Research in Economics and Management
ISSN 2470-4407 (Print) ISSN 2470-4393 (Online)
Vol. 7, No. 1, 2022
www.scholink.org/ojs/index.php/rem

Original Paper

The Influence of Corporate Governance on the Environmental Information Disclosure of MNCs: An Empirical Study on Corporations from China, Japan, the United Kingdom and the United States

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Received: December 20, 2021 Accepted: February 5, 2022 Online Published: March 2, 2022

doi:10.22158/rem.v7n1p49 URL: http://dx.doi.org/10.22158/rem.v7n1p49

Abstract

As one of the ways for multinational companies to obtain the advantages of sustainable development, corporate social responsibility (CSR) has been widely recognized by the academic community. Research featuring the influence of corporate governance (CG) on the environmental information disclosure of multinational corporations (MNCs) have gained much attention, but there is a lack of research into the empirical examination of cross-national samples. Drawing on Agency Theory, this study fills the gap by making a theoretical exploration and empirical test on relationships between CG and MNCs's environmental disclosure. Board independence, board size, board meeting frequency and their relationships to the environmental disclosure of MNCs are observed in this study. In order to examine the aforementioned relationships, this study incorporates measurement techniques used by Van Staden and Hooks (2007) [1] and Global Reporting Initiative 4.0 guideline (GRI4.0) and develops a set of comprehensive, systematic measurement standards to appraise the environmental information disclosure of corporations. The content analysis method is used to assess the environmental disclosure of 151 companies from China, the United States, Japan, and the United Kingdom, according to Forbes Global 2000 Ranking in 2019. We find that board independence, the board size, and the frequency of board meetings are all positively associated with the environmental disclosure of MNCs. This finding indicates that more independent boards of directors, larger boards, and more frequent board meetings are CG mechanisms which lower the likelihood for an opportunistic behaviour and increase information transparency and voluntary implementation of the disclosure, effectively enhancing the environmental

disclosure of MNCs. This impact of CG on corporations' environmental information disclosure exists across country contexts.

Keywords

corporate governance, environmental disclosure, agency theory, multinational corporations

1. Introduction

Over the past two decades, corporate social responsibility (CSR) has gradually become the focus of academic debate [2-5], and research scope is gradually expanding to corporate governance (CG) along with the change of the world and people's understanding. Agency theory holds that in addition to coordinating the relationship between shareholders and administrators [6], the responsibilities of the board of directors should be extended to a wide range of stakeholders. Therefore, Haniffa and Cooke (2002) suggested that CG may improve enterprises' ability to cope with new challenges and reduce agency conflicts [7]. Besides, efficient internal governance mechanisms can motivate administrators to hold their actions accountable [8]. The effective governance structure will enhance the legitimacy of a corporation [9] and improve its financial performance [10].

As the core of CG, the board not only plays a decisive role in overseeing business decisions but also determines the level of corporate transparency and information disclosure [11]. Among them, the board with more independent directors tends to show greater interest in carrying out and disclosing corporate social responsibility [12,13], and a higher level of disclosure [11]. As the number of board members increases, the possibility of having asymmetric information will be reduced [14] while the environmental performance will be improved [15].

Table 1. Corporate Governance and Corporate Social Responsibility Reference Summary

Reference	Independent Variables and Result	Dependent Variables	Source	Theories	Country
Halme and Huse, 1997[17]	Board Size (P)	Corporate Environmental Conduct	Annual Report	Agency Theory	Northern Europe
Johnson and Greening, 1999[18]	Board Independence (P), Board Ownership (P)	Social Responsibility on Product and Employee	Questionnaire	Agency Theory	US
Cheng and Courtenay, 2006[19]	Board Size (P), Board Independence (P), Board Composition (I), Board Size (I)	Voluntary Corporate Social Responsibility Disclosure	Annual Report	Agency Theory	Singapore
Lim et al, 2007[20]	Board Independence (P)	Corporate Social Responsibility Conduct	Annual Report	Agency Theory	Australia
Jo and Harjoto, 2011[10]	Corporate Governance Index (P), CEO Duality (P), Board Independence (P), Board Size (I), CEO as Chairman of Committee (I)	Corporate Social Responsibility Synthesis Score	KLD	Agency Theory	US
Post et al, 2011[21]	Board Independence (P), Ratio of Female on Board (I), Board Composition (I)	Environmental Information Disclosure	KLD	Agency Theory	US

Galbreath, 2011[22]	Board Independence (P), Ratio of Female on Board (P), Board Size (I)	Corporate Social, Environmental Responsibility Disclosure	Annual Report	Agency Theory	Australia
Rao et al, 2012[23]	Board Independence (P), Board Ownership (P), Board Size (P), Ratio of Female on Board (P)	Environmental Information Disclosure	OSIRIS Database	Agency Theory	Australia
Walls et al, 2012[24]	Board Independence (N), CSR Committee (P), Board Size (N), Ratio of Female on Board (P)	Environmental Information Disclosure	KLD	Agency Theory	US
Allegrini and Greco, 2013[25]	Board Independence (I), CSR Committee (P), Board Size (P), Audit Committee (P), CEO Duality (N)	Voluntary Information Disclosure	Annual Report	Agency Theory	Italy
Jizi et al, 2014[26]	CEO Duality (P), Board Independence (P), Number of Board Meeting (P), Board Size (P)	Corporate Social Responsibility Disclosure	Thomson Database	Agency Theory	US
Janggu et al, 2014[27]	CEO Duality (P), CEO Independence (I), Board Capability (P), Board Size (P), Board Ownership (I), Foreign Board Member (I)	Sustainable Development Disclosure	Annual Report	Agency Theory	Malaysia
Garcia-Sanchez et al, 2015[28]	Board Size (I), Foreign Board Member (I), Ratio of Female on Board (P), Board Ownership (P), Number of Board Meeting (I), Board Composition (P)	Corporate Social Responsibility Disclosure	Thomson Database	Agency Theory	Spain
Kaymak and Bektas, 2017[11]	Board Size (P), Board Independence (P), CEO Duality (I)	Corporate Social Responsibility	Company Website, Public Information	Stakeholder Theory, Agency Theory	MNCs

P: positive relationship; N: negative relationship; I: insignificant relationship

*This table is drawn by researcher according to relevant literature review

Lastly, a high level of board meeting frequency embodies its diligence, which plays to the board's strength in supervision and increases the corporation's transparency [16]. In summary, CG positively affects environmental information disclosure [11,26]. However, such influence relationship has not been consistent throughout relevant literatures (Table 1). For example, [24] found the relationships to be negatively related, and Janggu et al. (2014)'s and Garcia-Sanchez et al. (2015)'s study showed that the relationship between CG and CSR disclosure was not significant [27,28]. Hussain et al. (2018) suggested that part of the reasons for this unified conclusion phenomenon might be related to factors such as the country of origin and industry of the sample [29], and some researchers have selected a single country as the sample country of origin (Table 1). Therefore, it is necessary to further investigate the influence relationship between CG and environmental information disclosure, and cross-country sample need to be studied. With regard to sample selection, this study observed manufacturing MNCs from China, United States, Japan and United Kingdom in the 2019 Forbes global 2000 list.

To sum up, this study explores the impact of board independence, board size and the frequency of board meetings on the environmental information disclosure of multinational companies. A measurement method of CSR disclosure was constructed based on GRI4.0, and the sample CSR report was quantitatively processed by content analysis, and the influence relationship between CG and Environmental Information Disclosure was proved by empirical test. This data processing method provides new evidence for the knowledge system of Environmental Information Disclosure measurement in the CSR disclosure research field, and the research results also provide important empirical support for the connection between CG and CSR disclosure.

The following part of this study will be arranged as follows: first, in the next section, we will theoretically discuss the relationship between CG and environmental information disclosure and develop relevant research hypotheses. Then, we will propose the research design and sample selection. Second, in the empirical analysis section, we will discuss the empirical results. Finally, in the conclusion section, we will put forward the research conclusion, research limitations and future research directions.

2. Theoretical Background and Research Hypotheses

For environmentally sensitive industries, manufacturing MNCs under the pressure of environmental events or media focus on obtaining legitimacy strategies accompanied by corporate social responsibility disclosure to reduce the threat of legitimacy, attain sustainable development competitive advantage, and give enterprises corresponding returns. With an increasing emphasis on corporate social responsibility, scholars began to investigate corporate social responsibility from the perspective of management principles and found that the attention paid by the organizational strategy to the environment improve both the enterprises' environmental performance and its financial performance [30,31]. Scholars have also conducted ample empirical studies on the relationship between CG and environmental information disclosure [9,12,13,32,33,]. Existing research [17,23] has shown that effective CG can positively influence corporate environmental information disclosure, and a larger board of directors, more independent directors, and more board meetings can effectively lower the agency costs and opportunistic behaviour, and reach a more objective, independent decision-making. Therefore, the optimal board composition may improve the corporate environmental disclosure. This study will examine the relationship between the two using the indicators adopted by Jizi et al. (2014) on CG [26]. Next, based on agency theory, this paper will discuss the relationships between board independence, the board size, frequency of board meetings and the corporate environmental information disclosure, respectively, and put forward the following hypothesis.

2.1 Board Independence and Environmental Information Disclosure of MNCs

The board of directors is composed of executive directors and independent non-executive directors, who play an essential role in strategic decision-making and management supervision of the corporations. Executive directors are usually senior managers from within the company whereas independent directors, often selected from outside of the company, do not have ties to the company in addition to the

responsibility to uphold their positions. Agency theory suggests that board independence can effectively oversee and control the behaviours of managers because more independent directors adequately lower the chance of opportunistic behaviour and enhance the objectivity during the decision-making process, decrease the agency cost, and maximize the potential of the board on supervision [34]. In terms of roles and responsibilities: First, independent directors can adequately supervise the behaviour of managers and limit their chances to engage in opportunistic behaviour [21]. As the boards have a higher degree of independence, both the voluntary disclosure and transparency increase [35], and the decisions made by the board become more objective [34]. Galbreath (2011) believes that independent directors bring more views and opinions concerning the environment and society from stakeholder groups to the board of directors, challenging and changing the board's habitual thinking during the decision-making process [22]. In addition, independent directors are more attentive to the growth of a firm's environmental responsibility and other sustainability issues because their remunerations are not affected by the firm's financial performances [36]. Board independence represents a high level of transparency and serves as a driver for increasing a company's long-term value [26]. Previous studies have supported this position that the improvement of board independence can efficiently promote the transparency and voluntary disclosure tendency of corporate information disclosure [19,35,37]. Meanwhile, as external members of the company, the independent directors are subject to less pressure from the management cadres and shareholders, thus focusing more on the cost of reputation [38]. As a result, boards of MNCs with more independent directors are often less corrupt, more socially responsible [11], and more actively involved in corporate social responsibility disclosure [12,13]. Lastly, independent directors also help enterprises acquiring outside resources available to the group and establishing external linkages [39].

In conclusion, independent directors play a crucial role in enhancing objectivity, supervision role, information transparency, and voluntary nature, reducing corruption, and developing social responsibility of the board of directors in making decisions, all of which are conducive to improving the environmental disclosure of MNCs. Jo and Harjoto (2011) also proposed the notion that board independence may have significance in the corporate environmental disclosure [10]. By employing the proportion of outside board directors in the number of board members to represent the level of board independence, this study proposes the following hypothesis:

H1: the independence of the board of directors is positively related with the environmental information disclosure of MNCs

2.2 Board Size and Environmental Information Disclosure of MNCs

Board size, as another indicator of CG, may affect the strategic decisions made by the board of directors as the top management body of MNCs. These decisions, including the disclosure of environmental information, will be enacted by the board of directors, conveyed to and implemented by the managers. Although scholars have studied the relationship between them, they have not reached a unified conclusion. Studies have shown that the larger the board size, the less effective it is in terms of supervision, control, communication and decision-making, while the smaller the board size, the more

efficient it is in terms of communication, and the better it performs in terms of commitment and responsibility [40,41]. In addition, Byard et al. (2006) found that the size of the board of directors was negatively related in the sample of US companies [42]. However, in the sample of Singapore companies, the relationship between the two was not significant [19]. However, there are scholars put forward to increase in the number of members of the board of directors, can effectively reduce the possibility of asymmetric information [14], minimize the information loss and uncertainty [43], and improve the professional knowledge and experience of the board of directors to reach the goal of improving the corporate environmental performances [15]. For this reason, De Villiers et al. (2011) investigated the board composition and environmental performance of the board of directors using disclosed data and environment ratings data from Kinder Lydenberg Domini (KLD) Inc. for 151 enterprise reports from 1216 enterprises [15]. The results showed that a bigger board of directors is associated with a higher proportion of members with a legal background, and enterprise with more active CEOs is associated with higher environmental performance. In addition, in terms of the work pressure on board members, it is likely that with the increase of workload, the supervision ability of smaller boards on the management will be weakened [44]. Small boards are also inclined to be affected with regard to consultation and monitoring [45]. Therefore, board size is expected to affect the corporate environmental disclosure. Often, the larger the enterprise is, the more its board members are from other stakeholder groups [46], and the larger the board, the more representative it is of diverse stakeholder groups, and the more transparent it will be [11]. Frias-Aceituno et al. (2013) found through research that the size of the board has a positive impact on corporate information disclosure upon [47] which other scholars have conducted extensive research [9,32,33]. To sum up, MNCs can build relationships with stakeholder groups and satisfy their demands through the means of board expansion, which promotes organizational transparency and information disclosure. As boards grow in size and expertise and experience, so does the need for voluntary disclosure. In view of the current academic community, there is a void of a unified conclusion on this relationship, and cross-national empirical research is needed for further study. According to the arguments mentioned above, we propose a hypothesis as follows:

H2: board size is positively associated with the MNCs' environmental disclosure

2.3 The Frequency of Board Meetings and Environmental Information Disclosure of MNCs

Strategic policy enactment and management supervision, as two critical topics of the board meeting, directly affect corporate social responsibility disclosure. However, there have been two different views on the impact of board meetings on enterprises in the existing research conclusions. One argument is that frequent board meetings are a reflection of directors' incompetence, which limits the company's performance [48]. This notion is also supported by some scholars, Prado-Lorenzo and Garcia-Sanchez (2010) found a negative correlation between the number of board meetings and corporate transparency through empirical study [38]. In addition, Karamanou and Vafeas (2005) and Giannarakis (2014) discovered that there was no correlation between the number of board meetings and corporate social responsibility [49,50]. Another view holds that the frequency of board meetings is a measure of the

degree of board activity and the degree of diligence of directors [51]. Previous studies have shown that frequent board meetings play a significant role in motivating and improving corporate transparency [25] and in helping the board to perform its role in overseeing corporate operations [16]. Moreover, frequent board meetings also stand for the company's active involvement in strategic planning because decision-making, resource allocation, and accountability are the main agendas of board meetings and they are linked to sustainable development issues [52]. It has lead researchers to examine the relationship between the board meeting frequency and corporate social responsibility, and the results proved that the number of board meetings has a positive impact on the latter [25,26,53].

To conclude, although frequent board meetings may be a reflection of low-efficiency and insufficient ability, from an agency-theoretical viewpoint, they represent the degree of directors' attention to shareholders, creditors and other stakeholders, indeed a manifestation of the board's diligence. We infer that the number of board meetings may positively affect the environmental disclosure of MNCs. Therefore, we choose the number of board meetings held by sampled enterprises in the 2017-2018 financial year as our data, and propose the following hypothesis:

H3: board meeting frequency is positively related to the environmental disclosure of MNCs

3. Research Design and Sample Selection

3.1 Quality Index of Environmental Disclosure of MNCs

In order to objectively and comprehensively reflect the environmental disclosure of sample enterprises, this study will use an assessment method adopted by scholars in this field [1,54,55], and reports a new measure suitable for this study by incorporating GRI 4.0 indicators. This study achieves quantitative processing of qualitative data by evaluating the annual report in 2017-2018, the corporate social responsibility report (sustainable development report or ESG report), and its related rules and regulations through content analysis. According to the KPMG's Survey of Corporate Responsibility Reporting in 2017, 98% of enterprises, investigated among the corporate social responsibility reports published by N100 and G250 (Note 1), chose GRI4.0 or GRI framework as a standard to construct corporate social responsibility report [56]. Therefore, this research takes GRI4.0 as the standard while incorporating Van Staden and Hooks (2007)'s scoring system and develop a set of assessing systems capable of reflecting the environmental disclosure holistically [1]. The MNCs' environmental disclosure assessment scale developed in this research consists of 25 indicators, including energy use, recycling, water resources, greenhouse gas emissions, waste disposal, supplier environmental management policies. (see Appendix 1 for the details).

3.2 Measurement Standard for Social Information Disclosure of MNCs

This study summarizes and classifies the scoring criteria in quantifying the qualitative data realized by previous research through content analysis (see Table 2 for details) by sorting out research literature in related fields. As shown in Table 2, scholars mainly adopted a dichotomy method to evaluate corporate social responsibility disclosure [57-59], but there exists a drawback of not fully describing information

disclosure. In order to solve this problem, our study develops a scale employing Van Staden and Hooks (2007)'s multilevel assessment system in combination with the environmental indicators in GRI4.0 and proposes and examines the hypotheses based on results from evaluating corporate environmental disclosure determined by applying designed quality index through content analysis [1].

Guthrie and Abeysekara (2006) suggested that for corporate social responsibility disclosure, the same environmental scoring standard should not be adopted since the levels of importance vary according to topics [60]. Therefore, this study follows the standards adopted by Van Staden and Hooks (2007) and measures the indicators related to policies and regulations of MNCs using the "0-2" rating standard (see Table 3 for details), and other indicators such as energy use, water resources, waste treatment and other substantive disclosure indicators using the "0-4" scoring standard (see Table 4 for details) [1].

Table 2. Literature Summary with Content Analysis

Reference	Type of Information Disclosure	Scale	Specific Rating Description
Milne et al, 2003[61]	Environmental Information Disclosure (UNEP Index)	0-4	Based on UNEP 0-4 rating scales 0: (no disclosure);1 (minimum disclosure); 2 (disclosure including company strengths, weaknesses, and commitment); 3 (commitment and progress of sustainable development of core business); 4 (commitment and progress on TBL)
Frost et al, 2005[62]	Corporate Social Responsibility Information Disclosure (GRI Standard)	0-1	Evaluate GRI indicator using dichotomy
Haniffa and Cooke, 2005[57]	Corporate Social Responsibility (Independent Development)	0-1	Set word frequency as criteria of assessing corporate social responsibility and assess using dichotomy
Hasseldine et al, 2005[63]	Environmental Reputation	0-5	Evaluate on 0-5 scale, 0 (no disclosure); 1 (moderate disclosure); 2 (disclosure based on policy); 3 (specific disclosure and policy); 4 (specific implementation and monitoring, not including quantitative data); 5 (specific implementation, monitoring, target, including quantitative results)
Smith et al, 2005[55]	Corporate Social Responsibility (Independent Development)	0-2	Evaluate via sentence/word frequency. Measure quality using dichotomy and based on currency or non-currency; active and passive; future events and past events; information and promotion
Van Staden and Hooks, 2007[1]	Environmental Information Disclosure (UNEP Index)	0-4; 0-2	Evaluate information disclosure via sentence and word frequency. Rating scale 0-4description: 0 (no disclosure); 1 (minimum disclosure); 2 (descriptive disclosure); 3

			(disclosure including quantitative data); 4 (disclosure including integration of quantitative data and practice). Meanwhile cooperate with multiple measuring scales.
Wang et al, 2008[64]	Voluntary Disclosure	0-1	Evaluate with unweighted dichotomy
Webb et al, 2008[65]	Voluntary Disclosure (Independent Development)	0-3	0-4 levels of evaluation 0: (no disclosure); 1 (minimum disclosure); 2 (disclosure with supplementary discussion); 3 (detailed disclosure, additional discussion and benchmarking).
Cheung et al, 2010[66]	Voluntary Disclosure (Corporate Governance)	0-3	0-3 evaluation on disclosure quality: 0 (none); 1: (low); 2 (medium); 3 (high)
Cho et al, 2010[67]	Environmental Information Disclosure	N/A	Based on 5 dimensions: certainty, optimism, event, realism and commonality. Analyze the data using DICKSON software.
Elsayed and Hoque,2010[68]	Voluntary Disclosure	0-1	Evaluate disclosure index using dichotomy.
Guidry and Patten, 2010[69]	Corporate Social Responsibility Information Disclosure (GRI Standard)	0-3	Based on 55 core indicators in GRI, measure using Wiseman (1982) trichotomy, 0: (no disclosure); 1 (moderate disclosure); 2(detailed disclosure without quantitative data); 3 (detailed disclosure with quantitative data)
Hooks and van Staden, 2011[54]	Environmental Information Disclosure (UNEP Index)	0-4	Evaluate quantitative range via sentence/word frequency. 0-4 rating criteria for disclosure quality: 0 (no disclosure); 1 (minimum disclosure); 2 (moderate disclosure); 3 (disclosure with quantitative data); 4 (disclosure with quantitative data and specific measures

Table 3. MNCs Environmental Disclosure "0-2" Scoring Criteria

Score	Description	Example*
0	No Disclosure	None
1	Brief Disclosure	In 2017-2018, corporation responds to the call of government in saving water and improve water-use efficiency.
2	Detailed Disclosure with Specific Measures	In 2017-2018, the major units of the company completed the upgrading of equipment, added new water treatment equipment, and strengthened the staff's awareness of water-saving publicity. The annual water withdrawal of the company decreased significantly compared with previous years, and the proportion of water recycling increased significantly.

*Examples are hypothesized

Table 4. MNCs Environmental Disclosure "0-4" Scoring Criteria

Score	Description	Example*
0	No Disclosure	None
1	Minimum Disclosure	In 2017-2018, the company actively responded to the national call and took effective measures to improve the water recycling ratio of all departments of the company.
2	Average Corporate Disclosure with Moderate Explanation	In 2017-2018, the major units of the company completed the upgrading of equipment, added new water treatment equipment, and strengthened the staff's awareness of water-saving publicity. The annual water withdrawal of the company decreased significantly compared with previous years, and the proportion of water recycling increased significantly.
3	Detailed Disclosure with Quantitative Data	In 2017-2018, the main units of the company completed the upgrading of equipment, added new water treatment equipment, and strengthened the staff's awareness of water-saving publicity. The company's annual water intake reached XXX tons and water recycling reached XXX tons.
4	Authentic Disclosure Based on Best Practice (Including Quantitative Data and Benchmarking)	In 2017-2018, the major units of the company completed the upgrading of equipment, added new water treatment equipment, and strengthened the publicity of staff's awareness of water-saving. The annual water withdrawal of the company was XXX tons, which decreased by 20% compared with 2015-2016, and the water recycling reached XXX tons, which increased by 20% compared with 2015-2016.

*Examples are hypothesized

3.3 Sample Source and Data Collection

(1). Sample Source

To achieve the research purpose, we conduct a cross-national study and select samples from 151 companies in 4 countries including China, the United States, Japan, and the United Kingdom according to Forbes 2019 Global 2000 (Note 2) The Largest Public Companies. The reason for selecting MNCs from the above four countries on the Global 2000 list as the research samples is that corporations with larger size [70-73] and more extended history [74] are more active in participating in and fulfilling corporate social responsibility. Among enterprises on this list, companies that are established for a long time and are large in scale meet the sample requirements of this study. Based on this list and according to the Standard of National Economic Industry Classification (Note 3), this study selects multinational manufacturing companies from four countries. We restrict the range of sample industries, avoiding the problem proposed by Hussain et al. (2018) that the industry and source country of the sample may lead to inconsistent conclusions [29].

The overall sample screening process is as follows: First, statistically classify the listed MNCs from China, the United States, Japan and the United Kingdom. Then, leave out non-manufacturing enterprises that are irrelevant to this study. Next, at the data collection stage, exclude the enterprises with missing reports or missing data. Finally, enterprises with complete data are retained as the final research samples on the premise of ensuring the samples from four countries are evenly distributed (the sample screening process is shown in Table 5).

Table 5. Sample Screening Process

	China	US[1]	Japan	UK[2]	Total
Number of companies on the global 2000 list	251	336	223	83	893
Non-manufacturing enterprise	-177	-244	-153	-55	-629
Manufacturing enterprise	74	92	70	28	264
Missing reports or data	-30	-49	-29	-5	-113
Number of sample enterprises	44	43	41	23	151

1): There are 575 U.S. companies on the list. In this study, only 336 U.S. companies ranked 1-1111 in the global 2000 list were screened to achieve an even sample distribution.

2): As only 83 British enterprises are listed in the global 2000 list, and most of them are non-manufacturing enterprises, only 23 sample enterprises are selected.

(2). Data Collection

In order to objectively and comprehensively reflect the environmental disclosure of sample enterprises, this study uses an assessment method adopted by scholars [1,54,55], and reports a new measure suitable for this study by incorporating GRI 4.0 indicators. This study quantifies the results from evaluating the annual report in 2017-2018, the corporate social responsibility report (sustainable development report or ESG report), and its related rules and regulations using content analysis.

The data from 151 selected enterprises were collected for the empirical test. First of all, our study downloaded more than 5.5GB of qualitative data, including corporate social responsibility reports (sustainable development reports or ESG reports) and rules and regulations related to corporate social responsibility, in PDF or Word files from the official website of sample enterprises. After analyzing more than 4 million words of text data manually with content analysis and quantifying the qualitative data according to the evaluation criteria, we obtained data that are representative of MNCs' environmental disclosure.

(3). Test Code System

Examination on collected data and measurement scales through estimation of "Krippendorff Alpha" value [75] on http://dfreelon.org/utils/recalfont/recal2 ensures the reliability and validity in data collection. After processing the data using Boesso and Kumar (2007)'s three encodings [76] and calculating Krippendorff Alpha, the result of Alpha value greater than 0.8 shows substantial agreement and met Hasseldine et al. (2005), Krippendorff (1980), and Scott (1995)'s requirement for passing the test [63,75,77].

(4). Variable Description

The dependent variable of this study, environmental disclosure (ECSR), is calculated using the formula with a measurement scale developed for this study. The formula used is as follows:

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

The independent variables are the board independence (IND), board size (Bsize), and the number of board meetings (MT). Specifically, IND is the proportion of independent directors in the total number of board members, Bsize is the natural logarithm of the total board members, and MT is the natural logarithm of the number of annual board meetings.

The control variables are Corporate Social Responsibility Committee (COM), Big Four Accounting Firms (BIG4), Return on Assets (ROA), Debt Ratio (DEBT), and Business Size (Size), which are widely used in the research of related fields. Among these control variables, COM is a binary variable coded as 1 if there is a Corporate Social Responsibility Committee and as 0 otherwise. Similarly, BIG4 represents whether the sample enterprises employ four accounting firms as their external audit companies and is coded as 1 if true and 0 otherwise. ROA and DEBT are calculated by dividing net profit and total liabilities by total assets, respectively, and Size is calculated by taking the natural logarithm of the total number of employees of the sample enterprises. To strengthen the objective aspect of the research, we winsorized the continuous variables at level 1% and 99% (refer to Table 6 for a detailed variable description).

Table 6. **Variable Description**

Variable Name	Variable Code	Variable Type	Variable Description
Multinational Corporation Environmental Disclosure	ECSR	Dependent Variable	Multinational corporation environmental information disclosure
Board Independence	IND	Independent Variable	Proportion of independent directors in the total number of board members
Board Size	BSize	Independent Variable	Number of board numbers
Number of Board Meeting	MT	Independent Variable	Number of board meetings held annually
Corporate Social Responsibility Committee	COM	Control Variable	Whether there is a committee related to corporate social responsibility under the board of directors (1 yes; 0 no)
Big Four Accounting Firms	BIG4	Control Variable	Whether to employ the big four accounting firms as external independent audit firms (1 yes; 0 no)

Return on Assets	ROA	Control Variable	Return on assets
Debt Ratio	DEBT	Control Variable	Debt ratio
Corporate Size	Size	Control Variable	The natural logarithm of the number of employees in the sample

(5). Descriptive Statistics and Pairwise Correlation

Descriptive statistical results are shown in Table 7. The first column lists all variables involved in this study, the second and the third column are the descriptive statistics (mean, standard deviation), the fourth column is the variance inflation factor (VIFS) test results, and the rest of the columns give the relationships between variables. According to Table 1, both board independence (IND) and board size (Bsize) are positively and significantly related to the environmental disclosure. At the same time, board independence (IND) is also shown to be significantly related to the board size (Bsize) and the number of board meetings (MT). This indicates that, as the board size gets larger, there will be more independent boards of directors and a more independent board, which promotes more frequent board meetings accordingly.

There exist statistically significant relationships between Corporate Social Responsibility Committee (COM) and variables including board independence (IND), board size (Bsize), and number of board meetings (MT). Corporate size (Size) is also significantly related to board size (Bsize) and Corporate Social Responsibility Committee (COM). These relationships suggest that the expansion of board size may diversify the board by introducing more independent directors who will advocate greater focus on sustainable development strategy, increasing the possibility for enterprises to establish committees specialized in corporate social responsibility. In addition, with the expansion of enterprise scale, the increase of enterprises' demand for knowledge diversification leads to the expansion of the size of the board of directors, and as larger corporates are more actively involved in social responsibility, there will be a higher chance to set up a corporate social responsibility committee. Lastly, we examined the variance inflation factors (VIF) and the result of VIF < 1.40 for each predictor according to Table 6, indicates there was no multicollinearity in this sample.

Table 7. Descriptive Statistics and Correlation

Variable	Mean	Std. Dev.	VIFs	1	2	3	4	5	6	7	8	9
1.ECSR	3.985272	0.395637		1.0000								
2.IND	0.436498	0.159224	1.39	0.2758***	1.0000							
3.MT	2.238718	0.423593	1.19	0.1212	-0.3327***	1.0000						
4.BSize	2.353748	0.221246	1.17	0.3159***	0.2496***	-0.1035	1.0000					
5.COM	0.211920	0.410028	1.16	0.1290	0.2706***	-0.1932**	0.2077**	1.0000				
6.BIG4	0.874172	0.332758	1.17	0.4797***	0.2663***	-0.0005	0.2628***	0.1479*	1.0000			
7.ROA	0.069308	0.064317	1.16	0.0898	0.2138***	-0.2041**	0.0751	0.0092	0.0995	1.0000		
8.DEBT	0.603865	0.159847	1.19	-0.0611	0.2428***	-0.1179	0.1204	0.1558*	0.0748	-0.1688**	1.0000	
9.Size	10.81579	0.957649	1.18	0.1191	0.0923	0.0069	0.2248***	0.2147***	0.1609**	-0.1478*	0.2586***	1.0000
Mean VIFs			1.20									

The table is collated and plotted using STATA13.

This table shows the pairly-correlated results of dependent variables, independent variables and control variables, in which the significance is represented by asterisks (***, **, * respectively represent the statistical significance at the level of 1%, 5% and 10%). The first variable, ECSR, represents environmental disclosure of MNCs. Following is the independent variable representing the CG. CG

variables include board independence (IND), number of board meetings (MT), and board size (Bsize). The CG variable is followed by the control variable, which is based on the variables used by relevant research in the field. In this study, COM, BIG4, ROA, DEBT and Size are taken as control variables.

4. Empirical Analysis

4.1 Empirical Result

STATA13 was used for this analysis. To examine the proposed hypotheses, we used multiple regression and stepwise regression methods. Use of such procedures allows us to first test the regression model with only control variables, and then modify the model by adding or subtracting the variables from the model after each computation, making our study more objective.

Multiple regression results are shown in Table 8, including the relationships between the environmental disclosure and other relevant variables in this study, R-square, β coefficient, t value, and etc. According to Table 8, Model 1 describes the relationship between control variables and dependent variables, and Model 4 is a regression model after adding the independent variable IND to Model 1. Models 5, 7 and 8 are regression models after adding MT, Bsize, and MT and Bsize together to Model 4, respectively. Results have shown that IND and ECSR in Model 4, 5, 7 and 8 are positively and statistically related (Model 4: $\beta = 0.4742$, $p < 0.05$; Model 5: $\beta = 0.6426$, $p < 0.01$; Model 7: $\beta = 0.4096$, $p < 0.05$; Model 8: $\beta = 0.5797$, $p < 0.01$), which is consistent with the research results proposed by previous scholars [10,19,35,37]. This indicates that, in terms of managerial decision-making, boards with a high proportion of outside directors will be more objective, play a more active role in overseeing the process, and be more transparent and voluntary in information disclosure [10,11,34,35,37], and thus hypothesis H1 was supported. The addition of MT and Bsize enhances board independence's influence on environmental disclosure, denoting factors such as the expansion of the board of directors and the increase of the proportion of independent directors diversify the knowledge of the board of directors and promote the attention towards environmental issues. Moreover, more board meetings provide the board additional opportunities to discuss environmental issues and schedule environmental policies, further improving environmental disclosure.

Table 8. STATA13 Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR
IND				0.4742**	0.6426***		0.4096**	0.5797***
				(2.583)	(3.264)		(2.171)	(2.875)
MT			0.1315*		0.1900**	0.1439**		0.1952**
			(1.772)		(2.459)	(2.001)		(2.553)
BSize		0.3648**				0.3926***	0.3269**	0.3467**

		(2.501)				(2.812)	(2.234)	(2.520)
COM	0.0618	0.0356	0.0908	0.0242	0.0517	0.0654	0.0058	0.0331
	(1.008)	(0.571)	(1.373)	(0.422)	(0.881)	(0.982)	(0.100)	(0.557)
BIG4	0.5531***	0.5035***	0.5381***	0.5084***	0.4724***	0.4834***	0.4701***	0.4304***
	(4.849)	(4.541)	(4.757)	(4.309)	(3.933)	(4.381)	(4.085)	(3.658)
ROA	0.2017	0.0925	0.4232	-0.0693	0.1481	0.3269	-0.1302	0.0900
	(0.552)	(0.252)	(1.090)	(-0.184)	(0.392)	(0.837)	(-0.347)	(0.237)
DEBT	-0.2904*	-0.3194**	-0.2575	-0.4028**	-0.3913**	-0.2858*	-0.4134**	-0.4032**
	(-1.836)	(-1.994)	(-1.631)	(-2.503)	(-2.468)	(-1.782)	(-2.502)	(-2.459)
Size	0.0271	0.0135	0.0285	0.0280	0.0294	0.0140	0.0157	0.0165
	(0.859)	(0.434)	(0.878)	(0.915)	(0.928)	(0.437)	(0.519)	(0.526)
Constant	3.3567***	2.7191***	3.0160***	3.2742***	2.7601***	2.2972***	2.7142***	2.1504***
	(9.262)	(6.060)	(7.389)	(9.301)	(6.941)	(4.880)	(6.246)	(4.832)
F	5.39***	5.84***	5.17***	5.85***	6.44***	6.09***	6.24***	7.09***
Root MSE	0.34864	0.34132	0.34464	0.34311	0.33402	0.33576	0.33745	0.32717
Observations	151	151	150	151	150	150	151	150
R-squared	0.249	0.286	0.270	0.278	0.319	0.312	0.306	0.351

Robust t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Based on Table 8, we noticed that Model 2 is a regression model after including the independent variable Bsize on the basis of model 1, and Models 6, 7 and 8 are regression models after adding MT, IND, and both MT and IND respectively on the basis of Model 4. The statistical results have shown that Bsize is positively and significantly related to ECSR in Model 2, 6, 7 and 8 (Model 2: $\beta = 0.3648$, $p < 0.05$; Model 6: $\beta = 0.3926$, $p < 0.01$; Model 7: $\beta = 0.3269$, $p < 0.05$; Model 8: $\beta = 0.3467$, $p < 0.01$). The regression result is consistent with the results of De Villiers et al. (2011) [15] and Kaymak and Bektas (2017) [11], and thus H2 receives support.

Finally, the impact of the number of board meetings (MT) on the environmental disclosure of MNCs (ECSR) is reported in Table 7: We get Model 3 by adding MT to Model 1, and get Model 5, 6 and 8 by adding IND, Bsize, and both IND and Bsize to Model 4, respectively. The results suggested that MT is positively and significantly associated with ECSR in Model 3, 5, 6 and 8 (Model 3: $\beta = 0.1315$, $p < 0.1$; Model 5: $\beta = 0.1900$, $p < 0.05$; Model 6: $\beta = 0.1439$, $p < 0.05$; Model 8: $\beta = 0.1952$, $p < 0.05$).

This result is the same to the view of Ricart et al. (2005)'s and the findings of Adawi and Rwegasira (2011) because frequent board meetings represent the degree of board activeness and diligence [52,53], and also improves corporate transparency [25], thus improving environmental disclosure of MNCs. Therefore, H3 is supported. It is also found that after joining two independent variables, board

independence and board size, the impact of the number of board meetings on the environmental disclosure of MNCs is enhanced, showing that the number of board meetings will strengthen the impact of the environmental disclosure of MNCs conditional upon the board that is larger and more independent.

4.2 Robustness Check

To test the result of this multiple regression, we replaced the dependent variable with ESG data of Asset4 and conducted a robustness test. The reason for choosing Asset4 from Thomson Reuters is that the database has been recognized by the academic community, and scholars have done relevant research using this database [78,79]. After comparing and sifting the samples in the database, we found 91 matching samples in the Asset4 database, and we substituted the dependent variable (ECSR) with the part of the sample related to the environment for robustness test.

Table 9 reports the robustness testing results of this study. After the dependent variable was replaced with Asset4 data, IND and ECSR in Models 4, 5, 7 and 8 are positively and significantly related (Model 4: $\beta = 0.1982$, $p < 0.05$; Model 5: $\beta = 0.3579$, $p < 0.01$; Model 7: $\beta = 0.1717$, $p < 0.05$; Model 8: $\beta = 0.3339$, $p < 0.01$) as shown in Table 9. Bsize is also positively and significantly associated with ECSR in Model 2, 6 and 8 (Model 2: $\beta = 0.1182$, $p < 0.1$; Model 6: $\beta = 0.1708$, $p < 0.05$; Model 8: $\beta = 0.1448$, $p < 0.05$). In Model 3, 5, 6 and 8, MT is positively and significantly related to ECSR (Model 3: $\beta = 0.0758$, $p < 0.1$; Model 5: $\beta = 0.1328$, $p < 0.01$; Model 6: $\beta = 0.0982$, $p < 0.05$; Model 8: $\beta = 0.1479$, $p < 0.01$). The results of the robustness test are consistent with the empirical results of our study, proving not only the robustness of our model, but also that the reliability of assessment standards for environmental disclosure developed by this study.

Table 9. STATA13 Robustness Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR	ECSR
IND				0.1982**	0.3579***		0.1717**	0.3339***
				(2.439)	(3.574)		(2.252)	(3.624)
MT			0.0758*		0.1328***	0.0982**		0.1479***
			(1.732)		(2.724)	(2.142)		(2.912)
BSize		0.1182*				0.1708**	0.0911	0.1448**
		(1.711)				(2.315)	(1.407)	(2.176)
COM	-0.0535	-0.0528	-0.0411	-0.0646*	-0.0518	-0.0364	-0.0626*	-0.0471
	(-1.483)	(-1.505)	(-1.024)	(-1.920)	(-1.518)	(-0.945)	(-1.879)	(-1.407)
BIG4	-0.0191	-0.0177	-0.0127	-0.0457**	-0.0559*	-0.0088	-0.0411*	-0.0497
	(-1.170)	(-1.149)	(-0.460)	(-2.127)	(-1.793)	(-0.290)	(-1.860)	(-1.399)
ROA	0.0764	0.0116	0.1876	-0.0567	0.0308	0.1267	-0.0889	-0.0103
	(0.403)	(0.060)	(0.785)	(-0.294)	(0.144)	(0.552)	(-0.454)	(-0.049)

DEBT	0.0243	0.0084	0.0443	-0.0334	-0.0448	0.0273	-0.0380	-0.0533
	(0.407)	(0.130)	(0.720)	(-0.474)	(-0.609)	(0.394)	(-0.521)	(-0.671)
Size	0.0192	0.0152	0.0213	0.0191	0.0228*	0.0162	0.0161	0.0184*
	(1.446)	(1.129)	(1.642)	(1.531)	(1.980)	(1.293)	(1.252)	(1.669)
Constant	4.2805***	4.0559***	4.0528***	4.2643***	3.8522***	3.6610***	4.0934***	3.5335***
	(31.235)	(23.302)	(19.002)	(33.239)	(18.014)	(12.958)	(25.374)	(12.867)
F	1.49	1.67	1.79	2.16*	2.87***	1.90*	2.00*	2.62**
Root MSE	0.11623	0.11471	0.11318	0.11353	0.10433	0.10936	0.11293	0.10147
Observations	91	91	91	91	91	91	91	91
R-squared	0.060	0.095	0.119	0.113	0.260	0.187	0.133	0.309

Robust t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

5. Conclusions

Based on agency theory, our study explores and examines the relationships between board independence, the board size, number of board meetings, and the environmental disclosure of MNCs, respectively. Prior to this research, the academic community has been unable to reach a unified conclusion on the relationship between the two, and there is a distinct lack of literature support from cross-national experience. Therefore, our study decides to start from the data source and solves the problem with regards to the impact of industry and national characteristics proposed by scholars in the field by expanding the sample source country and by applying industry control.

Through literature review, our study finds that in terms of the environmental disclosure assessment methods used in previous studies, there is still room for improvement and innovation. So we introduced a set of more comprehensive and complete assessments for MNCs' environmental disclosure through the integration of previous composite assessment standards (the combination of multiple assessment standards) and GRI4.0 standards, and content analyzed the samples using this new standard. The evaluation criteria developed in our research as well as the application of content analysis method promote the development of the current environmental disclosure assessment.

By testing the relationship between CG and manually analyzed and quantified Environmental Information Disclosure, we found that independent director play an important role for enhance Environmental Information Disclosure (hypothesis 1). The larger the size of the board of directors, shows the better the environmental information disclosure of MNCs (hypothesis 2). Frequent board meetings can play a role in improving environmental information disclosure (hypothesis 3). Our results prove that effective CG is helpful to the environmental information disclosure of MNCs, which also attesting their relationships in a multinational context, broadening the research literature, and especially filling the void in multinational experience in this field.

Theoretically, our research has deepened the understanding of the relationship between CG and environmental information disclosure in a transnational environment and promoted the development of information disclosure measurement. First, we stressed the importance of CG and environmental information disclosure, and proposed relevant hypotheses from the perspective of agency theory, proving the role of effective CG in agency. Effective CG not only can improve legitimacy [9], competitiveness [80], innovation ability [81] and financial performance [10] of enterprise. At the same time, it also improves the environmental disclosure of MNCs. This study expands the research literature on CG and CSR disclosure, and filled up the lack of observation on transnational samples. Second, the measurement method of environmental information disclosure constructed in this study not only promotes the development of environmental information disclosure assessment, it also complements the application of content analysis method in CSR disclosure research.

Pratically, in the context of "The Belt and Road" initiative as well as "Going Global" strategy for corporations, the challenges Chinese enterprises must face in the process of internationalization are how to specify corporate social responsibility strategy and fulfil corporate social responsibility. This study testifies the influence of board independence, the board size, and the number of board meetings on the environmental disclosure of MNCs through empirical tests. It casts light on how Chinese enterprises can improve their corporate social responsibility, especially in the environmental sector, through board governance.

In addition, the research results also provide some new ideas for policymakers on how to improve environmental responsibility of MNCs through laws and regulations as they discuss environmental issues or enact and modify relevant laws and regulations for listed companies, so as to improve the effectiveness of laws and regulations. While helping Chinese MNCs "Going Global", it optimizes the allocation of the board structure in combination with the characteristics of host country and home country, achieving the goal of improving Chinese MNCs' corporate social responsibility.

Finally, this study has some limitations. Although the study sampled and analyzed data of enterprises from 4 countries, more data should be collected in order to enhance the externality of future research. Also, this study identified that the impact of the board characteristics on the environmental disclosure of MNCs also exists across countries. Does culture have a moderating effect on the relationship between them, or do cultural factors influence each other? Therefore, another future research direction might be to regard cultural factors as moderators and investigate the role of culture and its impact on the relationship between board characteristics and environmental information disclosure.

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Notes

Note 1. The N100 is made up of the top 100 companies by revenue in 49 countries. The G250 is made up of the top 250 companies in the fortune 500 by global revenue.

Note 2. Global 2000 List is a global ranking of the top 2000 companies compiled by Forbes based on FactSet Research database. The list is evaluated based on sales, profits, assets and market capitalization, with the dollar as the unit of account for the selection of listed companies around the world.

Note 3. The Standard of National Economic Industry Classification was drafted by the National Bureau of Statistics of China in 2017, issued with the approval of the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration, and was implemented on Oct 1, 2017.

Appendix 1: Assessment Scale of Environmental Disclosure of MNCs

Code	Evaluation Indicator of Environmental Disclosure of MNCs	Scale
E1	usage and weight of raw material	0-4
E2	Recycling rate of waste products and waste in Production Input	0-4
E3	Discussion on product and waste recycling	0-4
E4	Direct/indirect energy consumption	0-4
E5	Measures to reduce energy consumption	0-4
E6	Use of renewable energy	0-4
E7	Water resource usage (water withdrawal)	0-4
E8	Water resources recycling and utilization (including measures)	0-4
E9	The impact of production facilities on biodiversity	0-4
E10	Biodiversity conservation (ecological restoration)	0-4
E11	Management measures, strategies and plans for biodiversity	0-4
E12	Greenhouse gas emissions	0-4
E13	Initiatives to reduce greenhouse gas emissions	0-4
E14	Other emission information	0-4
E15	The impact of emissions on climate change or countries	0-4
E16	Effluent discharge	0-4
E17	Waste disposal weight and disposal method	0-4
E18	Disclosure of major leaks/environmental accidents	0-4
E19	Hazardous waste disposal weight and method	0-4
E20	Environmental impact of reducing product or service	0-4
E21	Environmental impacts of reducing product packaging	0-4
E22	Environmental penalties or fines	0-4
E23	Environmental impacts of product transportation or employees	0-4
E24	Total amount of environment-related inputs and expenses	0-4
E25	Supplier environmental management assessment	0-2
Total: 98		