Journal of Green Economy and Low-Carbon Development
https://www.acadlore.com/journals/JGELCD

The Influence of Board Diversity and Environmental Committees on Carbon Emission Disclosures in Southeast Asian Corporations

Alfina Khairunnisa[1], Christina D. Astuti[1*], Muhammadshaker A. Hussein[2]

[1] Department of Accounting, Faculty of Economics and Business, Universitas Trisakti, 11440 Jakarta, Indonesia
[2] Youth Speak NGO, 42001 Duhok, Kurdistan Region of Iraq, Iraq

[*] Correspondence: Christina D. Astuti (cdwi_astuti@trisakti.ac.id)

Received: 01-21-2024 **Revised:** 02-18-2024 **Accepted:** 03-06-2024

Citation: A. Khairunnisa, C. D. Astuti, and M. A. Hussein, "The influence of board diversity and environmental committees on carbon emission disclosures in Southeast Asian corporations," *J. Green Econ. Low-Carbon Dev.*, vol. 3, no. 1, pp. 26–35, 2024. https://doi.org/10.56578/jgelcd030103.

Abstract: This investigation seeks to uncover empirical evidence concerning the correlation between board diversity—including gender and nationality diversity—and the establishment of environmental committees, in relation to carbon emission disclosures by firms in Southeast Asia over the period 2018 to 2022. Analysis was conducted on a dataset comprising 210 firm-year observations, selected through purposive sampling from companies listed on the FTSE4Good ASEAN Index 2023. Utilizing a multiple linear regression model, the study revealed that diversity in board nationality and the existence of environmental committees are positively associated with the level of carbon emission disclosures by companies. Conversely, the presence of women on boards (WOB) was found to have no significant impact on the disclosure of carbon emissions. This research enriches the existing body of literature by delivering empirical insights from the Southeast Asian context, thereby contributing to a nuanced understanding of how corporate governance mechanisms influence environmental transparency. The findings underscore the critical role of board nationality diversity and environmental committees in enhancing carbon emission disclosures, suggesting that these factors may serve as vital levers for improving corporate environmental accountability in the region. This study aligns with ongoing efforts to promote sustainable corporate practices and provides valuable implications for policymakers, corporate leaders, and stakeholders in environmentally sensitive industries.

Keywords: Corporate governance; Environmental committees; Carbon emission disclosure; Environmentally sensitive industry; Southeast Asia

1 Introduction

At present, climate patterns throughout the world are experiencing an unnatural shift. The unpredictable weather, failed crops, endless disasters, and many more impact any living thing, from plants to animals to humans. Around 80% of the world's land area, inhabited by 85% of the world's population, has felt the impact of the climate crisis. According to the results of assessments conducted by the IPCC, human activities caused more than half of the global average surface temperature increase from 1951 to 2010 [1]. The human activities in question are activities that cause greenhouse gas (GHG) emissions.

GHG emissions are the release of greenhouse gases, which consist of many, with carbon dioxide (CO_2) as the highest GHG concentration in the atmosphere. CO_2 can naturally be found in the atmosphere, but in the last fifty years its concentration has increased drastically due to human activities, one of which comes from burning fossil fuels in transportation and manufacturing industry operations, the use of air conditioning and heating, and deforestation.

Efforts to reduce carbon emissions have been carried out several times at the international level. On December 11, 1997, the Kyoto Protocol was officially adopted as an international agreement that requires its members, especially those from developed countries, to strive to reduce emissions of CO_2 and other GHG elements by at least 5% below 1990's emission levels. This adoption became an important event because it succeeded in involving 192 countries until 2020. In December 2015, the 21st annual meeting of members of United Nations Framework Convention on Climate Change (UNFCCC), also known as the Conference of the Parties (COP 21), was held in Paris and resulted in the adoption of the Paris Agreement, which is an international agreement that aims to prevent the increase in average world temperature from exceeding 1.5 degrees Celsius above pre-industrial levels. This agreement also states that

each country needs to set a maximum limit on carbon emissions that can be produced by developing and developed countries through the five-year action plan that has to be submitted to UNFCCC called the Nationally Determined Contributions (NDC), which consists of actions and mitigations to reduce carbon emissions.

The rising concerns about GHG emissions have had an effect on its other disclosures related to GHG emissions. Consequently, companies are urged to develop proactive strategies to retain their good corporate image in response to the demands of stakeholders. Previous research has tried to explore the relationship between corporate governance and carbon emission disclosure. Al Fadli et al. [2] showed that female directors show a significantly positive effect on the level of CSR reporting. A study by Wasiuzzaman and Mohammad [3] also showed that the score of ESG disclosure is significantly improved when there is an increasing presence of women directors. Research conducted by Kılıç and Kuzey [4] on non-financial companies in Turkey proves the positive influence of the diverse nationality of directors and the existence of an environmental committee on carbon emission disclosure. Khan et al. [5] also found that nationality diversity has a positive influence on the quality of carbon emission disclosure in financial sector companies in Pakistan. Moreover, other studies have also attempted to find a relationship between the environmental committee and carbon emission disclosure, since the environmental committee is a distinct division that heavily focuses on the company's environmental aspects. Biswas et al. [6] reported a positive association between the existence of sustainability committees and environmental performance. This study is also supported by Kılıç et al. [7], who found that firms with a sustainability committee are more likely to issue sustainability reports. Based on these previous studies, we are interested in exploring the relationship between board diversity and environmental committees on carbon emission disclosure.

Prior research has been done around similar topics, focusing on specific areas. Research done by Kılıç and Kuzey [4] analyzed non-financial companies in Turkey. Biswas et al. [6] provided an empirical finding from Australia. Another study by Khan et al. [5] used samples from financial sector companies in Pakistan. Elmagrhi et al. [8] analyzed Chinese publicly listed corporations. Husted and Sousa-Filho [9] also gave perspectives from Latin American companies. Gerged et al. [10] enriched the findings from the sub-Saharan African region. These studies inspired us to contribute a perspective from the Southeast Asia region.

This paper wants to explore the impact of board diversity and environmental committees on carbon emission disclosures in Southeast Asian firms with the following research questions: 1) Do women on boards have a positive relationship with carbon emission disclosure? 2) Does board nationality diversity have a positive relationship with carbon emission disclosure? 3) Does the presence of the environmental committee have a positive relationship with carbon emission disclosure?

2 Literature Review

2.1 Legitimacy Theory

Legitimacy theory was first introduced by Dowling and Pfeffer in 1975. Legitimacy theory shows that an organization can legitimize its activities by making sure that the values implemented by the organization are in accordance with the values held by the wider community; however, organizational legitimacy can be threatened when potential or actual conflict occurs between two value systems.

Martinez et al. [11] mentioned that companies must comply with the laws that apply in a region; however, apart from laws, companies must also comply with the standards that apply in the place where the company operates to gain legitimacy in society so that the company can obtain the necessary resources. Disclosure regarding non-financial aspects such as the environmental and social aspects of a company is one of the efforts to comply with societal values that can be done to gain legitimacy so that the sustainability of the company's operations can be maintained. However, the definition of legitimacy might vary across countries; therefore, if something is considered legitimate in one country, that does not mean that it will be considered legitimate in another country.

2.2 Resource Dependency Theory

Resource dependency theory is a theory coined by Pfeffer and Salancik in 1978 that shows how organizational behavior is shaped by the need to obtain external resources from outside the organization. Resource dependency theory views an organization as an entity operating in an open system that needs to exchange and obtain resources to survive, thereby creating a dependency between the company and the external environment [12].

The exchange of resources in question can be reflected in the diversity within the board of directors. Diverse board members can enrich the capabilities and resources of the board of directors by providing unique information, experience, and knowledge to management for better decision-making [12]. Martinez et al. [11] also analyze the resource dependency theory, where the more diverse the board of directors, the greater its power to access the required funds and meet its social and environmental obligations.

2.3 Stakeholder Theory

The stakeholder theory explains that managers and stakeholders have a contractual relationship where managers are committed to representing and meeting stakeholder expectations, as explained by Elmagrhi et al. [8]. Stakeholders want companies to excel, not only in financial aspects but also in non-financial aspects, including social and environmental responsibility, so that companies will try to meet the expectations of these stakeholders [13]. Martinez et al. [11] explained that according to stakeholder theory, companies operate in society and are responsible for repairing the damage created through environmental pollution. This theory can be used to analyze the impact of WOB on carbon emission disclosure because WOB tend to be more concerned about companies behaving ethically and adopting socially responsible practices, i.e., being more stakeholder-oriented, according to Martinez et al. [11].

2.4 WOB on Carbon Emission Disclosure

Currently, there is a phenomenon where stakeholders pay special attention to the efforts made by companies to overcome environmental issues. One effort that can be made is to form a board of directors consisting of female directors so that environmental issues can be handled [14]. Female directors tend to be more oriented towards social responsibility compared to male directors. Female directors are also more interested in service to the community and philanthropic activities, are able to encourage more open conversations, improve decision-making processes related to CSR and stakeholder needs, and can provide a different perspective from the female side in board meetings [12]. The increasing number of female directors in companies will encourage companies to disclose to the public the carbon emissions resulting from their business processes [15].

Several studies have been conducted to analyze the impact of WOB on carbon emission disclosure. Martinez et al. [11] demonstrated that the ratio of women to men on board is inversely related to the CO_2 emissions of a company. This means that a high ratio of WOB will lower CO_2 emissions. Khan et al. [5] also found that gender diversity positively influences the quality of CSR disclosure. Tingbani et al. [14] provided a positive association between GHG voluntary disclosures and gender diversity.

These results align with stakeholder theory, which explains companies' efforts to meet the expectations of their stakeholders, namely efforts to overcome environmental issues. Stakeholder expectations regarding environmental issues are stated in the sustainability report, which contains environmental, social, and governance (ESG) information. Companies that publish these sustainability reports will gain a better reputation in the eyes of stakeholders [13].

H_1: WOB have a positive effect on carbon emission disclosure

2.5 Board Nationality Diversity on Carbon Emission Disclosure

The composition of directors who are diverse in terms of nationality background can provide fresh perspectives and values brought from their country of origin. One of the views and values that will be brought up is related to environmental aspects. The values brought by foreign directors will then be reflected in the directors' daily habits. The habit could be as simple as taking public transportation. For example, a board member has a habit of taking public transportation, which is considered 'the standard' in their home country, but somehow the habit is unusual for other members and employees who originated from a different nationality. As a figure of authority, their habit sets an example for employees and other board members to pick up that same habit, which will result in a lower carbon footprint for each individual and reduce the indirect carbon emissions in the company. At a higher level, foreign directors will bring their experience and expertise about carbon-related issues to board meetings, which will lead to a more carbon-sensitive decision-making process.

These environmentally friendly values will be an added value for the company because they can reach investors who have concerns about the environment. This is in line with resource dependency theory, which tries to explain how the board desires to reduce uncertainty by appointing company directors who can maximize access to valuable resources needed by the company [12].

However, Martinez et al. [11] mentioned that diversity could be seen as a double-edged sword. This is because the more diverse the board is, in terms of nationality background, the higher the communication barriers between the board members. So, while the board's nationality diversity could help in bringing in positive environmental values or habits, there is also a risk of running into communication barriers within the board and failing to improve the disclosures.

H_2: Board nationality diversity has a positive effect on carbon emission disclosure

2.6 The Presence of Environmental Committee on Carbon Emission Disclosure

The presence of an environmental committee in the company's organizational structure indicates the company's seriousness and commitment to reducing the environmental impact of its business operations. The environmental committee is a special body within the company that is responsible for advocating for the disclosure of GHG information to stakeholders and the public, as well as fighting for the implementation of long-term strategies for climate change [12]. A study conducted by Gerged et al. [10] reveals that the presence of an environmental committee

strengthens the impact of board gender diversity on corporate environmental disclosure. The explanation above is in accordance with legitimacy theory, which provides a special focus on the importance of legitimacy or recognition in society in terms of seriousness in minimizing the impact of climate change by forming a special body that is responsible for all company activities so that the business it runs can survive in the long term.

H_3: The presence of an environmental committee has a positive effect on carbon emission disclosure

3 Methodology

3.1 Data and Sample Considerations

This research aims to obtain empirical findings on the relationship between WOB, board nationality diversity, and the presence of environmental committees on carbon emission disclosure in the Southeast Asia region. Southeast Asia consists of eleven countries: Brunei, Myanmar, Cambodia, Timor-Leste, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. In the region, there is a regional organization that aims to promote cooperation in the economic and security sectors among its members. The organization is called the Association of Southeast Asian Nations (ASEAN), and its members are all countries in Southeast Asia except Timor-Leste. Our basis for selecting the candidates for this study was the FTSE4Good 5 ASEAN Index, an index consisting of companies with good ESG performances in Southeast Asia. The FTSE4Good 5 ASEAN Index is the ideal index to use for several reasons: 1) The constituents already went through the index's selection to be considered companies with good ESG performances, therefore reducing the extreme high and low gaps (outliers) while running the statistics on the data; 2) The majority of the constituents are public companies, which means the data are publicly accessible and we can utilize our available resources. We use secondary data from companies' annual reports together with sustainability reports and financial reports obtained from the company's websites.

3.2 Measures

We selected carbon emission disclosure as the dependent variable for this study. There are various ways to measure carbon emissions, such as calculating each scope of carbon emissions to gain information about which production process generates the most carbon emissions. It is also possible to measure the total amount of budget that goes into reducing carbon emissions. However, this study focuses on how well companies disclose the carbon emission indicators, which are calculated using the indicators from a previous study by Choi et al. [16]. Carbon emission disclosure is measured by dividing the number of disclosed indicators in the company's annual reports by the total number of indicators. We selected several independent variables for this study: 1) WOB; 2) board nationality diversity; and 3) the presence of an environmental committee.

WOB is measured by dividing the number of women directors by the total number of directors. We argue that calculating the ratio of WOB to the total number of directors could give us the percentage of women directors relative to the total number of directors. The majority of our literature references also used this technique. However, there are some potential techniques to explore regarding the measurement of WOB, such as using a dummy variable if there is at least more than one woman director [10] or using the heterogeneity index [5].

Board nationality diversity (BOARNAT) is calculated by dividing the number of foreign directors by the total number of directors. The method was previously used by Khan et al. [5] by categorizing board nationality into two categories. For example, if we analyze companies in Indonesia, the first category would be Indonesian, the second category would be non-Indonesian (foreign directors), and so on. Most companies disclose the nationality of their board of directors. However, if it is not disclosed, then we utilize the search engine to look for external information besides the company's reports. The other potential alternative to measuring BOARNAT is by categorizing the nationality of the directors into several regions in the world to see if there are any differences if the director originated from certain regions.

The presence of an environmental committee (ENVICOM) is measured using a dummy variable, taking the value of 1 if a company has an environmental committee and 0 if there is none.

The control variables for this study are industry type (INDUSTRY) and firm size (FIRMSIZE). INDUSTRY is used to measure if a company is considered an extractive or non-extractive industry. We want to see whether there are any differences in the disclosures if a company belongs to extractive or non-extractive industries. FIRMSIZE is used to measure if the firm size of a company has any correlation with the number of items disclosed for the carbon emission disclosure. The summary of the operational definition of variables is presented in Table 1.

3.3 Model Specifications

$$\text{CED} = \alpha + \beta 1 \text{WOB} + \beta 2 \text{ BOARNAT } + \beta 3 \text{ ENVICOM } + \beta 4 \text{ INDUSTRY } + \beta 5 \text{ FIRMSIZE} \quad (1)$$

We proposed Eq. (1) as the multiple linear regression model to test our hypotheses.

Table 1. Operational definition of variables

Variables	Operational Definition	Source
	Dependent	
CED	The ratio of CED indicators disclosed to the total CED indicators.	Choi et al. [16]
	Independent	
WOB	The ratio of the number of female directors to the total number of directors.	Gonenc and Krasnikova [15]
BOARNAT	The ratio of the number of foreign directors to the total number of directors.	Khan et al. [5]
ENVICOM	A dummy variable that takes the value of 1 if a company has an environmental committee and 0 if there is none.	Tingbanj et al. [14]
	Control	
INDUSTRY	A dummy variable that takes the value of 1 if a company is considered an extractive industry (industrial, basic materials, energy, or utilities) based on ICB Classification and 0 if the company belongs to non-extractive industries.	FTSE Russell [17], Martinez et al. [11]
FIRMSIZE	Natural logarithm of total assets.	Kiliç et al. [7]

4 Results

4.1 Data Description

Table 2 presents the process of research sample selection. All constituents in the FTSE4Good 5 ASEAN Index 2023 Report were considered candidates for this study, with a total of 117 companies. The candidates went through a selection process based on the purposive sampling criteria: 1) companies that published annual reports consistently during 2018–2022, 2) companies that had female directors consistently throughout 2018–2022, and 3) companies that had foreign directors consistently throughout 2018–2022. This selection process resulted in a sample of 42 companies with a 5-year observation period; therefore, the total firm-year observations were 210. The 42 companies consist of 3 Indonesian, 15 Malaysian, 3 Philippine, 13 Singaporean, and 8 Thai.

Table 2. Research sample selection

Criteria	Amount
Companies listed in FTSE4Good ASEAN 5 Index 2023	117
Companies do not publish annual reports continuously during 2018 - 2022	(3)
Companies do not have woman directors and/or foreign directors	(72)
Sample per observation year with complete data	42
Total observations (42 samples $\times$ 5 years)	210

4.2 Descriptive Statistical Analysis

Table 3. Descriptive statistics

Variables	Dummy Score	Frequency	Min. Value	Max. Value	Mean	Std. Dev.
CED			0.111	0.944	0.6745	0.203
WOB			0.056	0.600	0.2407	0.117
BOARNAT			0.083	0.929	0.2751	0.150
ENVICOM	1	182				
	0	28				
INDUSTRY	1	35				
	0	175				
FIRMSIZE			20.513	27.014	23.312	1.601

Based on Table 3, the CED variable has a minimum value of 0.111 owned by the Alliance Bank Malaysia Company in 2018. This value provides information that Alliance Bank Malaysia only disclosed two of the 18 items in the CED component. The maximum CED disclosure value of 0.944 was owned by the Fraser & Neave Holdings Company in 2019. This value illustrates that Fraser & Neave was able to disclose 17 out of 18 CED items. The average value of

carbon emission disclosure of the companies observed was 0.674, or 67.4%, which means on average, companies were able to disclose 12 items. The standard deviation value of carbon emission disclosure is 0.203, which means that the carbon emission disclosure of the companies analyzed is distributed close to the average value, meaning that the companies studied have a fairly good level of carbon emission disclosure, between 8 and 16 points out of a total of 18 CED indicators.

The women on boards (WOB) variable has a minimum value of 0.056 for TRUE Corp Company in 2018, meaning that the representation of female directors is only 5.6%. Meanwhile, the maximum value of 0.6 is owned by the Unilever Indonesia Company in 2020, which means that the representation of female directors is 60% of the total directors. The average value of the women on boards variable is 0.2407, which illustrates that at least 24.07% of the total directors are female directors in the companies observed. The standard deviation value of 0.117 illustrates that the data distribution of female directors in the companies studied ranges between 12.37% and 35.77%.

Board Nationality Diversity (BOARNAT) has a minimum value of 0.083 owned by the Sime Darby Company in 2019, meaning that of all the companies studied, the smallest percentage of nationality diversity was 8.3% of the total directors. The maximum value of 0.929 was owned by the Fraser & Neave Holdings Company in 2019, which means that 92.9% of the total directors of the Fraser & Neave Holdings Company are foreign directors. The average value of the board nationality diversity variable is 0.2751, meaning that on average, the companies studied in this research have 27.51% foreign directors. A standard deviation value of 0.150 illustrates that the percentage distribution of board nationality diversity is between 12.51% and 42.51%.

Firm size (FIRMSIZE) has a minimum value of ln 20.513 (USD 81,0000,000.00), meaning that the smallest company size, which is described by the company's total assets, is USD 81,000,000.00 owned by Fraser & Neave Holdings in 2018. The maximum value is ln 27.041 (USD 554,462,594,167.00), meaning that the largest company size of USD 554,462,594,167.00 will be owned by the DBS Group Holdings company in 2022. The average value of the firm size variable is ln 23.312 (USD 51,438,234,719.81), depicting the average size of the companies studied having total assets of USD 51,438,234,719.81. The standard deviation value is ln 1.601, which means that the data distribution is between ln 21.711 and ln 24.913.

The environmental committee (ENVICOM) is present in 182 companies (86.7%), meaning that the majority of companies have environmental committees in their organizational structure, while there are 28 samples of companies that have environmental committees (13.1%). From these results, it can be concluded that there are more companies listed in the FTSE4Good ASEAN index during 2018-2022 that have an environmental committee compared to companies that do not have an environmental committee.

The industry type (INDUSTRY) variable showed that the majority of companies were not included in the extractive industry, namely 175 samples (83.3%), while the companies included in the extractive industry were 35 samples (16.7%). From these results, it can be concluded that fewer companies listed in the FTSE4Good ASEAN Index for the 2018-2022 period are included in the extractive industry compared to companies that are not included in the extractive industry.

4.3 Classical Assumptions Test

4.3.1 Normality test (Kolmogorov-Smirnov test)

The result of the normality test is shown in Table 4. The asymptotic significance, or p-value, is 0.200, meaning that it's greater than 0.05. Therefore, it can be concluded that the data have a normal distribution, and the normality assumption is met.

4.3.2 Multicollinearity test

Table 5 shows that the independent variables, together with the control variables, have VIF values less than 10, therefore it can be concluded that the independent variables are not significantly correlated with each other. The results of this test show that the data analyzed meets the multicollinearity assumption.

4.3.3 Heteroscedasticity test (Glejser test)

Table 6 indicates that all variables have a significance value greater than 0.05, so it can be concluded that heteroscedasticity does not occur. The results show that the analyzed data meets the heteroscedasticity assumption.

4.3.4 Autocorrelation test (Durbin-Watson test)

The purpose of the autocorrelation test is to obtain information on whether the model is missing its key variables. The Durbin-Watson test is a common method to detect the presence of autocorrelation. The Durbin-Watson value from the autocorrelation test in Table 7 is 1.970, using 5 variables and a sample size of 210. The Durbin-Watson value falls in the area of dU (1.820) and 4-dU (2.180), so it can be inferred that the data used in this study are free from autocorrelation. This conclusion means that the model is not missing some key variables.

Table 4. Normality test

Variables	Significance	Conclusion
Asymp. (2-tailed)	0.200	Data are normally distributed

Table 5. Multicollinearity test

Variables	VIF	Conclusion
WOB	1.193	Multicollinearity is nonexistent
BOARNAT	1.063	Multicollinearity is nonexistent
ENVICOM	1.116	Multicollinearity is nonexistent
INDUSTRY	1.143	Multicollinearity is nonexistent
FIRMSIZE	1.173	Multicollinearity is nonexistent

Table 6. Heteroscedasticity test

Variables	Significance	Conclusion
WOB	0.884	Heteroscedasticity is nonexistent
BOARNAT	0.816	Heteroscedasticity is nonexistent
ENVICOM	0.084	Heteroscedasticity is nonexistent
INDUSTRY	0.851	Heteroscedasticity is nonexistent
FIRMSIZE	0.442	Heteroscedasticity is nonexistent

Table 7. Autocorrelation test

N	K	dL	dU	4 − dU	4 − dL	DW	Conclusion
210	51	1.718	1.820	2.180	2.282	1.970	There is no autocorrelation

4.4 Hypotheses Test

$$\text{CED} = 0.039 - 0.035\text{WOB} + 0.263\text{BOARNAT} + 0.302\text{ENVICOM} + 0.037\text{INDUSTRY} + 0.013\ \text{FIRMSIZE} \tag{2}$$

The regression model is written in Eq. (2). From Table 8, the value of adjusted R^2 is 0.303, or 30.3%. This number indicates that the dependent variable can be explained by the independent variables and control variables, with a value of 30.3%. The F test result shows that its value (0.000) is smaller than 0.005, which means that all independent variables simultaneously affect the carbon emission disclosure. The t-test result shows the following relationship between each independent variable and the dependent variable:

Table 8. Hypotheses test

Variables	Prediction	B	Significance (one-tailed)	Conclusion
Constant		0.039	0.422	
WOB	+	-0.035	0.376	H_1 Rejected
BOARNAT	+	0.263	0.001	H_2 Accepted
ENVICOM	+	0.302	0.000	H_3 Accepted
INDUSTRY	+	0.037	0.136	
FIRMSIZE	+	0.013	0.052	
Adjusted R^2			0.303	
F Test		0.303	0.000	

4.4.1 WOB has a negative effect on carbon emission disclosure

Table 8 shows the p-value for the women on boards variable is -0.035, meaning if there's an increase of one point for the women on boards variable, it will decrease the value of carbon emission disclosure by 0.035. The p-value of 0.035 is also less than 0.05, meaning that the hypothesis for this variable is rejected.

4.4.2 Board nationality diversity has a positive effect on carbon emission disclosure

Table 8 shows the p-value for the board nationality diversity variable is 0.263, meaning if there's an increase of one point for the board nationality diversity variable, it will increase the value of carbon emission disclosure by 0.263. The p-value of 0.263 is also greater than 0.05, meaning that the hypothesis for this variable is accepted.

4.4.3 The presence of an environmental committee has a positive effect on carbon emission disclosure

Table 8 shows the p-value for the presence of an environmental committee variable is 0.302, meaning that if there's an increase of one point in the presence of the environmental committee variable, it will increase the value of carbon emission disclosure by 0.302. The p-value of 0.302 is also greater than 0.05, meaning that the hypothesis for this variable is accepted.

5 Discussion

5.1 WOB on Carbon Emission Disclosure

This paper finds that WOB negatively affects carbon emission disclosure. This finding aligns with the studies by Gallego-Álvarez and Pucheta-Martínez [13] and Husted and Sousa-Filho [9]. The possible explanation for this might be that the countries analyzed are mostly developing or emerging countries. Previous studies have been done in developing countries, with samples having just one or two women members on the board structure, meaning that men still dominate the decision-making process and women, as the minority group, cannot influence the decision-making on CSR or various other topics. Developing countries also have different contexts, rules, regulations, and cultures compared to developed countries, and this may result in the relationship between WOB not always showing a positive sign as proposed by stakeholder theory [13]. It is worth noting that there might be better theories or methodologies to explain the negative effect of WOB and carbon emission disclosure. For example, instead of using the ratio of women directors, it is also possible to use a dummy variable, where if the percentage of women directors is less than 50%, then it takes the value 0, and if it is more than 50%, then the value would be 1.

5.2 Board Nationality Diversity on Carbon Emission Disclosure

The positive result of board nationality diversity and carbon emission disclosure is in accordance with prior studies by Khan et al. [5] that show positive results of nationality diversity on the quality of carbon emission disclosure and Harjoto et al. [18], which find board nationality positively affects CSR performance. A board of directors consisting of foreign directors with backgrounds from different countries has additional in-depth knowledge on the global scale in the institutions and markets sectors, which can strengthen the team's ability to inspect and explain the available global information, predict and prevent potential problems, and implement an effective global knowledge sourcing strategy. This empirical finding is in accordance with the resource dependency theory, which explains how companies will appoint directors who can maximize access to valuable resources needed by companies by utilizing directors' broad perspectives. However, other scenarios might happen where the nationality diversity among board members does not lead to improved carbon emission disclosure due to the higher communication barrier and cultural differences. This will be interesting to explore in further research.

5.3 The Presence of an Environmental Committee on Carbon Emission Disclosure

The positive result is in line with the findings from Gerged et al. [10], who show a positive relationship between the existence of an environmental committee and corporate environmental disclosure, and Biswas et al. [6], who found a positive association between the sustainability committee and social and environmental performance. The environmental committee has the responsibility to ensure that the company's operational system has as little impact as possible on the environment. In addition, the environmental committee also has responsibility for managing environmental risks from company activities. The existence of an environmental committee in the company's structure shows its seriousness and commitment to reducing the environmental impact of its business operations. This means that the presence of an environmental committee helps companies navigate every business decision in terms of its environmental impact, from the early stage, where the business decision is still being discussed, until the final stage, where the business decision is already being taken. This result aligns with the legitimacy theory, which states that companies need to gain legitimacy or recognition in society so that they can survive in the long term.

6 Conclusions

Based on the empirical findings from previous sections, board nationality diversity and the presence of an environmental committee positively affect carbon emission disclosure, while WOB show a negative effect. This research used three main theories to explain the association between independent and dependent variables: 1) legitimacy theory, 2) resource dependency theory, and 3) stakeholder theory. Legitimacy theory helps in explaining the positive relationship between the presence of environmental committees and carbon emission disclosure. Resource dependency theory supports the positive relationship between board nationality diversity and carbon emission

disclosure. However, stakeholder theory was unable to analyze the negative results of the relationship between WOB and carbon emission disclosure. The possible explanation for this phenomenon might be that the majority of the companies analyzed are coming from developing countries, where the board structure is still dominated by male directors. Several other theories might better explain the relationship between WOB and carbon emission disclosure, such as socialization theory, social role theory, resource dependency theory, agency theory, etc.

These findings have several implications: 1) Theoretical implication, which can provide various perspectives for future research, with a specific concern on how diversity and inclusivity affect carbon emission disclosure; 2) Practical implications for investors, governments, management, CSOs, and general populations. Investors can consider non-financial aspects as a concrete action to reduce the impact of climate change by carefully analyzing the company's efforts in ESG aspects. Governments can improve the existing regulations by learning from different countries, with a special focus on Southeast Asia. Managers can learn and implement the strategy that has been used by companies with high carbon emission disclosures. CSOs and the general population can also learn about various actions that can reduce the impact of the climate crisis and oversee the company's efforts to minimize pollution from business practices.

This paper has several limitations that have the potential to be explored for research in the future: 1) The period of this study is limited to only 5 years, and the companies analyzed are those listed on the FTSE4Good ASEAN Index 2023, so we recommend future research broaden the period and include companies outside of this index to gain more insights from countries that are not part of the index. This is interesting to explore, specifically for non-ASEAN members, to see if there are any differences in the disclosure of carbon emissions, whether it's the quality or the number of items disclosed; 2) The companies listed on the FTSE4Good ASEAN Index 2023 consisted of several sectors, and it would be interesting to see if the comparison between different sectors could produce the same result in terms of quality and number of disclosed items, as we know that extractive industries face more pressure to develop ways to reduce their emissions; 3) Various studies use different measurements in calculating the same variables, so we suggest future research look further into these differences; 4) We acknowledge that the origin country of the foreign director has characteristics related to sensitivity to the environment, and they can be explored using one of the indices, such as the Environmental Performance Index; 5) The adjusted R^2 value in this study is still 30.3%. We suggest future research consider other factors to find the other 69.7% of variables that influence carbon emission disclosure, for example, media exposure, profitability, independent directors, capital expenditures, or others.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Acknowledgements

The authors would extend our gratitude to the parties involved in the process of preparing this paper and to the reviewers who provided valuable constructive suggestions for this paper.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] IPCC, "Climate change 2013: The physical science basis," in *Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2013.

[2] A. Al Fadli, J. Sands, G. Jones, C. Beattie, and D. Pensiero, "Board gender diversity and CSR reporting: Evidence from Jordan," *Australas. Account. Bus. Finance J.*, vol. 13, no. 3, pp. 29–52, 2019. https://doi.org/10.14453/aabfj.v13i3.3

[3] S. Wasiuzzaman and W. M. Mohammad, "Board gender diversity and transparency of environmental, social, and governance disclosure: Evidence from Malaysia," *Manag. Decis. Econ.*, vol. 41, no. 1, pp. 145–156, 2019. https://doi.org/10.1002/mde.3099

[4] M. Kılıç and C. Kuzey, "The effect of corporate governance on carbon emission disclosure," *Int. J. Clim. Change Strat. Manag.*, vol. 11, no. 1, 2018. https://doi.org/10.1108/IJCCSM-07-2017-0144

[5] I. Khan, I. Khan, and M. A. Afridi, "Does board diversity matter for the quality of CSR disclosure? evidence from the financial sector of Pakistan," *Rev. Bras. Gest. Neg.*, vol. 23, no. 1, pp. 104–126, 2021. https://doi.org/10.7819/rbgn.v23i1.4091

[6] P. K. Biswas, M. Mansi, and R. Pandey, "Board composition, sustainability committee and corporate social and environmental performance in Australia," *Pac. Account. Rev.*, vol. 30, no. 4, pp. 517–540, 2018. https://doi.org/10.1108/PAR-12-2017-0107

[7] M. Kılıç, A. Uyar, C. Kuzey, and A. S. Karaman, "Drivers and consequences of sustainability committee existence? Evidence from the hospitality and tourism industry," *Int. J. Hosp. Manag.*, vol. 92, p. 102753, 2021. https://doi.org/10.1016/j.ijhm.2020.102753

[8] M. H. Elmagrhi, C. G. Ntim, and A. A. Elamer, "A study of environmental policies and regulations, governance structures, and environmental performance: The role of female directors," *Bus. Strat. Environ.*, vol. 28, no. 1, pp. 206–220, 2018. https://doi.org/10.1002/bse.2250

[9] B. W. Husted and J. M. Sousa-Filho, "Board structure and environmental, social, and governance disclosure in Latin America," *J. Bus. Res.*, vol. 102, pp. 220–227, 2018. https://doi.org/10.1016/j.jbusres.2018.01.017

[10] A. M. Gerged, A. M. Chijoke-Mgbame, R. Konadu, and C. J. Cowton, "Does the presence of an environmental committee strengthen the impact of board gender diversity on corporate environmental disclosure? Evidence from sub-Saharan Africa," *Bus. Strat. Env.*, vol. 32, no. 4, pp. 2434–2450, 2022. https://doi.org/10.1002/bse.3257

[11] M. D. C. V. Martinez, J. M. Santos-Jaén, R. S. Roman, and P. A. Martin-Cervantes, "Are gender and cultural diversities on board related to corporate CO_2 emissions?" *J. Clean. Prod.*, vol. 363, p. 132638, 2022.

[12] J. J. Cordeiro, G. Profumo, and I. Tutore, "Board gender diversity and corporate environmental performance: The moderating role of family and dual-class majority ownership structure," *Bus. Strat. Env.*, vol. 29, no. 3, pp. 1127–1144, 2020. https://doi.org/10.1002/bse.2421

[13] I. Gallego-Álvarez and M. C. Pucheta-Martínez, "Corporate social responsibility reporting and corporate governance mechanisms: An international outlook from emerging countries," *Bus. Strat. Dev.*, vol. 3, no. 1, pp. 77–97, 2019. https://doi.org/10.1002/bsd2.80

[14] I. Tingbani, L. Chithambo, V. Tauringana, and N. Papanikolaou, "Board gender diversity, environmental committee and greenhouse gas voluntary disclosures," *Bus. Strat. Env.*, vol. 29, no. 6, pp. 2194–2210, 2020. https://doi.org/10.1002/bse.2495

[15] H. Gonenc and A. V. Krasnikova, "Board gender diversity and voluntary carbon emission disclosure," *Sustainability*, vol. 14, no. 21, p. 14418, 2022. https://doi.org/10.3390/su142114418

[16] B. B. Choi, D. Lee, and J. Psaros, "An analysis of Australian company carbon emission disclosures," *Pac. Account. Rev.*, vol. 25, no. 1, pp. 58–79, 2013. https://doi.org/10.1108/01140581311318968

[17] "FTSE4Good ASEAN 5 index 2023," 2023. https://research.ftserussell.com/Analytics/FactSheets/Home/DownloadSingleIssue?issueName=F4GAS&isManual=False

[18] M. A. Harjoto, I. Laksamana, and Y. W. Yang, "Board diversity and corporate investment oversight," *J. Bus. Res.*, vol. 90, pp. 40–47, 2018. https://doi.org/10.1016/j.jbusres.2018.04.033