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Web-based Environmental Reporting: Evidence from Listed Manufacturing Companies in Bangladesh

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Abstract

Research aim: Businesses worldwide are attempting to exhibit accountability and efficacy in addressing the threat of severe environmental imbalances. Understanding the underlying issues responsible for environmental disclosures in digital media is essential to improve its status. This research investigates the environmental performance of manufacturing firms and evaluates the corporate governance factors that affect these disclosure practices.
Design/ Methodology/ Approach: This research applies multinomial logistic regression to deduce the nature of the connection between environmental disclosures made public on the web on 71 disclosure aspects or issues and corporate governance by collecting information from the websites of 193 listed manufacturing companies.
Research finding: The findings imply that board size, CEO duality, and foreign ownership have a major impact on web-based environmental reporting.
Theoretical contribution/Originality: This study integrates legitimacy theory and agency theory to understand the importance of efficient corporate governance in disclosing environmental information, thereby mitigating information asymmetry and voluntarily meeting stakeholder expectations.
Practitioner/Policy implication: Corporate governance may develop best practices to guarantee that the online platform of voluntary environmental reporting creates a credible environment for exposing information to end users, resulting in a more comprehensive evaluation of company prospects.
Research limitation: This study focuses on specific corporate governance characteristics. Other predictors can be considered to ensure better practices, such as the number of board meetings, educational quality of board members, stakeholder activism, political intervention, industry-specific environmental policy, etc. Moreover, longitudinal studies could offer further insights into the relationship between governance and environmental reporting.

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1. Introduction

The global community is increasingly worried about the future of the planet. Global warming poses a significant threat to the sustainability of nations due to its devastating impacts on both humans and other creatures, as well as the high costs it exacts on the environment. The threat of global warming is also a major economic problem, reducing national GDP by around 1.60% per year and costing the world around USD1.2 trillion. In 2017, climate change cost Bangladesh approximately USD2.83 billion, putting it in the seventh position among nations most hit by weather-related disasters (Rahman et al., 2023).

To respond to this global crisis, the United Nations established the Sustainable Development Goals (SDGs), comprising 17 objectives, in 2015. These objectives concentrate on tackling many global issues, such as climate change and environmental deterioration. The global adoption of SDGs necessitates that businesses assume responsibility, as their operations— encompassing raw material procurement, processing, distribution, and reverse logistics— persistently produce and emit hazardous substances, effluents, and chemicals, thereby intensifying environmental degradation (Haque & Sharif, 2021). Consequently, businesses around the world have shown a degree of responsibility in addressing the catastrophic threat of severe environmental imbalances like climate change, pollution, loss of biodiversity, deforestation, and ecosystem damage. The implementation of pro-environmental practices and the dissemination of this information through digital platforms can effectively connect companies' environmental concerns to and achievement of the SDGs, openness, and justice for a range of stakeholders. In this regard, the top management of companies take a proactive role in many capacities in deciding, presenting, and disseminating information on environmental aspects in a detailed and interpretable fashion so as to reach the stakeholders immediately for timely decision-making (Sammonds et al., 2021).

Web-based environmental reporting (WER) denotes the utilisation of online platforms and tools to disseminate and present a company's financial, operational, and performance data to stakeholders, including investors, regulators, employees, and the public. In contrast to conventional printed reports, web-based reports are accessible via websites, intranets, or specialised platforms, and provide a more dynamic, real-time, and user-friendly experience. Environmental reporting on company websites includes industry specific environmental policies, vision, waste management, environmental conservation approach, climate change adaptation and

mitigation approaches, etc., that reduce information asymmetry and investor tensions attributable to decision-making. Many large companies have implemented web-based corporate reporting practices and provide this information on their websites.

In today's world, aligning strategic goals with the SDGs is essential for doing business sustainably. Some developed countries, including Australia, Japan and Canada, have designed policies for disclosing environmental information on corporate websites (Kolk, 2003; Marston, 2003; Lodhia, 2004; Jose & Lee, 2007; Cormier et al., 2010). This is also being practiced in emerging markets, including in Turkey (Bozcuk et al., 2011), Gulf countries (Musleh Al-Sartawi, 2016), and Malaysia (Khan et al., 2016), though the level of voluntary disclosures are sometimes deemed insufficient, particularly in less-developed countries (Al-Msiedeen & Al-Sawalqa, 2021). Europe and the United States have surpassed emerging nations on the basis of online reporting, largely due to the influence of corporate governance directives stimulating such practices in advanced countries (Smith & Pierce, 2005; Aly et al., 2010). As environmental concerns become more widely recognised, there is a concomitant rise in the extent of environmental disclosure and stakeholders' expectations of environmental information (Sumiani et al., 2007). Environmental disclosure encompasses the provision of quantitative and qualitative social and environmental information by companies, with the intention of informing or influencing a range of people (O'Dwyer, 2002). WER holds great potential for enhancing transparency, accountability, and sustainability efforts. Disclosure includes the aspects of real-time monitoring, data visualisation, public awareness, compliance tracking, collaboration and sharing, mobile accessibility, customised dashboards, trend analysis, risk assessment, and integration with internet of things (IoT) devices. It assures the effectiveness of sustainability reporting, adds value to assurance statements, and underlines the moral concerns underpinning assurance procedures (Boiral et al., 2019).

Several factors influence the planning and carrying out of a company's framework for disclosing environmental information. Researchers have highlighted the importance of corporate governance (Huang & Kung, 2010; Merendino & Melville, 2019; Xue et al., 2022), such as board size (Ismail & Latiff, 2019; Kumar et al., 2022), board independence (Neville et al., 2019), and board diversity (Sarhan et al., 2019). Expanding board size will reduce the CEO's dominance within the company, which means it can influence the decisions of the CEO and might enhance corporate governance practices (Gerwanski et al., 2019; Vitolla et al., 2020; Chouaibi et al., 2022). Board independence, according to researchers, lowers tunnelling through investment efficiency, particularly through the quality of information sharing (Baboukardos & Rimmel, 2016). However, other researchers state that the level of board independence does not have substantial effect on

environmental sustainability reporting practices (Amran et al., 2014; Ismail & Latiff, 2019; Kumar et al., 2022). The inclusion of women on the board of directors is regarded as commendable due to their heightened awareness of societal, environmental, and community concerns in contrast to men, their larger range of job experience, and their ability to communicate smoothly, stimulating broader concepts and requirements from stakeholders (Huse & Grethe Solberg, 2006; Srinidhi et al., 2011; Rao & Tilt, 2016).

As a growing economy, Bangladesh is continuously developing its infrastructural setup to attract more foreign investment. The paradigm shifts in the global investment scenario stresses sustainable business practices. In this context, environmental sustainability aligned with SDGs is becoming a prime concern (Chowdhury et al., 2020). In 2018, the Bangladesh Securities and Exchange Commission (BSEC) enacted a corporate governance code for listed companies, mandating that the nomination and remuneration committees (NRC) of boards of directors establish and maintain a website for their companies, which must feature comprehensive disclosures on various aspects (Islam et al., 2022). Within a few years, listed companies started adopting the practice and reported on financial, social, governance and environmental issues regularly on their websites. Companies voluntarily exhibited their performance on environmental issues, including their pro-environmental vision, policies, strategies, and practices such as waste management, emissions control, energy conservation, recycling, reusing, and other conservation initiatives to enhance awareness and delineate their role as environmental stewards (Hassan et al., 2020). Users of environmental information and other stakeholders can easily access published reports from corporate websites, benefiting from real-time updates, interactivity, cost-effectiveness, scalability, security, centralised management, customisation, and cross-platform compatibility, which aid in raising awareness and making informed decisions (Lodhia, 2004; Sumiani et al., 2007; Nel & Baard, 2019). Overall, WER is seen as a progressive way to communicate environmental performance, driving better environmental governance and public participation in sustainability efforts (Sumiani et al., 2007).

Although numerous studies on corporate WER in Bangladesh have been conducted, particularly concerning multi-sector listed companies, representation remains significantly limited, and the issue of the heavily-polluting large manufacturing firms is insufficiently addressed (Dhar et al., 2022; Dutta & Bose, 2008; Mehedy et al., 2018; Mitra et al., 2017). As such, this study attempts to clarify the influence of corporate governance on web-based environmental disclosure, especially for manufacturing companies. These sectors are deemed more accountable for excessive resource utilisation and environmental degradation than the service sectors. Consequently, they are more resolute in tackling environmental challenges and have so developed a distinct set of strategies. Manufacturing firms can provide a standard for

other industries to prioritise environmental concerns (Banerjee et al., 2003; Herremans et al., 2016; Yu et al., 2017; Wang et al., 2018; Belgin & Balkan, 2020; Dzage et al., 2024). Thus, the following research question is formulated: what is the impact of corporate governance on environmental reporting practices of listed manufacturing companies in Bangladesh?

The present study aims to enrich the existing body of knowledge in multiple ways. Initially, we examine the influence of corporate governance on environmental reporting on company websites. Secondly, we perform multinomial logistic regression, utilising a comprehensive sample size with diverse reporting levels. The study employs multiple theoretical frameworks, including agency theory and legitimacy theory, to provide fresh evidence that satisfies the criteria for a multi-theoretical approach in determining environmental reporting status.

Therefore, this study seeks to address this gap by analysing the state of environmental disclosure on corporate websites and identifying the corporate governance elements that affect these disclosures. The rest of this paper is organised as follows: Section 2 provides an overview of the research and companies' environmental information disclosure and develops hypotheses. Section 3 provides a comprehensive explanation of the research, which includes data sources, model configuration, and definitions of key variables. Section 4 shows the regression outcomes and analysis. Section 5 explores varying effect of corporate governance elements on environmental disclosure, provides potential explanations for these correlations, and concludes with a summary of the findings.

2. Literature Review and Hypothesis Development

2.1 Background

Environmental concerns have gained significant importance among stakeholders, with increased attention directed towards the environmental impacts of corporate activities (Hughes et al., 2001; Clarkson et al., 2011; Braam et al., 2016). Numerous companies have faced criticism for contributing to environmental issues, including climate change, resource depletion, waste generation, and deficiencies in corporate environmental responsibilities (Verma, 2010; Braam et al., 2016). As a result, corporate environmental reporting has evolved into a crucial component of firms' societal relevance, reflecting its commitment to sustainable practices within its operational context (Uwuigbe, 2012). Environmental reporting is a process through which companies disclose environmental information to their stakeholders, demonstrating accountability for their activities and their subsequent impact on the environment (Lodhi, 2005; Ijeoma, 2015).

Historically, companies have disseminated their environmental information through various print media, including annual reports, single environmental reports, corporate social responsibility (CSR) reports, press releases, news outlets, advertisements, brochures, newsletters, internal publications, and pamphlets (Lodhi, 2005; Dutta & Bose, 2008). The problems with printed reports are its restricted readership and the cost of printing physical copies of corporate reports. Furthermore, there is a decreased level of interactivity, data presentation, and integration with other platforms or links. These media are not spontaneous, and as a result, it takes a longer time to incorporate corporate updates. With the advent of the internet, which serves as the broadest medium of communication in the contemporary globalised economy, companies have transitioned to utilising digital platforms and maintain their personal websites (Verma, 2010; Alarussi et al., 2013). Moreover, web-based environmental disclosure involves reporting on the management of emissions and effluents on corporate websites. It includes detailing the use of materials, processes, or practices aimed at reducing, minimising, or eliminating the generation of pollutants or waste (Ijeoma, 2015; Anyadufu & Orajekwe, 2023).

In 1970, Norway became the first country in the world to introduce environmental disclosure (Shil & Iqbal, 2005). In the following years, other countries in Europe, Asia and America, including the UK, US, Japan, Canada, etc., actively researched environmental accounting information and have taken important steps towards environmental protection (Zhang, 2009). Following this continuity, Bangladesh also initiated the disclosure of environmental reporting, and in 1990, some listed companies on the Dhaka Stock Exchange (DSE) disclosed environmental information (Shil & Iqbal, 2005; Mehedy et al., 2018). There has been extensive research conducted to measure just how much environmental information is disclosed by listed companies in Bangladesh (Belal, 2000; Hossain et al., 2006; Dutta & Bose, 2008; Saha & Akter, 2012; Akther, 2017). A study on textile industries revealed that 69% do not share any information related to the environment (Ullah et al., 2013). Moreover, some authors claim that the companies disclose only positive qualitative environmental information (Kabir, 2015; Hossain, 2016; Mehedy et al., 2018). Nonetheless, several studies have highlighted that corporate governance contributes to the disclosure of environmental information (Gibson & O'Donovan, 2007; Jamali et al., 2008; Wise & Ali, 2008; Rao et al., 2012; Islam et al., 2015; Rafique et al., 2017).

Corporate governance encompasses the processes, practices, policies, laws, and institutions that guide how organisations and corporations operate, manage, and control their activities (Khan, 2011). It can also be defined as the control systems put in place to safeguard the interests of investors and shareholders (Di Vito & Trottier, 2022). Good governance enhances accountability and transparency, ultimately leading to increased voluntary

and mandatory disclosure (Rao et al., 2012; Ika et al., 2021). Studies on the impact of corporate governance on environmental reporting in countries such as Canada (Ben-Amar & McIlkenny, 2015), India (Ezhilarasi & Kabra, 2017), Pakistan (Rafique et al., 2017), Malaysia (Buniamin et al., 2008; Yusoff et al., 2015), and Indonesia (Nurhayati et al., 2006; Gery Djajadikerta & Trireksani, 2012; Junita & Yulianto, 2018) differ on which corporate governance aspects affect environmental disclosure.

Researchers emphasise that corporate governance serves to enhance and explain the challenges associated with agency problems (Eng & Mak, 2003; Shan, 2010). An agency problem occurs when the interest of shareholders (principals) counter those of managers (agents). Agency theory describes this conflict of interest, suggesting that managers may not always act in the best interest of shareholders, leading to agency costs theory (Brammer & Pavelin, 2008; Jensen & Meckling, 2019; Kumar et al., 2022). Good corporate governance enhances transparency and accountability, thereby reducing information asymmetry between managers and shareholders and ultimately reducing agency cost (Amaeshi & Amao, 2009; Mody & Mudoi, 2011; Rodriguez-Fernandez, 2016).

Legitimacy theory, meanwhile, suggests that companies align their actions with societal norms and values to maintain legitimacy (Suchman, 1995; Aerts & Cormier, 2009; Deegan, 2014). This theory posits that companies choose to disseminate information about their social and environmental activities to demonstrate that they adhere to societal expectations and standards (Suchman, 1995; Deegan, 2002; O'Donovan, 2002; Higgins & Walker, 2012; Tregidga et al., 2014; Arena et al., 2018). This voluntary disclosure is essential for maintaining the social contract (Kılıç & Kuzey, 2019; Kumar et al., 2022) between the company and its stakeholders, which helps boost the company's credibility and acceptance in society (Guthrie et al., 2007; Reverte, 2009; Ching & Gerab, 2017; Atan et al., 2018). By implementing robust corporate governance and transparent environmental reporting, companies can build trust and legitimacy from their stakeholders, addressing both agency problems and societal expectations (Luft Mobus, 2005; Tilling & Tilt, 2010).

2.2 Board size

There is growing interest in the study of both environmental and social disclosures, and an emerging field has evolved to look into how firm-specific traits affect such reporting (Chapple & Moon, 2005; Brammer & Pavelin, 2008; Reverte, 2009). The board of directors is a crucial element of preparing the corporate governance framework; for this reason, board formulation is considered a significant part of firm-specific features (Hendry, 2005; Brennan & Solomon, 2008). The board is responsible for assessing the performance of

managers in addition to protecting the rights of shareholders (Ben-Amar et al., 2017). In this respect, there is an important characteristic that is widely studied—board size, which refers to the total number of directors serving on a board (Panasian et al., 2003; Levrau & Van den Berghe, 2007; Zabri, Ahmad & Wah, 2016).

However, there are some challenges associated with large boards. Often, large boards faces challenges including coordination and communication, which lead to unproductivity and prolonged decision-making (Lipton & Lorsch, 1992). Unproductivity involves the ability of individual directors to oversee management effectively, resulting in weaker governance—potentially leading to weak management practices (Guest, 2009). For this reason, some researchers recommend that board size should not exceed 10 members (Jensen, 1993), while others point to the benefits of larger board sizes (Zhou, 2019; Abeysekera, 2010; Suttipun & Bomlai, 2019). Expanding board size can reduce the CEO's dominance within the company, which means it can influence the decisions of the CEO and enhance corporate governance (Cuadrado-Ballesteros et al., 2017; Gerwanski et al., 2019; Vitolla et al., 2020; Chouaibi et al., 2022). A large board offers a higher level of expertise, in addition to a greater ability to oversee and exchange the workload (Laksmana, 2008; Said et al., 2009; Larmou & Vafeas, 2010). It contributes in mitigating the disputes between internal and external stakeholders of the company (Shamil et al., 2014; Kılıç & Kuzey, 2019). An large board also enables the inclusion of a bigger group of stakeholders, and enhances transparency regarding strategic objectives and data that is beneficial to a wider range of stakeholders (Ben-Amar & McIlkenny, 2015; Fasan & Mio, 2017).

From the legitimacy theory perspective, a large board carries more expertise and improves environmental reporting, thereby contributing towards addressing accountability and legitimacy concerns (Mahmood & Orazalin, 2017). Agency theory posits that effective corporate governance mechanisms can contribute to mitigate conflicts of interest between principals and agents. Although board size is considered a crucial element of the corporate mechanism, a large board can provide more effective monitoring of management. This can reduce the agency conflict by ensuring that managers act in the best interests of shareholders (Bakri et al., 2024). Thus, board size is important for environmental reporting. Many prior studies postulate that board size has a positive relationship with environmental reporting (Sufian & Zahan, 2013; Correa-Garcia et al., 2020; Vitolla et al., 2020; Chouaibi et al., 2022). Therefore, this study assumes that board size positively influences the environmental reporting of manufacturing companies in Bangladesh, leading to the proposed hypothesis:

H_1 There is a positive relationship between board size and web-based environmental reporting

2.3 *Board independence*

Board independence refers to the ability of the board of directors to make decisions that prioritise the company and its stakeholders' rights without being influenced by management. It is also described as the status of a director who is not an executive director and who does not have any substantial connections or relationships with the company's management or significant shareholders (Fuzi et al., 2016). Moreover, agency theory suggests that independent directors are less likely to experience conflicts of interest with management which makes them less biased in their monitoring. This tends to reduce the agency problem, as managers are assured that they will act in the best interest of the shareholders (Rashid, 2015). From the legitimacy theory perspective, independent directors' enhanced credibility is perceived as more impartial and less prone to conflicts of interest with management (Allaire, 2008). They also help to ensure transparency and accountability for operations, which builds trust in stakeholders (Al Amosh & Khatib, 2022).

Several studies claim that independent directors on the board enhance corporate mechanisms and board effectiveness (Barako, 2007; Shamil et al., 2014; Chouaibi et al., 2021). They also help to reduce agency costs by mitigating agency problems (Kathy Rao et al., 2012; Shamil et al., 2014) and to address legitimacy issues (Al Farooque & Ahulu, 2017; Mahmood & Orazalin, 2017). Baboukardos and Rimmel (2016) note that independent directors enhance the quality of information, leading to more comprehensive information sharing. Additionally, prior studies highlight that board independence is positively related to the quality of web-based environmental reporting (Sun et al., 2012; Ferrero-Ferrero et al., 2016; Kweh et al., 2017; Cucari et al., 2018; Liao et al., 2018; Chouaibi et al., 2021; Colakoglu et al., 2021). This leads to the following hypothesis:

H_2 There is a positive relationship between board independence and web-based environmental reporting

2.4 *Board diversity*

In this paper, board diversity measures gender diversity, specifically the percentage of women on the board (Nguyen & Thanh, 2022). Board diversity is an important component that is widely used. Several researchers have extended their focus on board diversity and analyse the impacts of gender diversity. Gender diversity is an essential element of practicing effective corporate governance and reporting, including financial, sustainability,

environmental, and voluntary reporting (Rupley et al., 2012; Vafaei et al., 2015; McGuinness et al., 2017). The inclusion of women on boards of directors is viewed positively due to their greater awareness of societal, environmental, and community issues compared to men, their diverse job experiences, and their effective communication skills, which foster broader stakeholder engagement (Webb, 2004; Srinidhi et al., 2011).

From the perspective of agency theory, board gender diversity can mitigate conflict of interests by fostering various perspectives and ideas. It also effective in monitoring and controlling managerial actions (Kabir et al., 2023). Moreover, board diversity boosts organisations' legitimacy by reflecting a dedication to social responsibility. This can exacerbate the reputation of the company as well as stakeholder relations (Ricci et al., 2023). Moreover, some researchers note that board diversification enhances financial reporting and good corporate practices (Pucheta-Martínez et al., 2016; Rogelberg & Rumery, 1996). In this regard, some researchers demonstrate that board diversity has a good correlation with WER quality (Filippo et al., 2020; Jannik et al., 2019; Kılıç & Kuzey, 2018). However, many researchers find that the increase in the number of women directors has no relationship with the level of corporate environmental reporting (Ismail & Latiff, 2019; Ika et al., 2021; Pucheta-Martínez et al., 2021). This leads to the following hypothesis:

H_3 There is an association between board diversity and web-based environmental reporting

2.5 CEO duality

Chief executive officer (CEO) duality refers to an individual who undertakes the responsibilities of an executive along with the chairperson of the board within the company (Rechner & Dalton, 1991; Surroca & Tribó, 2008). This structure fosters authority to make decisions in a single person, which weakens the board's autonomy and its ability to supervise and monitor the CEO's actions (Finkelstein & D'aveni, 1994; Gul & Leung, 2004). CEO duality undermines the board's impartiality, as the chairperson possesses the authority to set the agenda, choose its members, and withhold confidential information from the other board members (Haniffa & Cooke, 2002; Krishnan & Visvanathan, 2009).

Agency theory concentrates on the conflicts of interest between agents and principals. Researchers indicate that CEO duality can bolster these conflicts of interest by fostering authority in a single person (Goergen et al., 2020). This in turn can lead to decisions that incur costs for shareholders. On the other hand, legitimacy theory posits companies endeavour to achieve and sustain legitimacy by adhering to societal norms and expectations. In this

context, CEO duality can bolster companies' legitimacy among stakeholders through cohesive leadership (García-Ramos & Díaz Díaz, 2020). Zhou (2019) notes that companies with CEO duality provide less information in their voluntary disclosure. Other researchers report mixed results about the role of CEO duality in exacerbating environmental information (Marrone, 2020; María & Isabel, 2020; Huafang & Jianguo, 2007; Sun et al., 2022). Therefore, the proposed hypothesis is:

H_4 There is an association between CEO duality and web-based environmental reporting

2.6 Control variables

As discussed earlier, certain firm-specific characteristic and ownership structure also influence the disclose environmental information of the companies. Consequently, this study incorporates the age of business and foreign ownership as control variables in the research model. Some researchers highlight that older companies offer more environmental information (Habbash, 2016; Correa-Garcia et al., 2020) to maintain goodwill in society (Yulyan et al., 2021). Therefore, many researchers note that there exists a positive relationship between the environmental reporting and age of business (Macias & Farfan-Lievano, 2017; Yulyan et al., 2021).

Foreign ownership is an important element of corporate governance. Several researchers note that there is a positive relationship between environmental reporting and foreign ownership (Masud et al., 2018; Saini & Singhania, 2019; Al Amosh & Khatib, 2022; Ellimäki et al., 2024). This indicates that companies with a greater degree of foreign ownership are prone to participate in environmental reporting (Masud et al., 2018). Similarly, researchers contend that the presence of foreign ownership in ownership structures facilitates robust environmental laws for corporations (Oh et al., 2011). This is because foreign shareholders expect companies to disclose more environment-related information due to its engagement in foreign markets and the higher standards that that introduces (Muttakin & Subramaniam, 2015; Ellimäki et al., 2024).

3. Research Methodology

3.1 Sample

The sample initially included all 204 manufacturing companies from 10 sectors listed on the Bangladeshi stock exchanges. The selection of manufacturing companies was based on their greater liability for substantial emissions and environmental degradation than non-manufacturing firms

(Khan et al., 2021; Akter et al., 2022). After extensive internet search, 193 companies were found to have corporate websites, but the websites of 11 companies were not available or contained inaccessible environmental disclosures during the period of data collection from August to October 2022. Consequently, the sample of the present study consists of 193 companies, or 95% of listed manufacturing companies (See Table 1). Though BSEC promulgated new corporate governance code and rules of reporting in 2019, it took some time (two to three years) for listed companies to adopt the codes and include the information on their websites (Biswas, 2015; Islam et al., 2022). As a result, 2022 is selected as the research period.

Table 1. Sample Selection

Sector	Number of companies
Cement	7
Ceramic	5
Food and allied	21
Jute	3
Paper and printing	6
Pharma and chemicals	36
SME	20
Tannery	6
Textile	58
Engineering	42
Total	204
Elimination due to unavailability of information	(11)
Final sample	193

Source: Dhaka Stock Exchange

3.2 Collection of data

Data was collected from the websites of the sample companies. First, the web address of the selected companies was taken from the website of the stock exchange. Data relating to environmental aspects were identified at several segments of corporate reports, including sustainability reports, messages from the board, company mission, press briefings, and separate environmental reports. The reporting levels were categorised by comparing with a list of 71 disclosure topics.

3.3 Dependent variable

3.3.1 Web-based environmental reporting (WER)

WER denotes the utilisation of online platforms and technologies for the collection, analysis, and dissemination of environmental data and performance metrics. This procedure often entails the digital recording and dissemination of essential environmental metrics, including energy consumption, water usage, waste management, carbon emissions, and other sustainability indicators, either in real-time or at regular intervals.

WER is measured as a categorical variable. We fixed 71 environmental disclosure items as presented in Global Reporting Initiative (GRI) guidelines and recent literature (Sandhu & Singh, 2019). The level of reporting is categorised based on the disclosed items (Chowdhury et al., 2020). Companies that disclose up to 30% of the required disclosure items take the value 1, 30–60% disclosure take the value 2, and over 60% disclosure take the value 3. If a company discloses 29 items out of 71, it discloses 40% of the standard disclosures (Chowdhury et al., 2020; Chowdhury et al., 2023).

3.4 Independent variables

This study identifies six independent variables to elucidate the levels of environmental disclosure on company websites. The norms and regulations concerning board size, board independence (board composition), and CEO duality are determined by the BSEC corporate governance code.

3.4.1 Board size (BoS)

The total number of members of a company's board of directors shall not be less than five and more than 20. Board size is measured as the total number of directors on the board (Sandhu & Singh, 2019).

3.4.2 Board independence (BoI)

The assessment of board independence is based on the proportion of outside independent directors inside the board. The board must include a minimum of 20% independent directors to ensure effective representation. If there is a fraction, it will be rounded up to the next whole number for determining the number of independent directors (Abdelsalam & El-Masry, 2008; Correa-Garcia et al., 2020).

3.4.3 Board diversity (BD)

Though no specific guidelines on board diversity are mentioned in the BSEC regulations, gender diversity is considered as a proxy for diversity. The number of female members on the board denotes board diversity (Dobija et al., 2022).

3.4.4 CEO duality (CEOD)

The roles of the chairperson and the managing director (MD) and/or CEO of the corporation must be held by separate individuals. The variable CEO duality takes the value of 1 when the CEO of the firm also serves as the chair of the board, and 0 otherwise (Sandhu & Singh, 2019).

3.5 Control variables

3.5.1 Foreign ownership (FoO)

Foreign ownership denotes the possession of a segment of a company's assets by persons who are non-citizens of that nation or by corporations whose headquarters are situated outside that nation. Foreign ownership is measured by the percentage of shares owned by foreign investors (Al Amosh & Khatib, 2022).

3.5.2 Age of business (AgB)

Age of business is measured by the number of years the companies are in operation in the market (Zamil et al., 2023).

3.6 Model estimation

To test the relationship between the status of WER and corporate governance characteristics, we set the following model. As WER is a categorical variable, we employ a multinomial logistic model to test the hypothesis. SPSS 22 was applied to run the regression.

Web-based environmental reporting (WER) = $\beta 0$ + $\beta 1$ Board size (BoS) + $\beta 2$ Board independence (BoI) + $\beta 3$ Board diversity (BoD) + $\beta 4$ CEO duality (CEOD) + $\beta 5$ Age of business (AgB) + $\beta 6$ Foreign ownership (FoO) + εit

4. Findings and discussion

4.1 Descriptive statistics

Descriptive statistics include minimum and maximum value, mean, and standard deviation of the sample. It also presents the correlation among the variables. Table 2 indicates that the sample companies had a minimum age of seven years and a maximum age of 72 years. The age of a business is ascertained by its year of establishment. The mean age of firms in this industry is 30 years. This signifies a considerable degree of market expertise and understanding. The proportion of foreign ownership is 29%. Furthermore, 25% of CEOs also serve as chairpersons of the board, indicating that CEO duality in publicly listed companies confers significant authority, despite the preference for CEO non-duality to delineate critical managerial roles from board oversight.

Table 2. Descriptive Statistics and Correlation

	Descriptive statistics				Correlation						
	Min	**Max**	**Mean**	**SD**	**AgB**	**CEOD**	**BoS**	**BD**	**BoI**	**FoO**	**WER**
AgB	7	72	30.95	15.202	1						
CEOD	0	2	0.25	0.452	0.007	1					
BoS	3	19	7.23	2.548	0.074	-0.242**	1				
BoD	0	4	1.29	0.919	0.040	-0.015	0.195*	1			
BoI	0	5	1.88	0.804	-0.063	-0.027	0.572**	0.049	1		
FoO	0	1	0.29	0.457	0.184*	-0.163*	-0.028	-0.060	0.024	1	
WER	0.10	0.65	0.47	0.09	0.081	0.081	0.149	0.041	0.100**	0.119**	1

Notes: * Correlation is significant at the 0.05 level (2-tailed), ** correlation is significant at the 0.01 level (2-tailed)

In this study, the mean board size (BoS) is seven members, indicating an optimal composition of board members. The average representation of female directors (BoD) on the board is 1, constituting 14% of the board's total size, indicating restricted involvement in decision-making. The board comprises an average of two independent directors, constituting 30% of its total makeup. The mean quantity of independent directors (BoI) is two, indicating a 28% engagement in board activities. Table 2 also shows that the proportion of enterprises with foreign ownership (FoO) is 29%. The average WER is 0.47, indicating a moderate percentage of enterprises reported environmental issues in their 2022 disclosures. The above table also presents the correlation matrix of the variables. WER is positively and significantly correlated with foreign ownership and board independence.

4.2 Regression results

4.2.1 Likelihood ratio tests

Table 3 displays likelihood ratio tests that show statistically significant variables to explain the model. It can be observed that CEO duality (p = 0.008), foreign ownership (p = 0.003), and board size (p = 0.017) are statistically significant. In multinomial logistic regression the measure similar to R2 in ordinary least-squares linear regression is calculated that explains the proportion of variance in the model. In multinomial logistic regression, however, this is termed pseudo-R^2. We have chosen McFadden's pseudo-R^2 over other pseudo-R^2 measures because of its superior interpretive quality (Allison, 2013). McFadden's pseudo-R^2 value between 0.2 to 0.4 indicates an excellent fit (Hossain, 2023).

Table 3. Likelihood Ratio Tests

Effect	Model fitting criteria	Likelihood ratio tests			McFadden's pseudo-R^2
	-2 log likelihood of reduced model	Chi2	df	Sig.	
Intercept	311.556	11.392	2	0.003	0.233
Agb	301.443	1.279	2	0.528	
CEOD	309.890	9.727	2	0.008	
FoO	311.771	11.608	2	0.003	
BS	308.287	8.124	2	0.017	
BD	301.628	1.465	2	0.481	
BoI	302.165	2.001	2	0.368	

4.2.2 Parameter estimates

Table 4 displays the parameter estimates or coefficients of the model. Given the presence of three categories for the dependent variable WER, we can see the existence of two distinct sets of logistic regression coefficients, also known as two logits for reporting level 1 (0% to 30%) and 2 (30% to 60%).

In the first set of coefficients in row 1 (indicating a web-based disclosure level of up to 30%), CEO duality (CEOD) and board size (BoS) are identified as positively significant factors for lower level of environmental reporting.

Table 4. Parameter Estimates

WER		B	Std. error	Wald	df	Sig.	Exp(B)	95% confidence interval for exp(B)	
								Lower bound	Upper bound
"1"= (0-30%)	Intercept	-6.452	2.416	7.132	1	0.008			
	AgB	0.019	0.022	0.720	1	0.396	0.982	0.940	1.025
	CEOD	1.897	0.718	6.984	1	0.008	6.664	1.632	27.203
	FoO	1.327	0.721	3.390	1	0.066	3.770	0.918	15.488
	BoS	1.685	0.671	6.296	1	0.012	5.390	1.446	20.097
	BoD	-0.256	0.379	0.455	1	0.500	0.774	0.368	1.628
	BoI	0.324	0.396	0.668	1	0.414	1.382	0.636	3.006
"2"= (30-60%)	Intercept	0.647	1.140	0.322	1	0.570			
	AgB	0.011	0.011	0.966	1	0.326	0.989	0.967	1.011
	CEOD	-0.047	0.384	0.015	1	0.903	0.954	0.450	2.025
	FoO	0.769	0.383	4.034	1	0.035	0.464	0.219	.982
	BoS	0.555	0.324	2.939	1	0.086	1.741	0.924	3.283
	BoD	-0.199	0.172	1.337	1	0.248	0.819	0.584	1.149
	BoI	-0.180	0.236	0.584	1	0.445	0.835	0.526	1.326

Note: The reference category is 3.

The second set of coefficients is found in row 2 (representing the WER level from 30% to 60% in comparison to the reference category, 3). In this set of coefficients, the only significant variable is foreign ownership (p = 0.035). If the companies have greater foreign ownership or investment, it is more likely that the companies disclose environmental issues from 30% up to 60%.

Table 4 also presents the exponentiated value of the coefficients Exp(b), that can be considered for explaining the reporting level. In the first set of coefficients, Exp(B) of age (AgB) and board diversity (BoD) show inverse relation (value < 1) with disclosure (WER), suggesting that increasing age of business and number of female directors in the board correspond to greater extent of disclosures. In the second set of coefficients, the exponential of AgB, CEOD, FoO, BoD, and BoI all demonstrate a negative relationship with WER. This indicates that as the age of the business increases, the CEO holds a dual role, foreign ownership increases, and the number of female directors increases, so does the likelihood of disclosure of environmental information.

H_1 predicts that board size and web-based environmental reporting level are positively related irrespective of the levels of disclosure. In category 1 (up to 30%), disclosure, board size significantly affects the reporting status

which supports the hypothesis (β = 1.685, p = 0.012). When the disclosure level increases, the relation appears positive but insignificant (β = 0.555; p = 0.086). Board size to an optimal status may affect the reporting level, but a large board size may not substantially impact the reporting status (Uwuigbe et al., 2011). Therefore, H_1 is supported.

H_2 estimates that board independence has positive relationship with WER. The empirical results support H_2 when environmental information is reported up to 30% (β = 0.324, p = 0.668), but negatively related when disclosure level increases beyond 60% while this association is not statistically significant thus rejecting the hypothesis (β = -0.180; p = 0.445). Therefore, this analysis indicates that increased board independence does not guarantee enhanced environmental disclosure. So, H_2 is rejected.

H_3 predicts there is an association between board diversity and web-based environmental reporting. The results of the study implies that board diversity and WER are negatively related, thus supporting the mixed findings in previous literature (β = -0.256; p = 0.500; β = -0.199; p = 0.248). Diversity can be defined using various metrics, such as gender, ethnicity, level of education, and professional experience. This study examines the number of female directors on the board as a proxy for diversity, which does not adequately elucidate good governance but instead exerts a negative influence on disclosure, although the impact is not significant.

H_4 anticipates the association between CEO duality and web-based environmental reporting. Category 1 disclosures are positively and significantly connected, though this is not the case in category 2 disclosures (category 1: β = 1.897, p = 0.008; category 2: β = -0.047, p = 0.903). Therefore, when the CEO and the chairperson of the company are different persons, it reduces potential conflicts and makes CEOs more accountable to stakeholders (Ahmad et al., 2017).

This study aims to understand the effect of board characteristics on environmental reporting through the lens of agency theory and legitimacy theory. It presents empirical evidence that board size, CEO duality, and foreign ownership significantly influence the level of WER practices in listed manufacturing companies in Bangladesh. An ideal board size enhances mutual understanding, involvement, and fosters cohesive behaviour among members, hence facilitating effective decision-making (Arora, 2020).

CEO duality can markedly improve environmental reporting in several critical aspects. A key advantage is the establishment of cohesive leadership and vision throughout the firm. The company can attain a unified approach to its environmental policy by having one people occupy both positions. This cohesive leadership accelerates decision-making and enhances the execution of sustainability programmes, ensuring that environmental factors are prioritised in the company's strategic direction (Ali et al., 2022).

Foreign ownership can markedly improve environmental reporting

through many reasons and practices. Foreign-owned enterprises frequently benefit from the adoption of worldwide best practices in environmental management, derived from their parent corporations. This exposure to international standards compels local subsidiaries to establish comprehensive environmental reporting structures. Furthermore, the experience and proficiency that foreign firms provide can enhance reporting processes, as they are adept at manoeuvring through intricate regulatory environments and stakeholder demands across several markets (Aksan & Gantyowati, 2020).

In this era of advanced digital technology, it is very convenient to connect with diverse set of stakeholders through holistic reporting practices. Environmental reporting as a voluntary disclosure practice manifests the company's environmental concern and responsibility, reduces information asymmetry and consequently reduce agency costs. Moreover, to emphasise the importance of legitimacy, a company would voluntarily report on its financial, social, and environmental aspects if those activities were expected by the communities in which it operates. Manufacturing enterprises significantly contaminate the natural environment by routinely releasing waste, chemicals, and other dangerous substances. The management of these companies prioritises environmental conservation through pollution control, resource preservation, and ecological regeneration to assure sustainability. Through appropriate initiative and governance mechanisms, the reporting practices of these corporations can be optimised, thereby clarifying their stance on environmental concerns to the public.

5. Conclusion

Good governance is crucial to setting reporting standards in contemporary platforms that satisfy investor demands while safeguarding their rights. This research advocates for regulators to establish criteria that foster a credible environment and platform for disseminating information to end users, leading to a more precise evaluation of company prospects and improved investment decisions.

The primary strength of this paper lies in its sample, which predominantly focuses on heavily polluting manufacturing industries. The recent literature on environmental reporting practices in Bangladesh tend to present the reporting status in aggregate, despite the fact that not all industries contribute equally to environmental degradation (Ullah et al., 2013; Masud et al., 2017). Each industry should develop its own style or format of environmental reporting, tailored to the specific environmental threats it poses and the corresponding remedial actions required. Manufacturing firms are compelled to report environmental information more than service organisations due to their elevated resource

use, significant environmental impacts, legal obligations, and heightened public and investor scrutiny. Disclosures for manufacturing firms are crucial for compliance, risk management, and showcasing sustainability initiatives directly linked to the company's operations. For service companies, although environmental disclosure is significant, it is generally less crucial due to their comparatively smaller and less direct environmental impact.

Significant management implications are associated with online environmental reporting: it helps enhance transparency and engage stakeholders. Using the internet, those guiding companies are able to give immediate updates on their environmental performance; this in turn is a way of promoting accountability by showing stakeholders that they can trust them (Adams & Whelan, 2009; De Micco et al., 2021; Johnson et al., 2021). Such openness can also raise the profile of an organisation while at the same time drawing interest from environmental concern investors (Gray et al., 1995). Further, WER enables better management of data, which in turn leads to less expenditure on time-consuming conventional methods. However, managers have other problems, for example securing data accuracy and preventing privacy violations caused by digital security threats (Ghio & Verona, 2020).

This study is limited by several constraints. The search is conducted using a cross-sectional design. Engaging in longitudinal research may yield further insights into the relationship between governance systems and online reporting. Moreover, the study is compromised by the prejudiced viewpoints about the development of disclosure indicators and assessment methodologies. Data available on company websites is liable to modification. Therefore, the acquired information is pertinent to the specific time it was obtained. The outcomes may differ if the data is gathered at an alternative time frame within the same fiscal year. The study examines the correlation between board qualities and the WER.

Subsequent research can investigate the impact of board diversity and board structure on WER. Diversity encompasses various factors such as gender, ethnicity, educational background, and professional experience. However, in this particular case, we only choose female directors, which indicates a negative correlation with WER. In addition, future research can also investigate the correlation between the responsibilities of the board of directors and the performance of the company in relation to WER practices. The paper concludes that online environmental reporting in Bangladesh is at an early stage of development. Nevertheless, there is a growing demand for corporations to adopt the practice of web-based environmental disclosure on the internet in order to enhance the accuracy and reliability of information provided to stakeholders.

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Appendix

Appendix 1. Disclosure Items on Environmental Issues

1. Total amount of energy consumed by an organisation, often broken down by source (e.g., electricity, fuel, etc.)
2. The proportion of energy consumed that comes from renewable sources like solar, wind, or hydroelectric power
3. Measures how effectively energy is used, often expressed as energy savings per unit of output
4. The total amount of water used by an organisation, often measured in cubic meters or litres
5. The amount of water consumed per unit of production or revenue
6. The percentage or volume of water that is recycled and reused within the organisation
7. The total volume of water extracted from natural sources (rivers, lakes, groundwater, etc.)
8. The volume and quality of water discharged from the organisation's operations into the environment
9. The total amount of waste produced by an organisation, often categorised by type (e.g., hazardous, non-hazardous, recyclable, organic)
10. The percentage of waste diverted from landfills through recycling, composting, or other recovery methods
11. The amount of waste sent to landfill
12. The percentage of materials that are recycled from the total waste generated

13. The volume of hazardous waste produced by the organisation and its management practices
14. Total GHG emissions produced by an organisation
15. Separate sustainability department
16. Awareness building initiatives
17. Investments or actions taken by an organisation to protect or restore ecosystems or biodiversity
18. The proportion of operations within or near protected areas or areas with significant biodiversity, such as national parks or wildlife reserves
19. The amount of material used per unit of economic output (e.g., per unit of production or revenue)
20. The percentage of materials sourced sustainably, such as certified sustainable timber, fair-trade materials, or recycled content
21. The proportion of materials used in production processes that are recyclable
22. The amount of materials recovered for reuse, recycling, or repurposing
23. Identification and mitigation measures taken to address environmental risks, such as hazardous waste spills or chemical leaks
24. The extent to which an organisation discloses its environmental impact through sustainability reports or third-party certifications
25. The number or results of independent environmental audits conducted by certified auditors or organisations
26. The extent to which an organisation's products and materials are designed to be reused, remanufactured, or recycled rather than disposed of
27. The proportion of waste materials that are upcycled (transformed into higher value products)
28. Tree plantation and forestry related disclosure
29. Land and air pollution-related disclosures and investment in biogas/ bio-fertiliser plants
30. Water pollution and control related disclosures through effluent treatment plants
31. Miscellaneous green infrastructure projects
32. Green policy related disclosures
33. Award and recognition for environmental initiatives
34. Employee training and customer awareness related to environment disclosures

35. Climate change, fund allotment for climatic changes
36. Consumer awareness related to environmental disclosures
37. Ecological and carbon management policies
38. Environmental policies
39. Environmental review, area, audit, evaluation, including independent attestation
40. Environmental management systems
41. Air quality assessment
42. Development product, improvements in products
43. Research related information including new methods of production and reduce pollution
44. Technologies on contamination and prevention
45. Contamination control of industrial process
46. Recycling of waste products
47. Raw materials preservation
48. Future pollution expenditure and control equipment
49. Past and present operating costs related to pollution
50. Air quality assessment
51. Research on new methods for reducing environmental contamination
52. Past and current expenditure for pollution control equipment or facilities
53. Future estimates of expenditures for pollution control
54. Financing for pollution control
55. Equipment or facilities
56. Air emission information
57. Water discharge information
58. Solid waste disposal information
59. Environmental policies or company concern for the environment
60. Conservation of natural resources
61. Recycling plant of waste products
62. Installation of effluent treatment plant
63. Anti-litter and conservation campaign
64. Land reclamation and forestation programmes
65. Pollution control of industrial process
66. Research on new methods of production to reduce environmental
67. Raw materials conservation
68. Support for public or private action designed to protect the environment
69. Conservation of energy in the conduct of business operations

70. Obtaining certification for environmental management systems/ISO 14001
71. Conducting environmental impact assessment (EIA) / air quality assessment