

Article

Board Characteristics, Climate Change Disclosures and the Moderating Role of Corporate Governance Code: Evidence from a Developing Economy

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Abstract

This present study aims to investigate the influence of board characteristics on the level of climate change disclosures and the extent to which the implementation of the corporate governance code (CGC) moderates these factors. The ordinary least squares statistical method is used to analyze the panel data. In addition, the Tobit regression model is also estimated to check the robustness of the study findings. This study suggests that larger board sizes, more independent directors, and board meeting frequency are positively associated with higher levels of climate change disclosure. However, the study does not find any association between CEO duality, foreign ownership, and climate change disclosure. In addition, it is also observed that CGC can enhance the influence of board characteristics on the likelihood of disclosing climate information. The study offers necessary directions for regulatory authorities, business firms, and practitioners to be more transparent in disclosing climate information and extends guidelines to tackle climate change disclosure issues.

Keywords: climate change disclosure; board characteristics; corporate governance code (CGC)

1. Introduction

Climate change has attracted growing interest among scholars, researchers, policymakers, and regulators due to its impact of unprecedented ecological tragedies and devastating economic consequences on the planet's ecology and human life in recent decades (Adams et al., 2020; Y. Jiang et al., 2021). Greenhouse gas (GHG) emissions, responsible for creating global warming which instigates climate change, have created serious concerns for the atmosphere, monetary systems, and human life (Varney et al., 2020). More clearly, the excessive amount of greenhouse gas emissions is a major concern for businesses, government, and other stakeholders, affecting the growth of businesses and hampering the natural environment, socio-economic systems, and human life (Sun et al., 2020; Chakraborty & Sun, 2025). To mitigate the environmental effects on business and nature, various international and national initiatives, such as the 2015 Paris Agreement and the 1997 Kyoto Protocol, have served as catalysts for shifts in business strategies toward reducing global warming (Luo & Tang, 2021).

Despite the growing significance of climate change and global initiatives for reducing environmental effects and business risks, corporate organizations are facing mounting



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pressure from stakeholders. This is consistent with the claim (Newman et al., 2023) that a firm's financial statement disclosure of climate change information is linked to an effort to raise awareness of the issue and is also reflected in the operations of the company. Due to the growing impact of climate change on biological systems and afterward on business, (Attenborough, 2022) urges that a lack of transparent, nonfinancial information, such as climate change and other environmental disclosures, may create a risk for companies, investors, and the financial system. Such risk can dwindle the firm's profitability, subject it to fierce competition from its competitors because of higher operational costs, and lead to less demand, a decline in goodwill and reputation, and higher litigation expenses (Miller et al., 2020). As a result, investors worldwide are now more aware of their investments and returns and are conscious about investing in environmentally friendly business projects. These business approaches with an emphasis on reducing carbon emissions responsible for climate change are globally documented as being of the highest importance by shareholders in the corporate world (Uyar et al., 2020). To address these issues, firms' strong corporate governance (CG) practices and board characteristics have been proven to be a strong mechanism to create pressure on business firms toward implementing necessary disclosure practices to reduce business risks, greenhouse emissions, and other effects on the environment.

The purpose of this study is to investigate how board composition affects the disclosure of climate data. In addition, the study also examines whether corporate governance (CG) principles and conditions have any impact on the disclosure of climate data. Particularly, the study wishes to determine whether the release of climate information is impacted in any way by the corporate governance code (CGC, 2018) that was revised by the Bangladesh Security Exchange Commission (BSEC). Prior studies extended research findings on such an association in the settings of both developing and developed countries. In this regard, (Liu, 2024) found an association between companies with independent directors and with female board members on the board and achieving higher Corporate Environmental Performance (CEP) scores. Especially, firms with larger shareholders and more balanced ownership structures including foreign shareholders follow the resource provision mechanism to influence firms' (ESG) performance and activities to mitigate environmental loss (F. Jiang et al., 2024). According to a new study on the listed firms of the Indonesian Stock Exchange (IDX), governance characteristics positively improved both carbon emission disclosure and performance (Wahyuningrum et al., 2025). Surprisingly, limited studies have been done on the impact of the above-mentioned board characteristics on climate change disclosure and also the moderating roles of corporate governance code (CGC, 2018) on disclosing climate information in the context of Bangladeshi listed firms with polluted industries (Dhar et al., 2021; Saha & Khan, 2024). This study wants to fill this literature gap from the study findings by examining the influence of various board characteristics on climate change disclosures.

The present study focuses on Bangladesh, as this country is now heavily dependent on fossil fuels. Consequently, GHG emissions have also increased due to high industrialization and rapid urbanization, along with adverse environmental and public health consequences. The Dhaka Stock Exchange (DSE) listed business firms are chosen because they follow corporate and institutional practices, have comparatively higher economic performance, and are better equipped to implement proactive environmental management initiatives. For example, despite these better economic activities, the lack of proper advanced waste management systems, unsustainable behavior of textile industries, and even the textile factory disaster in Bangladesh caught the attention of global investors regarding their commitments to uphold the environment-first business philosophy, causing a negative impact on FDI and business growth (Siddiqui & Uddin, 2016). The lack of strong corporate institutional guidelines and the absence of business firms' in-house corporate governance

and disclosure practices, which could have prevented such an environmental disaster, make this study more justifiable and a timely initiative for Bangladeshi firms.

The study finds that corporate climate change disclosure is positively correlated with larger board sizes and more independent directors, based on a sample of 475 firm-year data from 2018 to 2022 for Bangladeshi companies listed on the DSE. The credentials and backgrounds of the independent directors on the board are highlighted in the revised code. Similarly, foreign ownership and CEO duality on the board do not prove the dissemination of climate-related information. On the other hand, board meeting frequency positively affects climate information. In addition, the moderating effects of the corporate governance code on climate disclosure are also found to be effective.

This paper pays attention to and contributes to the existing literature in several ways. First, earlier research examines how corporate governance affects different firm characteristics and performance (Bhuyan, 2018). On the other hand, the moderating impacts of corporate governance code on climate change disclosure and board features are included in this study. More precisely, as a unique study, it looks at how a company's board features relate to the climate change disclosures of a business concern and whether or not such aspects affect Bangladeshi businesses. Second, this study has chosen Bangladesh because its GDP has grown at its highest and most steady rate over the past few years, from 6.5% a decade ago in 2011 to over 7% shortly before the pandemic emergency. Furthermore, export-oriented ready-made apparel and other foreign investments play a major role in Bangladesh's national economy (Chakraborty & Sun, 2025).

Thus, businesses must follow conventional CSR principles and implement eco-friendly business practices to generate demand for information transparency regarding climate change issues in order to appease these overseas clients. Third, Bangladesh is one of the countries most impacted by climate change, which has already significantly altered the way of life in coastal regions. Additionally, the problem has gotten worse due to inadequate governance structures to oversee environmental activities and environmental transparency, which raises the risk of doing business and increases company losses. Along with the impact analysis of board features in disclosing climate-related information, this study addresses the inconsistencies of corporate governance principles developed in 2018 by the BSEC. More specifically, the results of the study will assist BSEC to add more principles and motivate firms to comply and follow the globally accepted corporate environmental disclosure practices.

In addition, the IFRS Foundation, the Financial Reporting Council (FRC) of Bangladesh, the other regulatory authority of Bangladesh, and developing countries could consider the outcomes of the study while previewing new guidelines to tackle climate disclosure in the background of emerging economies.

2. Literature Review and Hypothesis Development

Using a variety of relevant theoretical frameworks, we found a sizable number of studies done to check the link between corporate governance and its effects on climate disclosure. Legitimacy theory is widely considered a theory that highlights the firm's value as well as societal norms (Suchman, 1995). Tang and Luo (2016) argue that legitimacy theory relies on a social contract that is based on culture, belief, and system between the firms and the people who make up the society in which they operate. It also considers and motivates firms to disclose green information. To uphold the relationship between society and business, environmental disclosure extends an effort to obtain legitimacy from social community groups. In this regard, Deegan (2002) also justifies the importance of the green information of a firm in legitimizing its status within society. Thus, prior studies suggest that legitimacy becomes a resource that a corporation can influence and manipulate through disclosure-related strategies.

On the other hand, agency theory clarifies the interaction between managers, shareholders, and debt holders. The purpose of this theory is to disclose company information to minimize the gap among various information users (Jensen & Meckling, 2019). Generally, the owner of a firm nominates a manager to look after the firm's daily activities and the delegates' strategic and decision-making power. Thus, managers are more answerable than shareholders for social disclosures.

Moreover, as agency theory reduces conflicts between the two parties about various disclosure practices, it also impacts the decision-making process.

2.1. Board Size

Board size influences board efficiency and effectiveness in the case of monitoring compliance with rules and firm performance (Wang et al., 2022). It is anticipated that a large board with numerous members will benefit companies with greater knowledge and experience. Prior studies also confirm similar outcomes and suggest a larger board size (Bose et al., 2018; Akhtaruddin et al., 2009). Agency theory also justifies that due to the connections among shareholders, policymakers, local stakeholders, and their expectation to get maximum company information, a larger board size is appropriate for the dissemination of corporate information.

In contrast, some studies disagree with the above positive correlation and highlight that the lack of communication ability among many people is challenging. Consistent with this argument, other prior studies document that, as disclosing voluntary information requires significant involvement and coordination within managerial activities, it may sometimes create difficulties in the communication of a larger board. Another study on the Singapore Stock Exchange (SGX) by Cheng and Courtenay (2006) found an insignificant relationship.

In the case of the Bangladesh perspective, there are few studies in this field of impact analysis of board characteristics on climate change disclosures. Among them, some studies such as Muttakin et al. (2015) and Chakraborty and Dey (2023) extend positive affiliation and similar outcomes. Considering the conflicting literature with empirical evidence, this study aims to support the following hypothesis:

H1. *Firms with larger board sizes have a significant and positive impact on climate change disclosures.*

2.2. Board Composition

The proportion of independent directors, gender diversity, and nationality of the board members are all considered aspects of board composition. It is known that a diversified board with various characteristics, such as education, age, background, and personalities of the board members, influences board information and manages business complexities systematically. Agency theory emphasizes profit maximization by compromising firms' policies, whereas independent directors, on the other hand, try to improve monitoring, reduce agency conflicts, and improve transparency by ensuring voluntary disclosure.

Prior research findings largely suggest the association between more independent directors and maximum disclosure and transparent corporate reporting (Wang et al., 2022). On the other hand, researchers also claim that such board structures improve the performance of the firms, minimizing extra costs, and leading to the ignoring of additional disclosure. Prior studies by Esa and Anum Mohd Ghazali (2012) on Malaysian firms and another study by Alves (2012) on some Portuguese and Spanish firms report an insignificant relationship.

In the Bangladeshi context, the CG guideline (CGG, 2012) allows the recruitment of independent directors from the board of directors, whereas CGC (2018) prefers to select from the non-executive directors. In an earlier study, Dalton and Dalton (2005) also advocated for the inclusion of non-executive directors, which was supported by (Fernandes et al., 2018). With this reform and improvement in CGC 2018 and emphasis on accommodating more

independent directors in the corporate governance practices in Bangladesh, the following hypothesis is put forward:

H2. *Firms with more independent directors on the board have a significant and positive impact on climate change disclosures.*

2.3. Foreign Ownership

Foreign ownership is the proportion of a firm in which a domestic firm shares ownership with foreign investors receiving foreign investment. A firm with an ownership with diverse languages, values, and nationalities requires more information to satisfy all investors and reduce information asymmetry. Moreover, such firms should concentrate on communication with company shareholders to minimize language barriers and demand more information, which could increase company costs. Drawing from the idea of agency theory, a prior study documents that as foreign investors need more information to understand the company's nature and activities, it may increase the agency costs on the board. Also, language barriers, diverse values, and cultural differences may increase the legitimacy gap within the company (A. Khan et al., 2013). To overcome such issues, the board must follow voluntary disclosure practices to legitimize firm operational activities. However, some prior studies support such activities, whereas others were found to be insignificant. On the other hand, diversity in firm ownership highlights transparency, globally accepted disclosure practices and welcomes more foreign funds. Moreover, geographical differences or country-specific policies may motivate firm owners from different regions towards maximum information disclosures. Both legitimacy theory and agency theory endorse the literature of prior studies and advocate for foreign ownership on the board. In addition, foreign ownership on the board increases the acceptance rate of the companies within the industry and outside the country as they promote transparency and accountability and follow standard corporate governance practices (I. Khan et al., 2019).

In the corporate governance code (CGC, 2018) in Bangladesh, there are no specific rules on foreign ownership, while some studies claim a positive association. A study by A. Khan et al. (2013) and Muttakin et al. (2015) reveals that firms having foreign ownership or directors in the business tends to reveal social disclosure. Considering the above fact, the following hypothesis is made:

H3. *Firms with foreign ownership have a significant and positive impact on climate change disclosures.*

2.4. CEO Duality

CEO duality supports the structure of a firm where the same individual serves as both the board's chairman and CEO, which frequently results in a concentration of power and the expression of dominant personalities, limiting the board's freedom in the policy-making procedure (Dalton & Dalton, 2005). More specifically, CEO duality refers to a corporate governance structure where the same person who acts as chief executive officer, performs daily activities of a company and is involved in strategic decision making, is also a chairperson of the board, evaluates and monitors the board of directors' overall decision-making and performance, and protects the shareholders' interest. In line with the notion of agency, the person holding dual positions may become an opportunist when making decisions. Moreover, by holding the position of chairperson and CEO of a company, as an executive head, the CEO has free access to extra information about the company, which increases the chances of making autocratic decisions and reduces the transparency and accountability of firm disclosure practices, leading to weakening the monitoring power of the board. Prior research findings also disagree with the same person holding dual posts as Chairman or CEO of the board. The Bangladesh Security Exchange Commission (BSEC)

also made it mandatory to fill the two posts with separate persons (CGC, 2018). However, some studies opposed this concept and argued that CEO duality avoids leadership conflicts and reduces information-sharing costs (Samaha et al., 2015). A recent study documents that many successful firms holding two posts simultaneously run businesses (Wang et al., 2022).

From Bangladesh's perspective, Muttakin et al. (2018) did not find any association and revealed that in family-owned businesses, the CEO is given additional power and sometimes other directors are influenced by the CEO's decisions.

H4. *Firms with CEO duality have no relationship with the level of climate change disclosures.*

2.5. Board Meeting Frequency

The scholarly literature claims that the efficiency of the firm and the dexterity of the board members are often measured by the number of meetings arranged to solve various business issues. Generally, a high frequency of meetings allows company directors to share business complexities and improve the company's operation. Frequent meetings address increased competition, business and climate change risks, future expansion, resource collection, and fund allocation properly so that firms can become competitive in the market. Moreover, meetings disseminate and share maximum information with all parties interested in the company's actions. Thus, more board meetings highlight the company's shortcomings, ensure transparency, pacify shareholders' expectations, and help improve financial performance and quality of voluntary disclosures (Karim et al., 2021). In Bangladesh, the importance of board meetings has been mentioned in the CGG, 2012. The corporate governance code (CGC, 2018) added more conditions to keep records of all meeting minutes of the board of directors and preserve registers of meetings for transparency and accountability (Islam et al., 2022).

H5. *Board meeting frequency has a significant and positive impact on climate change disclosures.*

2.6. Moderating Role of Corporate Governance Code

Prior research highlights the effectiveness of corporate governance for better accountability, transparency, and sustainability in a business. Businesses can gain a great deal by improving corporate governance practices like openness, shareholder rights, and the quality of financial and nonfinancial firm information disclosure (Mihail & Dumitrescu, 2021). Therefore, governance reforms have been an issue in the corporate business world, more specifically, for the emerging economy in this cross-border business world.

Given the priority of ensuring effective governance and bringing corporate firms within a compulsory disclosure framework, the BSEC modified guidelines in 2012 and the Corporate Governance Code (CGC) in 2018. Before that, the regulatory authority of Bangladesh's capital market, BSEC, first accommodated the corporate governance guidelines in 2006 with a simple 'comply or explain' approach that led to firms' reluctance to oblige and comply with soft rules (Islam et al., 2022). Later, to bring uniformity and transparency in financial reporting, BSEC updated the corporate governance guidelines by making the rules and level of compliance stricter and mandatory.

However, inconsistencies and vague statements were found in previous guidelines, including regarding board size, independent directors' qualifications, work experience, board meetings, etc. Therefore, due to requirements to bring more clarity in the description of various conditions and principles, such as fixing up the minimum and maximum number of independent directors and their qualifications, the necessity of adding more subcommittees under the board of directors committee, and the inclusion of more specific guidelines about sustainability and environmental disclosures practices, the BSEC further improved and incorporated 62 new conditions under nine heads and three annexures. Later, those conditions were used as the corporate governance code (CGC, 2018) in 2018. Afterwards, firms

are now more obliged to maintain disclosure practices and follow governance principles while preparing annual reports.

From a theoretical point of view, legitimacy theory emphasizes the disclosure of environmental information to fulfill societal expectations (Elleuch Lahyani, 2022). In addition, agency theory explores the risk of concealing environmental information by the managers, which dilutes disclosure transparency (Al-Shaer, 2020). To address these issues, corporate governance principles ensure transparency of disclosure and reduce the chances of financial fraud, like the Enron and WorldCom scandals, which prompted worldwide reforms in corporate governance and accounting practices. Thus, board independence and diverse corporate governance structures promote voluntary disclosure and transparent environmental reporting. In a study on a developed-country perspective, Moses et al. (2020) reveal the same opinion and argue that effective board governance can improve sustainability performance.

H6. *The implementation of the principles of the corporate governance code can enhance the influence of board characteristics on the likelihood of disclosing climate information.*

3. Data and Methods

3.1. Sample and Data

This study collects data from non-financial companies of DSE in the period of 2018–2022 in Bangladesh. This study examines the moderating effects of the CGC, which was modified in 2018, on the propensity to disclose climate-related information. This study selected these particular financial years so that it can be seen whether listed firms of DSE followed the principles and guidelines formulated in 2018, disclosing climate change information accordingly. The reasons behind selecting non-financial companies are their distinct roles and the impact they have on the environment during production. Generally, this study prefers data from pharmaceuticals, cement, energy and oil, and textiles, which are all directly responsible for carbon emissions, whereas financial institutions such as banks, insurance, and telecommunications are involved in financing decisions. There are 115 enterprises in the study's total population, and 20 of those firms were left out because there was no financial data available. After integrating all reliable databases, this study received 475 firm-year observations from various firms (Table 1). Afterwards, a content analysis framework has been applied for examining the annual reports of the companies to test study hypotheses. To examine the social and environmental disclosures in the Bangladeshi context, many previous studies predominantly used annual reports widely, as all listed companies upload their annual reports to the company website. In addition, easy access, reliability, and availability of the source of disclosed information, which is absent in other channels like sustainability reports and director reports, as not all firms prepare such reports, annual reports have been utilized as the basis in studies on environmental disclosures in the Bangladeshi context. In addition, CDP reporting of Bangladeshi firms to disclose voluntary environmental information is still minimal. Moreover, many prior studies opted for this content analysis technique over impact analysis. This technique codifies the qualitative data into categories and generates quantitative scales. To measure disclosure items using various units, including the number of words, sentences, and lines, the climate change disclosure index aligned with the previous literature and GRI guidelines (GRI, 2021), includes codified keywords such as carbon, emission, climate change, greenhouse gas (GHG), sustainability, environmental policy, global warming, etc. under various disclosure items about climate and carbon management policy, waste management and investment, environmental protection strategy, environmental committee and CSR practices, climate education, etc. A grading spreadsheet was created to evaluate the level of climate change disclosure following the creation of a disclosure index with a score of one

(1) if disclosing any climate-related information and zero (0) otherwise. Usually, the climate change disclosure index helps measure the firms' transparency in the case of disclosing or reporting climate-related information, as well as checks firms' commitment toward corporate environmental responsibility. It is also stated that climate change disclosure has several limitations, as different studies use different scoring methods based on the nature of the study. Different industries also require different reporting requirements.

The climate change disclosure index is calculated using the binary formula method.

$$CLC_DISC = \frac{\text{Total disclosure items reported}}{\text{Total applicable disclosure items}} \times 100$$

The above discussion has demonstrated the relationship between corporate governance variables used for this study and described the variables in Table 2.

Table 1. Sample selection and distribution.

Sample Selection	
Coverage of corporate climate change disclosure data from 2018 through 2022.	610
Less: Firm-year observations were inconsistent with those in other archives.	90
Climate change disclosure provided with firm-year observations.	520
Less: Inadequate control variables caused a decline in firm-year observations.	45
Final Test Sample for the Years 2018–2022 for Climate Change.	475

Source: author's own elaboration.

Table 2. Variable definitions.

Variables	Operational Definition
CLMC_DIS	Voluntary disclosure score received from each company. [1 = if an item from our checklist is disclosed in the annual report, else 0]
Board size (BSIZE)	Total number of directors serving on the board.
Board composition (BCOMP)	The percentage of independent directors on the board.
Foreign ownership (FOROWNR)	The percentage of foreign directors on the board.
CEO duality (CEODUA)	The same person holds the positions of chairman and CEO. (value 1 = CEO and Chairman, value 0 = otherwise).
Board meeting Frequency (BMEEF)	The number of board meetings held in a financial year.
Corporate Governance Code (CGCODE)	1 if firms reveal/implement corporate governance code principles 0 otherwise.
Firm Size (FSIZE)	The natural logarithm of total assets.
Profitability (PROFI)	Return on assets is a measure of profitability.
Leverage (LEV)	Leverage is each company's debt-to-equity ratio of each firm.

Source: author's own elaboration.

3.2. Model Specification

The OLS model employed in this study is as follows:

$$CLMC_DIS_{i,t} = \beta_0 + \beta_1 BSIZE_{i,t} + \beta_2 BCOMP_{i,t} + \beta_3 FOROWNR_{i,t} + \beta_4 CEODUA_{i,t} + \beta_5 BMEEF_{i,t} + \beta_6 FSIZE_{i,t} + \beta_7 PROFI_{i,t} + \beta_8 LEV_{i,t} + \epsilon_{i,t} \quad (1)$$

To test the moderating effect of CGCODE on the board characteristics–climate change disclosure direct relationship, Equation (1) above was incorporated with moderator and interaction terms, which represented our sixth hypothesis (H6) and is described in Equation (2) as follows:

$$CLMC_DIS_{i,t} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_1 \times Z + \epsilon_{i,t} \quad (2)$$

$\beta_6 X_1 \times Z$ represents the standardized interaction term between corporate governance code, board characteristics, and climate disclosure.

Where

CLMC_DIS = climate change disclosure score, BSIZE = firm size, BCOMP = board composition, foreign ownership = FOROWNR, CEO duality = CEODUA, board meeting frequency = BMEEF, CGCODE = corporate governance code, firm size = FSIZE, profitability = PROFI, leverage = LEVERAGE.

4. Results and Discussion

4.1. Descriptive Statistics and Correlation Matrix

From the descriptive analysis, detailed descriptive statistics for each variable are observed. According to Table 3, the mean value of CLMC_DIS is 33.00. In the case of board size and independent directors, the study observes a significant variation between the minimum and maximum values. The average board size expresses greater variation in the sample firms, with a minimum of 2 and a maximum of 28.25, with a standard deviation of 3.75. In the case of board composition, firms follow the standard procedure of CGG, 2018, by nominating 20% of the independent directors of the total members of the board of directors. Additionally, descriptive statistics of foreign ownership express variations in results in the study periods. Moreover, the firms maintain the provision of board meetings with an average of 15.75 in the study period. The recently updated CGC, 2018, also shows a substantial variation in the observed sample.

Table 3. Variable-wise descriptive statistics.

Variable	Mean	Minimum	Maximum	SD
CLMC_DIS	33.00	5.00	57.00	10.56
BSIZE	10.57	2.00	28.25	3.75
BCOMP	20.76	3.00	30.14	5.90
FOROWNR	5.45	2.00	13.25	2.75
CEODUA	0.341	0.123	0.421	0.102
BMEEF	15.75	3.00	30.25	5.10
CGCODE	0.121	0.101	0.149	0.110
FSIZE	10.01	3.00	31.12	11.10
PROFI	7.75	4.00	26.21	7.01
LEV	8.25	3.00	29.25	4.21

Source: author's own elaboration.

From the Pearson correlation matrix, it is found that positive relationships between explanatory variables and climate change disclosure exist (Table 4). Further, to assess multicollinearity, this study considers correlation coefficients and the Variance Inflation Factor (VIF) test, which is less than two. Therefore, multicollinearity does not exist. When the correlation between the independent variables is 0.90 or higher, multicollinearity may be an issue. Therefore, all results mentioned above are fit for the regression analysis.

Table 4. Pearson Correlation analysis results.

Variables	CLMC_DIS	BSIZE	BCOMP	FORO	CEO	BMEF	CGCODE	FSIZE	PRO	LEV	V
CLMC_DIS	1										1.21
BSIZE	0.2605 (0.002) *	1									1.43
BCOMP	0.1012 (0.021) *	0.321 (0.310)	1								1.31
FORO	0.3220 (0.161)	0.241 (0.230)	0.1412 (0.2021)	1							1.45
CEO	0.2143 (0.150)	0.1201 (0.1102)	0.2051 (0.2020)	0.1023 (0.2051)	1						1.31
BMEF	0.0401 (0.013) *	0.0132 (0.1021)	−0.0140 (0.5420)	0.1501 (0.3161)	0.02321 (0.1542)	1					1.46

Table 4. Cont.

Variables	CLMC_DIS	BSIZE	BCOMP	FORO	CEO	BMEF	CGCODE	FSIZE	PRO	LEV	V
CGCODE	0.0215 (0.012) *	0.1201 (0.210)	0.4312 (0.231)	0.4512 (0.4123)	0.4321 (0.312)	0.1231 (0.231)	1				1.49
FSIZE	0.04081 (0.125)	0.0123 (0.4131)	−0.2041 (0.1042)	0.2641 (0.2120)	0.2121 (0.1414)	0.2102 (0.1420)	0.1314 (0.452)	1			1.58
PRO	0.4301 (0.136)	0.0824 (0.4052)	0.2030 (0.4171)	0.2124 (0.0321)	0.2025 (0.2210)	0.1304 (0.0131)	0.2042 (0.1211)	0.2011 (0.112)	1		1.21
LEV	0.3202 (0.131)	0.2321 (0.421)	0.3110 (0.211)	0.2411 (0.112)	0.2411 (0.110)	0.2112 (0.140)	0.0415 (0.2132)	0.2121 (0.201)	0.2521 (0.1212)	1	1.38

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Source(s): created by the author.

4.2. Multivariate Analysis

Table 5 displays the estimates of both proposed Model 1 and Model 2. By analyzing Model 1, the study checks whether board characteristics have any impact on the disclosure of climate information. More specifically, the study explores the connection between the various factors and their impact on climate change disclosure. Besides applying normality, heteroscedasticity, and endogeneity, the Breusch–Pagan–Godfrey test has been used to determine whether heteroscedasticity exists in the models. Also, the OLS regression approach has been used to analyze panel data, as prior studies have used the same approach to conduct the impact analysis of board characteristics and environmental disclosure. In the case of board size, the regression results from Model 1 indicate that BSIZE and CLMC_DIS, with the value of the coefficient of coordination R-square of 0.4121 and F value of 35.40, reveal an association. This result supports other study findings completed during various time periods (Chakraborty & Dey, 2023; Akhtaruddin et al., 2009). Regarding the board composition (BCOMP), the study finds a correlation between board composition and climate disclosure with a 10 percent level of significance. Similar findings are forwarded in a recent study by Chakraborty and Dey (2023) that more independent directors with diverse expertise and experience become more interested in disclosing environmental information (Muttakin et al., 2018). Conversely, Bhuyan (2018) did not find any association between independent directors and the likelihood of disclosing climate change information. In comparison to corporate governance guidelines (CGG, 2012) on qualifications and professional experiences of independent directors, the corporate governance code (CGC, 2018) in Bangladesh brought modifications in wording to recruit more capable persons on the board, ensuring necessary voluntary disclosure practices. The study findings also observed that to keep corporate goodwill intact and avoid negative criticism, independent directors play a relevant role in disclosure practices (Bose et al., 2018). Regarding the third explanatory variable, FOROWNR, this study finds no association with CLMC_DIS in the study period. A prior study also claimed that foreign investors prioritize their interests and are expected to ignore local investors and other voluntary disclosure practices, Laidroo (2009). Conversely, in a prior study on 116 manufacturing companies in Bangladesh, A. Khan et al. (2013) and Bhuyan (2018), in another study found a significant correlation. But that study together examined environmental and social disclosure. Concerning CEO duality, no relationship is found, and thus, the fourth hypothesis supports the study's findings and further justifies the claim of the existing literature. A recent study also claims that the same person holding both positions of Chairman and CEO may create a conflict of interest during decision-making activities on the board of directors (Saha & Khan, 2024). Turning to board meetings, this study reveals that board meeting frequency (BMEEF) affects climate disclosure information and addresses various risks related to operational complexity, uncertainty, and climate challenges. Previous studies suggest that frequent board meetings emphasize board transparency, improve the decision-making process, and highlight social needs (Karim

et al., 2021), which help reduce the information gap between shareholders and the board of directors. Thus, the fifth hypothesis of this study is supported. In Bangladesh, the CGC, 2018, updated earlier conditions and mentioned that businesses must have board meetings, document the minutes of those meetings, and maintain the necessary books and records in compliance with the applicable Bangladesh Secretarial Standards (BSS).

In addition, from the regression results of Model 2, it is observed that the coefficient estimated for BSIZE and CLMC_DIS, with the value of the coefficient of coordination R-square of 0.3214 and F value of 29.32, reveals an association. The rest of the four hypotheses in Model 2 also provide similar outcomes to Model 1. Additionally, the coefficient estimated for the interaction term between CGCODE and BCHARC is 0.13.23 which is significant at a 10 percent level. That means the last hypothesis regarding the CGCODE proves that the corporate governance code can enhance the influence of board characteristics on the likelihood of disclosing climate information.

More clarity in reformed corporate governance principles by the BSEC, such as fixing up the minimum and maximum numbers of independent directors, their superior qualifications and experience, newly added conditions about sustainability, environmental disclosure practices, subcommittees, and annexures, may affect the environmental disclosure practices of the DSE-enlisted firms. Thus, hypothesis H6 is accepted. Among the control variables, FSIZE seems to have an effect on CLMC_DIS. Other control variables, such as profitability and leverage, appear to be insignificant. The prior studies also support the above findings and claim that larger companies are scrutinized by stakeholders more as they engage in more environmental and climate change-related activities (Luo & Tang, 2021).

Table 5. Relationship between climate change disclosures and board characteristics during the study period of 2018–2022.

CLMC_DIS	Model 1		Model 2	
	Coef.	Std. Err.	Coef.	Std. Err.
BSIZE	0.1121 *	0.1022	0.2132 *	0.1210
	(1.02)		(1.45)	
BCOMP	0.2312 *	0.3271	0.1211 *	0.1121
	(1.04)		(1.87)	
FOROWNR	1.1410	0.3141	0.3212	0.3121
	(1.43)		(1.65)	
CEODUA	0.2041	0.1223	0.2314	0.1421
	(1.12)		(1.34)	
BMEEF	0.0212 *	0.2451	0.5412 *	0.3122
	(1.04)	0.2541	(1.89)	
CGCODE			0.2312 *	0.3121
			(1.98)	
CGCODE * BCHARC			0.1323 *	0.1214
			(1.26)	
FSIZE	0.0412	0.1031	0.5321	0.1215
	(0.13)		(1.58)	
PROFI	0.0242	0.2021	0.1321	0.2132
	(0.01)	0.2141	(1.33)	
LEV	0.0143		0.3412	0.1217
	(0.25)		(1.12)	
R square	0.4121		0.3214	
Adjusted R square	0.1251		0.1121	
F value	35.40		29.32	
F significance	0.006		0.004	

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively; source(s): created by authors.

4.3. Results of the Endogeneity Test

Researchers want to address this endogeneity problem by engaging an instrumental variable, as the presence of error terms may distort the study results (Ammann et al., 2011). It is assumed that BSIZE and BCOMP might be influenced by FSIZE and PROFI. So, utilizing the instrumental variables of the study, the predicted values for the independent variables were checked against the dependent variable, and the same results were found in both models, which are positive and statistically significant at a 10% level (Table 6).

Table 6. Result of endogeneity test.

CLMC_DIS	Model 1		Model 2	
	Coef.	Std. Err.	Coef.	Std. Err.
BSIZE	0.1012 *	0.2151	0.2131 *	0.2131
	(1.31)		(1.32)	
BCOMP	0.01501 *	0.5642	0.4123 *	0.1232
	(1.23)		(1.46)	
FOROWNR	0.2402	0.1421	0.2541	0.2312
	(1.45)		(1.50)	
CEODUA	0.1214	0.2032	0.3121	0.2319
	(1.32)		(1.27)	
BMEEF	0.1203 *	0.2506	0.1241 *	0.3211
	(0.25)		(1.09)	
CGCODE			0.2132 *	0.2123
			(1.87)	
CGCODE * BCHARC			0.2513 *	0.3412
			(1.56)	
FSIZE	0.1141	0.2402	0.2123	0.2123
	(0.21)		(0.23)	
PROFI	−0.2512	0.1023	0.3512	0.1213
	(0.20)		(1.25)	
LEV	0.135	0.0424	0.5123	0.3121
	(0.21)		(1.20)	

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively; source(s): created by authors.

4.4. Robustness Tests

4.4.1. Tobit Regression

To validate the findings and provide a reliable result, the main results were subjected to further testing, as no one procedure or statistical analysis can produce the best result. From the viewpoint of deeper economic justification and overcoming the limitations of the OLS regression method, which may limit the reliability of the empirical findings due to the presence of censoring and leading to biased and inconsistent parameter estimates, the alternative approach, the Tobit model, is required to confirm the robustness across methods. Therefore, the Tobit regression has been utilized as a dependent variable; CLMC_DIS only ranges from 0 to 100. The study revealed similar results and found an association with CLMC_DIS. In addition, it supports the positive relationship between FSIZE and CLMC_DIS shown in Table 7.

Table 7. Results of the Tobit model.

CLMC_DIS	Coef.	Std. Err.	z-Statistic	p-Value
BSIZE	0.1221	0.1413	1.32	0.007 *
BCOMP	0.3420	0.2121	1.41	0.029 *
FORONR	0.1312	0.2220	1.31	0.039
CEODUA	0.2123	0.2213	1.32	0.323
BMEEF	0.3401	0.1356	0.37	0.029 *

Table 7. *Cont.*

CLMC_DIS	Coef.	Std. Err.	z-Statistic	p-Value
CGCODE	0.1401	0.2423	0.15	0.019 *
FSIZE	0.1215	0.2132	0.30	0.211
PROFI	0.1214	0.2341	0.13	0.120
LEV	0.2023	0.1210	0.15	0.132
R ²	0.29			

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively; source(s): created by authors.

4.4.2. Lagged Climate Change Disclosure

To investigate further the study outcomes, this study replaces the dependent variable with other board characteristics individually. This study re-estimated BSIZE, BCOMP, and FOROWNR by incorporating a lagged dependent variable, CLMC_DIS, which replicates the study's main findings (Table 8). The study also presents similar results, with main findings, and has found an association with CLMC_DIS and no relation between CEO duality and climate change disclosure.

Table 8. Lagged effects on the relationship between board characteristics and climate change disclosure.

CLMC_DIS	Coefficient	t-Value	p-Value
BSIZE	0.1120	1.11	0.029
BCOMP	0.1021	1.32	0.021
FOROWNR	0.1413	1.45	0.410
CEODUA	0.2402	1.09	0.041
BMEEF	0.1302	1.19	0.031
CGCODE	0.2101	1.31	0.021
FSIZE	0.2102	0.40	0.125
PROFI	0.1021	0.21	0.154
LEV	0.1120	0.29	0.120
R ²	0.121		

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Source(s): created by authors.

5. Conclusions and Managerial and Practical Implications

The purpose of this study was to investigate how board composition affects the degree of climate information sharing. This study also wanted to check whether the CCG, the last amended corporate governance principles and norms, has any impact on climate disclosure. The study, containing a sample of 475 firm-year observations, reports that larger board size and climate change disclosure are correlated. The other variable, board composition, proves that more independent directors with diverse expertise and experiences also have a positive impact. On the other hand, the third variable, foreign ownership, has been found to be insignificant and its existence in Bangladeshi enterprises is still minimal. Concerning CEO duality, this study agrees with the study's hypothesis and finds zero association. In the case of board meetings, this study reveals that board meeting frequency affects the climate disclosure information and addresses various risks related to operational complexity, uncertainty, and climate challenges. Moreover, the moderating effects of the corporate governance code on the likelihood of climate disclosure have been observed.

The contribution of this study minimizes the existing research gap identified in the study and examines the impact analysis. The factors used for the study, firms' board size and directors' independence, have a positive effect on climate change disclosures. Moreover, board meeting frequency also affects the disclosure of climate-related information. As part of its activities of monitoring governance reforms and amendments, the Bangladesh Security

Exchange Commission (BSEC) brought necessary changes from voluntary to mandatory disclosure in 2018.

The modified version emphasizes the director's capacity, which was not highlighted earlier. In the case of board meeting frequency, the corporate governance code 2018 also added more clarifications and made it mandatory to keep records of all meeting minutes of the board of directors and preserve registers of meetings for transparency and accountability. Such a provision will put pressure on board directors to address vital issues like climate and other voluntary environmental disclosures in the board meetings. In the case of CEO duality, to bring more transparency and decentralize the decision-making power, the regulatory authority, BSEC, also made it mandatory to fill the two posts with separate persons. From the theoretical perspective, legitimacy theory suggests that as a socially responsible business entity, firms with larger board sizes and more independent directors are more willing to disclose climate-related information. In line with agency theory, this study's outcomes find a connection between favorable board characteristics and the likelihood of climate disclosure for the greater interest of a firm that may help minimize the gap between managers and shareholders.

The study outcomes extend practical and policy inferences for creating or improving the awareness level of the firms regarding the initiatives related to the improvement of corporate environmental guidelines. To improve the corporate environmental performance, firms should implement good CSR practices, strategies, incentives, and add a diversified board structure (Liu, 2024). Also, firms should create provisions and allocate resources to mitigate environmental loss (F. Jiang et al., 2024). To ensure more transparency in corporate governance practices, though the BSEC revised the corporate governance code 2018 by fixing the minimum and maximum number of independent directors, their qualifications, adding more specific guidelines about sustainability, environmental disclosure practices and subcommittee under the board of directors committee, more attention from regulatory authorities like BSEC that direct firms to maintain GRI sustainability reporting practices for transparency is required. Firms should focus on mandatory carbon reporting requirements, which influence entrepreneurs to invest in eco-friendly businesses. In general, the disclosures of climate risk information provided by Bangladeshi firms remain limited. So, the government should adopt strict policies to make corporate climate and other environmental disclosures mandatory in the future.

As Bangladesh is more prone to climate risk, such implications may work for Bangladesh and other developing countries while previewing new guidelines to tackle climate disclosure in the context of emerging economies.

This study has several limitations, even if the results are consistent across different econometric models. This study solely used information collected from the annual reports of the sample firms of DSE by ignoring other communication channels, as majority of the Bangladeshi firms depend on annual reports. Additionally, the study utilized a self-constructed climate disclosure index, which may have affected the results of its improper use in another study.

This study has also explored some opportunities for future research. Though this research applied legitimacy and agency theory by leaving other established theories, such as resource-based theory, voluntary disclosure theory, stakeholder theory, neo-institutional theory, future research is likely to incorporate several theories to examine the association. Due to the unavailability of data in the financial reports of all listed firms working in Bangladesh, the authors measured the board size by the total directors of the firm, whereas further research has the scope to use other board characteristics such as education background, age and the business experience of the board members to get new insights.

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Abbreviations

The following abbreviations are used in this manuscript:

GHG	Greenhouse Gas Emissions
CGC	Corporate Governance Code
CEP	Corporate Environmental Performance
ESG	Environmental, Social and Governance
IDX	Indonesian Stock Exchange
DSE	Dhaka Stock Exchange
SGX	Singapore Stock Exchange
CEO	Chief Executive Officer
BSEC	Bangladesh Security Exchange Commission

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