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DETERMINANTS OF ESG DISCLOSURE IN ASEAN-5 COUNTRIES: A LEGITIMACY AND INSTITUTIONAL THEORY APPROACH

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Abstract**:** *ESG disclosure among basic materials firms in the ASEAN-5 countries remains uneven, with notable implementation gaps. Drawing on legitimacy and institutional theories, this study employs moderated regression analysis on 185 firms from a population of 2.110 during 2019–2023 to identify key determinants of ESG reporting. Results reveal that carbon emission intensity and product disclosure. Results show that higher carbon emission intensity leads to greater ESG disclosure, suggesting firms seek legitimacy by providing extensive ESG information despite higher emissions. Firms with more diversified products also exhibit higher ESG disclosure, as complexity requires transparency to manage environmental and social risks. Contrary to expectations, business environmental uncertainty does not significantly influence ESG disclosure, supporting contingency theory's view that no single strategy fits all firms in navigating uncertainty. Geographic location negatively affects ESG disclosure, highlighting resource constraints and underdeveloped ESG infrastructure, particularly in Indonesia. Gender diversity significantly moderates the effects of environmental uncertainty and geographic location, strengthening their impact on ESG disclosure. However, its interaction with carbon emission intensity and product diversification is not significant. These findings deepen understanding of the institutional and legitimacy factors influencing ESG disclosure in emerging markets.*

Keywords : ESG Disclosure, Carbon Emission, Product Diversification, Business Environmental Uncertainty, Geographic Location

INTRODUCTION

The concept of Environmental, Social, and Governance (ESG) has emerged globally since the introduction of the Sustainable Development Goals (SDGs) by the United Nations in 2015, attracting significant attention from various stakeholders (Thammaraksa et al., 2024). In response to these global developments and rapid and uncertain economic growth, ASEAN countries have begun to adopt ESG disclosure as part of their regulatory frameworks, highlighting their growing commitment to sustainable and responsible business conduct. For instance, Malaysia issued ESG-related regulations for public companies in 2015, followed by Singapore, Thailand, and Indonesia in 2017, and the Philippines in 2019 (Irianingsih et al., 2024). Nevertheless, despite many companies reporting their commitment to ESG, a significant number have yet to fully implement these principles in their business operations.

One notable example in Indonesia is PT Indonesia Morowali Industrial Park (IMIP), a nickel industrial area located in Central Sulawesi, which recorded approximately 300 workplace accidents and 31 fatalities between 2023 and 2024 (Ikhlasi, 2025). This case highlights the company's limitations in effectively managing its corporate

governance responsibilities, as PT IMIP violated Article 86 of Indonesia Manpower Law No. 13 of 2003, which mandates employers to ensure occupational safety and health protection for workers (Fadila et al., 2024). Furthermore, mining companies in the Philippines have shown a lack of compliance with the social aspect that threatens human rights. In Cotabato, several Indigenous communities have been protesting mining projects on their ancestral lands for decades. This issue received more attention in 2017 when a well-known leader who opposed coal mining was killed due to their action. These protests continued until 2019, when the Philippines was named the world's deadliest country for environmental defenders (Delina, 2021).

This study focuses on the five largest capital market economies in Southeast Asia, referred to as ASEAN-5, which include Indonesia, Malaysia, Singapore, Thailand, and the Philippines. However, with the exception of Singapore, all ASEAN-5 countries scored below the global average on the Corruption Perceptions Index (CPI) from 2019 to 2023, indicating persistent weaknesses in governance that can lead to weak enforcement of environmental regulations, particularly in the basic materials sector (Wongsaen et al., 2023). Consequently, this sector has become a major contributor to global CO_2 emissions, accelerating climate change. Although there is growing evidence of a gap between ESG disclosure and the actual implementation of its underlying principles, the determinants of successful ESG disclosure remain a subject of ongoing debate. Previous studies have explored the key factors of ESG performance primarily from the perspectives of financial performance, investment behaviour, and institutional models (Martinez Meyers et al., 2024; Menicucci & Paolucci, 2024; Sun & Zhao, 2024). However, there remains a gap in the literature regarding the factors that drive ESG success, particularly in terms of firms' nature and strategies, including their environmental strategies on carbon emissions, product diversification, risk management in the face of business uncertainty, and geographic location.

This study provides a novel perspective on the determinants of ESG disclosure by drawing on legitimacy and institutional theories. According to legitimacy theory, companies with high carbon emission intensities often face intense scrutiny from stakeholders, prompting them to disclose ESG information to maintain their social legitimacy (Crossley et al., 2021; Emma et al., 2024). Institutional theory suggests that firms adapt their practices to comply with institutional pressures from regulators, industry standards, and societal norms through isomorphic tendencies (Gupta & Gupta, 2025; Gupta & Gupta, 2021). This explains why companies with broader product diversification, those operating under high business environmental uncertainty, or those located in distinct geographic regions may engage in ESG disclosure to enhance legitimacy, reduce institutional friction, and maintain competitiveness in their respective environments (Guo et al., 2024; Jongsma & Pennink, 2020).

Although there is still limited research that directly examines the effect of carbon emissions on ESG disclosure, existing evidence suggests a positive relationship between ESG disclosure and carbon emissions (Treepongkaruna et al., 2024). Additionally, according to Patrisia & Dastgir (2017), product diversification also plays a role in influencing firms' CSR-related performance. A study conducted by Vural-Yavaş (2021) shows that European firms perceive uncertainties as pressures that drive the enhancement of their sustainability disclosure capabilities. Furthermore, as a country-level factor, the carbon emission level of a region influences firms' ESG information reporting (Banerjee et al., 2019). However, inconsistencies in the findings have been observed in several studies. While carbon emissions, business environmental uncertainty, and diversification of geographic location are generally considered to have a positive influence on ESG disclosure, studies conducted by Baratta et al. (2023), Bin-Feng et al. (2024), and Wan (2023) reported contrasting results. A similar finding was noted by Liu (2022), who found that product diversification has no positive impact on ESG disclosure.

To address the inconsencies found in previous studies, this study introduces corporate governance, represented by board gender diversity, as a moderating variable. Empirical studies by Kusuma et al. (2018) and Kusuma et al. (2021) on the direct effect of board gender diversity on firm performance report either a significant negative impact or no significant relationship, underscoring its inconsistent influence that varies by context. Although board gender diversity has frequently been examined as a direct determinant of ESG disclosure, its role as a moderating factor remains relatively unexplored (Briano-Turrent, 2022; Chebbi & Ammer, 2022; Konadu et al., 2022). This limited perspective presents an opportunity for this study to offer novelty by investigating how board-gender diversity amplifies the relationship between key influencing factors and ESG disclosure outcomes. Overall, this study aims to make a significant contribution by filling the gap in the existing research on the determinants of ESG disclosure, particularly in the basic materials sector across ASEAN-5 countries.

THEORETICAL FRAMEWORK AND HYPOTHESES

Legitimacy Theory

Legitimacy theory suggests that an organisation cannot endure and garner support unless it can maintain its reputation as a successful and sustainable organisation in the eyes of stakeholders or society. It was initially introduced in 1975, as it can be seen as a source of advantages that help businesses survive. A common strategy adopted by companies to gain legitimacy is the disclosure of sustainability reports. This is validated by several studies examining the relationship between sustainability and environmental disclosure, which have revealed that businesses with high environmental impact frequently disclose their environmental information to gain acceptance in the public community (Crossley et al., 2021). Other studies suggest that the voluntary disclosure of a company's non-financial reports is positively associated with its efforts to gain legitimacy in the eyes of stakeholders (Rosser et al., 2022). An appropriate disclosure represents business practices deemed acceptable by society. According to Emma et al. (2024), there is a sort of "social contract" between an organisation and the society in which it operates. This term outlines the company's standards for how they should act in alignment with societal values and expectations. Therefore, in line with this concept, this study adopts legitimacy theory to support its hypotheses.

Institutional Theory

According to this theory, three main institutional mechanisms can be associated with sustainability reporting practices in organisations: coercive, normative, and mimetic. These mechanisms are explained by the concept of isomorphism, which refers to a constraining process that drives one entity within a population to resemble others facing similar environmental conditions (Duan et al., 2025; Posadas et al., 2022). Coercive isomorphism stems from political influence and legitimacy pressure. Normative isomorphism is often linked to professionalism, whereas mimetic isomorphism arises as a standard response to uncertainties. Following this theory, organizations operating under similar circumstances, such as regulatory environments, external pressures, or levels of uncertainty, tend to adopt similar behaviors to remain competitive and gain legitimacy (Gupta & Gupta, 2021). In addition, according to Vural-Yavaş (2021), higher institutional ownership can reduce information asymmetry as it is perceived as an effective control mechanism. In line with this theoretical perspective, sustainability disclosures may be influenced by the similarity of the business environments faced by firms, which will be further explored in the following sections.

Carbon Emission Intensity

Climate change and environmental awareness have become increasingly global concerns, marked by numerous campaigns and concrete actions in various sectors. Carbon emissions are one of the most significant drivers of climate change and a major contributor to current environmental issues. According to Chukwuemeka et al. (2024), carbon emissions account for approximately 75% of climate change, particularly from fossil fuels such as coal, oil, and gas. In developing countries, the increase in carbon emissions is often associated with economic growth driven by limited access to clean technologies and financial constraints in transitioning to renewable energy (Yang & Hei, 2024). Nevertheless, efforts to decarbonise have gradually been implemented, as evidenced by the introduction of various environmental policies that require companies to disclose environmental information in sustainability reports. Several studies have shown that carbon emissions are key indicators within the ESG framework, reflecting the extent to which a company is accountable for the ecological impact of its operations (Wedari et al., 2021; Wu & Memon, 2022; Adu et al., 2023; Treepongkaruna et al., 2024).

Legitimacy theory explains that organisations seek to align their operations with societal norms and expectations to maintain their legitimacy. Firms associated with high carbon emissions may face increased scrutiny from the public, investors and regulators. In response, these firms may be more motivated to transparently disclose environmental information to justify their operations and maintain legitimacy in the eyes of the public (Wedari et al., 2021). Therefore, examining the relationship between carbon emissions and ESG disclosure is particularly important in developing regions such as ASEAN-5, where countries strive to balance economic growth with environmental sustainability. Thus, based on the above discussion, the following hypothesis is proposed:

H1: Higher levels of carbon emissions are associated with greater ESG disclosure

Product Diversification

One of the strategic approaches adopted by companies to manage their operations is to segment their businesses into various lines through diversification. The concept of diversification was first studied in 1994 and was classified into related, unrelated, and total diversifications. Related diversification refers to business segments aligned with the company's core activities, whereas unrelated diversification involves business activities entirely different from the firm's primary operations. This strategy aims to expand the scale and scope of economics by enabling firms to share and leverage resources, operational potency, physical and informational assets, and

corporate reputation across various business segments (Kretschmer & Symeou, 2024). It is often employed to spread risk or capitalise on potential opportunities in new markets. Companies with high business complexity tend to have a broader impact on society. Furthermore, several studies suggest that product diversification significantly influences business performance, as diversification strategies can affect corporate governance, organizational structure, and the complexity of information disclosure (Fatmawati & Hariyana, 2024; King'ori et al., 2024).

According to institutional theory, companies operating across multiple segments and markets are exposed to a wider range of institutional pressures with distinct environmental and social expectations (Brower & Dacin, 2020; Risi et al., 2023). To respond to these heterogeneous pressures, firms with diversified business segments achieve better ESG scores (Barros et al. 2024). Moreover, according to Lin & Kim (2020), diversified firms tend to operate in complex organizational structures, which increases their visibility and vulnerability. Consequently, they are more likely to practice ESG reporting to demonstrate their alignment with normative and regulatory expectations across different sectors and jurisdictions. Therefore, we propose the following hypothesis:

H2: The more diversified product performs higher ESG disclosure

Business Environmental Uncertainty

Uncertainty refers to situations in which probabilities are unpredictable, making it difficult to accurately assess risks and affecting expert decision-making in various business operations. Numerous factors, including variations in supplier dynamics, legislative changes, technical breakthroughs, and market demand, contribute to the unpredictability of company value. High uncertainty challenges a firm's ability to maintain long-term sustainability commitments, making it a key determinant of ESG performance (Vilchez et al., 2017). Uncertainty can also drive proactive ESG strategies as firms adapt to regulatory changes, market fluctuations, and stakeholder expectations by integrating sustainability into their operations. This adaptive approach enhances ESG performance through resource efficiency, risk mitigation, and long-term value creation, fostering stronger environmental stewardship, social responsibility, and ethical governance (Alandejani & Al-Shaer, 2023; Skandera et al., 2023).

As elaborated in institutional theory, business uncertainty has a positive relationship with ESG performance by emphasising a firm's responsibility to address shifting societal expectations from regulators, regulatory frameworks and stakeholder demands. This concept is also associated with a strategy in which companies adopt proactive ESG reporting not only to comply but also to secure legitimacy and maintain their social licence to operate. In the context of institutional theory, mimetic isomorphism suggests that organisations seek stability and legitimacy in response to external uncertainty, often by mirroring the practices of leading firms and adhering to emerging norms. This implies that greater transparency is institutionalised as a reflection of resilience and strategic foresight. Thus, this study aimed to test the following hypothesis:

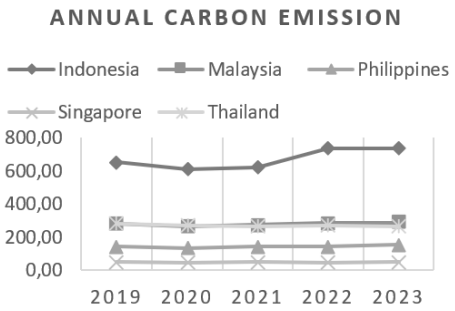
H3: Firms operating under high business environment uncertainty tend to disclose more ESG information.

Firms' Geographic Location

Following Hmouda et al. (2024), high-carbon-emission areas tend to demonstrate stronger ESG commitment because of increased regulatory scrutiny and stakeholder pressure. Their study highlighted North America as the largest contributor of carbon emissions among the rest of the world, such as the Asia-Pacific, Europe and South America. Additionally, spatial spillover effects in regions with stringent environmental policies and high pollution levels encourage firms to enhance their ESG practices through capital mobility, technological diffusion and labour shifts (Yang & Hei, 2024). Moreover, studies examining the determinants of ESG disclosure across different regions have yielded inconsistent results (David et al., 2024; P. C. Jiang, 2024). This may be attributed to variations in institutional isomorphism among countries, which influence how firms respond to environmental pressures and disclosure norms. The limited number of studies focusing on ASEAN-5 countries encourages this research, particularly by highlighting the high carbon emissions produced by Indonesia over the past few years, based on the data provided by the Our World in Data platform.

Based on the data, Indonesia has consistently been the highest contributor to carbon emissions among the ASEAN-5 countries from 2019 to 2023. Furthermore, Indonesia holds a dominant position in the basic material sector. According to Laksono & Putri (2024), Indonesia is the fifth largest coal producer in the world, following China, the United States, India, and Australia, with an annual production of more than 500 billion tons. This industrial dominance, coupled with its environmental impact, places Indonesian firms under greater scrutiny and pressure to improve ESG transparency and accountability. In this context, and in line with institutional theory, firms operating in regions with high carbon emission levels, such as Indonesia, are assumed to exhibit higher ESG ratings. This is primarily due to the tendency of firms to meet the rising expectations of stakeholders. Based on the above discussion, the following hypothesis is proposed:

H4: Firms headquartered in Indonesia have high ESG scores.



Source: Compiled and processed from Our World in Data (2024)

Figure 1. Annual Carbon Emission in the ASEAN-5 Countries from 2019-2023

Gender Diversity

Board gender diversity has garnered increasing attention in corporate governance literature, particularly for its role in enhancing transparency, independence, and ethical decision-making. The presence of female directors on corporate boards is believed to contribute to greater board independence, diverse perspectives, and enhanced oversight, all of which are crucial for driving responsible business conduct. Several studies have demonstrated a positive association between gender-diverse boards and ESG-related outcomes (Lu & Herremans, 2019; Odriozola et al., 2024; Romano et al., 2020). According to institutional theory, firms face three external pressures–coercive, normative, and mimetic–that push them to comply with regulations, norms, and best practices. Moreover, legitimacy theory explains how board gender diversification acts to maintain "legitimacy" under such pressures. It is also recognised as a strategic driver of sustainable development, as reflected in the United Nations SDGs 5, which points out Gender Equality (Merma-Molina et al., 2024). Thus, improving board gender diversity aligns with good governance practices and supports broader global development goals.

In contexts where firms are subject to environmental pressure, stakeholder expectations, or institutional uncertainty, female directors are often associated with greater environmental and social awareness (Barroso et al., 2024; Dutordoir et al., 2024; Gavana et al., 2024). Drawing on institutional and legitimacy theories, board gender diversity is a strategic governance tool that helps firms maintain their social licences to operate by responding to external pressures tied to each ESG-relevant driver. First, under coercive pressure from regulators and stakeholders focused on carbon emission intensity, gender-diverse boards may improve control and encourage the promotion of transparent ESG reports. Second, facing normative pressures arising from certain standards on product diversification, board gender diversity may support better communication on how the firm expands its business sustainably through ESG disclosure. Third, in uncertain business environments, where firms may follow others in how they report ESG, having a more diverse board can help bring about different perspectives to improve decision-making. Finally, in areas with high carbon emissions, producers may have stricter environmental rules; thus, gender diversity on boards can help companies build trust and show that they are committed to responsible and transparent ESG practices. Given this theoretical support, investigating the moderating effect of female board representation provides a novel perspective on how internal governance structures interact with external environmental and strategic factors to influence the ESG transparency. Thus, the following hypothesis is proposed:

H5: Board gender diversity amplifies the relationship between carbon emission and ESG disclosure

H6: Board gender diversity amplifies the relationship between product diversification and ESG disclosure

H7: Board gender diversity amplifies the relationship between business environmental uncertainty and ESG disclosure

H8: Board gender diversity amplifies the relationship between geographic location and ESG disclosure

RESEARCH METHODS

Population and Sample

This study aims to impact corporate strategies for enhancing ESG disclosure, influenced by carbon emissions, product diversification, business environmental uncertainty, and geographic location, moderated by board gender diversity. The sample in this study comprises basic materials sector companies listed on the stock exchanges of the ASEAN-5 countries, including Indonesia, Malaysia, Singapore, Thailand, and the Philippines, from 2019 to 2023. From the total population of 2.110 companies listed on the country's stock exchange, 185 samples were obtained, as shown in Table 1.

Table 1. Sample Criteria

No.	Sample Criteria	Companies Excluded	Remaining Companies
1.	Basic materials sector companies listed on the stock exchange in ASEAN-5 countries for the period 2019 – 2023		
	a. Indonesia Stock Exchange (IDX)		515
	b. Bursa Malaysia (BM)		700
	c. Singapore Exchange (SGX)		540
	d. Stock Exchange of Thailand (SET)		185
	e. Philippine Stock Exchange (PSE)		170
	Total		2.110
2.	Basic materials sector companies that have ESG Disclosure Score data available on Bloomberg and published both annual reports and sustainability reports consistently for the period 2019 – 2023	(1.925)	185

Source: Data Processing

Variables and Measurements

In this study, ESG disclosure served as the explained variable, which was obtained from the Bloomberg database. Following Romano et al. (2020), a higher score indicates better ESG disclosure performance. This finding was further examined using four variables. First, carbon emission intensity is manually proxied by dividing the total carbon dioxide equivalent (CO_2 eq) emissions by the company's total revenue, following the approach adopted in prior studies (Treepongkaruna et al., 2024). Second, product diversification is measured using the sales data of each business segment, which are calculated using the Herfindahl-Hirschman Index (HHI) formula (Barros et al., 2024). The calculation involves summing the squared proportions of each business segment's sales relative to the firm's total sales. The HHI value ranges between 0 and 1, where a lower score (closer to 0) indicates a higher degree of business diversification, and vice versa. The HHI is expressed as follows:

$$HHI = \sum_{i=1}^{n} \left(\frac{S_i}{S_t}\right)^2 \quad (1)$$

Third, business uncertainty, which originates from external conditions that impact core business activities, is reflected in fluctuations in sales revenue. This variable is measured by a firm's sales trend based on a five-year time-series regression of sales (Guo et al., 2024). The sales trend regression is represented by the following equation:

$$Sales = \varphi_0 + \varphi_1 Year + \varepsilon_1 \quad (2)$$

In this model, sales represent annual operating income or revenue, enabling the computation of the standard deviation of abnormal income to indicate the uncertainty. Specifically, the standard deviation of the regression residuals divided by the five-year average operating income serves as a measure of business environmental uncertainty. Fourth, geographic location was determined using a binary classification: companies operating in Indonesia were assigned a score of 1, whereas those in other countries received a score of 0 (Malini, 2024). This coding reflects Indonesia's status as a major carbon emitter among the ASEAN-5 countries (Hmouda et al., 2024). Additionally, board gender diversity acts as a moderating variable, measured by the proportion of female board members to the total number of board members, following the approach used in prior studies (Chebbi & Ammer, 2022).

Data Analysis Methods

This study employs two regression models to analyse the data. First, a multiple regression model was used to estimate the direct impact of carbon emission intensity, product diversification, business environmental uncertainty, and geographic location on ESG disclosure. This model captures the effect of each independent variable on ESG disclosure without introducing any additional variables. Second, to assess how board gender diversity amplifies this relationship, moderated regression analysis was conducted. It incorporates the interaction terms between gender diversity and each ESG disclosure predictor. The equations for these models are as follows:

$$ESG_{it} = \beta_0 + \beta_1 CI_{it} + \beta_2 PD_{it} + \beta_3 BEU_{it} + \beta_4 GEO_{it} + \varepsilon_{it} \quad (3)$$

$$ESG_{it} = \beta_0 + \beta_1 CI_{it} + \beta_2 PD_{it} + \beta_3 BEU_{it} + \beta_4 GEO_{it} + \beta_5 GD_{it} + \beta_6 (CI_{it} \times GD_{it}) + \beta_7 (PD_{it} \times GD_{it}) + \beta_8 (BEU_{it} \times GD_{it}) + \beta_9 (GEO_{it} \times GD_{it}) + \varepsilon_{it} \quad (4)$$

Table 2. Summary of the Operational Variables

Type of Variable	Name	Symbol	Measurement	Source
Explained	ESG Disclosure	ESG	ESG disclosure score from Bloomberg database	(Gavana et al., 2024; Romano et al., 2020)
Explanatory	Carbon Emission Intensity	CI	Total of CO_2 emission divided by Revenue	(Treepongkaruna et al., 2024)
	Product Diversification	PD	Calculated with HHI	(Barros et al., 2024; Patrisia & Dastgir, 2017)
	Business Environmental Uncertainty	BEU	Standard deviation of sales trend regression divided by the average of sales	(Bin-Feng et al., 2024; Guo et al., 2024; L. Jiang et al., 2025)
	Geographic Location	GEO	Assign a value of 1 if the company is headquartered in Inonesia and rest of them 0	(Hmouda et al., 2024; Malini, 2024)
Moderating	Gender Diversity	GD	The number of female board members divided by the total number of board members	(Chebbi & Ammer, 2022; Romano et al., 2020)

Source: Data Processing

Regression analysis was conducted using IBM SPSS 26, a statistical software designed for interpreting both main and interaction effects, allowing for a comprehensive understanding of the moderating role of board-gender diversity on ESG disclosure. To be used, the data must first pass classical assumption tests, namely normality, multicollinearity, heteroskedasticity, and autocorrelation tests (Dwijayanti & Jayanti, 2024). Only after meeting these assumptions was the regression analysis carried out in stages, starting with the main effects model and followed by the interaction model.

RESULTS AND DISCUSSION

Descriptive Statistic

Based on Table 3, the data sample of carbon emission intensity (CI) shows a minimum value of 0,0186 for Tipco Asphalt Public Co. Ltd. in 2020. This was calculated by dividing the carbon emissions of 15.150 tons of CO_2 equivalent to a total revenue of 814.107,12 thousand USD. In contrast, the maximum CI value is 4,5803 for Press Metal Aluminum Holdings in 2021, derived from carbon emissions of 12.094.500 tonnes CO_2 equivalent and total revenue of 2.640.546,59 thousand USD. Carbon emissions and total revenue data were manually collected from the firms' annual reports. Furthermore, the mean of 2,1029 and a standard deviation of 1,0370 indicate that the data are considerably heterogeneous in terms of carbon efficiency performance across the sample.

The product diversification (PD) sample data show a minimum value of 0,1973 for PT Timah Tbk in 2020. This value was manually calculated using the HHI method by summing the squares of the revenue shares of eight distinct business segments: tin metal, tin chemical, tin solder, aluminum, hospital services, coal, nickel, and real estate. Each segment's revenue was divided by the firm's total revenue of 936.714 thousand USD. The maximum PD value is 0,9872, recorded by China Sunshine Chemical Holdings in 2019, indicating that the firm is more focused on fewer segments, namely rubber chemicals, heating power, and hospitality. Moreover, the mean PD value is 0,5622 with a standard deviation of 0,2182, suggesting that firms in the sample have a moderate level of product diversification.

The business environmental uncertainty (BEU) sample data show a minimum value of 0,26 for Indorama Ventures Public Co. Ltd. in 2019. This value was obtained by dividing the standard deviation of sales regression over the past five years (2019 – 2023) by the average sales during that period. On the other hand, the maximum value of BEU is 5,21 for PT Krakatau Steel Tbk in 2023. This means that Indorama Ventures Public Co. Ltd. experienced a lower level of business environmental uncertainty in 2023 than PT Krakatau Steel in the same year. In addition, the mean value of 0,9896 with a standard deviation of 0,7163, indicates that firms in the sample operate under a relatively high level of environmental uncertainty.

The geographic location (GEO) sample data show a minimum value of 0,00 and a maximum value of 1,00. This is because the variable was measured using a dummy variable approach. Firms operating in Indonesia were

assigned a value of 1, indicating that they were located in the country with the highest carbon emissions among the five countries in the sample. Conversely, firms based in Malaysia, Singapore, Thailand, and the Philippines were coded as 0. The main value of GEO is 0,3784, indicating that 38% of the sample consists of firms operating in Indonesia. The standard deviation of 0,486 indicates a relatively even distribution between firms in Indonesia and those in other countries.

The board gender diversity (GD) variable shows a minimum value of 0,00 and a maximum value of 0,60. This indicates that some firms in the sample had no female representation on their boards, while the highest observed proportion of female board members was 60%. This result was obtained manually from the firms' annual reports by comparing the number of women on the board with the total number of board members. The mean value of 0,1458 suggests that, on average, women made up approximately 14,58% of board members, highlighting a relatively low level of gender diversity across firms. The standard deviation of 0,15463 indicates moderate variability in gender diversity among firms.

The ESG sample data, based on scores obtained from Bloomberg, show a minimum value of 29,18 for PT Indo Acidatama Tbk in 2019. In contrast, the maximum value is 83,22 for Indorama Ventures Public Co. Ltd. in 2020. The mean value of 54,679 suggests that, on average, firms in the sample have a moderate level of ESG performance. The standard deviation of 12,73 indicates a fairly widespread ESG score among the samples.

Table 3. Descriptive Statistic

	Min	Max	Mean	Std. Deviation	VIF
CI	,0186	4,5803	2,1029	1,0370	1,092
PD	,1973	,9872	,56223	,2182	1,091
BEU	,26	5,21	,9896	,7163	1,033
GEO	,00	1,00	,3784	,4863	1,296
GD	,00	,60	,1458	,1546	1,276
ESG	29,18	83,22	54,6791	12,7255	

Source: Output IBM SPSS 26 (Data Processing, 2025)

Classical Assumption Test

Four types of classical assumption tests must be conducted prior to performing regression analysis. The first was the normality test, which was assessed using the One-Sample Kolmogorov-Smirnov Test. Based on the output, the significance values for all variables in this study were reported as 0,200. Since the value is greater than the commonly accepted threshold of 0,05, it can be concluded that the data for all variables are normally distributed and thus meet the assumption of normality required for further regression analysis. Second, the multicollinearity test examines the correlation among the independent variables. A dataset is considered free from multicollinearity if the Variance Inflation Factor (VIF) is less than 10,00. As shown in Table 3, all the VIF values of the independent variables were below the threshold. Therefore, it can be concluded that the dataset is free of multicollinearity and suitable for regression analysis.

The third classical assumption test is the heteroskedasticity test, which aims to determine whether there is a variance inconsistency of the residuals across observations within the regression model. If the significance values of each independent variable exceed 0,05, it can be concluded that heteroskedasticity is not present. Based on the Glejser test, the significance values for all independent variables are 0,154, 0,429, 0,557, 0,283, and 0,756, respectively. Since all values are greater than 0,05, it can be concluded that the model does not exhibit signs of heteroskedasticity. The fourth classical assumption test is the autocorrelation test, which is used to identify whether there is a correlation between the residual values within the regression model. One of the most widely used methods for detecting autocorrelation is the Durbin-Watson test. According to the results, the obtained Durbin-Watson value was 1,983. This value falls within the range between the upper bound (dU) and (4 – dU), that is, between 1,8037 and 2,1963. Therefore, it can be concluded that the residuals are randomly distributed, and there is no systematic pattern that could compromise the validity of the regression model.

Hypothesis Testing

Based on Table 4, the results of the Moderated Regression Analysis indicate that only four of the eight hypotheses were supported by the data. A hypothesis is considered supported if its p-value meets one of the conventional significance thresholds ($p<0,10$; $p<0,05$; or $p<0,01$) and the relationship is in line with the proposed direction. The direct relationship within ESG disclosure was examined using Multiple Regression Analysis. First, the variable CI exhibits a significant positive effect on ESG disclosure, with a coefficient of 0,462 and a significance level of $p < 0,01$, thus supporting H1. Second, the variable PD shows a significant and positive relationship with

ESG disclosure, with a coefficient of 9,167 and p-value < 0,01, thus validating H2. Meanwhile, although GEO is significant at p-value < 0,01, the coefficients are negative. However, the significance level of BEU does not meet the threshold, thus rejecting H3 and H4.

Table 4. Regression Analysis Results

	Multiple Regression			Moderated Regression			
Variable	Sign	Coefficient	Sig.	Sign	Coefficient	Sig.	Decision
CI	+	,462	,000***	+	,481	,000***	H1 Accepted
PD	-	9,167	,000***	-	14,963	,000***	H2 Accepted
BEU	-	,238	,142	-	9,527	,000***	H3 Rejected
GEO	-	7,078	,000***	+	4,015	,003***	H4 Rejected
GD				-	10,709	,417	
CI*GD				-	,623	,210	H5 Rejected
PD*GD				+	24,034	,146	H6 Rejected
BEU*GD				+	10,986	,053*	H7 Accepted
GEO*GD				+	31,777	,001***	H8 Accepted
R^2	= ,596						
Adjusted R^2	= ,576						

Note: *** p<0.01; ** p<0.05; * p<0.1

Source: Output IBM SPSS 26 (Data Processing, 2025)

Furthermore, Moderated Regression Analysis was used to test the interaction between independent variables and Gender Diversity. First, the interaction between BEU and GD is statistically significant, followed by a coefficient of 10,968, indicating the acceptance of H7. In addition, the p-values of GEO and GD on ESG statistically support H8, with a coefficient of 31,777. This result indicates the presence of a moderating effect, whereby board gender diversity enhances the influence of business environmental uncertainty and geographical location on ESG disclosure. Nevertheless, the interaction terms between CI and GD, and PD and GD did not exhibit a significant moderating effect. This is evidenced by a p-value > 0,05, indicating that gender diversity on the board does not amplify the relationship between these variables and ESG disclosure. Thus, H5 and H6 are rejected in this study.

Coefficient of Determination

The *Model Summary* provides information on the explanatory power of the regression model through the coefficient of determination or R square (R^2). In this analysis, the R^2 value is 0,596, indicating that approximately 59,6% of the variance in the dependent variable (ESG) can be explained by the independent variables included in the model. The Adjusted R^2, which accounts for the number of predictors and provides a more accurate estimate in multiple regression, is slightly lower at 0,576. This means that after adjusting for the number of predictors, the model still explains approximately 57,6% of the variance in ESG. This suggests that the model is reliable and robust in explaining the variability of ESG disclosure.

The Relationship Between Carbon Emissions on ESG Disclosure

The direct relationship between carbon emissions and ESG disclosure is statistically confirmed in Table 4, with a significance value of p < 0,01. This result supports H1, which posits that the higher the carbon emissions produced by a company, the more extensive its ESG disclosures. The coefficient value indicates that for every one-unit increase in carbon emissions, ESG disclosure increases by 0,462 units. This shows the positive effect of carbon emissions on ESG disclosure, which aligns with legitimacy theory. According to this theory and a previous study by Wedari et al. (2021), society will legitimise firms with high ESG-related information disclosure, even if they contribute to higher carbon emissions. Furthermore, the findings suggest that carbon-sensitive firms engage in legitimacy-seeking behaviour through ESG disclosure (Braasch & Velte, 2023).

This is further supported by the data presented in Table 3. Tipco Asphalt Public Co. Ltd. (TASCO), which exhibited the lowest carbon emission intensity in the sample, reported an ESG disclosure score of 36,21 in 2020. This value was lower than the sample mean value. Conversely, Press Metal Aluminum Holdings, with the highest carbon emission intensity in 2020, achieved an ESG disclosure score of 76,84, substantially exceeding both the sample average and TASCO's score. These contrasting cases reinforce the statistically observed positive association between carbon emission intensity and ESG disclosure levels. This study thus supports the findings of Treepongkaruna et al. (2024), who revealed that ESG disclosure serves as an attempt to obtain positive justification from society, in alignment with the legitimacy theory perspective.

The Relationship Between Product Diversification and ESG Disclosure

Product diversification is measured by the Herfindahl-Hirschman Index (HHI), where lower HHI values indicate greater diversification. Based on the regression results, product diversification significantly influences ESG disclosure, with a p-value < 0,01 and a coefficient value of -9,167. This indicates that every one-unit decrease in the HHI is associated with a 9,167-point increase in the ESG disclosure score. This result confirms H2, that more diversified products have higher ESG disclosure. From the perspective of institutional theory, firms with more diversified product portfolios face stronger and more heterogeneous stakeholder pressures for transparency. This outcome is consistent with Jongsma & Pennink (2020), who argue that when firms expand into unrelated product markets, they must engage a broader and more varied set of stakeholders to secure legitimacy.

This is further supported by the data sample, where PT Timah Tbk operated across multiple business segments in 2020 and achieved an ESG score of 65,01. China Sunshine, with a smaller business segment, recorded an ESG score of 42,19. This comparison empirically proves the positive association between product diversification and ESG disclosure. Beyond stakeholder pressures, product diversification increases operational complexity, which necessitates transparent ESG disclosures to monitor and mitigate environmental and social risks across all business units. This finding echoes the conclusions of Patrisia & Dastgir (2017).

The Relationship Between Business Environmental Uncertainty and ESG Disclosure

Business environmental uncertainty has an insignificant relationship with ESG disclosure. As shown in Table 4, the p-value is 0,142 and the coefficient is 0,238. This result leads to the rejection of H3, which posits that firms operating under higher business environment uncertainty tend to disclose more ESG-related information. This finding contradicts institutional theory, which predicts that firms facing elevated uncertainty will implement strategic measures, such as enhanced transparency, to mitigate risk. This also contrasts with the findings of Alandejani & Al-Shaer (2023), Skandera et al. (2023), and Vural-Yavaş (2021), which suggest that firms tend to resolve uncertainty by enhancing ESG disclosure. As no previous study supports this finding, we argue that basic material firms in ASEAN-5 countries perceive uncertainty as a temporary or external issue driven by global market trends.

This is supported by the sample data, where PT Krakatau Steel Tbk (KRAS) faced high uncertainty in 2023, and the recorded ESG score was 48,66. Meanwhile, Scientex Bhd, which experienced less uncertainty in 2023, recorded an ESG score of 54,18. Although both companies faced different levels of uncertainty, their ESG scores were relatively close to the average score. Therefore, it is difficult to establish a significant relationship between business environmental uncertainty and ESG disclosures. Moreover, 63% of the firms in the sample had BEU levels below the average, showing that most firms experienced relatively low uncertainty. In line with the contingency perspective explained by Gavana et al. (2024), there is no single strategy that fits all firms in navigating uncertain situations. ESG disclosure may not be seen as a relevant or effective strategic response under conditions of uncertainty, especially in basic materials sector firms in the ASEAN-5 countries.

The Relationship Between Firms' Geographic Location and ESG Disclosure

Regression analysis reveals that firms' geographic location has a negative relationship with ESG. A significant p-value < 0,01 and a coefficient of -7,078, indicate that firms operating in Indonesia do not tend to disclose more ESG-related information, thus rejecting H4. Specifically, the coefficient value suggests that, on average, firms based in Indonesia score 7,078 points lower on ESG disclosure than firms in other ASEAN-5 countries. Contrary to institutional theory predictions, the Resource-Based View (RBV) suggests that many Indonesian firms still face internal resource constraints that hinder their ability to meet ESG reporting demands. This is influenced by the underdevelopment of ESG reporting infrastructure and the limited understanding of ESG issues among business leaders (Bhandari et al., 2022).

Furthermore, Table 3 shows that only 37,84% of the sample consists of Indonesian firms, suggesting that a large share of companies did not report or reported less ESG information during 2019–2023. This contrasts with the study by Hmouda et al. (2024), who found that North American companies characterised by high carbon emissions tend to provide more ESG disclosures. Beyond internal resource constraints, the regulatory framework in Indonesia was not fully effective during this study period. Under OJK Regulation No. 51/POJK.03/2017 and OJK Circular Letter No. 16/SEOJK.04/2021, ESG disclosure only became mandatory from the 2021 financial year. Prior to 2021, ESG disclosure remained largely voluntary and unstandardised; therefore, only a handful of firms consistently published their sustainability data.

The Moderating Role of Gender Diversity

The moderating effect is shown in Table 4, where gender diversity does not significantly affect the relationship between carbon emission intensity and ESG. This finding leads to the rejection of H5, suggesting a positive moderating effect of board gender diversity in this relationship. For instance, Lotte Chemical Titan Holding,

which had 60% women on board in 2023, achieved an ESG score of 67,47. However, Banpu Public Co. Ltd. which has no female board representation, recorded a score of 76,67. Notably, the ESG scores are above the average score in the sample. This supports the notion that there is no consistent pattern showing that gender diversity strengthens or weakens the relationship between carbon emission intensity and ESG disclosures. According to institutional theory, gender-diverse boards are assumed to strengthen corporate responsiveness by improving the oversight and encouraging greater disclosure. This contradiction may occur due to the limited ESG expertise across the board or the dominance of external institutional pressures over internal governance dynamics. This finding is relevant to the study by Shi et al. (2023), who found no significant association between the proportion of female directors on the board and firms' overall ESG disclosure.

Next, the moderating effect of gender diversity on the relationship between product diversification and ESG disclosure was found to be statistically insignificant, leading to the rejection of H6. This is empirically supported by the sample data, where Halcyon Agri Co. Ltd. and TOA Paint Thailand Public Co. Ltd. exhibit similar levels of product diversification but differ significantly in board gender diversity, with proportions of 0% and 43%, respectively. Despite this difference, both firms reported moderate ESG scores of 55,68 and 52,39, respectively. This forward finding from institutional theory can be interpreted through the strategy substitution perspective explained by Yu & Hwang (2024), where firms prioritise the effectiveness of a single dominant strategy over a combined approach. In this case, companies may deliberately focus on product diversification strategies rather than combining them with gender diversity on the board to enhance ESG disclosure. Consequently, female board representation may be underutilised because it is not perceived as a necessary complement to an already chosen strategic path.

The direct interaction between business environmental uncertainty and ESG disclosure was insignificant; however, when gender diversity was introduced as a moderator, the relationship became significantly positive, supporting the acceptance of H7. For instance, PT ANTAM faced high levels of uncertainty in both 2021 and 2022. In 2022, they increased their gender diversity by 10%. Consequently, their ESG score increased from 58,88 to 62,29. This supports institutional theory, as it suggests that internal governance mechanisms, such as board diversity, can help firms better navigate external pressures, especially when formal guidelines or expectations are unclear. Furthermore, from a resource dependence perspective, gender-diverse boards can marshal a broader array of informational and relational resources that help firms navigate turbulent environments and reduce information asymmetries (Boivie et al., 2016). In highly uncertain business environments, firms rely heavily on their boards of directors for strategic decision-making. In this context, female directors bring distinct networks, expertise, and risk sensitivities that enrich a firm's ability to manage and disclose ESG information effectively.

The significant moderating effect found in the interaction between geographic location and gender diversity supports the acceptance of H8, particularly in environmentally sensitive locations such as Indonesia. This is evidenced by the sample data, where PT Merdeka Copper Gold Tbk and PT Vale Indonesia Tbk, both located in Indonesia, demonstrate differing levels of board gender diversity at 7% and 36%, respectively. Consequently, their ESG scores also differ significantly, at 58,38 and 70,06 respectively. This aligns with institutional theory which suggests that female boards contribute broader ethical insights and diverse perspectives, especially in environmentally sensitive regions, thereby enhancing accountability in ESG disclosure (Briano-Turrent, 2022; Konadu et al., 2022). In the ASEAN-5 context, gender-diverse leadership can enhance a firm's strategic response to environmental legitimacy pressures in specific geographic contexts to overcome structural barriers.

CONCLUSION

The findings of this study indicate that carbon emission intensity has a significant positive effect on ESG disclosures. Firms that produce higher carbon emissions tend to disclose more ESG-related information. Similarly, firms with greater product diversification also show a higher tendency to report their ESG practices, as they have more accountability to disclose their information. However, when firms face business environmental uncertainty, it is difficult to establish a significant effect on ESG disclosure. In addition, firms located in environmentally sensitive regions do not necessarily disclose higher levels of ESG information. Notably, when gender diversity is introduced as a moderating variable, the previously significant direct effects of carbon emission intensity and product diversification on ESG disclosures become insignificant. In contrast, business environmental uncertainty and geographic location, when moderated by gender diversity, have a significant positive effect on ESG disclosure. These results suggest that the determinants of ESG disclosure are context-dependent and that gender diversity on corporate boards can play a strategic role in enhancing ESG transparency, particularly under conditions of environmental pressure and institutional complexity. Therefore, this study advances our understanding of ESG

disclosure drivers in emerging economies by framing carbon intensity, product diversification, business environmental uncertainty, and geographic location within legitimacy and institutional perspectives. It extends prior work by uncovering a novel moderating role for board gender diversity, which is underexplored in the literature. From a practical perspective, enhanced female representation on corporate boards may serve as a strategic mechanism for improving ESG transparency in high-risk or unstable contexts. Social implications include enhanced community trust, better labour and human rights outcomes, and closer alignment with stakeholder welfare.

Despite these valuable insights, this study has several limitations that should be considered. Determinants are confined only to carbon emission intensity, product diversification, business environmental uncertainty, and geographic location, excluding factors such as ownership structure or market competition. In addition, the measurement of product diversification may be conceptually unclear, as its direction of influence on ESG disclosure is not straightforward and can be difficult to interpret. For geographic location, it would be more insightful to include alternative country-based dummy variables to enable clearer cross-country ESG disclosure. The sectoral focus on basic materials also narrows the applicability of the findings, as firms in other sectors may behave differently. The regional limitations to the ASEAN-5 countries may not capture broader global variations in gender norms and ESG practices. Finally, the study period, covering years of regulatory changes and global crises, may have introduced time-specific effects that could affect generalisation. Thus, future research should expand variable coverage, explore other industries and regions, and adopt longitudinal designs to provide more robust insights.

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