-term institutional, state, managerial, and block-holders) are predominant groups of stakeholders, entitled to have a vital (but different) voice regarding strategic decisions related to business risks/development, particularly climate change reporting. They may use disclosed environmental information for various purposes (e.g., to evaluate their values of portfolios, measure carbon performance, estimate relevant costs of carbon emission controls, and determine the prospects of a business).

¹ A globally binding treaty on climate change, which was adopted by 196 countries to substantially reduce greenhouse gas emissions and limit the global temperature rise. This agreement entered into force on November 4, 2016.

However, those dominant shareholders may be able to access the information directly from the company due to their voting power (Ali et al., 2022). Therefore, they could either pressure or discourage firms from reporting carbon-related information. Furthermore, because the ownership structure is naturally heterogeneous, resulting in diverse investment horizons and objectives, different investors with various preferences could act as dissimilar stimulating drivers of a firm's climate change disclosure. For example, the owners with long-term commitment and sustainable priority, such as long-term institutional investors or state-owned enterprises, may encourage businesses to disclose more voluntary climate change-related information to enhance the transparency and accountability of companies. In contrast, managers and short-term investors may pay more attention to short-term economic benefits at the expense of external stakeholders by avoiding exposing sensitive information that may harm these short-term benefits (Calza et al., 2016). Consequently, the relationship between ownership structures and voluntary carbon disclosure is prone to be unclear and inconclusive, which requires further examination.

We employ two theories to make our predictions. First, *agency theory* (Jensen and Meckling, 1976) suggests the importance of disclosing carbon performance and targets to shareholders, which helps to alleviate the confrontation of interests between managers and investors triggered by asymmetric information problems (Ilhan et al., 2020). However, not all owners have the same motivations and preferences in disclosing information, especially environmentally sensitive information, which consequently impacts firm performance and their own benefits (Acar et al., 2021; Ali et al., 2022). Second, *political cost theory* (Watts and Zimmermann, 1978) depicts that firms voluntarily disclose more information due to economic reasons; notably, they try to reduce political costs by providing more information to external parties (Fields et al., 2001). Particularly regarding climate change and environmental information, prior studies argue that companies with higher carbon risk exposure tend to be the most politically visible and are likely to attract stricter scrutiny from stakeholders (Lemma et al., 2020). Firms, therefore, disclose more voluntary information to minimize the potential costs arising from the interaction between the firm and its natural and societal environment (Gamerschlag et al., 2011; Nguyen et al., 2023).

It is challenging to achieve the best measures of climate change reporting because of the lack of consistency and comparability of such reporting across firms giving rise to difficulties in properly assessing corporate efforts to reduce carbon emissions (Stanny and Ely, 2008). We overcome this by employing a comprehensive measure constructed by the Carbon Disclosure

Project (CDP)². The CDP is supported by financial institutions across the globe and widely adopted by several recent studies (Ben-Amar and McIlkenny, 2015; Haque, 2017; Chithambo et al., 2021) that provide evidence that the level of voluntary carbon disclosure could be well-reflected through the CDP, suggesting information obtained from the CDP is value-relevant for stakeholders. We investigate our research questions focusing only on large-sized firms because they are the dominant greenhouse gas emitters worldwide and show more propensity to pursue organizational and market actions to communicate carbon details with external stakeholders, which usually contain behavioral changes, product-based innovations to reduce carbon emissions, carbon management, and targets. In addition, these firms tend to have heterogeneous shareholders with different vested interests (Haque, 2017).

Based on a comprehensive panel sample of the S&P 500 firms for a period from 2015 to 2020, we find several interesting and mixed results. First, the results reveal that firms with greater proportions of institutional ownerships (total, short-term and long-term) exhibit lower voluntary carbon disclosure, which generally implies that investment horizons do not correspond with proactive environmental practices in the sample firms. Second, managerial ownership is inversely associated with the level of carbon disclosure, providing an implication that managers dominating a firm's decisions tend to withhold environmentally sensitive information for the sake of cost reduction and the preservation of managerial position. Third, we also find a negative association between ownership concentration and greenhouse gas disclosure, which manifests in that controlling shareholders are inclined to monopolize carbon information to maintain their superiority regarding decision-making and monitoring. Contrasting with these findings, our results on state ownership show that higher governmental shareholdings associated with legal policies and regulations could improve corporate transparency, giving rise to more public scrutiny of carbon performance and management. Hence, it is conspicuous that a firm's attitudes and actions on carbon disclosure are closely linked to different ownership structures, in particular the climate-conscious ownership.

Despite current research having made several contributions to firm-specific determinants of environmental proactivity (De Aguiar & Bebbington, 2014; Huang et al., 2023), our paper extends contributions to literature in several ways. First, it concentrates on climate change reporting through carbon disclosure, a relatively small but topical environmental practice,

² A not-for-profit organization with the aim of overcoming inconsistency and incomparability in carbon reports. It employs a standard questionnaire annually to request information from global companies including climate strategies, greenhouse gas performance, environmental proactivity, and potential risks. Besides, the completion of the questionnaire is an indirect indication to measure a firm's proactivity and commitment to carbon initiatives. Website: <https://www.cdp.net/en/info/about-us>

instead of the broad perspective of corporate social responsibility (CSR) disclosure (Bouten et al., 2011). As climate change has become a major threat to the growth of each sector and country, the demand for greenhouse gas information has significantly increased. Borghei (2021) highlights the emerging concern that carbon disclosure embodies stakeholders' pressures on the enhancement of corporate sustainability. Besides, the adoption of the CDP is in response to the absence of internationally acceptable standards in existing studies, which is more likely to generate innovative and objective results. Additionally, diverse organizational ownership structures are configured to explore the relationship between different types of investors and voluntary carbon disclosure while there seems to be less attention paid to the effects of stockholding on climate initiatives in most of the prior studies [i.e., Ali et al., (2022) examine the effect of ownership structure on political spending disclosure; Md Zaini et al., (2020) explore the influence of family-controlled firms on voluntary disclosure in Malaysia]. This study sheds light on the impact of diverse ownership structures on climate-related reporting since different owners show their various preferences and priorities in relation to carbon disclosure.

In addition, this paper uses a six-year time horizon from 2015 to 2020 during which full awareness of the essentiality of communicating information regarding sustainable performance was widely growing due to global events such as the Paris Agreement and the United Nations climate change conference, which motivated more companies to participate in the CDP questionnaire and get feedback from the professional scoring mechanism. Overall, the empirical evidence outlines how different shareholders exert corresponding impacts through their ownership structures on the level of proactive carbon disclosure in large firms due to the differences in preferences and the ability to access sensitive information. Accordingly, it could offer important insight and policy implications for firms, investors, and other stakeholders to ensure credibility and transparency of carbon-related details and value the interplay of portfolio investment and climate disclosure.

The remainder of this paper is structured as follows. Section 2 provides a critical review of prior studies and discusses the relevant theoretical framework and hypothesis development. Section 3 covers the research design including research data and sample. Empirical models and variables are presented in section 4. Empirical results along with discussion are reported in section 5. Section 6 covers several robustness tests. Finally, section 7 concludes this study.

2. Literature Review, Theoretical Framework, and Hypothesis Development

2.1 *Why do firms report climate change information?*

Reviewing these strategic and financial benefits of reporting climate change information, and specifically carbon performance, an increasingly considerable number of studies explore the determinants and outcomes of reporting efforts and activities related to climate change, such as carbon emission performance and green operation targets, as global warming and climate change have become crucial crises to combat (Gamerschlag et al., 2011; Lemma et al., 2020).

Borghei (2021) suggests carbon disclosure is more closely concerned with the climate-related risk that indicates how corporate performance impacts climate change. A study by Liu et al. (2017) considers carbon performance to explore market responses to excessive carbon emissions and finds firms with lower carbon performance tend to strategically disclose carbon information to reduce information asymmetry and avoid the potential cost. In addition, Al-Tuwaijri et al. (2004) emphasize environmental responsibility could be deliberately utilized for greenwashing, misleading investors about the efforts of carbon reduction. Consequently, biased reporting may adversely affect investors' confidence, the capital market for ecologically responsible investing, and firm value. To improve the transparency and accountability of corporate carbon footprints, voluntary carbon disclosure as a means to communicate to the market and reduce information asymmetry plays a prominent role in addressing climate change risks and opportunities (Alsaifi et al., 2020). Carbon information, however, is relatively complex and multidimensional. Luo and Tang (2014) suggest that critical elements of making the disclosure should be included, such as low-carbon initiatives, carbon reduction objectives, energy consumption, and potential uncertainties, as they are likely to impact business operations, expenditures, and profits.

Based on the theoretical perception of discretionary carbon disclosure, determinants of carbon information dissemination have been developed considerably, including political constraints, stakeholder expectations, and firm-specific factors (Velte et al., 2020). Companies driven by these pressures need to develop carbon disclosure to disseminate information regarding carbon abatement opportunities and risks. Nevertheless, there are no specific criteria to enhance the credibility, reliability, and comparability of voluntary carbon disclosure (Kolk et al., 2008). It is striking that companies with different characteristics are more likely to consider social and environmental issues differently, leading to disclosure approaches that are diverse and inconsistent in quality. Several prior studies suggest that firm-specific

characteristics affect climate change reporting, especially the effect of corporate governance mechanisms, for example, board composition, board independence, and gender diversity or executive compensation (De Villiers et al., 2011; Leung and Philomena, 2013; Liao et al., 2015; Siboni et al., 2016; Haque, 2017; Haque and Ntim, 2020).

Although corporate governance is regarded as a paramount dimension associated with voluntary carbon disclosure, there have been emerging investigations pertinent to the influence exerted by ownership structure on the adoption of proactive carbon initiatives. However, research findings concerning how different types of ownership influence the level of discretionary environmental information disclosure are relatively fragmented and inconclusive (Calza et al., 2016).

2.2 Theoretical framework

Prior studies have used several theories to understand motivations, incentives, and consequences of voluntary disclosure (Ali et al., 2022; Gamerschlag et al., 2011; Khlif et al., 2017). For example, Gamerschlag et al. (2011) rely on *political cost* theory to explore the determinants of voluntary CSR in Germany. Meanwhile, Ali et al. (2022) explain the voluntary disclosure of political spending in the US context using *agency* theory (Jensen and Meckling, 1976) and *signaling* theory (Hughes, 1986). Similarly, Flammer et al. (2021) apply agency theory to justify the impact of shareholder activism on voluntary disclosure of climate change risks. In this study, we use a combination of *agency* (Jensen and Meckling, 1976) and *political cost* theory (Watts and Zimmermann, 1978) to explain why *different ownership structures may impact* a firm's voluntary climate change reporting.

Firstly, agency theorists (e.g., Jensen and Meckling, 1976; Ali et al., 2022; Flammer et al., 2021; Khlif et al., 2017) argue that due to the conflict of interest and information asymmetry between principals and agents, the disclosure of information by agents is largely affected by the ***principal's monitoring mechanism*** (Ali et al., 2022). The ownership structure determines the level of monitoring and, thereby, the level of disclosure (Eng and Mak, 2003). However, not all owners have the same motivations and preferences in disclosing information, especially environmentally sensitive information, which consequently impacts firm performance and their own benefits (see Acar et al., 2021; Ali et al., 2022). Particularly, on one hand, the corporate governance literature suggests that institutional investors play an active role in the monitoring and control of firms that benefit the company by reducing agency costs and information asymmetry (Donnelly and Mulcahy, 2008; Khlif et al., 2017), therefore, voluntary disclosure of environmental information may be encouraged by institutional investors to reduce

information asymmetry, reduce agency conflict (principal-agent conflict) and obtain legitimacy (Ali et al., 2022). On the other hand, different principals may have diverse aims and objectives (principal-principal conflicts), which may influence the extent of information disclosure, depending on the shareholders' preferences (Chau and Gray, 2002). For example, many prior studies argue that managerial ownership has a negative association with voluntary disclosure of information because managers with a large proportion of the company's shares have incentives to reduce corporate transparency in order to preserve their strong voting power and serve their own interests (Khlif et al., 2017; Shleifer and Vishny, 1997).

In addition, besides the impact of external factors (i.e., *monitoring mechanisms*) on the level of voluntary disclosure, some studies stand on the perspective of *political cost* theory (Watts and Zimmermann, 1978) and argue that businesses decide to disclose more voluntary information due to the economic reasons; particularly, they try to reduce the political costs by providing more information to external parties (Fields et al., 2001). For example, concerning climate change and environmental information, Lemma et al. (2020) state that companies with higher carbon risk exposure tend to be the *most politically visible* and are likely to attract *stricter scrutiny* from stakeholders. Firms, therefore, disclose more voluntary information to minimize the potential costs arising from the interaction between the firm and its natural and societal environment (Gamerschlag et al., 2011). Furthermore, given that the ownership structure is well linked with the interference of the owners in business matters, the state-owned enterprises should have also interacted well with the government. They may prefer disclosing more environmental information to reduce the pressure from the government and other non-governmental organizations (Zeng et al., 2012).

In sum, while the *agency* and *political cost* theories indicate that firms voluntarily disclose carbon information to reduce information asymmetry and minimize political costs, different types of shareholders hold divergent views about corporate carbon initiatives. Hence, this study develops five hypotheses to analyze how diverse ownership structures influence climate change reporting regarding corporate carbon disclosure.

2.3 The effects of ownership structure on climate change reporting

2.3.1 Institutional ownership

Institutional investors are viewed as relevant dominant owners with a significant presence on the boards of corporations. In some countries (i.e., the US), institutional ownership became significant in the 21st century, with the growth of institutional investment from 6.1% of

aggregate ownership of equities in 1950 to over 50% by 2002 (Gillan and Starks, 2003). Yet, despite its prevalence, researchers conducting studies about the role of institutional owners in climate change reporting fail to reach a definitive agreement.

On the one hand, in line with agency theory, the institutional shareholders are considered an effective *monitoring mechanism* of corporate governance to reduce the information asymmetry between principal and agent since they usually hold a significant share proportion and actively participate in corporate voting, which influences how corporations are governed (Aghion et al., 2013; Bebchuk et al., 2017). As a result, the managers are under higher pressure from shareholders to disclose more voluntary information, especially information related to climate change risks (Flammer et al., 2021). According to Flammer et al. (2021), shareholder activism (especially by institutional investors) can elicit greater disclosure of firms' exposure to climate change risks. They also find that institutional shareholders value transparency concerning a firm's exposure to climate change risks (Flammer et al., 2021).

Furthermore, some studies argue that the concentration of ownership significantly impacts the quality of climate change disclosure due to the different preferences of dominant owners (Okudo, 2021). Cotter and Najah (2012) state that a company with a considerably high proportion of institutional shareholders may voluntarily disclose relevant carbon information because large investors are often more attentive to a firm's strategies and decisions than minority shareholders, which potentially affects management attitude and behavior towards greener practices. Besides, institutional shareholders providing credence services with their clients to signal credibility and reliability call for more transparent reporting, including carbon disclosure (Saleh et al., 2010). Accordingly, the influence of institutional shareholders helps to improve active monitoring to deter opportunistic manager behaviors such as greenwashing due to considerable investment in the capital market (García-Sánchez et al., 2020). In this case, institutional ownership may improve environmental disclosure (Nurleni and Bandang, 2018).

On the other hand, some studies argue that institutional shareholders may discourage releasing sensitive voluntary information to maximize their own private benefits at the cost of other stakeholders, which increases the agency problem (Shleifer and Vishny, 1997; Juhmani, 2013). This is because the large ownership size of institutional investors enables them to get information directly from the firm and its management, so they tend to have access to internal sources of information not available to all shareholders (Tsamenyi et al., 2007). Hermawan et al. (2018) examine the effect of institutional shareholders in a developing market (Indonesia) and find no significant association between institutional ownership and carbon emission disclosure. Due to inconclusive findings of prior studies regarding the impact of institutional

ownership and voluntary disclosure, we suggest a non-directional hypothesis:

H₁: Institutional ownership is associated with voluntary carbon disclosure.

However, attitudes and preferences towards carbon initiatives may create a divergence between long-term-oriented and short-term-oriented investors. Neubaum and Zahra (2006) specify shareholders concentrating on long-run business development are more likely to support greenhouse gas disclosure for sustainability reasons, while short-term investors may consider carbon disclosure as an uncertain and unprofitable practice due to the potential burden of extra costs.

Concerning the differences in institutional investors' time horizons, transient investors (short-term investors) tend to hold companies' stocks on a short-term basis (i.e., driven by speculation motives), while long-term investors may hold stock for a longer period, taking a vested interest in the companies' long-term success (Flammer et al., 2021; Gaspar et al., 2005) (principal-principal agency conflicts). Therefore, long-term investors may be more interested in improving the firm's business practices and are more inclined to actively engage with their portfolio companies to enhance corporate governance and the firm's long-term value (Krueger et al., 2020). Furthermore, according to Flammer et al. (2021), long-term institutional investors are less likely to reallocate their holdings away from the disclosing companies if the disclosure reveals unexpected vulnerabilities to climate risks. As a result, the management is less likely to face a divestment of these investors from unfavorable voluntary climate change information. This may motivate the management to engage more in voluntary climate change disclosure.

These findings confirm the importance of differentiating the investment horizons, as the effect of short-term and long-term institutional shareholders are not fully exploited in terms of organizational environmental proactivity (Gloßner, 2019). Therefore, underlying by agency theory, this study develops two contradictory hypotheses related to long-term and short-term institutional owners to clarify the differences among them as below:

H_{2a}: Long-term institutional ownership is positively associated with voluntary carbon disclosure.

H_{2b}: Short-term institutional ownership is negatively associated with voluntary carbon disclosure.

2.3.2 State ownership

State ownership such as government or other governmental institutions represents an important shareholder with the aim of political, social, and environmental alignment. Accordingly, state

owners have higher expectations towards corporate environmental proactivity compared with general institutional ownership (Earnhart and Lizal, 2006). In many countries, direct state investment as a means of policy regulation helps to improve the quality of carbon disclosure, especially the owning of shares in some sectors with high resource consumption and environmental pollution. For example, state-owned enterprises in China have exemplified a positive influence on the likelihood of organizational carbon initiatives (Li et al., 2013; Lee et al., 2017). This significantly implies state shareholders value firms' efforts about climate change and CSR activities, and policymakers could improve the level of disclosure by developing new regulations, reflecting the role of government intervention in the economic and business environments.

According to *political cost* theory (Watts and Zimmermann, 1978), management is concerned with political considerations, including preventing explicit and implicit taxes, regulations, and non-governmental interest groups' pressure. The management and organizations, therefore, decide to disclose more information on their social and environmental performance to minimize the potential political costs arising from the interaction between firms and their natural and societal environment (Fields et al., 2001; Gamerschlag et al., 2011).

Furthermore, as the state is a typically significant shareholder who aims to improve the quality of the environment to achieve political goals, increased state ownership may pay more attention to carbon performance and environmental disclosure (Hu et al., 2018). In the same vein, government-owned companies serving both business and public interests are likely to disclose more information related to climate change and carbon practices to avoid political actions (political cost) and reinforce stakeholders' interests (Muttakin and Subramaniam, 2015). According to Al Amosh and Khatib (2021), government ownership with politically sensitive aspirations could enhance transparency and accountability systems in organizations. In addition, state-owned firms are exposed to stringent regulations and policies, particularly rules concerning environmental performance. Besides, the involvement of the state in a firm's ownership could alleviate the conflict of interests between managers (agents) and shareholders (principals) concerning corporate environmental expenditure and management (Earnhart and Lizal, 2006). Furthermore, the shareholding of government is paramount in a corporation, providing critical resources and regulations.

In the context of the US, Ali et al. (2022) suggest that government ownership fosters corporate transparency by positively impacting the disclosure of political spending. This finding is consistent with several studies that government ownership has positive effects on the extent of voluntary disclosure (Ntim and Soobaroyen, 2013; Alshbili et al., 2018).

Taken together and in line with *political cost* theory, our study argues that state owners tend to encourage businesses to participate in voluntary climate change disclosure to minimize potential political costs. Therefore, we propose the following hypothesis:

H₃: State ownership is positively associated with voluntary carbon disclosure.

2.3.3 Managerial ownership

From the agency perspective, compensation (including stock and shares) has been proven to be an effective governance mechanism to align the interest of agents (managers) and principals (shareholders); therefore, managers will have a long-term interest in the company and less incentive to expropriate minority shareholders (Jensen and Meckling, 1976; Khelif et al., 2017). Managerial shareholding is the percentage of stocks held by executives and managers, which may reduce agency costs emerging from the divergence of interests between managers and external owners. Giving ownership to the managers could achieve the convergence of interests since managers are incentivized to act more cautiously when making decisions that impact general shareholders' value and where they take the consequences (Khelif et al., 2017). Johnson and Greening (1999) and Uwuigbe (2011) support that argument as they find a positive association between managerial ownership and CSR disclosures.

However, according to Jensen and Ruback (1983), an entrenchment effect may occur if managerial ownership exceeds a certain limit. In that case, managers may be motivated to decrease corporate disclosure to avoid public scrutiny, preserve their influential voting power, and serve their interests (Shleifer and Vishny, 1997). In this case, the agency problem seems to increase because managers with a considerable vote and a solid position to control the company tend to make decisions oriented to personal interests instead of other shareholders' interests (principal - principal's conflicts). For example, Chau and Gray (2002) find a negative association between managerial ownership and voluntary disclosures. Similarly, Ali et al. (2022) also find a negative association between managerial ownership and the level of political spending disclosure.

Concerning voluntary disclosure of social and environmental activities, Baek et al. (2009) and Nurleni and Bandang (2018) empirically find a negative association between managerial ownership and voluntary CSR disclosure, indicating that high managerial ownership is prone to yield an entrenchment effect because management could dominate decisions to limit participation in social activities and lower costs. In other words, it is difficult for external parties to monitor and control opportunistic managerial behaviors when managers hold

significant ownership.

Therefore, from an agency theory perspective, managers with ownership of the business may have incentives to disclose more voluntary climate change information to enhance corporate transparency (to reduce information asymmetry). However, managerial owners may also not want to disclose more voluntary climate change information, such as carbon performance, as it may contain sensitive information that may harm the business and managers in the short run. We, then, propose the non-directional hypothesis:

H₄: Managerial ownership is associated with voluntary carbon disclosure.

2.3.4 Ownership concentration

From the agency perspective, ownership concentration characterizes the internal corporate governance mechanism in which shareholders with significant shares of a company are empowered to scrutinize corporate managers and influence the firm's decision-making process, while an increase in the diffusion of stockholding signifies a lower ability of investors to monitor the management (Garcia-Meca and Sanchez-Ballesta, 2010). Empirically, Okudo (2021) conducts a study in Nigeria and suggests that managers under the pressure of dominant shareholders have inclinations to vigilantly invest in liquid assets as investors possessing a large proportion of shares have incentives to demand the disclosure of more information regarding long-term strategies. However, a handful of studies find a negative relationship between concentrated ownership and carbon disclosure projects because more significant stakes held by certain investors tend to decrease the need for public accountability and transparency. For example, Brammer and Pavelin (2008) find a negative relationship between ownership concentration and disclosure activism, which reveals that a firm with greater ownership concentration has the propensity to reduce environmental policy disclosure. In other words, firms with concentrated ownership tend to be incentivized to provide more information for influential shareholders with less consideration of other stakeholders (principal – principal's conflicts), consequently disclosing less information to the market (Garcia-Meca and Sanchez-Ballesta, 2010).

Furthermore, block-holder ownership as a proxy for ownership concentration is typically used in relevant research. Sengupta (2004) contends block-holders owning 5% or more of the total shares outstanding may restrict the information disclosure in public to maintain their information excellence, which is supported by the evidence of Calza et al. (2016). In a similar vein, concentrated block ownership is likely to depress the quality of CSR disclosure owing to the dominant effect of insufficient external supervision (Zheng et al., 2014). Stated differently,

large shareholders who pay high prices for stockholdings are unlikely to support social and environmental initiatives, assuming a trade-off between financial performance and CSR performance, since other investors may benefit from the green development at the cost of concentrated ownership financial gains (Dam and Scholtens, 2013). Accordingly, the following hypothesis is formulated.

H₅: Ownership concentration adversely impacts corporate voluntary carbon disclosure.

3. Data and Sample

Our initial sample includes all constituents continuously listed in the S&P 500 index from 2015 to 2020. We focus on this period because it attracted a high level of public awareness and extensive policy debates on greenhouse gas emissions. Based on the modified capitalization-weighted stock index, the S&P 500 index defines modern industrials and reflects the preeminent large-cap growth globally. This sample consists of large-sized companies listed on the US stock exchanges because they are more likely to integrate carbon disclosure initiatives than smaller counterparts (Giannarakis et al., 2017). Our main variable of interest, ownership structure data, was obtained from two databases: Standard and Poor's Capital IQ, and Wharton Research Data Services (WRDS, Execucomp and BoardEx). The carbon disclosure scores (i.e., *Green-Disc*) assessing corporate proactivity of climate actions were collected from the CDP database. We excluded firms with missing ownership and carbon data. We obtained a final (unbalanced) sample (234 firms) ranging from 1042 to 1404 firm-year observations for the summary statistics. However, such observations might differ in our regression models due to combining individual variables, which have missing data in different firms and years. This is consistent with prior studies such as (Li et al., 2022; Dunbar et al., 2020). See *Appendix 1* for the sample selection process and *Appendix 2* for the industry breakdown of our sample following the Global Industry Classification Standard (GICS).

4. Empirical Models and Variables

We employ the pooled ordinary least square (OLS) with robust standard errors to examine the effect of corporate ownership structure on voluntary carbon disclosure. The model is specified in Eq.1 as below:

$$\begin{aligned}
GreenDisc_{it} = & \beta_0 + \beta_1(SHORTINS_{it}) + \beta_2(LONGINS_{it}) \\
& + \beta_3(STATE_{it}) + \beta_4(MANAGERIAL_{it}) + \beta_5(BLOCK_{it}) + \beta_6(NED_{it}) \\
& + \beta_7(GENDER_{it}) + \beta_8(BODSIZE_{it}) + \beta_9(COMDUM_{it}) + \beta_{10}(FSIZE_{it}) \\
& + \beta_{11}(ROA_{it}) + \beta_{12}(DEBT_{it}) + \beta_{13}(CAPEX_{it}) + \beta_{14}(CARPEF_{it}) \\
& + \sum_t (\beta_t IND\_DUM_t) + Year\ fixed\ effect + \varepsilon_{it},
\end{aligned}$$

where $GreenDisc_{it}$ represents the green (climate change) reporting as reflected in the level of corporate carbon disclosure score. This measure reflects the comprehensiveness of corporate response in relation to the depth of the annual questionnaire issued by the CDP, an independent and not-for-profit charity³. This CDP measure represents a comprehensive index covering some information from global companies including climate strategies, greenhouse gas performance, environmental proactivity, and potential risks. It is also an indirect indicator to measure a firm's proactivity and commitment to carbon initiatives. It is supported by financial institutions across the world and commonly adopted by prior literature (e.g., Ben-Amar and McIlkenny, 2015; Haque, 2017; Chithambo et al., 2021) that provides evidence that the level of voluntary carbon disclosure could be well-reflected through the CDP, suggesting information obtained from the CDP is value-relevant for stakeholders.

$GreenDisc_{it}$ receives scores ranging from 0 to 100 and is applied to assess environmental attitudes and measure the quality of corporate carbon disclosure⁴. A score between 0 and 40 is the lowest level, which indicates firm-level awareness of climate change but a restricted ability to measure and report annual carbon emission from business operations. A higher level of score (40–70) suggests a company can provide relevant carbon information, but it is still insufficient and inactive. By contrast, firms with scores of +70 are considered as 'green' leaders due to a more in-depth involvement in addressing climate change risks and opportunities. With environmental leadership, these firms tend to have a positive attitude towards carbon problems, set a meaningful target for decarbonization, and actively disclose carbon emission and performance to achieve strategic advantages. The distribution of $GreenDisc_{it}$ (or the CDP) in our sample shows a wide min–max ranging value of 15–100 (see Table 2), implying substantial

³ To incentivize and guide global companies to boost their proactivity and transparency of carbon disclosure, the CDP has requested information on firm-level climate-related uncertainties and opportunities to run a global climate disclosure system for thousands of large companies worldwide on behalf of more than 590 institutional investor signatories and over 200 major purchasers since 2002. Specifically, information obtained from the questionnaire covered several broad topics such as climate change management to address carbon risks and opportunities, targets and strategies for greenhouse gas emissions, the extent to which a firm reports its carbon performance and emission measurement, and the disclosure frequency and relevance for various stakeholders. This publicly available data on the CDP website has a prominent implication for strategic investment decisions and firm reputation enhancement because participation in the CDP is justified by the response to voluntarily disclose carbon information. Alsaifi et al. (2020) state that the CDP is working for corporations and their stakeholders through standardized, globally recognized, and information-sharing reporting, making measurement and comparison easier.

⁴ The CDP website provides relevant details of the carbon disclosure scoring system:
<https://www.cdp.net/en/companies/companies-scores>

variations in the firm-level awareness of climate change and their ability to measure and report annual carbon emission from business operations, across firms.

Different forms of ownership incorporating *institutional*, *state* (government), *managerial* shareholders, and *block-holders* are our explanatory variables. $SHORTINS_{it}$ represents the short-term institutional investors such as hedge funds and investment banks, which is measured by the percentage of shares held by institutions that prefer near-term earnings instead of a long-run firm value. Unlike short orientation, long-term institutional owners ($LONGINS_{it}$), such as government pension funds and venture capital, is the proportion of shares held by institutional owners focusing on the future value (Calza et al., 2016). In the main tests, we also employ total institutional ownership (INS) as an alternative proxy for the two above variables: short-term and long-term institutional investors. State ownership ($STATE_{it}$) represents the percentage of shares owned by the government. Managerial ownership ($INSIDER_{it}$) is gauged by the proportion of shares owned by executive managers (Ali et al., 2021). Block-holder ownership ($BLOCK_{it}$) as a proxy for ownership concentration is measured by the portion of issued shares held by influential shareholders who own over 5% of outstanding stocks (Zheng et al., 2014).

We also employ a series of control variables related to firm-specific determinants, which potentially affect voluntary carbon disclosure. Generally, these variables could be classified into two aspects: board factors and other company-specific parameters. Board characteristics including board independence (NED_{it}), gender diversity ($GENDER_{it}$), board size ($BOD_{SIZE_{it}}$), and the existence of CSR committee ($COM_{DUM_{it}}$) are closely associated with organizational carbon performance and management. Based on agency theory and corporate governance, a plethora of studies empirically investigate how board effectiveness incorporating individual board members and committees influences the corporate climate policy. Haque (2017) finds that independent directors possess diverse backgrounds and strong stakeholder orientation, which help to reduce asymmetric information and improve the resource-provisioning role of the board through effective monitoring and critical advice support. It implies that the extent of board independence is linked to corporate carbon initiatives. Additionally, Liao et al. (2015) find a board with greater gender diversity is more likely to engage in carbon reduction projects, and female board members focus more on corporate sustainability strategies to strengthen stakeholder relations. Board size is also one of the determinants of carbon disclosure propensity. Available literature observes that a larger board may generate greater conflicts and inefficient responses in the decision-making process owing to free-rider problems, while resource dependence theory argues that more board members with experienced skills and

knowledge could enhance environmental proactivity by providing expert assistance to reduce carbon risks. Therefore, board size is expected to exert an influence on voluntary greenhouse gas disclosure (Zhang and Liu, 2020). At present, many firms have designated specific board committees to positively address social and environmental issues. The CSR committee, for instance, systematically implements and reviews sustainability activities to enhance business environmental accountability and facilitate effective interactions with external stakeholders. Liao et al. (2015) comment that the presence of the CSR committee regarding proactive carbon disclosure is analogous to the role of an audit committee in accounting disclosure assurance.

Despite board factors, some variables related to the firm's features may drive the examined variable. Firm size ($F_{SIZE_{it}}$), measured by the log natural logarithm of the company's total assets, plays an important role in a firm's carbon emission, but academic findings seem to be inconclusive. De Villiers et al. (2011) claim that large companies show propensities to remain proactive on carbon matters because they experience increased social pressure and accountability. However, the large scale of operations and sales signifies greater greenhouse gas emissions unless advanced technologies, efficient energy management, and effective supervision and feedback mechanisms are integrated into these large firms. As a proxy for profitability (ROA_{it}), return on assets is considered to account for more economic resources distributed to carbon initiatives in firms with adequate financial slack (Yin et al., 2019). Leverage ($DEBT_{it}$) is viewed as an obligation to pay interests for debtholders, indicating decreased free cash flows and a decline in climate-related commitment. From creditors' perspectives, they are inclined to influence managers to focus on short-term value rather than long-term performance so that interests to be repaid are assured. Karim et al. (2021) find capital expenditure ($CAPEX_{it}$), measured by the ratio of capital expenditure to sales, has a positive association with greenhouse gas disclosure, which could be explained by the fact that corporations with higher capital intensity are likely to make green investments. Introducing new and energy-efficient technologies, for example, helps to reduce carbon emission and motivate companies to disclose more relevant information on carbon footprint. Furthermore, we also add environmental performance as reflected by the carbon emission (intensity) ($CARPEF_{it}$) to our empirical model because both agency theory and political cost theory argue that environmental performance is an important driver of carbon disclosures. Investors may also invest in firms with certain environmental performance and policies (Haque and Ntim, 2020; Khan et al., 2022). This variable is measured by the natural logarithm of carbon

performance (emissions)⁵. Last, the inclusion of the industry dummy variable (*IND_DUM_t*) is expected to control the variation of corporate environmental engagement across different sectors. In particular, firms belonging to environmentally sensitive industries such as oil, gas, electricity, chemicals, and industrials take the values 1 and 0 because they are more closely connected to environmental and social issues (Alsaifi et al., 2020). All variables are winsorized at 1%–99% to minimize the impact of outliers. We employ year fixed effect and cluster errors at firm level in some of our tests. *Table 1* presents the details of all variables.

[Insert Table 1]

Table 2 reports the summary of descriptive results of all variables used in the regression model. The mean of *Green-Disc* is 48.88 with a standard deviation of around 23.92, indicating a large variance across the observed companies regarding voluntary carbon disclosure. It is evident that some firms tend to voluntarily disclose carbon information to enhance organizational transparency and accountability over this six-year period, but there could be a significant room for consistent improvement of the level of discretionary carbon disclosure in response to the request from investors in the future. With respect to the independent variables, The total institutional ownership variable shows a mean (median) of 67% (69%). When taking the investment horizons into account, our statistics show that short-oriented institutional shareholding accounts for a considerable percentage of total outstanding shares (63%) with a maximum of 90% and a minimum of 13% on average, while the proportion of shares held by long-term institutional owners appears at a relatively small average (3%), which manifests in short-term institutional shareholders controlling most of the S&P 500 corporations. Compared to institutional ownership, governments own a smaller percentage of shares (2%), representing limited state participation in the sample companies. The presence of managerial investors with a mean proportion of 3% implies that executive managers are likely to be incentivized by a portion of stockholding to align interests between shareholders and managers. The average of block-holder ownership amounts to 27%, and its standard deviation is 0.12, suggesting that no majority ownership in most S&P 500 companies but the existence of a certain proportion of controlling shareholders could impact firms' decision-making on carbon initiatives (Buerthey, 2021).

[Insert Table 2]

⁵ We also employ other alternative proxies for carbon performance such as carbon emissions scaled by sales or carbon emissions scaled by total assets. The findings are all consistent, but for brevity, the results will be only provided upon request.

Table 3 reports that correlation coefficients of other pairs are low (within accepted limits of 0.8), which implies that there are no serious multicollinearity problems if we add all variables into the same empirical models. This is supported by unreported low variance inflation factors ($VIF < 10$).

[Insert Table 3]

5. Empirical Results

5.1. Main findings

Table 4 reports our regression results on the relationship between ownership and climate change reporting. Panel A (Models 1–5) reports the results when all independent variables are measured in the form of zero-year lag fashion while Panel B (Models 6–10) shows those in the form of one-year lag fashion. The latter helps to reduce the endogeneity (i.e., simultaneity) problem. Generally, across all models, we find consistent results that institutional investors (*INS*), short-term (*SHORTINS*) and long-term (*LONGINS*) institutional investors⁶, managerial shareholders (*MANAGERIAL*), and block-holder ownership (*BLOCK*) have significantly negative associations with the level of carbon disclosure. This provides clear evidence that corporate ownership structures represent a major factor of firms' activism regarding climate change reporting.

We explain the negative effect of institutional shareholders (total, short-term and long-term) on carbon disclosure in two-fold. First, this type of shareholder discourages releasing sensitive voluntary information to maximize their private benefits at the cost of other stakeholders, which increases the agency problem (Shleifer and Vishny, 1997; Juhmani, 2013). This is because institutional investors can request and access internal sources of information directly from the firm and its managers (Tsamenyi et al., 2007). More specifically, institutional ownership holding a majority of shares is seen as more sophisticated and experienced in accessing relevant information. It signifies large institutional shareholders, no matter what their time horizons of investment are, are more likely to enjoy their privilege of acquiring internal sources of information, leading to a lower level of attention to voluntary carbon disclosure (El-Diftar et al., 2017). Second, another potential factor contributing to the negative relation is the shifted interest focus of institutional shareholders. Acar et al. (2021) argue that institutional owners tend to have short-run horizons attributed to tremendous pressure to deliver returns to their constituents quarterly. Similarly, institutions are short-term to a great extent, placing more

⁶ As the results on institutional investors and those on institutional ownership with investment horizons are similar, for brevity, from the next section and following tests, we only examine the latter including short-term and long-term institutional investors.

emphasis on short-term financial benefits rather than the long-term value of social and environmental projects.

The results on managerial ownership support our fourth hypothesis (H_4) that this type of ownership is significantly associated with voluntary carbon disclosure. We find a negative direction, which can be justified that managerial owners may not want to disclose more voluntary climate change information, such as carbon performance, as it may contain sensitive information that may harm the business and managers in the short run.

The results support the last hypothesis (H_5) that ownership concentration is negatively associated with carbon proactivity. We explain this result for two reasons. First, a low concentration of shareholders is likely to call for more active and transparent disclosure of carbon information because the dispersed ownership, without dominant powers to control management, results in information asymmetry. Accordingly, more environmental disclosure is expected to alleviate potentially higher agency costs arising from the asymmetric information problem. Second, if block-holders who own a substantial proportion of shares in a company shift their investment decisions from pursuing economic interests towards long-term values such as social and environmental activities, it could give rise to the free-rider problem that other stakeholders holding a minority of stocks may benefit at the cost of block ownership's gains. Hence, to protect their financial interests, concentrated shareholders are not inclined to force corporate carbon initiatives. Our results are in line with a handful of studies (e.g., Brammer and Pavelin, 2008; Garcia-Meca and Sanchez-Ballesta, 2010; Zheng et al., 2014; Dam and Scholtens, 2013) that find a negative relationship between concentrated ownership and carbon disclosure projects because more significant stakes held by certain types of investors tend to decrease the need for public accountability and transparency.

Conversely, we find that state ownership (*STATE*) is significantly and positively associated with *Green-Disc*, suggesting that a higher proportion of government shareholdings induces increased environmental proactivity and improved carbon disclosure, which supports H_3 and is consistent with prior literature (Rudyanto, 2017; Lee et al., 2017). We explain that state ownership has higher expectations towards corporate environmental proactivity than general institutional ownership (Earnhart and Lizal, 2006). Therefore, in line with *political cost* theory (Watts and Zimmermann, 1978), managers appear concerned with political considerations. As such, they may decide to disclose more carbon information to minimize the potential political costs arising from the interaction between firms and their natural and societal environment (Fields et al., 2001; Gamerschlag et al., 2011). In addition, the voluntary nature of carbon disclosure reveals the social responsibility, stimulating

governmental members on the board to demonstrate their efforts about reporting more carbon information to the community. Therefore, the state with an explicit objective to enhance green and sustainable development is empowered to supervise managers to improve the proactivity and transparency of carbon disclosure to minimize the potential political cost. This is particularly true for enterprises in environmentally sensitive sectors where environmental concerns and possible costs are the priority of operational agendas (Acar et al., 2021).

Regarding control variables, we find consistent results with the prior research. For example, board independence, board gender diversity, and CSR committee seem to primarily affect a firm's environmental activism to disclose relevant information. These results imply that board characteristics play a more significant role in managing greenhouse gas information. A board with more independent commissioners and female directors is more likely to elevate the level of voluntary carbon disclosure for the sake of various stakeholder expectations (Saraswati et al., 2021). The introduction of these control variables, however, may partially neutralize the pressure from different types of corporate ownership (De Villiers et al., 2011).

[Insert Table 4]

5.2. *Environmentally sensitive industries versus non-environmentally sensitive industries*

In line with Liao et al. (2015), carbon-intensive (or environmentally sensitive) sectors such as energy, materials, utilities, chemistry, and pharmaceuticals viewed as major greenhouse gas emitters are subject to more rigorous policies and regulations than less-intensive industries. In this section, we examine whether and how the ownership structures affect voluntary carbon disclosure in the environmentally sensitive industries compared to the non-environmentally sensitive industries. Results are reported in *Table 5* (Panel A and Panel B). We find that the results found in *Table 4* on short-term institutional investors, as well as managerial owners, remain unchanged for both sub-samples of environmentally sensitive industries and non-environmentally sensitive industries. However, we further find that the results of long-term institutional shareholders are more pronounced in the non-environmentally sensitive industries. In contrast, in environmentally sensitive industries, long-term institutional shareholders have a significant and positive association with carbon disclosures. Possibly, firms in environmentally sensitive industries may be forced by these shareholders to disclose more due to poor carbon performance or a lack of disclosures. We also find that the positive results on state ownership are driven by the firms operating in the environmentally sensitive industries, while the negative results on block-holders are more pronounced in their non-environmentally sensitive peers. We

argue that the environmentally sensitive industries should receive more substantial, constraining, and strict regulatory institutions. Therefore, the role of state shareholders is clearer for environmentally sensitive firms, while the role of block-holders (as a substitute for statutory controls) is crucial in monitoring a firm's carbon initiatives when carbon regulations are insufficient in less-intensive industries. The results reflect a strong monitoring mechanism (owing to ownership structure) of controversial industry sectors in relation to environmental activities, where the CSR engagement helps to reduce firm risk (Jo and Na, 2012) and CSR engagement of firms in controversial industries positively affects firm value (Cai et al., 2012).

[Insert Table 5]

5.3. *The role of climate governance quality*

We argue that corporate governance mechanisms may influence the effect of ownership structures on climate change reporting because they are found to have essential roles in carbon disclosure and carbon emission performance (see among many others, Ben-Amar et al., 2017; Bui et al., 2020; Moussa et al., 2019; Haque et al., 2017). In line with prior research suggesting that corporate performance can be explained by factors such as firm-specific resources and capabilities (Amit and Schoemaker, 1993), a firm could establish internal structures/processes to develop its specific competencies and adapt to changing strategic needs. Climate change research based on such a view (e.g., Albitar et al., 2023) has argued that the existence of an *environmental committee* could constantly push for a firm's environmental policy, which could institutionalise climate change governance forming the corporate ability to address issues related to climate change. Similarly, *climate-based compensation packages paid for management teams* could be a corporate strategy to incentivise self-interested executives to engage in carbon reduction and disclosure. In addition, firms producing corporate social responsibility (CSR) reports should exhibit their resources and capability to commit to issues related to climate change because CSR reports are argued to be more comprehensive and contain better-quality information (Romero et al., 2019). Taken together, we contend that integrating climate change issues at the board level might represent a firm's commitment to tackling climate change (e.g., climate change reporting) because the transition from traditional to climate governance could strengthen the firm's competitive advantages and ultimately enhance its performance (e.g., Haque et al., 2017). Recently, Albitar et al. (2023) find a positive association between climate governance and corporate commitment to climate change.

In this study, we follow Bui et al. (2020) and Albitar et al. (2023) to construct a climate governance index (*CLIMATE_GOV*) including three components: *a board-level environmental committee* (i.e., this board's primary role is to discuss and promote ecological issues; it is measured by a dummy variable denoting a value of one if the firm has the committee and zero otherwise); *climate-based compensation packages for management teams* (i.e., this is an incentive linked to environmental issues; it is measured by a dummy variable denoting a value of one if the firm has offered incentives for individual management of climate change issues and zero otherwise); and *sustainability reporting* (i.e., this is the sustainability reports issued by firms; it is measured by a dummy variable denoting a value of one if the firm has published the sustainability report and zero otherwise). These components of *CLIMATE_GOV* are collected from Thomson Reuters, and the range of the composite *CLIMATE_GOV* index is (0-3). We then create the interaction terms between the index and five types of ownership and re-test them with the main empirical models. We report the moderating effects of climate governance quality on the relationship between ownership structures and climate change reporting in Table 6. In line with our expectations, we find significant evidence of such impacts for two types of ownership: Long-term institutional investors (*LONGINS*) and Block-holder ownership (*BLOCK*). More specifically, we find that the observed adverse effects of *LONGINS* and *BLOCK* have turned positive after interacting with the *CLIMATE_GOV* moderator. This result suggests that better climate governance quality motivates long-term institutional investors and block-holder owners to force businesses to perform at higher levels of voluntary carbon disclosure. Impacts on other ownership types are insignificant and unclear.

[Insert Table 6]

6. Robustness Analysis

6.1. Effect of Ownership Structure on Carbon Emissions

We use a broad-based environmental performance index to measure a firm's activism in updating decarbonization targets, the trajectory of greenhouse gas emission in business, and climate disclosure by replacing the *GreenDisc_{it}* with the carbon emissions (*CARPEF*) obtained from the Refinitiv Datastream. Haque (2017) argues that using alternative measures of dependent variables helps to deal with endogeneity issues and confirm empirical evidence. Moreover, the potential endogeneity issues may cause spurious correlations between corporate ownership structures and voluntary carbon disclosure, which is not conducive to the

interpretation and generalizability of results. The results are reported in *Table 7*, which generally show that firms with a larger percentage of short-term institutional and block shareholders (state shareholders) have lower (higher) levels of carbon emissions.

[Insert Table 7]

6.2. Self-selection bias and endogeneity treatments

To address the potential endogeneity problems and sample selection bias, this study conducts different tests including (i) two-step system generalized method of moments estimations (Ali et al., 2023; Trinh et al., 2020); (ii) Two-stage least square estimations (Elnahass et al., 2020; Safiullah & Shamsuddin, 2019; Trinh et al., 2021); (iii) Heckman two-stage estimations (Heckman, 1979) and (iv) Propensity score matching (Phung et al., 2022; Qiao et al., 2023; Trinh et al., 2021). For brevity, we report these additional tests' results in the Online appendix. Overall, the results show that our main results generally remain unchanged, implying that our main findings are robust after capturing several issues related to unobserved heterogeneity, simultaneity, and dynamic endogeneity.

7. Conclusion

Motivated by the growing public concern about climate change and carbon practices, this study has examined the effects of different types of ownership on the level of voluntary carbon disclosure. Based on relevant theoretical perspectives, including agency theory and political cost theory, investigating diverse corporate carbon disclosure ownership drivers is intended to extend prior research.

Using firm-level data from a sample of the S&P 500 index from 2015 to 2020, the empirical findings suggest a strong positive correlation between state ownership and climate change reporting presented by discretionary greenhouse gas disclosure. On the contrary, the involvement of institutional and managerial shareholders and block-holders inversely impacts corporate proactivity of carbon disclosure. Surprisingly, short-term and long-term institutional ownership negatively impact voluntary carbon disclosure, suggesting that institutional investors may not encourage businesses to disclose environmentally sensitive information, possibly because they can access this information privately.

Furthermore, we consider industry effects as one of the control variables to moderate the relationship between ownership structures and environmental disclosure, particularly in the case of carbon-sensitive sectors due to rigorous policies and regulations. Therefore, these empirical findings shed light on the need for a better understanding of the different impacts of

ownership structures on a firm's carbon activities. Prior studies have explored various aspects of ownership structure concerning CSR, voluntary disclosure (Khlif et al., 2016), or voluntary political disclosure (i.e., Ali et al., 2022). Our findings complement the existing evidence by comprehensively connecting ownership structure with voluntary climate change reporting. We find that different types of ownership cause dissimilar impacts on voluntary climate change reporting.

Our study offers valuable insights and several implications for relevant parties at a practical level. First, managers and public authorities acting in strategic decision-making roles and oversight provisions are expected to identify prominent investors willing to foster corporate proactivity on carbon disclosure. For instance, institutional shareholders with large ownership sizes or managerial owners can benefit from the ability to access information directly from the firm and its management by discouraging businesses from disclosing voluntary climate change-related information. In contrast, firms with governmental ownership seem to commit to disclosing more carbon performance information to avoid political costs caused by their environmental involvement. Second, we confirm a significant contribution of the government in response to climate change disclosure by encouraging businesses to disclose more carbon-related information. State ownership, such as government or other governmental institutions, represents an essential shareholder with the aim of keeping political, social, and environmental alignment. Therefore, governmental ownership can balance the economic interest/focus of other shareholders with the social and ecological commitment of the business (Lopatta et al., 2017). Third, findings from our work also have implications for regulators and stakeholders concerning the negative impact of managerial ownership and block-holders on the voluntary disclosure of climate change-related information. The regulators and policymakers should prevent corporate managers from holding a significant proportion of shares to eliminate the negative impact on carbon disclosure.

Despite such contributions, this study has some limitations, providing potential implications for future research. First, although our sample size is sufficient, it mainly includes the US large-sized companies, neglecting small- and medium-sized firms and firms from other countries. Therefore, future studies can deal with different sizes of firms and conduct a cross-country analysis. Second, this paper does not consider some types of ownership due to data availability, such as foreign shareholders (Garanina and Aray, 2021) or family owners (Nekhili et al., 2017). For example, as Garanina and Aray (2021) highlight, foreign ownership is essential in enhancing the disclosure of a firm's performance in the environmental, social, and governance dimensions; future studies can explore those types of shareholders further to

investigate diverse ownership impacts on climate change reporting. Finally, future studies of the US context can also consider whether there are any differences among states in relation to regulations and policies regarding carbon performance.

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Tables

Table 1:

Variable definition and measurements

This table reports the variable definition and measurements.

Variables	Descriptions	References
<i>Green-Disc</i>	This variable representing corporate efforts to respond to global warming and climate change is measured by carbon disclosure scores from the CDP website.	Al Amosh and Khatib (2021)
<i>INS</i>	Percentage of shares held by short-term and long-term institutional investors	Ilhan et al. (2020); El-Diftar et al. (2017)
<i>SHORTINS</i>	Percentage of shares held by short-term institutional investors	Ilhan et al. (2020); El-Diftar et al. (2017)
<i>LONGINS</i>	Percentage of shares held by long-term institutional investors	García-Meca and Pucheta-Martínez (2018)
<i>STATE</i>	Percentage of shares held by government	Rudyanto (2017); Lee et al. (2017)
<i>MANAGERIAL</i>	Percentage of shares held by CEO and executive directors	Shan et al. (2021); Paek et al. (2013)
<i>BLOCK</i>	Percentage of shares held by shareholders who own 5% or more total of shares	Zheng et al. (2014)
<i>NED</i>	Percentage of independent directors on the board	Saraswati et al. (2021)
<i>GENDER</i>	Percentage of female directors on the board	Buertey (2021)
<i>BOD_SIZE</i>	The number of directors serving on the board	Muttakin and Subramaniam (2015)
<i>COM_DUM</i>	A dummy variable that is equal to 1 if the firm has the CSR committee and 0 otherwise	Liao et al. (2015)
<i>F_SIZE</i>	The natural logarithm of total assets	Borghei (2021)
<i>ROA</i>	Return on assets	Nishitani et al. (2017)
<i>DEBT</i>	The ratio of total liabilities divided by total assets	Chithambo and Tauringana (2014)
<i>CAPEX</i>	The ratio of capital expenditure to sales	Karim et al. (2021); Yin et al. (2019)
<i>IND</i>	A dummy variable that is equal to 1 if the firm belongs to environmentally sensitive sector and 0 otherwise	Kouloukoui et al. (2021)
<i>CARPEF</i>	The natural logarithm of carbon performance (emissions)	Haque and Ntim (2020); Khan et al. (2022)
<i>CLIMATE_GOV</i>	Climate governance index, which includes three components: a <i>board-level environmental committee</i> (i.e., this board's primary role is to discuss and promote ecological issues; it is measured by a dummy variable denoting a value of one if the firm has the committee and zero otherwise); <i>climate-based compensation packages for management teams</i> (i.e., this is an incentive linked to environmental issues; it is measured by a dummy variable denoting a value of one if the firm has offered incentives for individual management of climate change issues and zero otherwise); and <i>sustainability reporting</i> (i.e., this is the sustainability reports issued by firms; it is measured by a dummy variable denoting a value of one if the firm has published the sustainability report and zero otherwise).	Bui et al. (2020); Albitar et al. (2023)
IV(OWNERSHIP)	Year-average of each ownership variable of other firms in the country as an IV for the pertinent firm.	John et al. (2008); Laeven and Levine (2009); Aggarwal et al. (2010); Anginer et al. (2014); Safiullah & Shamsuddin (2019).

Table 2:

Descriptive statistics

This table reports the descriptive statistics of all main variables

	N	mean	p50	std	min	max
Green-Disc	1404	48.88	45.00	23.92	15.00	100.00
INS	1357	0.67	0.69	0.16	0.14	0.95
SHORTINS	1379	0.63	0.66	0.16	0.13	0.90
LONGINS	1376	0.03	0.03	0.01	0.01	0.07
STATE	1398	0.02	0.00	0.02	0.00	0.06
MANAGERIAL	1378	0.03	0.01	0.06	0.00	0.22
BLOCK	1381	0.27	0.24	0.12	0.12	0.72
NED	1394	0.68	0.67	0.08	0.50	0.90
GENDER	1392	0.24	0.25	0.09	0.00	0.42
BOD_SIZE	1404	9.73	10.00	1.73	5.00	14.00
COM_DUM	1404	0.09	0.00	0.29	0.00	1.00
F_SIZE	1381	3.88	3.78	0.58	2.65	5.51
ROA	1380	0.13	0.13	0.05	0.03	0.31
DEBT	1379	0.65	0.67	0.22	0.15	1.06
CAPEX	1384	0.03	0.03	0.02	0.01	0.12
CARPEF	1042	12.91	12.58	2.02	9.39	17.60
IND_DUM	1404	0.36	0.00	0.48	0.00	1.00
CLIMATE_GOV	1370	1.74	2	0.97	0	3

Table 3:

Correlation matrix

*This table reports the Pearson correlation matrix among all variables. * denotes the significance level at 5%*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Green-Disc	1																
(2) INS	-0.1650*	1															
(3) SHORTINS	-0.1573*	0.9972*	1														
(4) LONGINS	-0.1510*	0.3812*	0.3113*	1													
(5) STATE	0.1883*	-0.0076	-0.0083	-0.0129	1												
(6) MANAGERIAL	-0.1900*	-0.3164*	-0.3307*	0.1545*	-0.2378*	1											
(7) BLOCK	-0.3475*	-0.2331*	-0.2485*	-0.1787*	-0.1516*	0.1099*	1										
(8) NED	0.3410*	-0.1273*	-0.1130*	-0.0709*	0.0558*	0.1382*	-0.1999*	1									
(9) GENDER	0.4149*	-0.0389	-0.0328	0.0305	0.2308*	-0.2879*	-0.1832*	0.1698*	1								
(10) BOD_SIZE	0.2909*	-0.0156	-0.0142	-0.0164	0.1365*	-0.1561*	-0.1521*	0.2036*	0.4363*	1							
(11) COM	0.3876*	-0.2507*	-0.2358*	-0.0216	0.1435*	-0.0359	-0.2057*	0.3527*	0.2600*	0.1070*	1						
(12) F_SIZE	0.4053*	-0.1563*	-0.1572*	-0.0955*	0.1127*	0.0970*	-0.2982*	0.2077*	0.1886*	0.2789*	0.2396*	1					
(13) ROA	0.3064*	-0.1582*	-0.1658*	0.0841*	0.0946*	0.1310*	-0.2260*	0.2182*	0.2770*	0.2972*	0.3142*	0.4135*	1				
(14) DEBT	-0.3846*	0.2208*	0.2183*	0.1287*	-0.0011	-0.0503	0.0632*	-0.1609*	-0.0761*	-0.2317*	-0.2319*	-0.4069*	-0.3468*	1			
(15) CAPEX	0.3770*	-0.3093*	-0.2910*	-0.1824*	0.0184	0.2162*	-0.1365*	0.2860*	0.1184*	0.2472*	0.3132*	0.5444*	0.4216*	-0.6477*	1		
(16) CARPEF	-0.1072*	0.1657*	0.0164	0.0539	-0.0185	0.0513	-0.0585	-0.001	0.0204	-0.0335	-0.0800*	0.0479	0.0424	0.0514	0.024	1	
(17) IND	-0.3458*	0.9972*	0.1766*	0.0538*	-0.0264	-0.015	0.1807*	-0.1000*	-0.1339*	-0.0903*	-0.1037*	-0.1448*	-0.2105*	0.2111*	-0.1334*	0.1204*	1

Table 4:

Corporate ownership structure and voluntary greenhouse gas disclosure

This table reports the OLS regression results in the relationship between corporate ownership structure and voluntary greenhouse gas disclosure. ***, **, and * denote the significance level at 1%, 5% and 10%, respectively.

	Panel A: 0-year lag fashion of independent variables					Panel B: One-year lag fashion of independent variables				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>
INS	-0.202*** (0.000)					-0.273*** (0.000)				
SHORTINS		-0.485*** (0.000)	-0.265*** (0.000)	-0.182*** (0.000)	-0.182*** (0.002)		-0.560*** (0.000)	-0.331*** (0.000)	-0.231*** (0.000)	-0.231*** (0.000)
LONGINS		-2.108*** (0.000)	-0.970* (0.059)	-0.784 (0.109)	-0.784 (0.191)		-2.320*** (0.000)	-1.680*** (0.002)	-1.502*** (0.004)	-1.502** (0.023)
STATE	1.749*** (0.001)	2.684*** (0.000)	1.966*** (0.000)	1.729*** (0.000)	1.729*** (0.001)	1.372** (0.024)	1.661*** (0.006)	1.544*** (0.004)	1.296** (0.014)	1.296** (0.039)
MANAGERIAL	-0.571*** (0.000)	-0.676*** (0.000)	-0.489*** (0.000)	-0.520*** (0.000)	-0.520*** (0.000)	-0.636*** (0.000)	-0.742*** (0.000)	-0.498*** (0.000)	-0.533*** (0.000)	-0.533*** (0.001)
BLOCK	-0.475*** (0.000)	-0.836*** (0.000)	-0.585*** (0.000)	-0.481*** (0.000)	-0.481*** (0.000)	-0.498*** (0.000)	-0.841*** (0.000)	-0.625*** (0.000)	-0.511*** (0.000)	-0.511*** (0.000)
NED	0.421** (0.013)		0.396*** (0.000)	0.415*** (0.000)	0.415** (0.014)	0.367** (0.034)		0.330*** (0.005)	0.359*** (0.002)	0.359** (0.038)
GENDER	0.549*** (0.000)		0.600*** (0.000)	0.557*** (0.000)	0.557*** (0.000)	0.377*** (0.000)		0.442*** (0.000)	0.394*** (0.000)	0.394*** (0.000)
BOD_SIZE	0.001 (0.878)		-0.000 (0.972)	0.001 (0.852)	0.001 (0.911)	0.003 (0.635)		0.001 (0.768)	0.002 (0.588)	0.002 (0.727)
COM	0.056* (0.057)		0.050** (0.010)	0.060*** (0.002)	0.060** (0.048)	0.053* (0.094)		0.049** (0.018)	0.063*** (0.002)	0.063* (0.054)
F_SIZE	0.038** (0.046)		0.038*** (0.001)	0.039*** (0.001)	0.039** (0.046)	0.053*** (0.007)		0.054*** (0.000)	0.053*** (0.000)	0.053*** (0.008)
ROA	-0.444** (0.045)		-0.281* (0.069)	-0.420*** (0.007)	-0.420* (0.056)	-0.732*** (0.005)		-0.495*** (0.008)	-0.679*** (0.000)	-0.679*** (0.010)
DEBT	-0.138** (0.035)		-0.183*** (0.000)	-0.139*** (0.000)	-0.139** (0.032)	-0.094 (0.157)		-0.160*** (0.001)	-0.096** (0.026)	-0.096 (0.142)
CAPEX	1.952** (0.025)		1.451** (0.013)	1.859*** (0.001)	1.859** (0.034)	3.224*** (0.000)		2.270*** (0.000)	3.034*** (0.000)	3.034*** (0.001)
CARPEF	-0.013*** (0.004)		-0.015*** (0.000)	-0.013*** (0.000)	-0.013*** (0.004)	-0.011** (0.012)		-0.014*** (0.000)	-0.011*** (0.000)	-0.011** (0.014)
IND	-0.085***			-0.085***	-0.085***	-0.098***			-0.097***	-0.097***

	(0.000)			(0.000)	(0.000)	(0.000)			(0.000)	(0.000)
Constant	0.441**	1.085***	0.584***	0.450***	0.450***	0.518***	1.211***	0.704***	0.537***	0.537***
	(0.011)	(0.000)	(0.000)	(0.000)	(0.009)	(0.003)	(0.000)	(0.000)	(0.000)	(0.002)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered at firm level	Yes	No	No	No	Yes	Yes	No	No	No	Yes
Observations	893	1,307	893	893	893	715	1,097	715	715	715
R2	0.555	0.276	0.531	0.556	0.556	0.548	0.287	0.520	0.552	0.552
Wald Chi 2 (p-value)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Table 5:

Environmentally sensitive industries *versus* non-environmentally sensitive industries

*This table compares the relationship between corporate ownership structure and voluntary greenhouse gas disclosure between environmentally sensitive industries versus non-environmentally sensitive industries. ***, **, and * denotes the significance level at 1%, 5% and 10%, respectively.*

VARIABLES	Panel A: Environmentally sensitive industries		Panel A: Non-environmentally sensitive industries	
	(1)	(2)	(3)	(4)
	<i>0-year lag fashion of independent variables</i>	<i>One-year lag fashion of independent variables</i>	<i>0-year lag fashion of independent variables</i>	<i>One-year lag fashion of independent variables</i>
	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>	<i>Green-Disc_t</i>
SHORTINS	-0.181*	-0.205**	-0.227***	-0.274***
	(0.059)	(0.038)	(0.003)	(0.002)
LONGINS	2.142**	2.021**	-1.390*	-2.776***
	(0.048)	(0.040)	(0.079)	(0.002)
STATE	3.315***	4.254***	0.411	-0.893
	(0.000)	(0.000)	(0.578)	(0.303)
MANAGERIAL	-0.351*	-0.578***	-0.722***	-0.571**
	(0.082)	(0.002)	(0.000)	(0.018)
BLOCK	0.001	-0.038	-0.638***	-0.713***
	(0.996)	(0.723)	(0.000)	(0.000)
NED	0.652***	0.827***	0.288	0.151
	(0.009)	(0.001)	(0.152)	(0.458)
GENDER	0.359**	0.116	0.621***	0.402***
	(0.025)	(0.502)	(0.000)	(0.001)
BOD_SIZE	0.001	-0.004	-0.001	0.011
	(0.901)	(0.704)	(0.893)	(0.277)
COM	0.187***	0.187**	0.040	0.075***
	(0.010)	(0.032)	(0.169)	(0.009)
F_SIZE	0.084***	0.069**	0.020	0.046*
	(0.001)	(0.016)	(0.432)	(0.069)
ROA	-0.763***	-0.726**	-0.041	-0.694*
	(0.006)	(0.021)	(0.897)	(0.084)
DEBT	-0.074	0.037	-0.077	-0.076
	(0.396)	(0.668)	(0.359)	(0.378)
CAPEX	4.609**	5.530***	2.164**	2.916***
	(0.015)	(0.003)	(0.047)	(0.008)
CARPEF	-0.002	-0.007	-0.017***	-0.013**
	(0.686)	(0.262)	(0.005)	(0.037)
Constant	-0.410*	-0.347	0.672***	0.789***

	(0.087)	(0.160)	(0.007)	(0.002)
Year fixed effect	Yes	Yes	Yes	Yes
Clustered at firm level	Yes	Yes	Yes	Yes
Observations	339	268	554	447
R2	0.594	0.583	0.507	0.515
Wald Chi 2 (p-value)	0.000***	0.000***	0.000***	0.000***

Table 6:

The Effects of Climate Governance Quality

*This table reports the moderating effect of climate governance quality on the relationship between corporate ownership structure and voluntary greenhouse gas disclosure.*****, **, and * denotes the significance level at 1%, 5% and 10%, respectively.*

VARIABLES	(1) <i>Green-Disc_t</i>	(2) <i>Green-Disc_t</i>	(3) <i>Green-Disc_t</i>
SHORTINS	-0.195** (0.036)	0.253 (0.105)	0.021 (0.854)
SHORTINS x CLIMATE_GOV	0.009 (0.840)	-0.058 (0.264)	-0.049 (0.341)
LONGINS	-3.457** (0.014)	-4.392*** (0.002)	-4.935*** (0.002)
<i>LONGINS x CLIMATE_GOV</i>	1.246** (0.045)	1.433** (0.015)	1.777*** (0.010)
STATE	1.516** (0.043)	0.092 (0.885)	1.542** (0.046)
STATE x CLIMATE_GOV	0.093 (0.770)	0.013 (0.952)	-0.023 (0.944)
MANAGERIAL	-0.084 (0.772)	0.281 (0.575)	-0.182 (0.590)
MANAGERIAL x CLIMATE_GOV	-0.208 (0.115)	-0.181 (0.239)	-0.134 (0.378)
BLOCK	-0.798*** (0.000)	-0.337** (0.018)	-0.731*** (0.000)
<i>BLOCK x CLIMATE_GOV</i>	0.159*** (0.002)	0.120** (0.037)	0.123** (0.042)
CLIMATE_GOV	-0.079** (0.027)	-0.039 (0.321)	-0.040 (0.344)
NED	0.426*** (0.000)	0.494*** (0.000)	0.426*** (0.000)
GENDER	0.544*** (0.000)	0.603*** (0.000)	0.548*** (0.000)
BOD_SIZE	0.000 (0.927)	-0.049*** (0.000)	-0.003 (0.543)
COM	0.059*** (0.002)	0.078*** (0.001)	0.059*** (0.006)
F_SIZE	0.042*** (0.000)	0.009 (0.708)	0.027* (0.075)

ROA	-0.412*** (0.009)	0.500** (0.011)	-0.361* (0.059)
DEBT	-0.144*** (0.000)	-0.276*** (0.000)	-0.140*** (0.001)
CAPEX	1.886*** (0.001)	-0.218 (0.786)	2.402*** (0.000)
CARBONPER	-0.013*** (0.000)	0.006 (0.638)	-0.011*** (0.002)
IND	-0.085*** (0.000)	-0.398*** (0.000)	-0.116*** (0.000)
Year fixed effect	Yes	Yes	Yes
Clustered at firm level	No	Yes	No
State fixed effect	No	No	Yes
Constant	0.604*** (0.000)	0.565** (0.011)	0.665*** (0.000)
Observations	888	888	797
R2	0.562	0.869	0.598
Wald Chi 2 (p-value)	0.000***	0.000***	0.000***

Table 7:

Regression results of corporate ownership structures and carbon emissions

*This table reports the regression results on the effects of corporate ownership structures and carbon emissions. ***, **, and * denotes the significance level at 1%, 5% and 10%, respectively.*

	CARPEF _t
SHORTINS	-1.216** (0.032)
LONGINS	4.111 (0.498)
STATE	11.184* (0.062)
MANAGERIAL	0.736 (0.611)
BLOCK	-2.976*** (0.000)
Control variables	Yes
Year fixed effect	Yes
Constant	13.394*** (0.000)
No. of observations	893
R ²	0.086
Wald Chi 2	0.000***

APPENDIX 1:

Sample selection process

This table presents the sample selection process

Steps	No. of companies	Observations
<i>Obtain the list of S&P500 firms</i>	503	3018
<i>Excluding the firms with no data for ownership</i>	269	1614
Final sample	234	1404

APPENDIX 2:

Sample distribution by industry

This table reports the sample distribution and number of companies in each industry.

Global Industry Classification Standard (GICS)	No. of companies	Observations	Percentage
<i>Communication Services</i>	11	66	4.70%
<i>Consumer Discretionary</i>	31	186	13.25%
<i>Consumer Staples</i>	10	60	4.27%
<i>Energy</i>	10	60	4.27%
<i>Health Care</i>	28	168	11.97%
<i>Industrials</i>	26	156	11.11%
<i>Information Technology</i>	37	222	15.81%
<i>Financials</i>	41	246	17.52%
<i>Materials</i>	9	54	3.85%
<i>Real Estate</i>	18	108	7.69%
<i>Utilities</i>	13	78	5.56%
Total	234	1404	100%