

Original Research

Does Board Gender Diversity Improve Environmental Disclosure of Multinational Corporations? A Cross-Cultural Analysis

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Abstract

The relationship between board gender diversity and environmental disclosure has received considerable scholarly attention. However, the influence of national cultural dimensions on this relationship has not been extensively studied. Therefore, we investigate the data of multinational corporations (MNCs) to examine the relationship between board gender diversity and the environmental disclosure of MNCs, and the moderating effect of national culture. We find that (1) board gender diversity positively affects the environmental disclosure of MNCs, and (2) power distance, individualism, masculinity, and uncertainty avoidance negatively moderate this relationship and show how board members' gender differences influence the board's stakeholder management, as well as the effects of national cultures. We offer suggestions for policymakers to improve corporate environmental responsibility when formulating related policies by considering board gender diversity and national culture. We also provide suggestions for MNCs on ways to promote the positive effects of female directors and national cultural characteristics to maintain corporate reputation.

Keywords: board gender diversity, environmental disclosure, national culture, stakeholders

Introduction

With increasing climate concerns, academics' attention to public regulation and enterprises' behaviors concerning environmental issues have been growing. In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) suggested that climate

change could threaten global ecosystems and food production.¹ After this, the UNFCCC also issued the Kyoto Protocol and Paris Agreement to call for actions from governments and organizations to achieve

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¹ UNFCCC. United Nations Framework Convention on Climate Change. 1992. https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf. Accessed 27 August 2021.

the limited 2°C global warming target.² In terms of governments, environmental regulation can promote green technology development, especially the realized tax effect [1]. Governments can also guide communities toward better environmental behavior [2]. The majority of environment-friendly goods and services and green finance in the world are promoted by multinational corporations (MNCs).³ This leads to MNCs becoming the key to the reduction of global carbon emissions.⁴ Thus, corporate environmental responsibility is a concern.

Environmental disclosure reflects corporate social responsibility (CSR) practices and has received much attention from academics. Enterprises are always under a great pressure of environmental responsibility from global stakeholders in political risks, competition, public monitoring, and other demands [3]. This requires enterprises to take appropriate environmental actions to respond to stakeholders' concerns [4]. Meanwhile, environmental disclosure could help enterprises to provide environmental practices and performance to stakeholders, which become the communication channel between enterprises and stakeholders [5]. Therefore, existing literature has investigated the impact of firm characteristics [6-8] and other factors on enterprises' environment-related issues. Moreover, the importance of the board of directors in CSR has been addressed [9]. This is because the board is the core of corporate strategy and the characteristics of board composition can directly prescribe CSR practices [9]. For example, board independence could increase the objectivity of CSR decision-making [10] and enhance the board's attention to stakeholders [3]; board size could reduce the board's information asymmetry issue [11] and help board communication with stakeholders [10]; CEO duality may increase collision risk between the board and managers and restrain the board's diverging voices [10]; board diversity could strengthen a board's knowledge and expertise and promote its concerns on vulnerable stakeholder groups [12, 13]. Previous studies also provide evidence that board composition characteristics can affect CSR disclosure [14], corporate transparency [10], corporate environmental responsibility [15], and environmental sustainability performance [16].

Recently, academics have put forward arguments regarding board gender diversity in CSR decision-making. Board gender diversity is one of the most significant heterogeneity characteristics of board diversity [17, 18], and moral gender differences could cause female directors to show higher ethical standards [19] and exhibit concerns of vulnerable stakeholders [12]. These not only reflect the ethical implications of modern corporations [20] but also embody the egalitarianism of enterprises, leading to better financial performance [21]. As a result, CSR decision-making may be enhanced with higher board gender diversity. However, much less research has been conducted on the relationship between board gender diversity and environmental disclosure, and previous research has yielded mixed results. Byron and Post (2016) conducted a meta-analysis to find a positive relationship between board gender diversity and corporate social performance [22]. Conversely, several studies have shown that the relationship between board gender diversity and social performance is insignificant [23-25]. Therefore, because of the complexity of the mechanism between board gender diversity and CSR, and the limited understanding of board gender diversity's potential influence on CSR issues, Rao and Tilt (2016) argue that further study of how board gender diversity impacts CSR is needed [9].

National culture may affect the relationship between board-gender diversity and CSR. Research has shown that the empathy and prosocial preferences of female directors are key to corporate environmental disclosure improvement [19, 26, 27], and the advantages female directors possess depend on the extent of social legitimacy acceptance. Furthermore, the legitimacy of board composition and decision-making is shaped by cultural norms [28-30], and different national cultures value board gender diversity and environmental disclosure to different extents, thereby impacting board gender diversity and environmental disclosure [12, 31]. Hence, the purpose of our study is to explore the following question: How does board gender diversity and national culture affect the environmental disclosure of MNCs?

To address this challenge, we adopt the stakeholder theory [32, 33] and use data from 150 MNCs to investigate how Hofstede et al.'s (2010) five national culture dimensions (i.e., power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation) [34] moderate the relationship between board gender diversity and MNCs' environmental disclosure. The results of the empirical test show that the relationship between board gender diversity and MNCs' environmental disclosure is positive, and this relationship can be moderated by national culture dimensions. Our results explain how board gender diversity affects stakeholder management of the board and the subtle changes in female directors' attention to environmental stakeholders under different national cultures. This deepens the understanding of the relationship between female

² UNFCCC. Paris Agreement. 2015. https://unfccc.int/sites/default/files/english_paris_agreement.pdf. Accessed 18 August 2021.

³ UNCTAD. Trade and Development Report 2021-From recovery to resilience: The development dimension. 2021. https://unctad.org/system/files/official-document/tdr2021_part2_en.pdf. Accessed 5 November 2021.

⁴ CDP. CDP Japan 500 Climate Change Report 2019. CDP Japan. 2020. <https://cdn.cdp.net/cdp-production/cms/reports/documents/000/005/322/original/CDP2019-Japan-edition-climate-change-report-EN.pdf?1596205779>. Accessed 22 July 2021.

directors and environmental disclosure, establishes a link between board gender diversity, environmental disclosure, and national culture, and enriches the application of the national culture dimension concept in both the corporate governance and CSR research fields. Our study also provides suggestions for policymakers on how to enhance corporate environmental responsibility regulations by promoting board gender diversity and considering the national culture. For helping MNCs maintain better corporate reputations, suggestions are provided on strengthening CSR management by increasing board gender diversity and adjusting board structure with national culture. Next, we discuss the links between board gender diversity, environmental disclosure, and national culture.

Board Gender Diversity and Environmental Disclosure of MNCs

Stakeholder theory emphasizes that organizations should focus on the interests of a variety of stakeholder groups rather than shareholders alone [32]. Stakeholders who benefit from or are harmed by, and whose rights are respected or violated by corporate actions, have the right to demand certain actions to protect their welfare [32]. Cennamo et al. (2009) and Plaza-Úbeda et al. (2010) argued that stakeholders are the requirement of business ethics and resources for strategic decision-making, which could bring competitive advantages to enterprises [35, 36]. Therefore, enterprises should understand and respond to stakeholder demands and focus on nonfinancial performance [32, 37, 38]. Based on this, managers, especially directors, who must balance the multiple claims of conflicting stakeholders to monitor the health of the firm, play a vital role in satisfying the needs of stakeholders [37].

Board gender diversity is one of the most important heterogeneity characteristics of board members [18] and plays an important role in the board's decision-making in business ethics. Amorelli and García-Sánchez (2021) argued that there are differences in social values and thoughts between men and women [39]. Compared to male directors, female directors' altruistic preferences are much stronger [40], which causes female directors to engage more in ethical [41] and prosocial behaviors [42]. This result indicates that female directors normally have higher moral standards and obligations than male directors [19, 39] and pay more attention to stakeholders' welfare (e.g., consumers, investors, creditors, employees, and communities) [43]. Therefore, the board's problem-solving quality and leadership efficiency could be enhanced by increasing the number of female directors [44], which includes decision-making in business ethics.

The strengths of female directors are critically important in corporate governance and are especially important in environmental disclosures for manufacturing MNCs. Environmental disclosure is a well-documented heightened profile among

stakeholders, coinciding with the growing incidence and sophistication of corporate social responsibility [45, 46]. According to the stakeholder theory, companies should be responsible for all stakeholders who can affect or be affected by the achievement of the organization's objectives [33], and environmental disclosure is used by management as a tool to provide information to the various stakeholders in MNCs [47]. That is, environmental disclosure benefits generalized stakeholders by diminishing the informational asymmetries between a firm and its stakeholders [45]. However, the relationship between financial performance and environmental disclosure is uncertain and mixed [48-50]. To reduce risk and uncertainty, male-dominated boards tend to prioritize primary stakeholders (i.e., shareholders), that is, focus on maintaining and improving financial performance [50, 51]. If the presence of female directors increases, financial performance can be improved. As mentioned above, compared with men, women have stronger moral standards and obligations [19, 24, 27, 39], are generally more concerned about environmental issues, and are inclined to take action to reduce perceived environmental risks [3, 23, 52]. Moreover, previous studies have shown that female directors play an important role on the board with regard to environmental issues, and can boost environmental and CSR reporting, especially when their number exceeds three [24, 26, 43]. Therefore, the more female directors there are, the more inclined MNCs are to disclose.

H1: Board gender diversity is positively associated with the environmental disclosure of MNCs.

Moderating Effects of National Culture

Hofstede (2001) defined national culture as "the collective programming of the mind that distinguishes the members of one group or category of people from another" and proposed a five-dimensional model of national culture: power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation [31]. Stakeholder theory highlights that managers should make ethical decisions that reconcile financial performance with social and environmental performance [32, 33, 37] and that ethical decision-making and management's moral philosophy are immersed in cultural norms [29]. National culture, as a social norm, affects cognition, motivates, and justifies certain types of behavior that are consistent with values, beliefs, and assumptions prevailing within a given country [28]. Thus, considering that board gender diversity and environmental disclosure are essentially social conventions, we postulate that culture plays a critical role in determining management behavior with respect to environmental disclosure; that is, we expect that cultural dimensions may moderate the effect of board gender diversity on environmental disclosure.

Moderating Effects of Power Distance

Power distance describes the extent to which society accepts and expects a hierarchical distribution of power [31, 34]. High power distance societies are characterized by strong hierarchies and loose monitoring at low levels. Individuals who obtain higher status have stronger discretion without being restricted by others' views or behaviors [53]. In such societies, there are fewer dialogues between the directors and general stakeholders, and the directors receive less monitoring from general stakeholders [54]; thus, the environmental pressure from customers and investors is decreased, and the board on the whole tends to give more weight to financial performance and less weight to environmental disclosure, even though female directors have intentions to disclose environmental information. Research shows that in Jordan (high power distance society), managerial ownership, institutional ownership, and ownership concentration are negatively associated with corporate environmental disclosure [52]. This means that a high power distance likely dampens board members' disclosure of environmental information.

By contrast, in low power-distance societies, organizations are decentralized, relationships between stakeholders are viewed as less hierarchical and more democratic, and stakeholders expect to be treated equally [55]. In such contexts, individuals have stronger prosocial preferences [56], and directors are more likely to adhere to the social norms that stakeholders should share the firm's information equally, are more engaged in responsibility of all stakeholders, and pay more attention to social responsibility. In particular, low power distance cultures allow female directors greater discretion to take ethical actions such as environmental disclosure [57]. Gallego-Álvarez and Ortas (2017) and Thanetsunthorn (2015) revealed that companies from low power-distance countries are more likely to disclose information regarding corporate social responsibility [54, 58]. Therefore, a low power distance culture motivates female directors to be more assertive about environmental disclosures.

H2a: Power distance negatively moderates the association between board gender diversity and MNCs' environmental disclosure, such that this association is less positive when the power distance is higher than when the power distance is lower.

Moderating Effects of Individualism

Individualism characterizes the extent to which people feel independent as opposed to being interdependent as members of larger wholes [34]. In countries with high individualism, freedom of choices and decisions is encouraged, and an individual's importance has been emphasized [34]. Therefore, society members tend to show self-orientation and low connection with each other [54]. People in an individualistic society are more concerned about their

own interests and less concerned about others [34]. In such settings, directors experience less restraint from general stakeholders and can prioritize their own interests and corporate financial performance [59]; that is, directors can focus more on maximizing their own performance and meeting investors' or shareholders' needs and show less concern for general stakeholders and the broader impact of business on the public.

Unlike high individualism, people in societies with low individualism are integrated into strong and cohesive groups [34]. They have a strong desire to belong to groups, show strong loyalty to groups, and are indoctrinated with responsibility for fellow members of the group [64]. Individuals in societies with low individualism are more apt to share statements like "I usually sacrifice my self-interest for the benefit of my group" and "My happiness depends very much on the happiness of those around me" [65]. In such cultures, directors are more concerned about the interests and welfare of all stakeholders, rather than themselves or shareholders, and believe that they should make ethical decisions and contributions to society, which encourages them to devote more effort to supporting environmental disclosure. Existing evidence also show that directors in countries with low individualism are more motivated to engage in CSR [55, 60].

H2b: Individualism negatively moderates the association between board gender diversity and the MNCs' environmental disclosure, such that this association is less positive when individualism is higher as opposed to lower.

Moderating Effects of Masculinity

Masculinity is the extent to which social gender roles are clearly defined. As Hofstede et al. (2010) pointed out, in masculine cultures, "gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success, while women are supposed to be more modest, tender, and concerned with the quality of life," whereas in feminine cultures, "gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life [34]. In countries with high masculinity, males play a dominant role in society; they value ambition, competition, and strive for material success [61]. Against this backdrop, although a board is composed of male and female directors, male directors dominate the power structure of companies [58]. Men value material success and advancement, resulting in shareholder orientation of the board and concern for economic and financial reporting [66]. In addition, although female directors serve on the board, they are stereotypically unsuitable for leading the company to success [28]. To counter stereotypes and acquire legitimacy, female directors tend to behave like men and put aside their prosocial views, impairing the positive impact of female directors on the board's decision-making in business ethics.

Compared to masculine societies, individuals in low-masculinity societies are less rigid about the differentiation of traditional roles between genders and tend to recognize the interdependencies between them [28]. In such settings, competition is not openly endorsed, sympathy for the underdog is acceptable, and females are treated equally to males in every way in society [34, 54]. Thus, female directors on the board are not discriminated against, and people universally tend to value harmony with society rather than money [60, 64]. In other words, feminine cultures magnify female directors' motivation to present their altruistic preferences and prosocial behaviors so that the board would become more responsive to stakeholder orientations and engage in environmental disclosure. Furthermore, previous research has consistently shown that masculinity/femininity plays a pivotal role in weakening/reinforcing environmental disclosure [58, 60, 65].

H2c: Masculinity negatively moderates the association between board gender diversity and the MNCs' environmental disclosure, such that this association is less positive when masculinity is higher as opposed to lower.

Moderating Effects of Uncertainty Avoidance

Uncertainty avoidance is defined as the extent to which members of a culture tolerate uncertainty and ambiguity [34]. It reflects people's wish for fixed or flexible habits and rituals in uncertain, unknown, or unstructured situations [34, 54]. Individuals living in cultures with strong uncertainty avoidance feel anxious and suspicious toward the unknown and prefer rigid codes of conduct and behavior to minimize uncertainty [34]. Thus, a board in a society with high uncertainty avoidance is more likely to obey written rules or regulations to control the future [66]. Even when mandatory requirements of environmental disclosure are in place, the disclosure is still brief and poor by scientific reporting requirements; a statement in the CSR report that "we value environmental issues and try our best to practice sustainable development" is usually adequate, and corporations often reveal useless information [67]. In countries with non-mandatory requirements, enterprises do not tend to disclose environmental information [45]. In such settings, directors are becoming cautious and more willing to limit voluntary environmental information because the risk is uncertain and the cost may exceed the benefit [55]. Moreover, compared to male directors, female directors have more prosocial preferences for disclosure of environmental information; however, they are also more anxious about unknown situations [68], which suppresses their prosocial preferences [69]. Accordingly, high uncertainty avoidance is likely to impede female directors' environmental disclosure.

In contrast, people in low uncertainty avoidance societies tend to have more relaxed and flexible attitudes

toward uncertainty and are more comfortable with ambiguity owing to low stress [34]. In such cultures, the board is more open and inclusive; accordingly, female directors more often engage in environmental disclosure, regardless of the potential ambiguity caused by environmental reports. Gallego-Álvarez and Ortas (2017) revealed that uncertainty avoidance is negatively related to corporate environmental sustainability reporting [54]. Vachon (2010) also found a negative relationship between uncertainty avoidance and sustainable development practices [70]. Taken together, we propose that the positive relationship between board gender diversity and environmental disclosure may be attenuated by high uncertainty avoidance.

H2d: Uncertainty avoidance negatively moderates the association between board gender diversity and the MNCs' environmental disclosure, such that this association is less positive when uncertainty avoidance is higher as opposed to lower.

Moderating Effects of Long-Term Orientation

Long-term orientation deals with change; it refers to the fostering of virtues oriented toward future rewards. Its opposite pole, short-term orientation, refers to the fostering of virtues related to the past and present [34]. In cultures with long-term orientation, the basic notion about the world is that it is in flux, and it is always necessary to prepare for the future [34]. People focus on future goals and prefer current sacrifices for future benefits [71]. Accordingly, directors under such schemas do not expect immediate gratification [55], but are inclined to synthetic thinking, building long-term strategic competitive advantages to achieve long-term financial and non-financial objectives [34, 54]. This implies that the board favors establishing strong ties with diverse stakeholders, including employees, customers, investors, and social and environmental organizations. Although stakeholder orientation may not immediately improve financial performance, it is conducive to maintaining sustainable development and improving the company's profile [72, 73]. In addition, long-term orientation cultures emphasize careful husbandry of resources and sustained efforts toward slow results, which also affects the way a company handles its environmental issues; that is, directors are more committed to environmental preservation and sustainability issues [54, 74]. The functions of female directors in facilitating environmental disclosure have been found to be consistent with the values of cultures with long-term orientation. Stated differently, in long-term orientation climates, female directors can function better to facilitate environmental disclosure.

In cultures with short-term orientation, the fundamental cognition of the world is that it is stable and that following the prescribed order is appropriate [34]. People believe that efforts should produce quick results, and the main work values include freedom, achievement, and thinking [34, 74]. We propose that

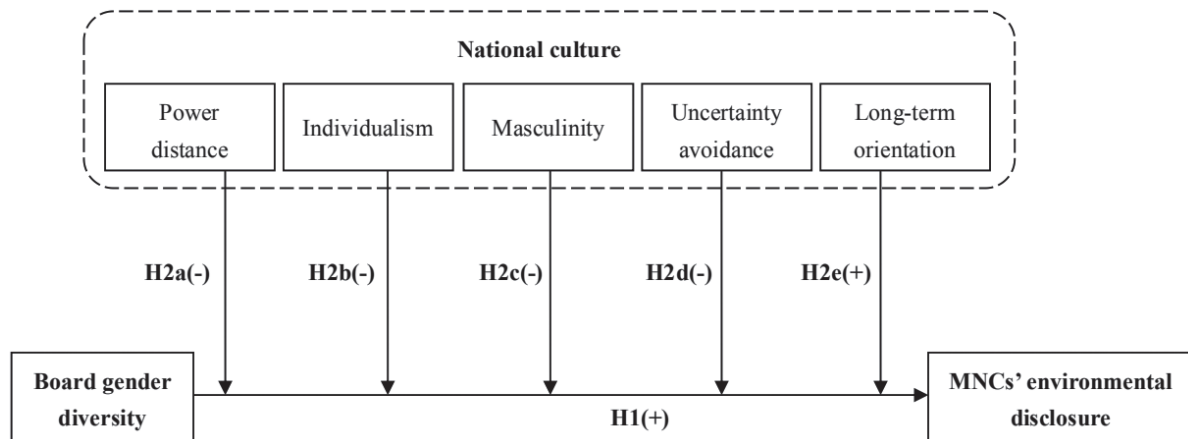


Fig. 1. Research Framework.

short-term orientation will suppress female directors' motivation for environmental disclosure since directors in such societies prefer shareholder orientations that highlight financial performance [54]. On the one hand, improving financial performance is a prominent symbol of achievement and benefits directors quickly. On the other hand, short-term orientation entails meritocracy and differentiation according to abilities [34]. Financial performance provides an instant demonstration of directors' abilities. Khlif et al. (2015) found that long-term orientation has a positive influence on corporate social and environmental disclosure [60]. Similarly, Sannino et al. (2020) revealed that long-term orientation positively affects the commitment of global reporting initiatives [75]. Thus, we posit:

H2e: Long-term orientation positively moderates the association between board gender diversity and MNCs' environmental disclosure such that this association is more positive when long-term orientation is higher as opposed to lower.

The overall research framework is illustrated in Fig 1.

Methods, Sample and Data

Data and Sample

Sample Selection

Based on the Industry Classification for National Economic Activities of China, we selected 150 MNCs from China, Japan, the United Kingdom, and the United States on the Forbes 2019 Global 2000 list. The reasons for selecting these firms were as follows: (1) National cultural diversity. These four countries manifest national characteristics in their scores on national cultural dimensions (see Table 1 for details). In particular, the long-term orientation between China and Japan is similar, but China has the highest power distance among the four countries, while Japan has

the highest masculinity; the United Kingdom and the United States are similar in individualism, but the long-term orientation of the United Kingdom is higher than that of the United States, the power distances of both the United Kingdom and the United States are much lower than that of China, and compared with Japan, the masculinity also differs. (2) Company size and age. Roberts (1992) argued that older companies normally focus on CSR [76]. In addition, Brammer and Pavelin (2006) and Haddock (2005) confirmed that larger companies are normally more active in CSR [77, 78]. The Forbes list represents the largest companies in the world and the average age of those on the list is higher than that of non-Forbes companies. The sample taken from the Forbes 2019 Global 2000 list meets the criteria for national cultural diversity, company size, and age, and is suited to the research objectives regarding the moderating effect of national culture.

After determining Forbes 2019 Global 2000 list as the basis for sample selection, we selected a sample of listed MNCs from China, Japan, the United Kingdom, and the United States. The selection process is as follows.

1. After screening all the listed companies, 251 sample firms from China, 223 from Japan, 83 from the United Kingdom, and 336 from the United States⁵ were selected.

2. We excluded 177 firms in non-manufacturing industries from China, 153 from Japan, 55 from the United Kingdom, and 244 from the United States.

3. During the data collection process, certain MNCs from China (30), Japan (28), the United Kingdom (5), and the United States (49) were excluded because of missing reports or data.

⁵ The United States has 575 companies on the list. For an even distribution across countries, we only observed MNCs from the United States in the top 1,111 positions in the Forbes 2019 Global 2000 list and selected 336 firms from the United States.

Table 1. Diversity of National Culture*

Dimensions	China	Japan	UK	USA
Power Distance	80	54	35	40
Individualism	20	46	89	91
Masculinity	66	95	66	62
Uncertainty Avoidance	30	92	35	46
Long-term orientation	87	88	51	26

*The national culture score was calculated by Hofstede et al., (2010)

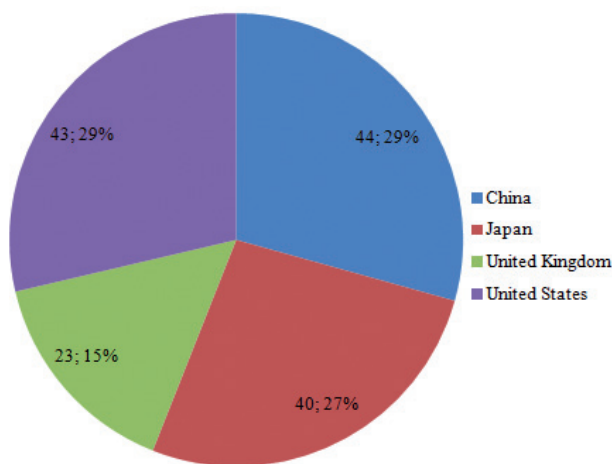


Fig. 2. Country Distribution of Samples (Amount; Proportion).

4. There were 44 MNCs in China, 40 in Japan, 23 in the United Kingdom, and 43 in the United States remaining as research samples. The sample distribution by country is illustrated in Fig. 2.

The top three industries are computing and other related electronic equipment (33, 22.00%), automobiles (16, 10.67%), and pharmaceutical and medical equipment (16, 10.67%). The bottom three industries are papermaking and paper products (2, 1.33%), rubber and plastic products (2, 1.33%), and non-metallic mineral products (1, 0.67%). The sample distribution by industry is shown in Fig. 3.

Data Collection

To create a comprehensive description of the environmental disclosure of MNCs, we used

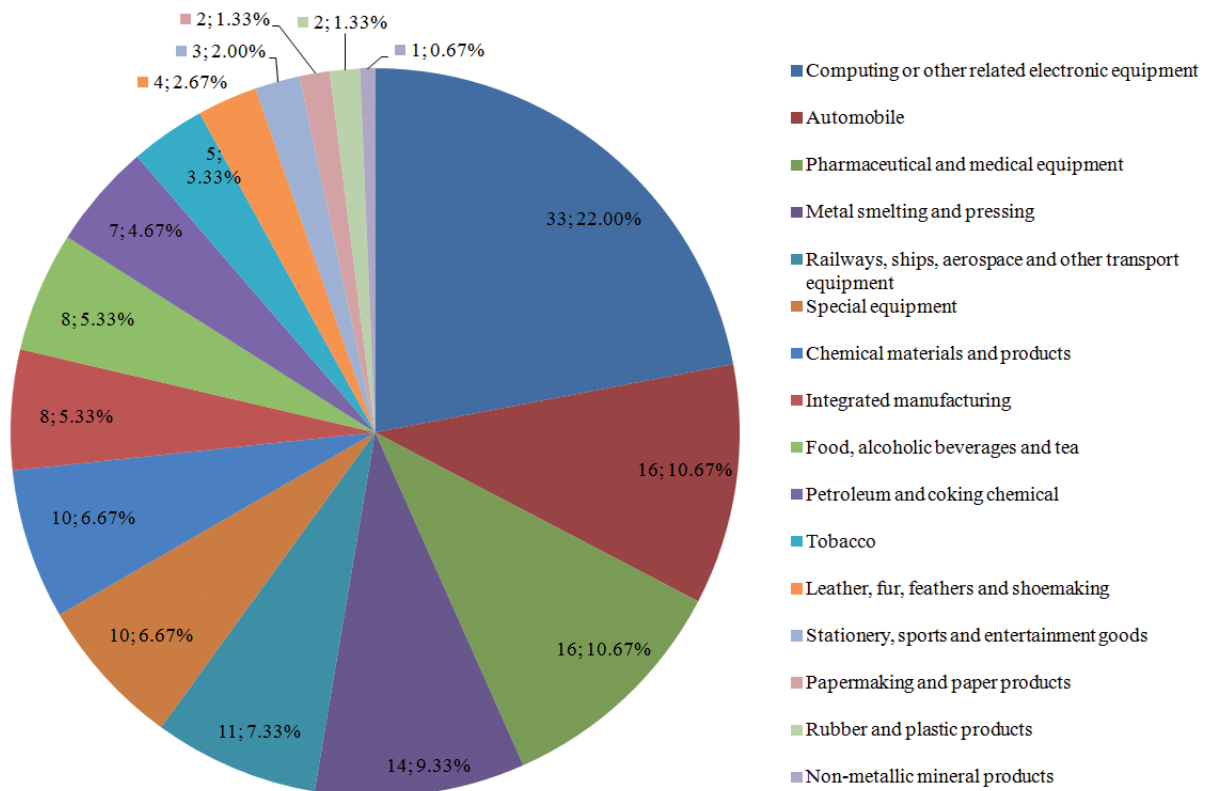


Fig. 3. Industry Distribution of Samples (Amount; Proportion).

measurement methods from an earlier study [3] for content analysis of CSR reports. The environmental disclosure measurement includes 25 indicators, such as recycling, energy use, greenhouse gas emissions, water use, and waste disposal.

This study uses a multigrade scoring system (0-2 and 0-4) to evaluate environmental disclosures of MNCs. We followed the evaluation principles of Van Staden and Hooks (2007) [79] and Cui et al. (2020) [3], in which indicators related to the regulations or policies of MNCs were scored 0–2 and indicators related to environmental performance indicators with quantitative data were scored 0-4. For scores of 0–2, 0 means that MNCs have not disclosed any information about the indicator, 1 means that the indicator is briefly disclosed, and 2 means that the indicator is disclosed in detail. For scores of 0-4, 0, 1, and 2 are the same as for 0-2, 3 means detailed disclosure with quantitative data made by MNCs, and 4 means a disclosure of a level 3 with years of data comparisons.

Based on the measurement of environmental disclosure, we used a content analysis method to measure the CSR report (sustainability report or ESG report) and other related documents from the sample enterprises in fiscal years 2017–2018 (the total amount of qualitative data downloaded from the official websites of enterprises is approximately 5.5 GB). The processing of sample selection, data collection, and reliability checks took approximately 1,000 hours and yielded environmental disclosure data that met the research needs.

Reliability of the Measurement Method

To ensure the reliability and validity of the measurement results, we tested the reliability of the measurement method and data based on Krippendorff's (2004)⁶ suggestion [80]. The specific methods are as follows:

To ensure consistency, we used an approach from Boesso and Kumar (2007) [81]. The multigrade scoring system and scoring standards for all the coders were explained. All coders then used content analysis to measure the CSR reports from Toyota based on the indicators of environmental disclosure. The calculated value of "Krippendorff Alpha" was 0.85, demonstrating the consistency of the multigrade scoring system and the score standard.

We followed Krippendorff (2004) [80] and Scott (2014) [82] to ensure the reliability of the measured data by repeatedly measuring 20% of CSR reports by two coders as reliability test data. The Krippendorff Alpha of the above data was 0.92, which is not only consistent

with Hasseldine et al.'s (2005) criterion of 0.75 [83], but also higher than Krippendorff's (2004) [80] and Scott's (2014) [82] 0.80 test pass. The reliability of the measured data was confirmed.

We verified the stability by referring to Boesso and Kumar (2007) [81], who suggested encoding the same data twice within a certain time after coding and comparing the consistency of the measurement results to ensure stability. One month after data collection, the coders selected the top 20% of MNCs from each country as test samples for stability verification. The Krippendorff alpha of the re-measurement results and original measurement results was 0.89, confirming the stability of the measured data.

Variable Descriptions

Dependent Variable

As in previous studies [3, 79, 83, 84], we adopted the measurement results of environmental disclosure by MNCs (*ED*) based on content analysis as the dependent variable.

The formula for environmental disclosure of MNCs*:

$$ED = \sum_{i=1}^{25} \frac{X_i}{98} * 100\%$$

*Adapted from Cui et al. (2020) [3]

Independent Variables

We followed earlier studies [12, 13, 85] in measuring the proportion of female directors to total directors on the board as an independent variable to represent board gender diversity (*BGD*).

Moderator Variables

We used national culture dimensions as the moderator variables. Hofstede based on the survey data of IBM employees (1967-1973) to develop national culture dimensions (power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation) by his original model [34]. Hofstede et al. (2010) suggest that the mindset of social members and the society values could be derived by this model, which includes power distance measures how social members could accept to authority, individualism describes social member focus on individual or organization, masculinity expresses the specific society values, uncertainty avoidance represents how social members avoid unknown, and long-term orientation describes why social members focus on future goal [34]. Therefore, we followed Hofstede et al. (2010) [34] in measuring national culture dimensions, as in other studies [3, 86, 87], and include power distance (*PDI*), individualism (*IDV*), masculinity (*MAS*), uncertainty

⁶ Krippendorff (2004) suggested that test results for consistency, reliability, and stability can be used to measure the reliability of the measurement method [80]. The <http://dfreelon.org/utills/recalfront/recal2> online tool was used to calculate "Krippendorff Alpha."

avoidance (*UAI*), and long-term orientation (*LTO*) as moderator variables.

Control Variables

Regarding control variables, CSR is treated as a strategic decision-making practice of the board constrained by corporate governance [9] and the firm's available resources [88]. Therefore, we controlled for several board characteristics and firm-specific characteristics as control variables. Regarding board characteristics, existing studies have reported that a larger number of directors [10] and more frequent board meetings [89] led to higher levels of information disclosure. In addition, research shows a positive relationship between CSR committees and environmental performance [90]. Regarding firm-specific characteristics, previous studies have shown that information disclosure can be affected by the auditing quality and debt-to-asset ratio [13], a positive relationship between profitability and environmental

performance [90], and firm size and CSR disclosure [89]. Thus, board size (*BFSIZE*), board meeting frequency (*BMT*), CSR committee (*CSRCOM*), Big 4 accounting firms (*BIG4*), profitability (*ROA*), debt-to-asset ratio (*DEBT*), and firm size (*SIZE*) were selected as control variables in this study.

For measurement, we followed the approach of Hussain et al. (2018) [90] and Peng et al. (2021) [13] to measure control variables: *BFSIZE* is measured as total board members, *BMT* is measured as the yearly frequency of board meetings, *CSRCOM* is a measurement for whether CSR is established (1 for *yes*, 0 for *no*), *BIG4* indicates whether a Big 4 accounting firm is an external auditor (1 for *yes*, otherwise 0), *ROA* is the ratio of operating income to total assets, *DEBT* is the ratio of total liabilities to total assets, and *SIZE* is the natural logarithm of the total number of employees. To improve the scientific objectivity of this study, a winsorized tail reduction was applied at the 1% and 99% levels. Table 2 presents a summary of the variables.

Table 2. Summary of Variables.

Name of variable	Mnemonics	Role	Description
Environmental disclosures of MNCs	<i>ED</i>	Dependent variable	Measurement results of environmental disclosures
Board gender diversity	<i>BGD</i>	Independent variable	Proportion of female directors to total directors on board
Power distance	<i>PDI</i>	Moderator variable	Measured by Hofstede et al (2010)
Interaction of power distance and board gender diversity	<i>PDI*BGD</i>	Interaction	Power distance *board gender diversity
Individualism	<i>IDV</i>	Moderator variable	Measured by Hofstede et al (2010)
Interaction of individualism and board gender diversity	<i>IDV*BGD</i>	Interaction	Individualism*board gender diversity
Masculinity	<i>MAS</i>	Moderator variable	Measured by Hofstede et al (2010)
Interaction of masculinity and board gender diversity	<i>MAS*BGD</i>	Interaction	Masculinity*board gender diversity
Uncertainty avoidance	<i>UAI</i>	Moderator variable	Measured by Hofstede et al (2010)
Interaction of uncertainty avoidance and board gender diversity	<i>UAI*BGD</i>	Interaction	Uncertainty avoidance*board gender diversity
Long-term orientation	<i>LTO</i>	Moderator variable	Measured by Hofstede et al (2010)
Interaction of long-term orientation and board gender diversity	<i>LTO*BGD</i>	Interaction	Long-term orientation*board gender diversity
Board size	<i>BFSIZE</i>	Control variable	Total number of directors on board
Board meetings	<i>BMT</i>	Control variable	Total number of board meetings per year
CSR committee	<i>CSRCOM</i>	Control variable	Binary variable: value 1 for board of directors established a committee, which related to CSR, otherwise 0.
Big 4 accounting firm	<i>BIG4</i>	Control variable	Binary variable: value 1 for external auditor is one of the four largest accounting firms, otherwise 0.
Profitability	<i>ROA</i>	Control variable	Ratio of operating income to total assets
Debt-to-asset ratio	<i>DEBT</i>	Control variable	Ratio of total liabilities to total assets
Firm size	<i>SIZE</i>	Control variable	Log of total employees of the MNCs

Table 3. Variables Statistics and Pearson's Correlation*.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. <i>ED</i>	57.23	18.10	1.000													
2. <i>BGD</i>	0.165	0.127	0.279***	1.000												
3. <i>PDI</i>	54.70	17.65	-0.611***	-0.661***	1.000											
4. <i>IDV</i>	57.87	30.46	0.492***	0.745***	-0.960***	1.000										
5. <i>MAS</i>	72.59	13.66	0.336***	-0.460***	0.048	-0.314***	1.000									
6. <i>UAI</i>	51.89	25.05	0.486***	-0.277***	-0.214***	-0.027	0.932***	1.000								
7. <i>LTO</i>	64.26	27.45	-0.267***	-0.732***	0.760***	-0.908***	0.611***	0.303***	1.000							
8. <i>BSIZE</i>	10.79	2.34	0.324***	0.321***	-0.364***	0.365***	-0.038	0.087	-0.323***	1.000						
9. <i>BMT</i>	10.33	5.06	0.132	-0.224***	0.122	-0.233***	0.475***	0.449***	0.325***	-0.079	1.000					
10. <i>CSR</i>	0.213	0.411	0.134	0.328***	-0.325***	0.380***	-0.294***	-0.213***	-0.383***	0.206**	-0.182**	1.000				
11. <i>BIG4</i>	0.873	0.334	0.479***	0.278***	-0.518***	0.458***	0.142*	0.284***	-0.317***	0.265***	-0.016	0.149*	1.000			
12. <i>ROA</i>	0.070	0.068	0.094	0.138*	-0.241***	0.260***	-0.138*	-0.085	-0.235***	0.073	-0.199**	0.008	0.101	1.000		
13. <i>DEBT</i>	0.605	0.165	-0.066	0.343***	-0.147*	0.212***	-0.255***	-0.189**	-0.270***	0.124	-0.112	0.158*	0.073	-0.167**	1.000	
14. <i>SIZE</i>	10.82	0.97	0.127	0.174**	-0.081	0.079	-0.002	0.028	-0.068	0.222***	0.019	0.213***	0.164**	-0.151*	0.263***	1.000

This table presents the results of Pearson's bivariate correlation coefficients. ***, **, and * represent statistical significance at 1%, 5%, and 10%, respectively.

*Mean and standard deviation for all the variables were calculated by original data (except *SIZE* was processed by natural logarithm), the Pearson correlation was based on the data processed by natural logarithm and winsorized tail reduction (1% and 99% levels), which used in our regression analyses.

The first variable is environmental disclosure of multinational corporations (*ED*), which is the dependent variable. The correlation results of *ED* are followed by the independent variables board gender diversity (*BGD*). Independent variables are followed by the moderator variables (national culture dimensions), which introduced by Hofstede et al(2010). National culture dimensions variables include power distance (*PDI*), individualism (*IDV*), masculinity (*MAS*), uncertainty avoidance (*UAI*) and long-term orientation (*LTO*). Moderator variables are followed by the control variables (specific characteristics of board of directors and firm). For the board specific characteristics we selected board size (*BSIZE*), board meetings (*BMT*) and CSR committee (*CSR*), and for the firm specific characteristics we selected four largest accounting firm (*BIG4*), profitability(*ROA*), debt-to-asset ratio (*DEBT*) and firm size(*SIZE*) as control variables.

Results and Discussion

Statistics and Correlation Analysis

The results for Pearson's correlation and variable statistics are presented in Table 3. The first column shows the name of the variable, the second and third columns show the descriptive statistics (means and standard deviations), and the remaining columns show the correlation coefficients of the variables.

Pearson's correlation analysis yielded positive correlation coefficients between board gender diversity (*BGD*) and environmental disclosure (*ED*; 0.265), individualism (*IDV*) and environmental disclosure (*ED*; 0.492), masculinity (*MAS*) and environmental disclosure (*ED*; 0.336), uncertainty avoidance (*UAI*) and environmental disclosure (*ED*; 0.486), board size (*BSIZE*) and environmental disclosure (*ED*; 0.324), and Big 4 accounting firms (*BIG4*) and environmental disclosure (*ED*; 0.479), with all coefficients significant at the 1% level. Negative correlations were found between power distance (*PDI*) and environmental disclosure (*ED* -0.611) and long-term orientation (*LTO*), and environmental disclosure (*ED* -0.267), which were also significant at the 1% level. There were also positive and negative correlations between the other variables. Furthermore, extremely high significant correlations between different national culture dimensions were obtained: the correlation coefficient between power distance (*PDI*) and individualism (*IDV*) was 0.960, masculinity (*MAS*) and uncertainty avoidance (*UAI*) was 0.932, and individualism (*IDV*) and long-term orientation (*LTO*) was 0.908. Similar results have been reported elsewhere [91, 92]. To avoid multicollinearity

problems between different national culture dimensions, we first borrowed the approach of Eisend et al. (2016) [92] to ensure that only one national culture dimension was included per model for our study. Second, we calculated the variance inflation factors (VIFs) of the independent variable, moderator variable, and all control variables for each model in our empirical test for additional checks (Table 4 shows the VIFs). As Table 4 shows, the highest VIF was 2.73 and the lowest VIF was 1.11, indicating that there were no multicollinearity issues in our regression models.

Multivariate Regression Results

In this study, we used Stata 13 to empirically test our hypotheses using stepwise multivariate regression models. Table 5 shows the multivariate regression results; Model 1 reports the regression of the dependent variable with control variables only, whereas Model 2 addresses the impact of *BGD* on *ED* with control variables. Model 3 is a regression model showing the impact of *BGD* on *ED* with the moderating effect of *PDI* and control variables. Models 4-7 are regressions of *BGD* on *ED*, with the moderating effect of the rest of the national culture dimensions and control variables.

Board Gender Diversity

As Table 5 shows, in Model 2, *BGD* was positively associated with *ED* ($\beta = 0.736$, $p < 0.05$). This means that board gender diversity positively affects the environmental disclosure. This is similar to previous results on the positive impact of board gender diversity on CSR tenure [20, 88] and a positive relationship

Table 4. Results of Variance Inflation Factors (VIFs).

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
BGD		1.46	2.31	2.24	1.75	1.52	2.11
PDI			2.73				
IDV				2.65			
MAS					1.86		
UAI						1.59	
LTO							2.22
BSIZE	1.15	1.20	1.22	1.23	1.21	1.24	1.22
BMT	1.11	1.14	1.14	1.14	1.37	1.36	1.17
CSRCOM	1.13	1.18	1.23	1.22	1.23	1.21	1.22
BIG4	1.11	1.16	1.41	1.42	1.27	1.37	1.18
ROA	1.13	1.15	1.19	1.19	1.15	1.15	1.17
DEBT	1.14	1.25	1.25	1.25	1.27	1.26	1.26
SIZE	1.18	1.18	1.20	1.20	1.19	1.18	1.20
Mean VIFs	1.14	1.22	1.52	1.50	1.37	1.32	1.42

Table 5. Regression Results.

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
BGD		0.736**	-10.224**	4.071*	24.730***	6.574***	1.981
		(2.458)	(-2.326)	(1.963)	(3.688)	(2.962)	(0.837)
PDI*BGD			2.436**				
			(2.221)				
PDI			-1.135***				
			(-5.418)				
IDV*BGD				-1.179**			
				(-2.186)			
IDV				0.538***			
				(5.349)			
MAS*BGD					-5.524***		
					(-3.515)		
MAS					1.6202***		
					(6.505)		
UAI*BGD						-1.476**	
						(-2.515)	
UAI						0.5838***	
						(7.092)	
LTO*BGD							-0.320
							(-0.549)
LTO							0.024
							(0.240)
BSIZE	0.393***	0.329**	0.199*	0.186	0.257**	0.195	0.325**
	(2.812)	(2.328)	(1.717)	(1.589)	(2.106)	(1.627)	(2.270)
BMT	0.144**	0.170**	0.097	0.090	0.001	-0.021	0.178**
	(2.001)	(2.329)	(1.352)	(1.256)	(0.021)	(-0.334)	(2.279)
CSRCOM	0.065	0.028	-0.030	-0.019	0.080	0.080	0.022
	(0.982)	(0.458)	(-0.554)	(-0.352)	(1.291)	(1.361)	(0.345)
BIG4	0.483***	0.444***	0.207*	0.211*	0.267**	0.213*	0.436***
	(4.381)	(3.992)	(1.735)	(1.761)	(2.517)	(1.945)	(3.788)
ROA	0.327	0.170	-0.266	-0.236	0.325	0.212	0.162
	(0.837)	(0.453)	(-0.721)	(-0.653)	(0.884)	(0.610)	(0.429)
DEBT	-0.286*	-0.425***	-0.288	-0.307*	-0.295**	-0.285*	-0.442**
	(-1.782)	(-2.614)	(-1.628)	(-1.726)	(-1.979)	(-1.926)	(-2.588)
SIZE	0.014	0.013	0.032	0.031	0.015	0.017	0.015
	(0.437)	(0.400)	(1.103)	(1.091)	(0.502)	(0.574)	(0.468)
Constant	2.297***	2.429***	7.604***	1.067**	-4.018***	0.956**	2.309***
	(4.880)	(5.105)	(6.727)	(2.343)	(-3.866)	(2.094)	(3.304)
F	6.09***	5.54***	10.77***	10.54***	12.71***	13.43***	4.67***

Table 5. Continued.

Root MSE	0.336	0.330	0.291	0.292	0.291	0.283	0.332
Observations	150	150	150	150	150	150	150
R-squared	0.312	0.340	0.493	0.489	0.493	0.520	0.342

*, ** and *** represent significance at the 10%, 5% and 1% levels, respectively.

between female directors and corporate social performance [10], in addition to the evidence from Liao et al. (2015) that female directors promote greenhouse gas disclosure [93]. This is consistent with the argument that female directors can boost environmental disclosure through greater concern for environmental issues [26]. Considering the previous argument and the fact that the regression result of Model 2 is also consistent with our expectation, H1 is supported.

This result reveals that the difference between women and men in ethical behavior [41] and prosocial behavior [42] not only leads to female directors bringing unique knowledge and perspectives to the board [39] but also enhances the board's attention to environmental stakeholders [12]. As a result, environmental disclosures of MNCs are promoted.

National Culture

Regarding the moderating effects of national culture, in Table 5, the results for Model 3 show the significance of BGD ($\beta = -10.224, p < 0.05$) and the interaction term $PDI*BGD$ ($\beta = 2.436, p < 0.05$). This indicates that power distance negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure. This result indirectly corroborates the findings that power distance negatively affects CSR performance [59], engagement [65], and environmental reporting [54]. Moreover, this also confirms that female directors tend to exhibit ethical actions in a low power distance environment [57]. Therefore, considering the previous argument, and that the regression results of Model 3 conform to our expectations, H2a is supported.

This result indicates that, compared with societies with high power distance characteristics, female directors have stronger prosocial preferences [56] and take more ethical actions [57] in low power distance societies, which could increase their attention to environmental stakeholders. Consequently, the positive role of female directors in environmental stakeholders is promoted in low power distance societies.

Model 4 shows the results for BGD ($\beta = 4.071, p < 0.1$) and the interaction term $IDV*BGD$ ($\beta = -1.179, p < 0.05$). This means that individualism negatively moderates the relationship between board gender diversity and environmental disclosure of MNCs, corroborating the findings that individualism negatively impacts corporate social performance [58], as well as the negative relationship between individualism and CSR disclosures [55], and the argument of Lu et al. (2021)

that members of a low individualistic environment are more concerned with collective interests [62]. Thus, considering the previous argument and the fact that the regression result of Model 4 meets our expectations, H2b is supported.

This result reveals that the tendency toward collective interest emphasized in societies with low individualism [74] may increase female directors' attention to social welfare. Meanwhile, the spirit of personal sacrifice exhibited in such societies [62] could increase female directors' attention to corporate long-term environmental development goals rather than their financial self-interest. This leads female directors to focus on environmental stakeholders in societies with low individualism.

Model 5 shows the results for BGD ($\beta = 24.730, p < 0.1$) and the interaction term $MAS*BGD$ ($\beta = -5.524, p < 0.1$). This indicates that masculinity negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure. This result is similar to Cui et al.'s (2020) finding that masculinity negatively moderates the relationship between board independence and environmental disclosure [3] as well as the evidence of negative relationships between masculinity and CSR engagement [65] and between masculinity and environmental reporting [54]. Our results support the argument that societies with low masculinity exhibit more interdependence recognition [28] and are more concerned with social value in harmony than high-masculinity societies [64]. Considering the previous argument and the fact that the regression results of Model 5 are consistent with our expectations, H2c is supported.

This result reveals that women are treated more equally in low masculinity societies [74], which encourages female directors to present more diverse advice to the board. Simultaneously, female directors' attention to environmental stakeholders could be enhanced by the social value of harmony [64] and the tendency for less material achievement in such societies [74]. These differences have increased the concern of female directors for environmental stakeholders.

Model 6 shows the results for BGD ($\beta = 6.574, p < 0.1$) and the interaction term $UAI*BGD$ ($\beta = -1.476, p < 0.05$), indicating that uncertainty avoidance negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure. This indirectly supports the findings of existing studies, in which uncertainty avoidance negatively impacts CSR [94] and negatively moderates

the relationship between board independence and environmental disclosure [3]. Our results also support the argument that member societies feel less anxious when dealing with ambiguity [74] and that corporations can more easily adapt to emerging CSR requirements in low uncertainty avoidance societies [59]. Therefore, considering the previous argument and the fact that the regression results of Model 6 also conform to our expectations, H2d is supported.

This result reveals that in societies with high uncertainty avoidance, female directors' concern for environmental stakeholders could be weakened by high regulation control [66] and high anxiety when dealing with uncertain situations [74]. This is because, in such societies, the board tends to be more cautious in avoiding uncertainty risks [55], and women normally exhibit more anticipatory anxiety than men [68]. This may result in female directors reducing their attention to environmental stakeholders through the board's actions to avoid uncertainty.

Model 7 shows the results for *BGD* ($\beta = 1.981$, $p < 0.1$) and the interaction term *LTO*BGD* ($\beta = -0.320$, $p < 0.1$), indicating that the moderating effect of long-term orientation between board gender diversity and MNCs' environmental disclosure is insignificant. Previous studies have shown similar results, such as an insignificant impact of long-term orientation on corporate social disclosures [72] and an insignificant relationship between long-term orientation and CSR reports in countries with higher and lower GDP per capita [55]. This result is inconsistent with the argument that long-term oriented society members sacrifice current interests to ensure future benefits [71], and that enterprises tend to sacrifice short-term economic

interests to ensure long-term sustainable development goals [54]. Thus, considering the previous argument, and that the regression result of Model 7 does not support our expectations, H2e is not supported.

The reason for this insignificant moderating effect may be that environmental disclosure could be enhanced by both long- and short-term orientations for different motivations. On the one hand, enterprises with long-term orientation normally focus on sustainable financial performance [74]. To achieve this goal, enterprises tend to establish better relationships with various stakeholder groups, which may lead to an increase in the number of stakeholders. On the other hand, enterprises from societies with a short-term orientation are more likely to be concerned with present financial targets [34]. When an enterprise encounters a reputation crisis, voluntary disclosure can effectively restore the corporate reputation [95]. Enterprises are likely to increase environmental disclosure as "green washes" to reduce their potential economic loss risk. Therefore, the moderating effect of long-term orientation between board gender diversity and MNCs' environmental disclosure is insignificant.

Robustness Testing

In this study, we use another set of data to represent the environmental disclosure of MNCs, replacing the dependent variable to test the robustness of the regression model. Data from Thomson Reuters' Asset4 database have been widely used in CSR-related studies [96, 97]. The environmental scores from the Asset4 database could be used to measure MNCs' environmental disclosure to replace our dependent

Table 6. Robustness Test.

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
BGD		0.262*	-4.536**	2.094*	10.224***	2.738**	0.665
		(1.899)	(-2.100)	(1.712)	(3.314)	(2.496)	(0.613)
PDI*BGD			1.150**				
			(2.071)				
PDI			-0.361***				
			(-3.256)				
IDV*BGD				-0.543*			
				(-1.816)			
IDV				0.183***			
				(3.543)			
MAS*BGD					-2.294***		
					(-3.255)		
MAS					0.453***		
					(3.883)		

Table 6. Continued.

UAI*BGD						-0.597**	
						(-2.192)	
UAI						0.183***	
						(4.307)	
LTO*BGD							-0.134
							(-0.512)
LTO							-0.024
							(-0.518)
BSIZE	0.208**	0.211**	0.187**	0.181**	0.197**	0.174**	0.206**
	(2.459)	(2.480)	(2.361)	(2.306)	(2.415)	(2.163)	(2.475)
BMT	0.075*	0.094**	0.067*	0.065*	0.065	0.044	0.102**
	(1.792)	(2.041)	(1.705)	(1.685)	(1.615)	(1.155)	(2.178)
CSRCOM	-0.024	-0.038	-0.047	-0.046	-0.033	-0.025	-0.043
	(-0.706)	(-1.150)	(-1.401)	(-1.361)	(-1.009)	(-0.821)	(-1.330)
BIG4	0.191	0.165	0.078	0.073	0.097	0.058	0.171
	(1.370)	(1.181)	(0.622)	(0.587)	(0.752)	(0.460)	(1.198)
ROA	0.081	0.010	-0.142	-0.152	0.008	-0.018	-0.011
	(0.354)	(0.044)	(-0.613)	(-0.673)	(0.036)	(-0.083)	(-0.052)
DEBT	0.059	0.012	0.083	0.080	0.029	0.059	-0.002
	(0.859)	(0.153)	(0.999)	(0.983)	(0.397)	(0.841)	(-0.020)
SIZE	0.013	0.011	0.011	0.012	0.013	0.009	0.016
	(1.070)	(0.945)	(1.235)	(1.351)	(1.506)	(1.050)	(1.298)
Constant	3.450***	3.443***	5.093***	2.970***	1.581**	2.985***	3.503***
	(8.716)	(8.755)	(10.892)	(6.907)	(2.139)	(6.645)	(8.076)
F	1.45	1.59	2.61***	2.75***	2.47**	2.99***	1.34
Root MSE	0.124	0.123	0.117	0.116	0.116	0.113	0.123
Observations	99	99	99	99	99	99	99
R-squared	0.231	0.255	0.339	0.354	0.348	0.382	0.274

*, ** and *** represent significance at the 10%, 5% and 1% levels, respectively.

variable data source. After screening the database, the environmental scores of 99 matching samples from Asset4 were selected for the robustness test of the moderating effect of national culture.

The same multivariate regression models used in our empirical tests were applied to the robustness tests. Table 6 shows the robustness of the results. As shown in Table 6, *BGD* positively affected *ED* (Model 2), *PDI* negatively moderated the relationship between *BGD* and *ED* (Model 3), *IDV* negatively moderated the relationship between *BGD* and *ED* (Model 4), *MAS* negatively moderated the relationship between *BGD* and *ED* (Model 5), *UAI* negatively moderated the relationship between *BGD* and *ED* (Model 6), and the

moderating effect of *LTO* was not significant (Model 7). The results of the robustness test are consistent with our empirical results. Thus, H1, H2a, H2b, H2c, and H2d passed the robustness test.

Conclusions

Recently, the importance of board gender diversity has attracted wide attention in CSR research, especially the role of environmental disclosure. Researchers have investigated the relationship between board gender diversity and environmental disclosure from various perspectives. However, there is still a lack

of consideration regarding the influence of national culture dimensions. We believe that the differences in cultural dimensions between countries could enhance or weaken the impact of board gender diversity on the environmental disclosure of MNCs from the perspective of stakeholder theory. Therefore, this study establishes a link between board gender diversity, environmental disclosure, and national culture to theoretically and empirically investigate the moderating effect of national culture on the board gender diversity and environmental disclosure of MNCs.

The following interesting findings were obtained. First, board gender diversity can effectively promote the environmental disclosure of MNCs (H1). Second, power distance negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure (H2a). Third, individualism negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure (H2b). Fourth, masculinity negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure (H2c). Fifth, uncertainty avoidance negatively moderates the relationship between board gender diversity and MNCs' environmental disclosure (H2d). Finally, the moderating effect of long-term orientation was insignificant (H2e). Our results reveal the positive role of board gender diversity in promoting MNCs' environmental disclosure, and this positive role could be affected by different female directors' attention to environmental stakeholders under different national cultural backgrounds.

This study theoretically explains how gender differences affect the board's stakeholder management from the stakeholder theory perspective. This emphasizes the importance of gender diversity in the board's environmental stakeholder management. We also explain subtle changes in female directors' attention to environmental stakeholders in different national cultures. This not only explains the theoretical link between board gender diversity, environmental disclosure, and national culture but also provides a new research perspective and further opportunities for the expansion of existing CSR research fields. Moreover, we suggest that policymakers and MNCs should pay more attention to female directors and the national culture to improve corporate environmental responsibility for CSR management policy enhancement and corporate reputation maintenance. In particular, it aims to maximize the positive effect of female directors on the board's stakeholder management by considering national culture.

This study has several limitations and directions for future research. Due to our manual measurement of environmental disclosure, the small sample size is a limitation of our study. Therefore, we plan to expand the sample size in future studies. Moreover, our insignificant moderating effect reveals the potential for further research on different corporate environmental responsibility motivations at different levels of the

national culture dimensions. Thus, the study of CSR motivations in high or low national culture dimensions will be an interesting and valuable research topic for the future.

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Conflict of Interests

The authors declare no conflicts of interest.

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