

THE EFFECT OF BOARD SIZE, LEVERAGE, AND COMPANY SIZE ON CARBON EMISSION DISCLOSURE, WITH ENVIRONMENTAL PERFORMANCE AS A MODERATION VARIABLE.



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Abstract

An empirical assessment was carried out to identify key factors influencing the level of carbon emission information disclosed by firms, emphasizing internal governance structure and financial characteristics. The variables examined include board member count, debt utilization, and firm scale, with environmental performance incorporated as a conditional variable. The study concentrates on publicly traded energy companies on the Indonesia Stock Exchange (IDX) over the 2022–2024 timeframe and employs a quantitative research strategy. Data were gathered from publicly accessible annual and sustainability documentation, and the sample was selected based on predefined purposive criteria. The extent of carbon-related disclosure was evaluated using indicators derived from the Carbon Disclosure Project (CDP), while environmental performance was assessed through national PROPER rankings alongside ISO 14001 adoption. To analyze the relationships among variables, panel-based fixed effect estimation and moderated regression techniques were applied. The findings indicate that board size and financial leverage do not serve as significant predictors of carbon emission disclosure practices. In contrast, firm scale exhibits a meaningful positive relationship with disclosure intensity. Additionally, environmental performance does not condition the influence of board size or leverage; however, it interacts with firm scale by reducing its effect on disclosure levels. These results underscore that organizational magnitude plays a central role in determining transparency in carbon emission reporting.

Keywords: Board Size, Carbon Emission Disclosure, Company Size, Environmental Performance, Leverage

INTRODUCTION

Rising global attention to environmental sustainability reflects the growing impact of climate change, which is strongly influenced by carbon emissions generated through human-driven economic activities. The extensive use of fossil energy in industrial operations and transportation systems has intensified carbon accumulation in the atmosphere. Within this global landscape, Indonesia contributes a substantial share of emissions, estimated at around 700 million tons per year, positioning the country among the top ten emitters worldwide, with fossil-based energy as the dominant source (Global Carbon Project., 2022). These circumstances demonstrate the increasing importance of corporate involvement in environmental stewardship, particularly through the voluntary and transparent reporting of carbon emissions as evidence of responsibility and long-term sustainability orientation.

Corporate transparency regarding carbon emissions reflects an organization's accountability for the environmental consequences of its business operations. Such disclosure goes beyond numerical data by also describing the environmental implications generated by corporate activities. This information serves as a critical reference for stakeholders, including investors, regulators, and the public, in evaluating long-term sustainability risks. However, in Indonesia, carbon emission reporting has not yet been mandated and remains inconsistent in its application (Choi, B., Lee, D., & Psaros, 2013).

Differences in the transparency of carbon emission information among firms can be attributed to internal organizational elements, such as governance arrangements, capital structure characteristics, and the magnitude of business activities. However, the academic literature still shows a lack of agreement on whether and how these elements determine disclosure behavior. The size of the board can increase oversight of environmental policy, but an oversized board can lead to difficult coordination (Mansour et al., 2025; Mardini, G., & Elleuch Lahyani, 2021). Leverage has a variety of effects, both encouraging transparency to maintain reputation and suppressing disclosure due to high costs (Hapsari, N., & Prasetyo, 2020; Saraswati et al., 2021). Large companies tend to be more able to allocate resources to environmental disclosures, although management orientation can influence the outcome (Harits, F., & Mutasowifin, 2024).

Differences in corporate environmental outcomes can alter how internal company characteristics translate into carbon emission disclosure practices. Organizations that achieve stronger environmental results are generally more willing to communicate emission-related information, whereas firms with weaker outcomes often limit such disclosures to avoid potential damage to their public standing (Dharma, R., Santoso, B., & Wicaksono, 2024).

Research addressing carbon emission disclosure within Indonesia has not yet received substantial academic attention, particularly in relation to the energy industry, despite its significant impact on national emission levels. Evaluation of disclosure practices largely depends on sustainability reports released by energy-sector firms that are publicly traded on the Indonesia Stock Exchange (IDX) is the main source of information to assess this disclosure practice (Amaliyah, N., & Solikhah, 2019). The theoretical foundation of stakeholders and legitimacy shows that carbon emissions disclosure helps companies maintain public trust and social legitimacy (Freeman, 1984).

Focusing on the Indonesian energy industry, this research examines publicly listed firms on the Indonesia Stock Exchange over the 2022-2024 timeframe to understand determinants of carbon emission disclosure. Departing from earlier studies that report

contradictory outcomes, the analysis investigates the impact of corporate governance and financial characteristics namely board size, capital structure, and firm scale while positioning environmental performance as an interacting variable. The study aims to provide clearer empirical evidence and to advance environmental accounting research within the Indonesian setting..

REVIEW OF LITERATURE

Carbon Emission Disclosure

Environmental challenges such as climate change and declining air quality are strongly associated with greenhouse gases produced from the consumption of carbon-intensive energy sources, including fossil fuels and biomass. These emissions largely originate from industrial and organizational operations, making corporations central contributors to carbon-related environmental risks. In response to these concerns, Carbon Emission Disclosure (CED) has emerged as a voluntary corporate reporting practice through which companies enhance transparency by communicating information about their greenhouse gas emissions, typically presented within sustainability reports or integrated into broader corporate reporting documents (Meiryani et al., 2023). These disclosures are part of corporate social responsibility (CSR) and sustainability strategies, which aim to increase transparency, reduce information asymmetry, and build trust with stakeholders (PSAK, 2009; Abbas, A., Zhang, G., Bilal, & Chengang, 2023; Meiryani et al., 2023). The information disclosed can be quantitative or qualitative, including emission levels, projections, risks, opportunities, and financial implications related to climate change.

CED measurements can be done using the Carbon Disclosure Project (CDP) Index, which includes five main categories:

1. Climate Dynamics and Organizational Response (CC) – explores how shifting environmental conditions influence business risk profiles and how firms incorporate climate mitigation considerations into long-term planning and policy formulation.
2. Emission Measurement and Transparency (GHG) – addresses organizational practices in quantifying atmospheric emissions, including methodological diversity, third-party assurance, consolidated emission reporting, and full coverage of operational and value-chain emission categories (Scopes 1, 2, and 3) (Choi et al., 2013).
3. Energy Consumption (EC/Energy Consumption) – the total energy consumed and the contribution of renewable energy.
4. Reduction and Cost (RC) – plans, targets, and savings on carbon emissions.
5. Executive Accountability for Environmental Strategy (ACC) – considers the degree to which senior executives and governing boards are held responsible for overseeing, implementing, and aligning organizational strategies with environmental and climate objectives (Bae Choi et al., 2013).

Table 1
Carbon Emission Disclosure Indicators

No.	Categories	Code	Sub-Categories
1.	Climate change: risks and opportunities (CC/Climate Change)	CC1	Assessment/description of risks related to climate change and Actions that have been or will be taken to reduce risks

		CC2	Assessment of the financial and business implications and other risks and opportunities resulting from climate change at this and in the future.
2.	Greenhouse Gas (GHG) Emissions Accounting	GHG1	Description of the methodology used to calculate greenhouse gas emissions
		GHG2	The existence of external verification of the amount of greenhouse gas emissions (by whom and on what basis)
		GHG3	Total greenhouse gas emissions produced in metric tons of CO ₂
		GHG4	Scope 1 and 2 or scope 3 greenhouse gas emissions disclosure
		GHG5	Disclosure of greenhouse gas emissions by source (such as electricity, gas, oil, fossil fuels, etc.)
		GHG6	Disclosure of greenhouse gas emissions by facility or segment
		GHG7	Comparison of greenhouse gas emissions with previous years
3.	Energy Consumption Accounting (EC)	EC1	Total energy consumed in tera-joules or peta-joules
		EC2	Quantification of energy sourced from new and renewable energy
		EC3	Disclosure by type, facility or segment
4.	Reduction and Cost	RC1	Details of energy reduction plans
		RC2	Specification of greenhouse gas emission reduction targets and target years
		RC3	Emission reductions and costs or savings that have been made to date based on the target reduction plan
		RC4	Calculation of emission expenditures taken into account in the capital expenditure plan
5.	Carbon Emission Accountability (ACC)	ACC1	Indications of the responsibility of board members or other executive bodies for activities related to climate change
		ACC2	A technical explanation of the board's or other executive body's review of the Company's ability to address climate change

The CED is calculated by assigning a score of 1 for each item revealed from a total of 18 subcategories, then summing and converting it into a percentage:

$$\text{CED (\%)} = \frac{\text{total items disclosed}}{18} \times 100$$

This approach allows for an evaluation of how comprehensively a company discloses information related to carbon emissions, while supporting environmental impact management efforts more effectively.

Board Size

Within the framework of corporate governance, the composition of a company's board can be viewed as an indicator of how decision-making authority and supervisory responsibilities are distributed among top-level leaders, including both managerial and oversight positions (Nur Arifah, 2021). Rather than merely serving an administrative function, this body acts as a strategic control system that shapes corporate direction, coordinates organizational resources, and anticipates a wide range of risks, particularly those associated with environmental impact (Mardini, G., & Elleuch Lahyani, 2021).

Existing literature highlights that the connection between board composition and the disclosure of carbon emission information is inherently complex. Organizations supported by a broader governance structure tend to have stronger monitoring processes, richer professional backgrounds, and greater analytical capacity, which may facilitate more extensive and transparent communication regarding their carbon emission performance. However, the large size of the board can also pose internal challenges, such as difficult coordination, conflicts of interest, and slow decision-making (Mansour, H., Elgazzar, S., & Elbanna, 2025).

From the perspective of stakeholder theory, organizations are not solely accountable to shareholders but must also respond to the interests of various stakeholder groups influenced by corporate activities. Carbon disclosure is considered an important mechanism to demonstrate accountability and transparency, while responding to stakeholder needs and reducing public concerns regarding a company's operational activities. A larger board is able to consider multiple perspectives, improve the quality of strategic decisions, and drive greater transparency in environmental reporting (Aniah, R., Santoso, D., & Lestari, 2024).

In quantitative empirical analyses, board size is typically quantified by applying the natural logarithm to the total count of board members:

$$\text{Board Size} = \ln (\text{number of board members})$$

Considering variations in company size, this approach offers a clearer insight into the connection between the number of board members and the reporting of carbon emissions.

Leverage

Leverage indicates the level to which a company utilizes debt to fund its activities, commonly calculated as the ratio of total debt to total assets (Debt to Asset Ratio, DAR):

$$\text{DAR (\%)} = \frac{\text{Total Debt}}{\text{Total Assets}} \times 100$$

Creditors can significantly shape a company's choices through the concept of leverage. When a firm carries substantial debt, it experiences stronger demands from creditors to honor its financial commitments (Ulupui et al., 2020). This dynamic can extend to environmental reporting: businesses under high leverage may feel compelled to disclose carbon emissions more openly to protect their credibility and maintain trust with lenders (Ayu Laksani et al., 2020).

When a company carries a heavy debt load, it must consider the expectations of all stakeholders, especially those holding long-term loans. Reporting on carbon emissions then becomes an important way to meet informational needs and show responsible management (Meiryani et al., 2023). As a result, firms with higher debt ratios are often compelled to provide more detailed and transparent carbon disclosures to satisfy these pressures.

Company Size

The size of a company serves as an indicator of its operational scope and the resources at its disposal. This is typically reflected in metrics such as overall assets, market value, and total revenue. Sari et al (2022) Larger organizations often possess more robust resources and broader operational reach, which enhances their ability to accurately monitor and transparently report their greenhouse gas emissions (Choi, B., Lee, D., & Psaros, 2013).

Large corporations often encounter heightened expectations from society to operate in an environmentally sustainable manner. Thanks to their access to specialized knowledge, advanced technological solutions, and strong financial backing, these companies can develop well-organized systems for monitoring and reporting carbon emissions in accordance with international standards such as GRI and TCFD (Ulupui et al., 2020). This structured reporting enables transparent and comprehensive disclosure of environmental impact, which is essential for upholding public trust and social credibility.

In empirical studies, a firm's size is typically expressed as the logarithm of its total assets, serving as a proxy for its financial capability and operational sustainability:

$$\text{SIZE} = \ln (\text{Total Assets})$$

With this indicator, large companies have a higher chance of disclosing carbon emissions more broadly than small companies, because more adequate resources support the collection, processing, and presentation of carbon emission data as a whole (Sari et al., 2022; Ulupui et al., 2020).

Environment Performance

A company's ability to manage its impact on the environment is often captured through what is called environmental performance. This concept evaluates how effectively a business addresses ecological concerns, implements sustainability practices, and aligns its operations with its strategic goals and policies (Kawilarang, M. F., & Daromes, 2020). Strong environmental performance demonstrates that a company can operate responsibly while earning the trust and support of the public.

Organizations that actively control their environmental footprint are more likely to comply with laws, maintain stakeholder confidence, and reduce risks in their operations. On the other hand, neglecting environmental responsibilities can damage a company's reputation, undermine public backing, and endanger long-term business stability (Kawilarang, M. F., & Daromes, 2020). By reporting their environmental initiatives transparently, companies signal accountability and a commitment to ecological stewardship.

Legal requirements, such as Indonesia's Law No. 32 of 2009 on Environmental Protection and Management, further encourage businesses to adopt practices that sustain natural resources and support long-term environmental well-being. By implementing an effective environmental management system, companies can reduce the negative impacts of their operations and improve environmental accountability through environmental performance disclosure.

RESEARCH METHOD

This study explores how board composition, financial leverage, and the scale of a company impact the transparency of carbon emissions reporting, with environmental performance influencing the strength of these effects. Data were drawn from the annual and sustainability reports of energy sector firms listed on the Indonesia Stock Exchange from 2022 to 2024. Companies were selected intentionally to include only those that provide consistent reports and disclose at least one carbon emission indicator. The extent of carbon disclosure was quantified using 18 CDP-based measures, while board size, leverage, and firm size were treated as predictors, and environmental performance was gauged using ISO 14001 certification levels. Analysis involved both descriptive statistics and inferential methods in Stata 17, with preliminary checks for multicollinearity and heteroscedasticity. To examine relationships, panel regression models including Common Effect, Fixed Effect, and Random Effect were applied, with the most appropriate specification determined through Chow, Hausman, and Lagrange Multiplier tests. The role of environmental performance as a moderation variable was tested through Moderated Regression Analysis, while hypothesis tests use partial t-tests, simultaneous F tests, and determination coefficients (R^2) to assess the contribution of independent variables to carbon emission disclosure.

Research Hypothesis

- H1: Board Size has a Positive Effect on Carbon Emission Disclosure
- H2: Leverage has a negative effect on Carbon Emission Disclosure
- H3: Company Size has a Positive Effect on Carbon Emission Disclosure
- H4: Environmental Performance Strengthens Board Size's Influence on Carbon Emission Disclosure
- H5: Environmental Performance strengthens the influence of Leverage on Carbon Emission Disclosure
- H6: Environmental Performance Strengthens Company Size's Influence on Carbon Emission Disclosure

Research Model

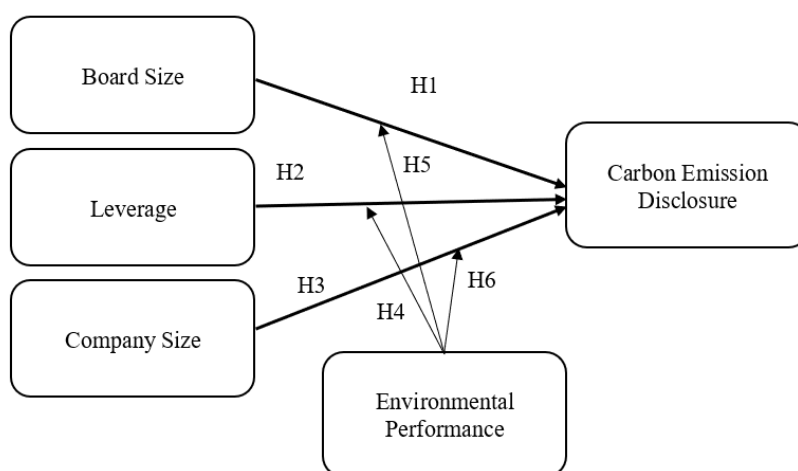


Figure 1
Research Model

RESULTS AND DISCUSSION

Descriptive Analysis

Table 2
Descriptive Statistics

Variable	Obs	Red	Std. Dev.	Minimum	Maximum
CED	150	0,6914815	0,2622061	0,1111111	1
BS	150	2,004151	0,3927204	1,386294	3,178054
LEV	150	0,2446592	0,1729701	0	0,659015
CSIZE	150	29,24224	1,717173	25,63564	32,75395
EP	150	0,9066667	0,2918735	0	1

Source: Data Processed by Researchers with STATA 17 (2026)

Analysis of 150 sampled firms uncovers notable differences across governance, financial strategies, company scale, and environmental practices. Board Size (BS) shows variation among companies, with the smallest board at 1.39 and the largest at 3.18, producing an average of 2.00, which reflects diverse management structures. Debt reliance, measured by Leverage (LEV), fluctuates between 0 and 0.66, averaging 0.24, indicating that firms adopt different approaches to financing operations. Company Size (CSIZE) ranges from 25.64 to 32.75, with a mean of 29.24, illustrating variation in organizational magnitude. Disclosure of Carbon Emissions (CED) spans a wide spectrum from 0.11 to 1, averaging 0.69, highlighting differences in transparency regarding environmental impact. Environmental Performance (EP) scores extend from 0 to 1, with an average of 0.91, showing that companies implement eco-friendly initiatives at varying levels. Collectively, these statistics depict the heterogeneity among firms in both corporate characteristics and sustainability practices.

Panel Data Regression Testing

Chow Test

Table 3
Chow Test Results

Effect Test	Prob.
F(3.97)	8,85
Prob. > F	0,0000

Source: Data Processed by Researchers with STATA 17 (2026)

Table 3 presents the Chow Test findings, which highlight that the Fixed Effect Model (FEM) is the preferable choice. The test result shows a Prob > F value of 0.0000, indicating it is below the 5% significance level and therefore leading to the dismissal of the null hypothesis. Based on this evidence, the FEM emerges as the most appropriate method for estimating the model.

Hausman Test

Table 4
Hausman Test Results

Effect Test	Prob.
Chi-square (3)	13,20
Prob. Chibar ² > F	0,0042

Source: Data Processed by Researchers with STATA 17 (2026)

Table 4 displays the Hausman Test outcome with a Prob>chi2 value of 0.0042. Since this figure falls below the 5% significance level, the null hypothesis (H0) is rejected, indicating that the Fixed Effect Model (FEM) is the preferred estimation technique.

Normality Test

Table 5
Normality Test Results

Skewness and Kurtosis test for normality				Test Joint	
Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adjchi2	Prob>chi2
Residual	150	0,0295	0,3309	5,56	0,0620

Source: Data Processed by Researchers with STATA 17 (2026)

The normality analysis summarized in Table 5 yields a probability of 0.0620. Since this exceeds the conventional 0.05 cutoff, the data in this study can be assumed to follow a normal distribution pattern.

Multicollinearity Test

Table 6
Multicollinearity Test Results

	BS	LEV	CSIZE
BS	1,0000		
LEV	-0,1670	1,0000	
CSIZE	0,6431	0,1134	1,0000

Source: Data Processed by Researchers with STATA 17 (2026)

An examination of Table 6 shows that the independent variables do not exhibit strong correlations with one another, as none exceed the 0.85 threshold. This confirms that multicollinearity does not affect the dataset.

Heteroscedasticity Test

Table 7
Heteroscedasticity Test Results

Bruesch Pagan/ Cook-Weisberg test	Prob.
Wald Chi2(1)	3,30
Prob>Chi2	0,0691

Source: Data Processed by Researchers with STATA 17 (2026)

Based on the analysis shown in Table 7, the data does not show signs of heteroscedasticity, as the significance value of 0.00691 surpasses the 0.05 benchmark.

Panel Data Regression Analysis Results

Table 8
Results of Panel Data Regression Analysis (Fixed Effect Model)

Variable	Coef.	Std. Err.	T	P> t
BS	-0,0435813	0,0971785	-0,45	0,655
LEV	-0,0596314	0,2131223	-0,28	0,780
CSIZE	0,3383852	0,0700081	4,83	0,000
cons	-9,101728	2,027458	-4,49	0,000

Source: Data Processed by Researchers with STATA 17 (2026)

The results of the panel data regression test show the regression equation:

$$\text{CED} = -9.101728 - 0.0435813 \text{ BS} - 0.0596314 \text{ LEV} + 0.3383852 \text{ CSIZE} + \varepsilon$$

The results indicate that if Board Size, Leverage, and Company Size were hypothetically zero, the model predicts a Carbon Emission Disclosure (CED) value of -9.101728. Looking at each variable individually, increasing the number of board members by one (BS) is expected to slightly lower CED by 0.0435813 units, assuming all other factors stay constant. Likewise, a one-unit rise in Leverage (LEV) would lead to a decrease in CED of approximately 0.0596314 units, while keeping other variables fixed. In contrast, expanding the size of the company (CSIZE) by one unit is associated with an increase in CED of about 0.3383852 units under the same conditions. The symbol ε represents the standard error, reflecting the degree of random fluctuations or deviations in the model's predictions.

Hypothesis Test Results

Partial Test (t)

Table 9
Partial Test Results

CED	Coefficient	Std. err.	t	P>t	[95% conf interval]
BS	-1,33248	0,6749845	-1,97	0,051	-2,672865
LEV	-1,210972	0,6268967	-1,93	0,056	-2,455865
CSIZE	1,01333	0,2722009	3,72	0,000	0,4727926
EP	19,92169	8,543061	2,33	0,022	2,95686

BS_EP	1,333511	0,6812859	1,96	0,053	-0,0193882	2,686409
LEV_EP	1,054081	0,6665231	1,58	0,117	-0,269502	2,377664
CSIZE_EP	-0,7413295	0,2806792	-2,64	0,010	-1,298703	2,377664
_cons	-26,98607	8,2251	-3,28	0,001	-43,31949	-10,65266

Source: Data Processed by Researchers with STATA 17 (2026)

The partial t-test analysis reveals that each independent variable has a distinct impact on carbon emission disclosure (CED). Increasing the number of board members Board Size (BS) tends to lower the level of disclosure, as reflected in a negative coefficient of -1.33248 and marginal significance at 0.051. While Leverage (LEV) also shows a downward trend with a coefficient of -1.210972, its effect is not statistically significant (0.056), indicating that variations in financial obligations do not substantially affect disclosure behavior. Company Size (CSIZE) has a clear negative influence, supported by a highly significant coefficient of -1.210972 (0.000), suggesting that larger firms are less forthcoming in reporting carbon emissions. Regarding moderation, Environmental Performance does not meaningfully alter the relationship between either Board Size or Leverage and CED, as seen in non-significant interaction results for BS_EP and LEV_EP (0.053 and 0.117). In contrast, the interplay between Company Size and Environmental Performance (CSIZE_EP) is statistically significant with a coefficient of -0.7413295 and significance of 0.010, demonstrating that firms with stronger environmental performance tend to exhibit an amplified effect of size on carbon emission disclosure.

Coefficient of Determination (R2)

Table 10
Determination Coefficient Results

R-Square	
Within	0,2149
Between	0,3830
Overall	0,3519

Source: Data Processed by Researchers with STATA 17 (2026)

According to Table 10, the fixed effect model yields an R² value of 0.3519, meaning that Board Size, Leverage, and Company Size collectively account for just 35.19% of the variations in carbon emission disclosure. The remaining 64.81% is determined by factors beyond the scope of this research, such as company-specific policies, technological progress, regulatory influences, organizational practices, and the broader economic environment.

Results of Moderation Regression Analysis

Table 11
Results of Moderation Regression Analysis

CED	Coefficient	Std. err.	t	P>t	[95% conf interval]
BS	-1,33248	0,6749845	-1,97	0,051	-2,672865 0,0079056
LEV	-1,210972	0,6268967	-1,93	0,056	-2,455865 0,0339203
CSIZE	1,01333	0,2722009	3,72	0,000	0,4727926 1,553867
EP	19,92169	8,543061	2,33	0,022	2,95686 36,88651
BS_EP	1,333511	0,6812859	1,96	0,053	-0,0193882 2,686409

LEV_EP	1,054081	0,6665231	1,58	0,117	-0,269502	2,377664
CSIZE_EP	-0,7413295	0,2806792	-2,64	0,010	-1,298703	2,377664
_cons	-26,98607	8,2251	-3,28	0,001	-43,31949	-10,65266

Source: Data Processed by Researchers with STATA 17 (2026)

Based on Table 11, the equation of fixed effect regression with Environmental Performance moderation is:

$$\text{CED} = -26.98607 - 1.33248 \text{ BS} - 1.210972 \text{ LEV} + 1.01333 \text{ CSIZE} + 19.92169 \text{ EP} + 1.333511 \text{ BS_EP} + 1.054081 \text{ LEV_EP} - 0.7413295 \text{ CSIZE_EP} + \varepsilon$$

The results of the regression analysis suggest that when Board Size, Leverage, and Company Size are absent, Carbon Emission Disclosure (CED) would stand at -26.99%. Board Size and Leverage are found to reduce CED, with each 1% increase lowering disclosure by 13.32% and 12.11%, respectively. In contrast, larger companies tend to disclose more, as a 1% increase in Company Size raises CED by 10.13%. Environmental Performance plays a moderating role in this relationship, enhancing the negative effects of Board Size and Leverage while counteracting the positive influence of Company Size. This demonstrates that the impact of corporate governance, financial leverage, and organizational scale on carbon reporting is shaped by the company's environmental performance, which can either strengthen or weaken these effects.

The Effect of Board Size on Carbon Emission Disclosure

The findings suggest that the size of the board, reflected by a coefficient of -1.33248 and a significance value of 0.051, does not have a meaningful effect on how companies report their carbon emissions. Despite the negative sign hinting that larger boards might be linked to lower levels of disclosure, the relationship is not statistically robust. This indicates that the mere number of directors does not automatically translate into stronger environmental oversight. Instead, the board's contribution to sustainability reporting appears to rely more on the members' expertise, commitment, and active involvement in environmental matters. These insights correspond with previous research, which also found that the quantity of board members alone does not significantly determine environmental disclosure practices.

The Effect of Leverage on Carbon Emission Disclosure

The findings indicate that a company's leverage, reflected by a coefficient of -1.210972 and a significance of 0.056, does not have a strong or meaningful impact on how carbon emissions are disclosed. Although the negative sign might imply a potential downward effect, the statistical support is too weak to confirm this. This points to the idea that the amount of debt a firm carries does not largely dictate its carbon reporting practices. Instead, as previous research has suggested, disclosure behavior is more heavily influenced by factors unrelated to finance, such as the organization's scale, regulatory pressures, and expectations from the public or other stakeholders.

The Effect of Company Size on Carbon Emission Disclosure

The findings indicate that firm scale is a key factor influencing environmental transparency, particularly in the reporting of carbon emissions. Statistical results confirm a strong and meaningful relationship, where an increase in company size corresponds with broader disclosure practices. Larger firms tend to operate under greater public attention and institutional oversight, which creates stronger incentives to communicate their environmental impacts more openly. In addition, these firms generally possess more advanced financial and managerial capabilities, allowing them to absorb the costs associated with carbon monitoring,

evaluation, and reporting systems. Such evidence supports the theoretical view that organizations with greater economic presence are more inclined to respond to external expectations, as proposed by both stakeholder theory and legitimacy theory in the context of social and environmental accountability.

The Effect of Environmental Performance in Moderating Board Size on Carbon Emission Disclosure

The analysis suggests that Environmental Performance fails to meaningfully alter the relationship between Board Size and the extent of Carbon Emission Disclosure. While the interaction between these variables is associated with a positive coefficient of 1.333511, the effect does not reach statistical significance, as reflected by a p-value of 0.053. This outcome implies that stronger environmental results do not necessarily empower larger boards to be more effective in promoting carbon disclosure. Rather than being driven by environmental achievements, board influence on disclosure practices appears to stem mainly from internal governance arrangements, compliance requirements, and strategic orientations adopted by the company.

The Effect of Environmental Performance in Moderating Leverage on Carbon Emission Disclosure

Incorporating environmental performance into the analytical model does not produce evidence of a meaningful interaction with leverage in explaining carbon emission disclosure. The estimated interaction effect (coefficient = 1.054081; p-value = 0.117) fails to meet conventional significance thresholds, suggesting that environmental performance does not modify the relationship between leverage and disclosure practices. Although the positive sign of the coefficient points to a theoretical possibility that environmental performance may alleviate the restrictive effect of leverage, this potential is not supported empirically. Firms operating with substantial debt obligations continue to allocate their resources and strategic attention toward financial stability rather than voluntary transparency regarding carbon emissions. As a result, environmental performance cannot be regarded as a determining or moderating mechanism in the association between leverage and carbon emission disclosure.

The Influence of Environmental Performance in Moderating Company Size on Carbon Emission Disclosure

The analysis demonstrates that the influence of firm size on carbon emission disclosure is conditional upon a company's environmental performance. The negative and significant interaction value (-0.7413295; p = 0.010) indicates that superior environmental performance suppresses the disclosure-enhancing effect typically associated with larger firms. Organizations with substantial operational scale and strong environmental achievements often regard their environmental responsibilities as already fulfilled, thereby reducing the perceived necessity to expand carbon emission reporting. This behavior is consistent with the assumptions of legitimacy theory and stakeholder theory, which suggest that firms calibrate their disclosure intensity in response to perceived external scrutiny and stakeholder expectations rather than internal capacity alone.

CONCLUSION

This study analyzes the factors that shape corporate carbon emission disclosure by examining governance capacity, financial structure, and firm characteristics, while incorporating Environmental Performance as a conditional element. Using data from energy

sector companies listed on the Indonesia Stock Exchange during 2022–2024, the findings reveal that board capacity and debt exposure do not play a decisive role in determining the extent of carbon-related disclosure. These results indicate that internal governance size and leverage levels have not yet become dominant mechanisms for encouraging transparency in carbon reporting. In contrast, firm scale emerges as a significant determinant, as larger organizations are more inclined to disclose carbon emission information due to increased public visibility, stronger stakeholder expectations, and greater availability of reporting resources.

The moderation analysis further shows that Environmental Performance does not significantly alter the influence of governance capacity or financial leverage on carbon emission disclosure, although a slight directional tendency is observed in relation to board capacity. However, Environmental Performance significantly weakens the relationship between firm scale and disclosure intensity, suggesting that large firms with strong environmental outcomes may reduce the breadth of their carbon emission disclosures. This pattern implies that favorable environmental performance can function as a substitute for extensive disclosure, reinforcing the view that Environmental Performance acts as a context-dependent moderating factor rather than a universal driver of carbon emission disclosure practices.

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