

The Impact of Board Characteristics on Carbon Transparency: Evidence from Bangladesh across the Corporate Governance Code 2018

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Abstract

This study examines the influence of various board characteristics on the disclosure of carbon emissions among listed companies in Bangladesh. The study also aims to assess the variations in findings before and after adoption of Corporate Governance Code in 2018. Using an empirical research approach, the study analyzes panel data from 140 listed companies in Bangladesh from 2012-2022, with 1210 observations collected from annual reports. An Ordinary Least Squares (OLS) regression model was used to examine the relationships between board characteristics and carbon emission disclosure. The analysis shows that board qualities considerably influence the disclosure of carbon emissions, with remarkable differences identified before and after the implementation of the Corporate Governance Code in 2018. More specifically, there is a positive association between the size of the board and the level of disclosure and larger boards lead to higher levels of disclosure. On the other hand, including independent board members has a detrimental impact on transparency, especially after 2018, claiming the need for ongoing policy refinement, robust enforcement, and active stakeholder engagement to sustain more corporate environmental accountability. The continuous negative correlation between female board members and carbon disclosure indicates possible difficulties in utilizing their participation to promote environmental transparency. CGC-18 aimed to improve governance but unconsciously weakened the impact of accounting experts, reducing their previously significant impact on corporate effectiveness and highlighting the need to reevaluate the code to ensure it strengthens key governance roles. On the other hand, the presence of foreign board members has a favorable impact on disclosure standards, reflecting their important responsibilities in improving corporate governance. The findings emphasize the complex and varied effects of board membership on the disclosure of carbon emissions in a changing regulatory environment.

Keywords: Board Characteristics, Carbon Emission, Environmental Disclosure, CGC-18, Bangladesh.

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1. INTRODUCTION

As the world is being threatened by the negative impact of climate change, reduction of carbon emission has become the most significant issue in all aspects. Since carbon emission is the key peril behind this scenario, most the responsibilities held by the corporation accountable from carbon emission. Considering this, now both business and political leaders are insisting on converting carbon intensive economy to low carbon economy. Additionally, firms globally are facing significant challenges due to climate change, manifesting in various forms such as regulatory, reputational, physical, and litigation risks (Amran et al., 2015). Climate change impacts are increasingly disrupting business activities, leading to interruptions in supply chains, revenue losses, asset damages, increased insurance costs, and declining financial performance (Esham, 2021). Thus, reduction of carbon emission is global need for existence of both society and corporations.

Corporate governance, particularly, board diversity could be excellent solutions in addressing this climate issues. Corporate boards are accountable for planning strategic priorities, monitoring management, and ensuring accountability to a broad set of stakeholders. Studies have demonstrated that board attributes such as board size, independent members, accounting experts, foreign board members, audit committee, and law and expert affect carbon emission disclosure. Empirical evidence on the relationship between board attributes and carbon disclosure findings is mixed, indicating contextual verities across jurisdictions and firms. Many research outcomes infer that larger board having independent directors promotes highest level of environmental monitoring and more enhanced CED, as they are more capable of supporting and monitoring sustainability exposures and initiatives. Such board can lead to more comprehensive and informed discussions about carbon emission disclosures, improving their quality and transparency (Frias-Aceituno, 2013; Liao, 2015). On the other hand, some research identified potential limitations such as possibility of coordination challenges, lack of accountability etc (Michelon & Parbonetti, 2012). Gender variation is also got notable attention as female directors have received huge attention as the their attitudes and qualities are more consistent with social demand of carbon emission reduction (Ben-Amar & McIlkenny, 2015 ; Martinez & Isabel, 2019). Similarly, foreign board members often bring a wealth of international experience and exposure to different regulatory environments and best practices in sustainability (Estélyi & Nisar, 2016) and director having accounting and legal expertise can improve quality of disclosure through global knowledge, reporting skill, regulatory knowledge etc (De Villiers & Marques, 2016 ; Peters & Romi, 2015). Research findings also demonstrates that effectiveness of foreign director can be hindered due to differences in languages and culture (Ruigrok et al., 2007) while competing priorities can reduce the effectiveness of accounting expert (Kim et al., 2019).

These empirical and theoretical understanding are salient in emerging economies like Bangladesh, where framework of corporate governance and disclosures have been evolving. In Bangladesh, companies face additional challenges such as damage to infrastructure, increased operational costs, and disruptions to supply chains, resulting in financial losses (Sarder, 2023). In such countries, where deficient disclosure practices are prevalent in some firms (Rahman & Kabir, 2019), board attributes impact on CED is particularly significant.

Studies investigating Bangladeshi firms, have demonstrated a positive correlation between board independence, female representation, and the number of board members with carbon emission disclosures (Ullah et al., 2019). However, certain governance mechanisms may not have a substantial effect on enhancing CED (Astari et al., 2020). These results underscore the need to conduct further studies and regulatory measures to promote accountability in environmental reporting practice, and more so in growing economies such as Bangladesh.

Past research has focused on developed states and has a geographical bias that restricts the extrapolation of the study to developing countries with changing corporate governance systems. Research that considers a more varied range of geographical contexts to obtain a clearer picture of the effects of board features on carbon emission disclosure in the global context is urgently required. This study addresses a gap that is very important in the literature and aids in creating a more detailed picture of international environmental governance in the emerging markets because it emphasizes an unexplored area. Accordingly this study pursues following two objectives:

1. To investigate the relationship between board characteristics and carbon disclosure information on carbon disclosure in Bangladeshi companies.
2. To examine whether pre- and post-introduction of laws regarding corporate governance regulation (Corporate Governance Code 2018) impact the relationship between board characteristics and CED.

These two research objectives are achieved by exploring following two research questions:

- RQ. 1 Whether the board characteristics impact carbon emission disclosure practices in Bangladeshi companies?
- RQ.2 Does the relationship between board characteristics and CED varies due to introducing the corporate governance code-2018?

It provides a valuable examination of the impact of the board feature on disclosure of carbon emissions, including the significant changes in the situation before and after adopting the Corporate Governance Code 2018. To start with, this study makes an important contribution to the theoretical basis of corporate governance and ecological transparency by choosing a distinctive multidimensional approach towards board characteristics. Secondly, the present study is a new side to the topic, as it applies the legitimacy and stakeholder theory to a developing nation, which has not previously been extensively studied in past studies. Moreover, the research discusses data limitations of the prior studies, considering a large sample of 140 firms between 2012 and 2022 in a study. This will enable a comprehensive statistical study of the practice of carbon disclosure in Bangladesh. Lastly, the implications of the findings of this study are large in practice. They assist in making wise policy guidelines for policymakers, companies, and the government in Bangladesh. This present paper has delved into the practical imperatives of the arguments put across in Belal and Roberts (2010) by correcting the institutional problems associated with carbon emission disclosure. The analysis provides valuable information for policymakers and businesses, which will help them to increase transparency and environmental responsibility and promote ecological governance in developing areas.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Theories

This paper is largely based on two theories, the stakeholder theory and the legitimacy theory, based on the evidence from earlier literature. Stakeholder theory suggests that a business has a duty to other stakeholders besides shareholders. This framework lies especially in the area of looking for interactions between carbon emissions and tax avoidance, and how it affects various stakeholder groups. Other stakeholders such as NGOs, the community, and employees can lobby to put the companies in a situation where they have to be stringent in the amount of carbon emissions. On the contrary, the shareholders that have strong financial stakes may make demands to promote weaker rules, which serves as a counterbalance (Rosolen & MacLennan, 2016). Several studies indicate that though businesses might start by engaging with the environment by carrying out minimal compliance activities, stakeholder pressure is also capable of instigating proactive environmental activities. Goodwill can be promoted through proactive environmental practices, which can invite stakeholders who are environmentally concerned (Jan et al., 2023). Although it is legitimate, aggressive tax avoidance can erode the legitimacy and reputation of a company, especially when the preventive measures are viewed by the stakeholders as immoral or unjust. It may contribute to consumer boycotts, bad publicity, and loss of shareholders, resulting in a loss of shareholder value (Landry et al., 2013). There are research hypotheses suggesting that there is a trade-off between environmental investments (which can be referred to as CSR) and tax payments. Firms may engage in green projects as a way of compensating for the perception of their tax avoidance to the community. Nonetheless, some suggest that the motivation to be sustainable should not revolve around the tax maximization process but the sustainable good of society in the long term (Van Rensselaer, 2016). It is not enough to measure the performance of a company by financial results or environmental metrics only. The stakeholder theory suggests a subtle way and takes into account how environmental practices and tax policies affect all the stakeholders (Jan et al., 2023). The stakeholder theory can be applied to the current study as they provide a strong model of understanding the effects of different external forces on corporate carbon emission reporting. These theories aid in understanding why the nature of the relationship between regulatory requirements, cultural expectations, and normative standards is so complicated by acknowledging that businesses are not only expected to comply with the wishes of shareholders, but also a host of other stakeholders, which include people, organizations, and all facets of culture. This is specifically relevant in the scenario in Bangladesh whereby coercive forces by the Corporate Governance Code 2018 and normative forces by the Global Reporting Initiative influence corporate transparency practices. Viewing these interactions as based on the stakeholder theory gives a full perspective on how various stakeholder groups such as NGOs, community groups, employees and investors push companies into more sustainable and transparent ways of doing business (Freeman, 2010).

The legitimacy theory holds that organizations depend on social acceptance of mainstream society to obtain critical assets such as licenses, investors, and consumers. This social license can be undermined by environmental non-compliance and aggressive tax evasion, resulting in boycotts, negative publicity, and destruction of reputation (Suchman, 1993). By showing

dedication to reducing carbon emissions and reasonable taxation, companies can mitigate the risk of tighter control and audits. It is possible to achieve cost savings and operational efficiencies (Dillard, 2014; Pantic and Clarke-Midura, 2019). Research has shown that environmentally conscious stakeholder pressure can encourage companies to go beyond regulatory compliance to active environmental activities. These programs make a company more legitimate and increase its image in society (Todaro et al., 2019). However, aggressive tax avoidance tactics may be viewed as unfair and damaging the legitimacy of an enterprise. Firms may not want to implement such measures because they may need to pay larger taxes to ensure their trust and support by stakeholders (Landry et al., 2013). This theory is founded on the notion that corporations ought to abide by ethical and legal regulations lest they be found liable for doing things. This is more so during the scenario of environmental transparency when society's expectations and regulatory pressures make companies reveal their carbon emissions. Companies in Bangladesh can raise their legitimacy by following the Corporate Governance Code 2018 (CGC-18), cultural norms established by the Big Four accounting firms (BIG-4), and the Global Reporting Initiative (GRI) Standards, thus ensuring that they obtain their social license to operate and, perhaps, are seen as magnets by environmentally friendly stakeholders (Deegan, 2002; Lindblom, 1994). The theoretical angle is vital in the study of how and why firms react to the different institutional influences in their disclosure of carbon emissions.

2.2 Hypothesis Development

The two issues that are of great concern in the global economic picture are carbon disclosure and board characteristics, which are more pronounced in Bangladesh. Being a developing country that is struggling and trying to keep up with the pace of industrialization and increasing carbon emissions, it is not only crucial to know how the two problems might interact with each other to promote sustainable development. This paper has been reviewed in a different way, by doing a literature review of the literature that has been achieved on the nature and features of boards as well as environmental legislation with a particular focus on their relationship in the emerging economies.

2.2.1 Board Size

Bigger boards will probably also include members who will be of diverse backgrounds and experience (environmental management, sustainability, and compliance with the regulations). It is this diversity that will result in more detailed and informed debates concerning carbon emission disclosures, enhancing their quality and transparency (Wang, 2022; Al Amosh and Khatib, 2021; Khan, 2012). Furthermore, larger boards are increasingly becoming recognized as influencing carbon use disclosure. It is projected that well-organized and larger boards of enterprises have a more crucial impact on other companies to engage in climate-friendly activities compared to enterprises that have smaller boards (Karim, 2021; Ntim, 2013). However, it is significant to acknowledge a counterpoint. The increased number of members can lead to longer discussions and difficulties in reaching consensus, potentially delaying or complicating the carbon emission disclosure process (Jensen, 2010). In larger boards, less accountability by member may result in taking specific decisions related to carbon emission disclosures. This "free-riding" behavior can result in less diligent oversight and a lower

quality of environmental reporting (Ntim et al., 2013). Consequently, larger boards are considered more vulnerable to management influence, potentially undermining the organizations. This contradictory literature demands the need for a more focused investigation on environmentally sensitive enterprises to decide about impact of board size on CD. Therefore, this study hypothesizes following:

Hypothesis (H1): *There is a positive relationship between board size and the level of carbon emission disclosure.*

2.2.2 Board independence

Ben-Amar & McIlkenny (2015) identified a positive relationship between independent directors and carbon emissions. They contend that independent member of board are more inclined to implement rigorous monitoring and oversight measures, guaranteeing the company's compliance with environmental standards and voluntary disclosure of its carbon emissions. Independent directors often focus on long-term sustainability and stakeholders diverse interest. This perspective can drive more thorough carbon emission reporting as part of a strong oath to socially responsible activities (A. Khan et al., 2013). According to Rupley et al. (2012), independent directors from many businesses and sectors contribute distinct perspectives and skills, including sustainability. Directors who value environmental openness can provide more extensive and knowledgeable carbon emission disclosures. Once again, Michelon and Parbonetti (2012) found that independent directors had a negative correlation with carbon emissions. The use of independent directors, particularly those without environmental science or sustainability experience, might not have the level of expertise to judge and direct the processes of carbon emission disclosures critically. With this knowledge gap, they might not be able to encourage proper environmental reporting. Independent directors can have a contradiction with the senior management in case they push towards transparency, which would result in regulatory sanctions. This dispute might lead to management being uncooperative with independent directors trying to reduce carbon emissions (M. I. Jizi et al., 2014). Despite some evidences negative impact, this research assumes possible positive and postulates following hypothesis:

Hypothesis (H2): *A positive relationship exists between the number of independent board members and the level of carbon emission disclosure.*

2.2.3 Female Board Member

Board members are female and could provide different perspectives, which can enhance environmental discussions and decisions. Holistic sustainability and carbon emission reporting can be encouraged by diversity (Bear et al., 2010). Glass et al. (2016) evidenced a positive impact of female directors on sustainability issues. They allege that female directors are more socially and ecologically aware. This trend can make corporations more transparent in their carbon emission reporting as a part of their corporate responsibility strategy. Conversely, female directors who champion more openness and eco-friendliness can be opposed by the rest of the board or management. This conflict may impede their attempts to improve carbon emission disclosures (Aribi et al., 2015). Ștefănescu1 2013 discovered that

there was a negative connection between female board members and carbon emission disclosure. When the female board members are the minority and they are not a critical mass, they might not have an impact on carbon usage disclosure. When most of the board of directors is men, then there might be a lack of a substantial effect of the few women directors on the disclosure procedures since they will be overwhelmed (Kramer et al., 2006).

Another literature on gender differences in ethical decision making in executives also indicates a name that promises a lot of manufacturers. Marketing women, for example, have been demonstrated to have an improved ethical judgment when compared with men (Akaah, 1989). Gender diversity was positively correlated with ethical CSR disclosure (the timely submission of the CY2013 Form SD) reported by Sankara et al. (2017) in their study. Such results highlight the possibility of a favorable shift in ethics in companies as more women are represented. Based on these insights, the study proposes the following hypothesis:

Hypothesis (H3): *A positive relationship exists between the number of female board members and the level of carbon emission disclosure.*

2.2.4 Foreign Board Member

According to Frias-Aceituno, (2013), it is a good move to incorporate foreign board members that could contribute to enhancement of the practice of corporate information disclosure as unique cultural elements of them could easily lead to diversified role. This implies that foreign board members might introduce different views and practices that will have a positive impact on the disclosure of carbon emissions in Bangladesh. Also, Mardini and Elleuch Lahyani (2022) present evidence of the effectiveness of foreign board members in possession of different kinds of expertise in fostering sustainability disclosure. In addition, Ummah and Setiawan (2021) concluded a strong association between the board size of commissioners and carbon emission disclosure, indicating that a higher level of commissioners on the board might result in more transparency in reporting of emissions. This means that the presence of a diverse board that has members who are foreigners would perhaps improve disclosure of carbon emissions in Bangladesh. Khan, (2010) highlights the impact of independent members on the reporting of corporate social responsibility hence it implies that the more independent directors within an entity the stronger the corporate social responsibility practices are likely to be. To conclude, the foreign board members can be instrumental in the process of carbon emission disclosure in Bangladesh. Without undermining their independence and diversity, their various experience, cultural views, and possible contribution to increased board size may lead to more open reporting practices. Through the experiences and expertise of foreign directors, businesses in Bangladesh will be able to enhance their sustainability efforts and score higher in their carbon emission disclosure policy. Accordingly, this study produces following hypothesis:

Hypothesis (H4): *There is a positive association between the representation of foreign board members and carbon disclosure.*

2.2.5 Accounting Expert

These roles of accounting professionals on boards have drawn the attention of people all over the world, and the importance of the same has been acknowledged by regulators and institutions. Empirical evidence shows the importance of having accounting expertise on boards. Kusnadi et al. (2016) proved that the presence of such individuals greatly improves financial reporting quality in Singaporean companies, and they show that they are good supervisors of the financial reporting system. Accounting professionals' positive impact on financial reporting should reassure the audience of their crucial role. According to DeZoort and Harrison (2018), there was a direct relationship between the capacity to recognize fraud and the accountability of auditors in the US. Expressing the effect of accountability on corporate governance, they observed that accountable auditors are more aggressive in fighting corruption and fraud as compared to their anonymous peers. The authors Al-Shaer & Zaman (2019) have found that the publication of corporate social responsibility (CSR) information, specifically anti-corruption efforts, is encouraged by accounting professionals who have a specific understanding of the matter and enjoy a good reputation in UK companies. Also, we have a negative relationship reported by a study by Albrecht (2010), where the manifestation of high standards of accounting and audit reporting was negatively linked with perceptions of corruption through cross-country analysis. Nevertheless, obstacles persist. Saha (2019) in their research highlighted how substantial the accounting professionals' challenges have been in terms of recruitment and compliance with regulations in multinational firms. Such obstacles can cause more cases of corporate scandals and corruption. However, there is a clear need for more research in the literature about the influence of accounting specialists on the exposure of corruption in enterprises in Bangladesh, which leads us to state the following hypothesis:

Hypothesis (H5): *The presence of accounting experts on the board positively promotes carbon disclosure.*

2.2.6 Legal expert

Legal professionals have an extensive understanding of environmental legislation and regulations, and this will ensure that carbon emission reporting by the company does not contradict the law. Their legal expertise will allow the company to stay away from legal risks and penalties relating to non-compliance (Peters and Romi, 2015). Kassinis and Vafeas (2002) think that legal practitioners are able to give strategic advice on how to balance difficult environmental laws and regulations. Their knowledge ensures that carbon emission disclosures are made in accordance with national and international disclosure standards, improving disclosure credibility. Conversely, legal professionals might give more focus to legal obedience than voluntary or pro-active environmental reporting. This orientation can initiate little transparency since the companies might not disclose as much as is required by the laws (Adnan et al., 2018). Legal experts might be conflicted by a conflict of interest, particularly when they offer advice to a company on litigation or regulatory matters on the performance of the company on environmental matters. Such a duality may weaken the objectivity and honesty of carbon emission reporting (Klettner et al., 2014).

Although the effects and role of lawyers in corporate governance have been heavily researched, further studies are required to examine the impact of the presence of a legal expert on the board. Thus, the study proposes the following hypothesis.

Hypothesis (H6): *The presence of legal experts on the Board Promotes carbon Emission Disclosure.*

2.2.7 Audit Committee

Audit committee is considered to play significant role, particularly in monitoring the process of financial reporting (Al-Shaer & Zaman, 2018). AC focuses on controlling disputable reporting by management of firm (Zaman et al., 2011). While traditionally associated with financial oversight, audit committees can provide valuable oversight of (CDI) practices (Abbott et al., 2016). Corporate governance mandates this role (CG) guidelines in Bangladesh (Bangladesh Securities and Exchange Commission, 2018 and Securities and Exchange Commission, 2012). Despite the recognized importance of audit committees in financial oversight, their impact on carbon emission disclosure (CDI) practices has not been largely studied (Saha et al., 2019), which adds an intriguing element to the research. For example, Alkayed Omar, (2023) has shown a generally positive connection between audit committees and CD. In contrast, Alkurdi et al., (2023) have identified a negative relationship between audit committees and CD. Based on the existing research and policies, it is suggested that audit committees may have a role in overseeing carbon disclosure (CD) practices in addition to their traditional role in financial oversight. In light of this, these studies propose the following hypothesis:

Hypothesis (H7): *There is a positive relationship between the presence of an audit committee and the level of carbon emission disclosure.*

3. METHODOLOGY

3.1. Sampling and Data Collection

The study meticulously and rigorously utilizes panel data from 140 listed companies in Bangladesh, covering 2012 to 2022. A sample of 1210 observations was collected financial and other report of these companies which are published annually. The panel data set comprises a comprehensive collection of time series data from the same 140 listed companies over ten years from 2012 to 2022. This extensive data set includes 1210 records, providing a solid and robust basis for the empirical analysis.

3.2. Measures and Definitions of Variables

The variables used in this study can be divided into three categories: dependent, independent, and control variables. Dependent variable is carbon disclosure (CDI). This CDI has been developed by using scores of "1" if the company discloses the carbon disclosure (CDI) items and "0" if it does not. The independent variables are board size, independent board member,

female board member, legal expert, accounting expert, independent audit committee member, foreign board member. The *board size* is measured by total number of directors included in the board (Al-Bassam, 2018; Rodrigues, 2017; Braz & Lopes, 2018; Sankara et al., 2017; Yusoff, 2016). *Independent board member* is measured the number of non-executive directors divided by the number of corporate board members (Braz & Lopes, 2018 and Elmagrhi et al., 2016; Shahab & Ye, 2018;). *Female board member* is measured by calculating ration of female board member to total member (Aribi et al., 2018; Ben-Amar et al., 2017a; Braz & Lopes, 2018; Castilla-Polo et al., 2018;). *Law experts* is quantified as 1 if board includes legal expert and 0 otherwise (Masud et al., 2019). *Accounting experts* is quantified by showing percentage of accounting expert on board (Al-Shaer Zaman, 2018; Kusnadi et al., 2016). *Independent audit committee* is calculated as the ratio of independent audit committee directors to the total number of audit committee directors (Raweh & Kamardin, 2019). *Foreign Board member* is measured as the number foreign director included in Board of Directors (Mardini & Elleuch Lahyani, 2022). In this empirical models, this study used firm profitability, age, total assets, leverage, and capital intensity as control variables (Al-Bassam et al., 2018; Scholtz & Smit, 2015; Fakhari & Rezaei Pitenoei, 2017; Ling & Sultana, 2015; Sankara et al., 2017; Welbeck et al., 2017).

3.3 Model Specification

To explore the impact of board attributes on CED, this study uses a multivariate Ordinary Least Squares (OLS) regression model. The baseline model predicts the influence of board attributes on carbon emission disclosure level while controlling firm-specific characteristics, industry effects, and year effects.

The baseline regression model is as follows:

$$CED_{it} = A_0 + B_1BSIZE_{it} + B_2IBM_{it} + B_3FBM_{it} + B_4FOBM_{it} + B_5AE_{it} + B_6Lawex_{it} + B_7ACTM_{it} + B_8Tasset_{it} + B_9LAGE_{it} + B_{10}MV_{it} + B_{11}ROA_{it} + B_{12}LEV_{it} + B_{13}CAPI_{it} + B_{14}IND\ DUMMY_{it} + B_{15}YEAR\ DUMMY_{it} + \varepsilon_{it}$$

Where i=number of firms, t= the financial years 2012 to 2022, B1 to β_{12} = the coefficients of variables; all variables are defined in Table 1.

Table 1 Measurement of variable

Variables	Symbols	Variable types	Operationalization
Carbon disclosure index	CDI	Dependent	Here, carbon disclosure is calculated on a 1 or 0 scale if an item is disclosed in the annual report, else 0]
Board size	BSIZE	Independent	Natural log of the total number of directors on the board of a company
Independent Board Member	IBM	Independent	The percentage of independent directors on the board
Foreign Board Member	FOBM	Independent	The percentage of foreign directors on the board

Female Board Member	FBM	Independent	Percentage of females to the total number of directors on the board of a company
Law expert	Lawex	Independent	The percentage of legal advisors on the board
Accounting expert	AE	Independent	The percentage of accounting experts on the board
Audit Committee	ACTM	Independent	Natural log of the number of audit committee members
Firm Age	Lage	Control	Log of the number of years in business.
Profitability	ROA	Control	Earnings before interest and taxes/total assets
Market Value	MV	Control	Market capitalization divided by stockholders' equity
Leverage	LEV	Control	Total debt divided by total assets
Capital Intensity	CAPI	Control	Total net fixed assets to total assets
Total Asset	Tasset	Control	The sum of the total current assets and noncurrent asset
Industry	IND	Control	Industry belongingness.
Year	YEAR	Control	Sample year. Dummy variable

3.4 Measurement Instrument

By using STATA software, regression analysis was first done followed by descriptive statistics. Regression analyses are employed to ascertain a variable's degree of significance. A significance level of 5% was used in our data calculation process. In this case, each independent variable needs to be significant; it can be considerably positive or negative. The relationships between the variables differ. Descriptive statistics are used to examine the general summary of a data set. They offer interpretations derived from unprocessed data. As such, it is an essential metric for all studies. Next, this study examined the variations' multicollinearity. Then, finally, the OLS regression test is completed.

4. RESULTS AND DISCUSSION

The descriptive statistics are presented based on an analysis of 1,210 observations. CDI (dependent variable) has a mean of 10.03 with a standard deviation of 5.91, ranging from a minimum of 1 to a maximum of 23, indicating variability in carbon disclosure practices among firms. The board size (BSIZE) has a mean of 7.59 which indicate diverse perspectives and expertise that can improve strategic decision-making and monitoring. Independent board members (IBM), with a mean of 1.85%, play a important role in maintaining impartiality and reducing conflicts of interest, thereby supporting robust corporate governance. The low percentage of female board members (FBM), at 1.24%, indicates the need for increased gender diversity to ensure inclusive decision-making. Foreign board members (FoBM), with

an average of 0.46%, suggest limited international representation, which could limit the firm's global perspective. Accounting experts (AE) and legal experts (LawEx) on boards, averaging 1.03 and 0.55 respectively, are vital for ensuring financial transparency and legal compliance. The average audit committee size (ACTM) of 3.57 members supports strong internal controls and financial oversight. The log-transformed average firm age (Lage) of 1.44 indicates that established firms benefit from accumulated experience and stability. Profitability (ROA) with a mean of 0.05 indicates moderate returns, crucial for sustaining operations and growth. The average market value (MV) of 2.15 shows firm valuation and market perception variability. Leverage (LEV) averages at 0.53, indicating a balanced use of debt, and capital intensity (CAPI) with a mean of 0.51 shows varying investment in fixed assets, supporting long-term operational capabilities.

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CDI	1,210	10.0314	5.908932	1	23
Board	1,210	7.594215	2.226199	5	15
IBM	1,210	1.852893	0.712534	0	4
FBM	1,210	1.23719	1.117174	0	4
FoBM	1,210	0.462366	1.383003	0	7
AE	1,210	1.034711	0.78475	0	4
LawEx	1,210	0.549669	0.65953	0	3
ACTM	1,210	3.57438	1.051922	0	6
TAsset	1,210	539.6245	317.141	1	1078
Lage	1,210	1.436374	0.215157	0.90309	1.838849
ROA	1,210	0.053525	0.080965	-0.14779	0.441097
MV	1,210	2.150721	5.553156	0.009052	45.21947
Leverage	1,210	0.53497	0.737702	0.027261	6.447689
CapitalIny	1,210	0.511623	0.72922	0.000072	6.26296

Table 3 depicts correlation analysis which inferring board diversity, independent and foreign board member, accounting expert keeps positive impact on carbon disclosure as these are positively linked with CDI. The inverse condition is evidenced for legal experts. The relation between CDI and control variables such profitability (ROA), firm size (Total Assets), market-to-book ratio, and leverage are negative which depict the less impact on carbon information disclosure. There is no multicollinearity problem exists as no correlation coefficient is higher than .90. To test multicollinearity problem, this test also run VIF (shown in table 4). As all the VIF values are less than 10, so there is no multicollinearity problem.

Table 3: Pearson correlation analysis

Variables	CDI	Board	IBM	FBM	FoBM	AE	LawEx	ACTM	TAsset	Lage	ROA	MV	Leverage	CAPI
CDI	1													
Board	0.150***	1												
IBM	0.103***	0.506***	1											
FBM	-0.168***	0.230***	0.03	1										
FoBM	0.189***	0.208***	0.200***	0.028	1									
AE	0.119***	0.110***	0.133***	-0.090***	0.017	1								
LawEx	-0.095***	-0.023	0.023	-0.056**	0.043	0.116***	1							
ACTM	0.068*	0.114***	0.111***	0.047*	0.247***	0.061**	0.094***	1						
TAsset	-0.088**	-0.206***	0.015	-0.008	-0.018	-0.071**	0.145***	0.066**	1					
Lage	0.118***	0.105***	0.014	0.073**	0.063**	-0.056**	-0.248***	-0.105***	-0.208***	1				
ROA	-0.028	0.019	0.029	0.048*	0.236***	-0.092***	-0.104***	0.090***	-0.039	-0.056**	1			
MV	-0.069**	-0.055*	-0.145***	0.057**	0.003	-0.061**	-0.114***	-0.041	-0.102***	0.096***	0.325***	1		
Leverage	-0.051*	-0.050*	-0.065**	-0.129***	-0.041	0.072**	-0.038	-0.026	-0.151***	0.086***	0.072**	0.130***	1	
CAPI	-0.032	-0.085***	-0.069**	-0.080***	-0.085***	-0.019	-0.084***	-0.054*	-0.060**	-0.054*	0.167***	0.191***	0.658***	1

Table 4 regression analysis offers critical insights into the relationships between board composition, firm characteristics, and the Carbon Disclosure Index (CDI). In the comprehensive model presented in Column (1), board size (Board) shows a significant positive correlation with CDI ($\beta = 0.3394$, $p < 0.01$) which suggest that larger boards facilitate enhanced carbon disclosure. Independent board members (IBM) shows a negative but statistically insignificant relationship with CDI ($\beta = -0.3563$). The presence of female board members (FBM) is significantly negatively associated with CDI ($\beta = -1.1269$, $p < 0.01$), while foreign board members (FoBM) show a robust positive impact ($\beta = 0.8326$, $p < 0.01$). Accounting expertise (AE) on the board is positively correlated with CDI ($\beta = 0.5377$, $p < 0.01$) which stress the role of audit expertise in promoting comprehensive disclosure practices. In contrast, legal expertise (LawEx) is negatively correlated with CDI ($\beta = -0.9013$, $p < 0.01$) which indicates that legal professionals may prioritize compliance over proactive disclosure. Other variables, including total assets (TAsset) and market value (MB), demonstrate significant negative relationships with CDI, while firm age (Logage) and capital intensity are positively correlated. Column (2) disaggregates the data for the period before 2018, revealing that board size remains significantly positively correlated with CDI ($\beta = 0.3912$, $p < 0.01$). The negative impact of female board members persists ($\beta = -1.1707$, $p < 0.01$). Foreign board members ($\beta = 0.7962$, $p < 0.01$) and accounting expertise ($\beta = 0.6120$, $p < 0.05$) continue to influence CDI positively. Notably, independent board members (IBM) show an insignificant relationship during this period ($\beta = -0.0536$), while legal expertise maintains its significant negative impact ($\beta = -0.8982$, $p < 0.01$). The negative association between total assets and CDI is more pronounced ($\beta = -0.0018$, $p < 0.01$), indicating that larger firms were less likely to disclose comprehensive carbon information before 2018.

Table 4: Regression analysis

	Baseline Model	Pre corporate governance code -2018 (CGC-18)	Post Corporate Governance Code -2018 (CGC-18)	VIF
	CDI	CDI	CDI	
Board	0.3394*** (0.0886)	0.3912*** (0.1136)	0.3293** (0.1436)	1.589
IBM	-0.3563 (0.2680)	-0.0536 (0.3353)	-0.7732* (0.4450)	1.486
FBM	-1.1269*** (0.1473)	-1.1707*** (0.1841)	-1.0658*** (0.2440)	1.105
FoBM	0.8326*** (0.1237)	0.7962*** (0.1478)	0.8416*** (0.2205)	1.198
AE	0.5377*** (0.2070)	0.6120** (0.2796)	0.4797 (0.3148)	1.095
LawEx	-0.9013*** (0.2545)	-0.8982*** (0.3093)	-0.8331* (0.4429)	1.139
ACTM	0.1834 (0.1547)	0.1001 (0.1950)	0.3229 (0.2558)	1.109
TAsset	-0.0010* (0.0005)	-0.0018*** (0.0007)	-0.0000 (0.0009)	1.167
Logage	1.7857** (0.7954)	1.7341* (0.9596)	1.8097 (1.4146)	1.217
ROA	0.4305 (2.1812)	1.4138 (2.7043)	-0.1379 (3.6956)	1.29
MB	-0.1091*** (0.0312)	-0.1091** (0.0467)	-0.1055** (0.0459)	1.25
Lev	-0.9983*** (0.2900)	-0.8576** (0.3805)	-1.1215** (0.4571)	1.921
CAPI	0.5653* (0.2962)	0.4147 (0.3811)	0.7097 (0.4811)	1.942
YEAR	Yes	Yes	Yes	
Industry	Yes	Yes	Yes	
_cons	3.4500** (1.6651)	3.3739* (1.9148)	0.4666 (4.7594)	
N	1146	660	485	
F	14.4943	8.6146	5.5434	

r2	0.2291	0.2124	0.1679	
r2_a	0.2133	0.1877	0.1376	

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Post-2018 data, as depicted in Column (3), show nuanced shifts. Board size still has a positive but less significant impact on CDI ($\beta = 0.3293$, $p < 0.05$). Independent board members now display a significant negative relationship with CDI ($\beta = -0.7732$, $p < 0.10$), which indicate a potential shift in their influence. Female board members continue to impact CDI negatively ($\beta = -1.0658$, $p < 0.01$) while the positive influence of foreign board members ($\beta = 0.8416$, $p < 0.01$) and accounting expertise ($\beta = 0.4797$) remains consistent. The negative influence of legal expertise weakens but persists ($\beta = -0.8331$, $p < 0.10$). Interestingly, the relationship between total assets and CDI becomes insignificant which suggest changes in how firm size relates to disclosure practices in the recent period.

These findings infer the complexity of the factors influencing carbon disclosure practices. The positive association between board diversity and expertise with CDI underscores the importance of diversified and knowledgeable board composition. However, the varying impact of independent and legal experts, particularly over different periods, points to evolving dynamics in governance and regulatory environments. The negative influence of female board members on CDI warrants further analysis into potential underlying factors. These results suggest that while board composition significantly affects disclosure practices, broader organizational culture and strategic priorities also play crucial roles. Continued research is needed to understand these growing dynamics and to develop governance reforms that improve transparency and sustainability practices in response to regulatory changes.

5. CONCLUSION

Carbon disclosure and board characteristics as two contemporary challenges in the global economic landscape are significantly relevant in Bangladesh. As a developing nation with rapid industrialization and increasing carbon emissions, understanding the potential interplay between these issues is not just significant but vital for sustainable development. Focusing on 140 environmentally sensitive firms in Bangladesh from 2012 to 2022, this study investigates the complex relationships between board characteristics and CDI using a dynamic, multidimensional theoretical framework. The study is particularly relevant for Bangladesh, which has recently experienced significant economic growth through export-led industrialization. However, it bears substantial climate-related costs, as reflected in its low ranking on the 2020 Global Environmental Performance Index.

The empirical study has strong theoretical contribution. First, outcomes of this study goes in line with legitimacy theory as it demonstrates the positive relationship between board size (BSIZE), foreign board members (FOBM), and accounting experts (AE). The results of the study demonstrates that larger and diversified boards are more suitable to address the dynamic need of enhanced, which is very consistent with stakeholder theory. This research study also have managerial implications suggesting that firms should enhance their structure of

corporate governance by maintaining large and diversified board, including foreign board of directors and member having legal accounting expertise, empowering female and independent directors more in climate related decision making. Moreover, firm should increase the role audit committees and legal expert in ESG to foster CED and stakeholder trust. While this study makes significant contributions, it has limitations. First, for collecting secondary data only annual reports are used. Another limitation is that this study focuses on only single country, Bangladesh. the results may not be applicable to developed countries. Moreover, the study's deployed relatively small sample size of 1210 years of data which may limit the wider implications of the findings.

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