The Effect of Board Diversity on Carbon Emission Disclosure: Evidence from Indonesian Mining Companies

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Abstract

Urged by the intensifying pace of global warming, carbon-intensive sectors most notably the mining industry are under escalating demands to elevate their environmental transparency. This inquiry investigates the impact of various board diversity dimensions, including gender, academic background, tenure, age, and nationality, on carbon emission disclosure (CED). Drawing upon Stakeholder and Upper Echelons theories, the inquiry employs a quantitative approach utilizing multiple linear regression analysis. Using a purposive sampling approach, this study obtained a final dataset consisting of 114 firm-year observations from mining companies registered on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. The empirical evidence demonstrates that board diversity in terms of gender, education, and tenure significantly stimulates higher climate transparency. On the contrary, diversity in age and nationality exerts a notable adverse effect on CED, implying that generational divides and institutional hurdles potentially impede voluntary environmental reporting. Collectively, the F-test confirms the joint significance of all independent and control elements on CED. These insights contribute to the sustainability accounting literature and provide strategic implications for optimizing corporate governance to foster robust environmental accountability.

Keywords: Board Diversity, Carbon Emission Disclosure, Mining Companies, IDX, Sustainability Accounting

INTRODUCTION

Climate change currently stands as a pivotal sustainability issue impacting modern business operations and macroeconomic stability. The persistent rise in greenhouse gas emissions stemming from human activities, notably fossil fuel consumption and carbon-intensive industrial processes, serves as the primary driver of global warming. The International Energy Agency (IEA, 2025) reported a recent 0.8% increase in global energy-related carbon dioxide (CO_2) emissions, reaching a record 37.8 gigatons and raising atmospheric CO_2 concentration levels to 422.5 ppm. Although these figures indicate a slight decoupling among economic expansion and carbon output, corporate activities in high-emission sectors remain overwhelmingly accountable for global ecological and economic vulnerabilities.

Stakeholder Theory explains that business organizations operate within a broader network of associations and therefore carry responsibilities that extend beyond maximizing shareholder interests. As per to Freeman (1984), companies are expected to consider the expectations and concerns of various stakeholder groups, including investors, employees, customers, regulators, local communities, and the natural environment. The theory argues that organizational continuity and legitimacy depend on the ability to maintain balanced associations with these groups and respond

to their evolving demands. In this context, corporate transparency becomes an important mechanism for demonstrating accountability. Oneway firms address stakeholder expectations is through the disclosure of environmental information, including carbon emission reporting. By communicating environmental performance openly, companies can strengthen stakeholder trust, maintain legitimacy, and signal commitment toward sustainable business practices.

Within this global framework, Indonesia faces serious challenges in carbon mitigation, making greenhouse gas management across its economic sectors a matter of national urgency (BPS, 2024). Due to intensive energy requirements and substantial environmental footprints, the mining and critical mineral processing sectors are highly susceptible to climate risks (Wahyono et al., 2024). However, corporate transparency within this sector remains weak. A recent report by Ember (2024) revealed that major Indonesian coal mining entities, including "PT Berau Coal, PT Bumi Resources, PT Adaro Energy, PT Bayan Resources, PT Baramulti Suksessarana, and PT ABM Investama", omitted calculations for coal mine methane (CMM) emissions. Meanwhile, other enterprises such as Indo Tambangraya Megah, PT Bukit Asam, Golden Energy Mines, and Indika Energy utilized non-standardized and inconsistent estimation methods. These disclosure gaps obscure the true environmental impacts of these firms, hinder mitigation strategies, and position mining companies as a highly relevant sample for carbon emission disclosure (CED) inquiry.

In Indonesia, sustainability reporting and environmental transparency are guided by regulatory mandates "POJK No. 51/POJK.03/2017 and SEOJK No. 16/SEOJK.04/2021". However, because these policies do not strictly standardize reporting depth or methodology, corporate carbon disclosures remain highly fragmented. This policy gap urge that external pressures from investors, the public, and stakeholders play a critical role in encouraging environmental disclosure (Blesia et al., 2023).

From a theoretical perspective, Stakeholder Theory posits that corporate survival depends on satisfying the expectations of non-shareholder groups through transparent communication (Freeman, 1984). Furthermore, Upper Echelons Theory urge that strategic disclosure choices are heavily crafted by the figures, experiences, and demographic characteristics of the board of directors (Hambrick & Mason, 1984).

Among governance characteristics, board gender diversity is widely expected to improve sustainability reporting. Several scholars argue that female directors enrich strategic perspectives and strengthen monitoring quality, positively influencing voluntary carbon disclosures (Gonenc & Krasnikova, 2022; Hidayah et al., 2024). Conversely, other empirical studies found that gender diversity has no significant impact on climate transparency (Gulo et al., 2025).

Similarly, board educational background diversity is believed to provide directors with broader knowledge for managing environmental issues (Khan et al., 2019). Nevertheless, empirical contradictions remain, as subsequent studies found no significant association among educational diversity and CED (Hidayah et al., 2024).

Inconsistencies also appear regarding board age and tenure diversity. While younger directors may contribute progressive environmental perspectives and older directors may provide regulatory expertise, age diversity can also generate decision-making conflicts, resulting in mixed empirical outcome (Chams & García-Blandon, 2019; Hidayah et al., 2024). Board tenure diversity may balance

internal organizational familiarity with fresh perspectives to improve reporting quality (Katmon et al., 2019; Hidayah et al., 2024), although prolonged tenure could weaken monitoring independence (Huang & Hilary, 2018).

Finally, while board nationality diversity introduces global governance perspectives that may strengthen corporate accountability (Lahyani, 2022), conflicting evidence indicates that foreign directors may negatively influence carbon disclosure practices within the Indonesian corporate context (Gantyowati et al., 2026).

Reflecting on these mixeds empirical outcome and the importance of transparent climate reporting, this inquiry examines whether five dimensions of board diversity, namely gender, education, age, tenure, and nationality, influence carbon emission disclosure. Focusing on IDX-listed mining companies is justified given the sector's high emission risk and substantial exposure to environmental accountability demands. The outcome are expected to contribute to sustainability accounting literature and provide practical insights for managers, investors, and regulators in designing corporate governance frameworks that support carbon transparency.

Stakeholder Theory explains that business organizations operate within a broader network of associations and therefore carry responsibilities that extend beyond maximizing shareholder interests. As per to Freeman (1984), companies are expected to consider the expectations and concerns of various stakeholder groups, including investors, employees, customers, regulators, local communities, and the natural environment. The theory argues that organizational continuity and legitimacy depend on the ability to maintain balanced associations with these groups and respond to their evolving demands. In this context, corporate transparency becomes an important mechanism for demonstrating accountability. Oneway firms address stakeholder expectations is through the disclosure of environmental information, including carbon emission reporting. By communicating environmental performance openly, companies can strengthen stakeholder trust, maintain legitimacy, and signal commitment toward sustainable business practices.

Upper Echelons Theory explains that organizational decisions and performance are primarily shaped by the characteristics and perspectives of those serving in top management positions. Hambrick and Mason (1984) argued that executives interpret business conditions and make strategic choices as per their personal characteristics, experiences, and underlying figures. As a result, organizational decisions often reflect the cognitive perspectives of the board and senior management. Within this framework, demographic attributes such as gender, educational background, tenure, age, and nationality are frequently used to explain differences in managerial judgment and strategic behavior. Diversity among board members may expand the range of perspectives available during decision-making processes, enabling organizations to address complex issues more effectively. Consequently, leadership heterogeneity is expected to influence corporate policies related to transparency, sustainability initiatives, and environmental disclosure.

RESEARCH METHODOLOGY

This inquiry adopts a quantitative inquiry approach and utilizes secondary data collected from the Indonesia Stock Exchange (IDX) website, annual reports,

and sustainability reports of mining companies listed on the IDX during the 2022–2024 period. Multiple linear regression analysis is employed to examine the effect of the independent elements on the dependent variable, both simultaneously and partially, as well as to determine the direction and magnitude of these associations.

The proposed hypotheses were examined using a regression-based analytical approach to evaluate the association among the research elements. The estimation model applied in this study is presented below:

$$CED = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6SIZE + \beta_7LEV + \beta_8PROF + e$$

This study focuses on publicly traded companies operating in Indonesia's mining sector. The sample was determined through purposive sampling to ensure consistency with the research objectives. Only companies that satisfied the established requirements were included in the final observation set. The selection requirements consisted of: (1) mining companies continuously listed on the Indonesia Stock Exchange during 2022–2024; (2) companies that published complete annual reports and/or sustainability reports throughout the observation period; and (3) companies that disclosed complete information regarding board gender diversity, educational background diversity, tenure diversity, age diversity, nationality diversity, along with the control element:

Table 1. Operational Definitions

Variable	Definition	Measurement
Carbon Emission Disclosure (CED)	Measures the extent of corporate carbon and greenhouse gas transparency.	*CED* = Number of items disclosed / Maximum total items (18), based on Choi et al. (2013).
Board Gender Diversity (GENDER)	Measures the gender composition of the board of directors.	$B = 1 - \Sigma Pi^2$, with 2 categories: male and female.
Board Educational Diversity (EDU)	Measures the variations in academic disciplines within the board.	$B = 1 - \Sigma Pi^2$, with 5 categories: accounting, economics, law, engineering, and others.
Board Tenure Diversity (TENURE)	Measures the variations in the length of directorial service in the firm.	$B = 1 - \Sigma Pi^2$, with 5 categories: ≤3 years, 3–≤6 years, 6–≤9 years, 9–≤12 years, and >12 years.
Board Age Diversity (AGE)	Measures the distribution of age groups within the board of directors.	$B = 1 - \Sigma Pi^2$, with 4 categories: <40 years, 40–49 years, 50–59 years, and >60 years.
Board Nationality Diversity (NATIONAL)	Measures the presence of cross-border or foreign directors on the board.	$B = 1 - \Sigma Pi^2$, with 2 categories: Indonesian and foreign directors.
Firm Size (SIZE)	Measures company size based on total assets.	*SIZE = ln (Total Assets)*.
Leverage (LEV)	Measures the level of debt usage in the company's capital structure.	*LEV = (Total Debt / Total Assets) × 100%*.
Profitability (PROF)	Measures the firm's efficiency in generating profits from its assets.	*ROA = (Net Income / Total Assets) × 100%*.

RESULTS AND DISCUSSION

This inquiry examines the effect of board diversity on carbon emission disclosure among mining companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. The sample was selected using a purposive sampling technique as per criteria established to meet the inquiry objectives. The sampling procedure is presented in Table

Table 2. Sample Selection Criteria

Sample Criteria	Total
Mining sector companies listed on the IDX that published Sustainability Reports from 2022 to 2024	39
Total Samples (3 years)	117
Outlying observations	(3)
Number of observations	**114**

As reveal in Table 2, 39 mining companies met the sampling criteria over the 3-year period, yielding 117 initial observations. After excluding 3 outlying observations during data screening, the final dataset utilized for analysis consists of 114 observations.

Descriptive Statistics

Descriptive statistics are employed to provide an overview of the dataset characteristics by reporting the lowest figure, highest figure, average score, and dispersion level for each variable. Table 3 summarizes the descriptive statistical results as per 114 observations:

Table 3. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CED	114	0.0000000	1.0000000	0.7007797	0.2209289
GENDER	114	0.0000000	0.5000000	0.15156111	0.1763975
EDU	114	0.0000000	0.7777777	0.53599414	0.1753048
AGE	114	0.0000000	0.7500000	0.47830470	0.1901621
TENURE	114	0.0000000	0.7500000	0.36378069	0.2572870
NATIONAL	114	0.0000000	0.5000000	0.18052050	0.2039789
SIZE	114	24.994804	32.817550	29.853260	1.7992427
LEV	114	0.0000004	0.9211311	0.4207647	0.2248999
PROF	114	-0.4105917	0.6163459	0.1152407	0.1553930
Valid N (listwise)	114				

Carbon emission disclosure (CED) recorded a minimum figure of 0.0000 and a maximum figure of 1.0000, producing a mean score of 0.7008 and a dispersion level of 0.2209, reflecting differences in carbon reporting practices among companies. In terms of board characteristics, board gender diversity showed figures from 0.0000 up to 0.5000, with an average score of 0.1516 and a variation level of 0.1764, demonstrating differences in female representation across boards. This is accompanied by board educational diversity, which recorded figures from 0.0000 to 0.7778, a central tendency of 0.5360, and a dispersion figure of 0.1753, suggesting relatively diverse educational backgrounds among directors. Furthermore, board age diversity produced a minimum figure of 0.0000 and a highest figure of 0.7500, with an average score of 0.4783 and a variability of 0.1902, reflecting differences in board age composition.

Completing the board characteristics, board tenure diversity generated figures from 0.0000 to 0.7500, achieving a mean score of 0.3638 and a dispersion figure of 0.2573, showing differences in directors' years of service, while board nationality diversity recorded figures from 0.0000 up to 0.5000, an average of 0.1805, and a variability level of 0.2040, reflecting unequal foreign director representation among companies. Regarding company financials and

scale, firm size recorded a lowest figure of 24.9948 and a highest figure of 32.8176, with a mean score of 29.8533 and a dispersion figure of 1.7992, illustrating differences in company scale. Finally, leverage produced figures from 0.0000 to 0.9211, with an average score of 0.4208 and a variability figure of 0.2249, showing differences in capital structure among firms, while profitability generated figures from -0.4106 to 0.6163, reaching a mean of 0.1152 and a dispersion figure of 0.1554, reflecting variation in company financial performance.

Robustness Testing

Normality Test

Table 4. Normality Test

			Unstandardized Residual
N			114
Normal Parameters[a,b]	Mean		0.0000000
	Std. Deviation		0.14633451
Most Extreme Differences	Absolute		0.075
	Positive		0.073
	Negative		-0.075
Test Statistic			0.075
Asymp. Sig. (2-tailed)			0.156
Monte Carlo Sig. (2-tailed)	Sig.		0.120
	99% Confidence Interval	Lower Bound	0.112
		Upper Bound	0.128

As reveal in Table 4, the residual analysis yields an Asymp. Sig. (2-tailed) figure of 0.156. Since this figure exceeds 0.05 (0.156 > 0.05), the residuals follow a normal distribution, satisfying the normality assumption.

Multicollinearity Test:

Multicollinearity was assessed using tolerance figures and the Variance Inflation Factor (VIF). The results in Table 5 reveal that each independent and control variable has a tolerance figure above 0.10 and a VIF figure below 10. Therefore, the regression model does not suffer from multicollinearity.

Table 5. Multicollinearity Test

Model		Collinearity Statistics Tolerance	VIF
1	GENDER	0.901	1.110
	EDU	0.808	1.237
	AGE	0.928	1.078
	TENURE	0.969	1.031
	NATIONAL	0.882	1.134
	SIZE	0.819	1.221
	LEV	0.855	1.169
	PROF	0.789	1.268

Heteroscedasticity Test

Table 6 reveal that the significance figures of all independent and control elements exceed 0.05. Gender, educational, age, tenure, and nationality diversity have significance figures of 0.125, 0.828, 0.729, 0.935, and 0.852, respectively. The control elements also exceed the threshold, with firm size at 0.460, leverage at 0.835, and profitability at 0.269. These results indicate that heteroscedasticity is not present in the regression model.

Table 6. Heteroscedasticity Test

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-0.143	0.308		-0.465	0.651
	GENDER	-0.181	0.109	-0.679	-1.661	0.125
	EDU	0.020	0.092	0.119	0.222	0.828
	AGE	-0.024	0.068	-0.158	-0.355	0.729
	TENURE	-0.010	0.119	-0.043	-0.084	0.935
	NATIONAL	0.022	0.116	0.079	0.191	0.852
	SIZE	6.700	8.759	0.308	0.765	0.460
	LEV	0.001	0.005	0.095	0.214	0.835
	PROF	0.056	0.048	0.349	1.164	0.269

Autocorrelation Test

The autocorrelation test determines whether a correlation exists among the residual of a specific period and the residuals of previous periods. This model's reliability was verified using the Durbin-Watson (DW) test, where a model is certified as free from autocorrelation if the DW statistic rests within the standard acceptable range of 1.5 to 2.5.

Table 7. Autocorrelation Test

Model	Durbin-Watson
1	1.868

As per Table 7, the Durbin-Watson figure is 1.868. Since this figure lies within the acceptable range of 1.5 to 2.5, the regression model is free from autocorrelation problems. This result indicates that the residuals are independent across observations, so the model satisfies the autocorrelation assumption and can be used for further hypothesis testing.

Hypothesis Testing

Table 8. Hypothesis Testing

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-1.714	0.251		-6.835	0.000
	GENDER	0.203	0.085	0.162	2.380	0.019
	EDU	0.245	0.091	0.194	2.705	0.008
	AGE	-0.227	0.078	-0.196	-2.913	0.004
	TENURE	0.149	0.056	0.173	2.636	0.010
	NATIONAL	-0.164	0.075	-0.152	-2.202	0.030
	SIZE	0.082	0.009	0.665	9.313	0.000
	LEV	-0.216	0.069	-0.220	-3.149	0.002
	PROF	-0.089	0.103	-0.063	-0.859	0.392

As per the empirical estimates compiled in Table 8, the formal multiple linear regression equation is specified as detailed below:

CED = -1.714 + 0.203GENDER + 0.245EDU - 0.227AGE + 0.149TENURE - 0.164NATIONAL + 0.082SIZE - 0.216LEV - 0.089PROF + e

t-Test (Partial Test)

The t-test was conducted to determine the partial effect of each independent and control variable on carbon emission disclosure (CED). A variable is considered to have a significant effect when its significance value is lower than the 0.05 threshold.

The t-test was carried out to examine the individual effect of each independent and control variable on carbon emission disclosure (CED). Elements are considered significant when the significance figure is below 0.05. As per Table 8, gender diversity positively affects CED ($\beta = 0.203$; $p = 0.019$), supporting H1. Educational background diversity also reveal a positive and significant effect ($\beta = 0.245$; $p = 0.008$), confirming H2. Likewise, tenure diversity has a positive influence on CED ($\beta = 0.149$; $p = 0.010$), supporting H3. Conversely, age diversity negatively affects CED ($\beta = -0.227$; $p = 0.004$), causing H4 to be rejected. Nationality diversity also reveal a significant negative effect ($\beta = -0.164$; $p =$

0.030), indicating that H5 is not supported. Among the control elements, firm size has a significant positive effect on CED, leverage has a significant negative effect, and profitability reveal no significant influence.

F-Test (Simultaneous Test)

The F-test is applied to examine whether the independent and control elements collectively influence carbon emission disclosure (CED). The regression model is considered statistically acceptable when the significance probability of the F-test falls below the 0.05 threshold.

Table 9. F-Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.096	8	0.387	16.792	0.000
	Residual	2.420	105	0.023		
	Total	5.515	113			

As reveal in Table 9, the regression model generates an F-statistic of 16.792 with a significance probability of 0.000. Since the significance figure is below 0.05, the null hypothesis is rejected, indicating that all explanatory elements collectively have a significant effect on carbon emission disclosure. Theseoutcome demonstrate that board gender diversity, educational background diversity, age diversity, tenure diversity, nationality diversity, along with the control elements represented by firm size, leverage, and profitability, simultaneously influence the level of carbon disclosure. Therefore, the regression model is considered adequate and capable of explaining differences in CED practices among mining companies listed in Indonesia

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Coefficient of Determination

The coefficient of determination is used to assess how far carbon emission disclosure (CED) can be explained by the independent and control factors included in the regression framework. Because several explanatory factors are incorporated in this analysis, the Adjusted R Square figure serves as the most suitable measure for evaluating explanatory strength.

Table 10. Coefficient of Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.708[a]	0.501	0.463	0.13451

The information in Table 10 presents an R figure of 0.708, reflecting a strong association among the explanatory factors and carbon emission disclosure. The R Square figure of 0.501 suggests that these factors account for 50.1% of the overall variation in CED. After adjustment for the number of predictors, the Adjusted R Square figure declines to 0.463. This indicates that board gender diversity,

educational background diversity, age diversity, tenure diversity, nationality diversity, along with the control factors consisting of firm size, leverage, and profitability, jointly explain 46.3% of the variation in carbon emission disclosure. The rest 53.7% is driven by other determinants not included in this analysis.

Board Gender Diversity and Carbon Emission Disclosure

The empirical outcome demonstrate that board gender diversity contributes positively to carbon emission disclosure (CED), as sign by a regression coefficient of 0.203 and a significance level of 0.019. Given that the probability figure remains below the accepted 5 percent threshold, hypothesis H1 is supported. This result urge that companies with greater female participation at the board level tend to disclose carbon-related information more extensively

This outcome highlights the strategic role of women in strengthening environmental accountability within corporate governance structures. Drawing on Stakeholder Theory and Upper Echelons Theory, female directors are often associated with broader stakeholder orientation, stronger ethical considerations, and more effective oversight mechanisms. Their presence may also encourage more cautious and responsible approaches toward environmental risks and sustainability-related decisions. In the context of Indonesia's mining industry, which faces substantial environmental pressure, female representation on the board appears to increase organizational sensitivity toward societal expectations and regulatory requirements concerning climate transparency. As a result, companies become more willing to reduce information gaps and reinforce public trust through expanded environmental disclosure.

These outcome are consistent with previous studies conducted by Hidayah et al. (2024), Liao et al. (2015), Githaiga and Kosgei (2022), and Velte (2022), all of which emphasized that gender diversity within corporate boards strengthens the quality of voluntary sustainability and environmental reporting. Nevertheless, this result differs from the conclusions presented by Gulo et al. (2025) and Fidiano and Dewi (2026), who concluded that female representation on corporate boards does not significantly contribute to carbon disclosure practices, suggesting that the relatively small proportion of women in traditional board structures limits their capacity to shape strategic disclosure decisions

Board Educational Background Diversity and Carbon Emission Disclosure

Statistical evidence confirms that carbon emission disclosure (CED) is positively influenced by the variety of academic disciplines represented on the board ($\beta = 0.245$, $p = 0.008$). Because the p-value falls safely below the 5% significance threshold, hypothesis H2 is validated, proving that diverse educational backgrounds prompt mining firms to be more transparent about climate risks.

From an Upper Echelons perspective, having directors trained in fields like engineering, economics, law, and accounting equips the board with broader analytical capabilities. This intellectual variety mitigates short-sighted executive decisions, making it easier for the leadership team to process intricate environmental metrics and meet stakeholder demands.

This outcome mirrors the conclusions of Khan et al. (2019) and Fidiano and Dewi (2026), who noted that heterogeneous educational backgrounds

boost sustainability reporting. Conversely, it diverges from Hidayah et al. (2024), who claimed that academic fragmentation.

Board Tenure Diversity and Carbon Emission Disclosure

Empirical evidence from the regression analysis validates H3, revealing that heterogeneity in board tenure exerts a significantly positive influence on Carbon Emission Disclosure (CED), as evidenced by a coefficient of 0.149 ($p = 0.010 < 0.05$). This finding implies that corporate boards characterized by a diverse spectrum of service lengths are better equipped to deliver superior carbon reporting.

From the perspective of Stakeholder Theory, this condition suggests that a balance among long-serving and newly appointed board members enhances environmental transparency. While long-standing directors offer institutional memory, historical foresight, and a nuanced grasp of sector-specific ecological threats, incoming directors counteract intellectual insularity, challenge cognitive consensus (groupthink), and introduce cutting-edge carbon accounting frameworks. This collaborative synergy ultimately fortifies the board's oversight capacity and overcomes corporate passivity, driving proactive adherence to sustainability mandates.

Furthermore, these outcome align with the scholarly assertions of Katmon et al. (2019), Aladwey et al. (2022), Cahyono et al. (2023), Ardianto et al. (2024), and Hidayah et al. (2024), who collectively argue that tenure diversification deters operational stagnancy. Conversely, this outcome diverges from the perspectives of Rao and Tilt (2016) and Huang and Hilary (2018), who contended that protracted board service breeds rigid conservatism and compromises supervisory autonomy due to an over-alignment with executive interests.

Board Age Diversity and Carbon Emission Disclosure

The regression results show that board age diversity has a significant negative effect on carbon emission disclosure (CED) ($\beta = -0.227$; $p = 0.004$). Since the significance level is below 0.05 and the association is negative, H4 is not supported. This finding urge that greater age diversity within the board tends to reduce environmental disclosure practices.

From an organizational and behavioral perspective, this negative association implies that substantial generational differences among board members may create challenges in reaching agreement on environmental strategies and sustainability priorities. As per to Upper Echelons Theory, directors' demographic characteristics, including age, influence managerial figures, perspectives, and attitudes toward risk. Senior directors may place greater emphasis on financial stability and adopt a more conservative stance toward voluntary non-financial disclosure, whereas younger directors are often more supportive of innovation and broader environmental accountability. These differing perspectives can generate strategic tension within the boardroom, making collective decision-making more difficult and ultimately reducing the extent of voluntary carbon disclosure.

This finding is consistent with prior studies carried out by Hidayah et al. (2024), Katmon et al. (2019), and Hafsi and Turgut (2013), which found that greater age heterogeneity among board members may weaken environmental and social disclosure due to generational differences and coordination challenges. Nevertheless, the result contrasts with the outcome of Chams and García-Blandón (2019) and Handajani et al. (2014), who argued that age diversity can create complementary perspectives and cognitive benefits that enhance sustainability reporting practices.

Board Nationality Diversity and Carbon Emission Disclosure

Empirical estimation yields a negative coefficient of -0.164 for board nationality diversity, accompanied by a p-value of 0.030. Given that this significance level falls below the standard 0.05 threshold, it is statistically verified that nationality diversity exerts a significant adverse effect on carbon emission disclosure (CED). Consequently, H5 is rejected, demonstrating that an increased proportion of foreign directors within the boardroom corresponds to a reduction in the comprehensiveness of carbon reporting.

This finding implies that integrating foreign directors into the boardroom does not inherently guarantee an elevation in climate disclosure quality within the landscape of the Indonesian mining sector. From a practical and human perspective, cross-border directors often grapple with sociocultural, linguistic, and institutional disconnects that diminish their strategic influence over domestic corporate decisions. Additionally, international board members may suffer from a lack of contextual familiarity regarding Indonesia's distinct environmental mandates such as POJK No. 51. Alternatively, they might exhibit a strategic preference for immediate financial returns, thereby sidelining localized, voluntary initiatives dedicated to ecological accountability.

This negative dynamic aligns closely with prior domestic evidence by Setiawan et al. (2026), who observed that foreign directorship frequently correlates with diminished climate-related reporting due to institutional frictions inherent in emerging economies. Conversely, this result stands in sharp contrast to international literature by Lahyani (2022), Mardini & Lahyani (2022), and Wahyuningrum et al. (2025), which broadly asserts that boardroom national heterogeneity functions as a powerful catalyst for enhancing global corporate transparency and environmental responsibility

CONCLUSION

This inquiry analyzes whether board diversity, represented by gender, educational background, tenure, age, and nationality, influences carbon emission disclosure in mining companies listed on the Indonesia Stock Exchange. The outcome reveal that gender diversity, educational background diversity, and tenure diversity have positive and significant effects on carbon transparency. These results support Stakeholder Theory and Upper Echelons Theory because female representation, diverse academic expertise, and varied director tenure improve monitoring quality, reduce managerial inertia, and strengthen responsiveness to stakeholder demands for environmental accountability. In contrast, board age diversity and board nationality diversity exert statistically significant negative effects on carbon emission disclosure. This finding indicates that substantial generational differences within leadership teams may trigger strategic friction and misalignment regarding sustainability policies, thereby delaying or limiting voluntary environmental reporting. Furthermore, the negative influence of nationality diversity urge that international board members may encounter cultural, linguistic, or institutional barriers in the domestic market. As a result, they may be less familiar with local environmental regulations or place greater emphasis on short-term financial performance than on localized voluntary disclosure initiatives. Overall, all board diversity dimensions, together with the control elements, demonstrate a significant simultaneous influence on carbon emission disclosure. These outcome provide important theoretical and practical implications for designing corporate governance structures that support climate accountability and strengthen environmental transparency.

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