

Determinants Carbon Emission Disclosure and the Moderating Role of Firm Size

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ABSTRACT

Research to examine effect Environmental Performance, Leverage, also Financial Slack on Carbon Emission Disclosure with Firm Size as moderator. Population consists basic materials sector IDX 2019–2024. 60 samples were used, selected through purposive sampling. Data analysis techniques employ Moderate Regression Analysis. Results indicate that environmental performance has positive also significant impact on carbon emission disclosure, while leverage has negative and significant effect on carbon emission disclosure. Financial slack does not have a significant influence on carbon emission disclosure. Furthermore, firm size weakens impact of environmental performance on carbon emission disclosure. Firm size is unable to moderate effects of leverage and financial slack on carbon emission disclosure.

INTRODUCTION

Climate change has emerged as a pressing global concern that has drawn extensive attention from nations worldwide due to its profound consequences on human livelihoods, ecosystems, and the sustainability of economies. Global warming, as a manifestation of climate change, has triggered numerous environmental crises, including the escalation of global temperatures, the melting of polar ice caps, also rising sea levels that endanger communities in coastal zones (S. K. Putri & Ariefiara, 2023). According to Lestari (2023), Earth's average surface temperature is expected to rise by approximately 1.5 degrees Celsius within the next twenty years. Additionally, the World Meteorological Organization (2025) revealed that global temperatures have reached an unprecedented 1.54 degrees Celsius above pre-industrial levels, positioning 2025 as the warmest year ever recorded.

Increase in global temperatures is strongly associated with the accumulation of greenhouse gases in atmosphere chiefly carbon dioxide, methane, also nitrous oxide which stem from activities such as fossil fuel combustion, deforestation, and industrial production. The Global Carbon Project (2024) reported that emissions from fossil fuel consumption amounted to 37.4 billion tons of carbon, representing a 0.8% rise from the preceding year. These findings emphasize the critical necessity for global mitigation efforts, urging every nation to play an active role in curbing carbon emissions.

Indonesia, as a rapidly growing developing country, confronts significant obstacles in reducing its carbon footprint. Based on data from the Energy Institute (2024), ranks as sixth largest carbon emitter globally, producing 704.4 million tons of CO₂. Furthermore, the Climate Transparency Report (2022) highlighted a 193% increase in Indonesia's carbon emissions between 1990 and 2019. This alarming trend not only threatens the natural environment but also imposes direct health risks to the population.

In fulfilling its global commitments, Indonesia ratified Kyoto Protocol through Law 17:2004. This commitment was further reinforced by Presidential Regulation 61:2011 on National Action Plan for Greenhouse Gas Reduction and Presidential Regulation 98:2021 on Carbon Economic Value. Policies establish frameworks for carbon trading, offsets, and market-based mechanisms that allow companies to internalize the financial cost of their emissions (A. A. Putri & Paramita, 2025). They also mandate greater corporate transparency through carbon emission disclosure practices. Fitriana et al. (2025) assert that such disclosure not only satisfies regulatory demands but also functions as a tool of transparency and accountability toward the public. Similarly, Kristari & Teruna (2022) argue that carbon emission disclosure embodies company's social and environmental responsibility, demonstrating its commitment to sustainability.

Despite these frameworks, implementation of carbon emission disclosure in Indonesia remains voluntary, leading to inconsistencies and incomplete reporting among companies (Priliana & Ermaya, 2023). Rahmatika et al. (2024) further observed that the absence of binding regulations requiring comprehensive disclosure results in substantial variation in report quality. While

some firms voluntarily provide detailed and systematic disclosures, others merely offer symbolic information.

A number of prior studies have examined factors influencing carbon emission disclosure. Viulina et al. (2023); Meiryani et al. (2023); Yesiani et al. (2023) founded environmental performance positively affects carbon disclosure, as companies with good environmental performance have an incentive to demonstrate social legitimacy. However, research conducted by Nurjanah & Mulyandini (2024) and Rahmawati et al. (2024) still shows different results, indicating environmental performance doesn't affect carbon emission disclosure, so no consistent conclusion has been reached.

Financial factors have also been recognized as critical determinants. Studies by Devi et al. (2024); Afrizal et al. (2023); Harits & Mutasowifin (2024) highlight the role of leverage in carbon emission disclosure. Companies with high leverage levels tend to be more cautious in incurring costs for voluntary reporting, resulting in lower carbon disclosure. In contrast, Aini et al. (2022) emphasize companies with adequate financial slack have the financial flexibility to fund sustainability initiatives, including carbon emission disclosure.

In addition, firm size is also considered to have a significant influence. Rahmah et al. (2024); Rosa et al. (2024); and Fitriani & Sunarsih (2024) larger corporations often attract heightened scrutiny from both regulators and the public, motivating them to disclose environmental information more transparently. Furthermore, firm size is considered a moderating factor that can amplify or weaken the relationships between environmental performance, leverage, and financial slack with carbon emission disclosure.

Nonetheless, the existing empirical evidence remains inconsistent, revealing a gap in the literature that warrants further investigation. Consequently, this research concentrates on companies within Indonesia's basic materials sector for the 2019–2024 period.

LITERATURE REVIEW

Legitimacy Theory

Dowling (1975) popularized legitimacy theory, which posits that organizations disclose social and environmental information to secure societal approval. The legitimacy granted by the public is a vital strategic asset for ensuring a company's long-term sustainability; hence, it becomes an essential concern for corporate management, interdependence between businesses also societies in which operate. To maintain legitimacy, companies must align their actions with norms, values, also legal expectations prevailing within their operating environments (Syafis, 2022). As part of their efforts to gain legitimacy, firms often engage in environmental management initiatives that demonstrate their responsibility toward both society and the ecosystem. One approach to obtaining such legitimacy is through carbon emission disclosure, typically presented in sustainability reports. The more a company's operations generate positive environmental and social impacts, the more favorable the public response toward its existence becomes (Mardiana et al., 2019).

Agency Theory

Jensen & Meckling (1976) describe contractual relationship between owner also agent. It emphasizes that conflicts of interest may arise when the goals of principals and agents are misaligned. Principals delegate authority to agents to make decisions intended to achieve specific objectives (Avianty & Lestari, 2023). Within this framework, managers as agents are expected to act in best interest of shareholders as principals. However, when personal motives dominate managerial decisions, agency conflicts occur, often undermining the firm's overall value (Wiguna et al., 2025). Factors triggering agency conflicts is the existence of information asymmetry, where agents have greater access to information compared to principals. This imbalance enables managers to control or even limit the extent of corporate transparency (Ayu et al., 2025). From the standpoint of agency theory, managers may choose to restrict disclosure of environmental information, such as carbon emissions, due to concerns about the associated costs or potential reputational risks.

Carbon Emission Disclosure

Form of transparency or openness of information and corporate accountability toward environmental management (Probosari & Kawedar, 2019). Pratiwi et al. (2021) define it as an aspect of environmental disclosure that covers greenhouse gas emissions, climate change strategies, and governance structures related to environmental impacts. Carbon emission disclosure is measured using several items adopted from research of Bae Choi et al. (2013), and it is disclosed through sustainability reports. Nevertheless, in many developing countries, including Indonesia, carbon emission disclosure remains voluntary.

Environmental Performance

Factors measure of how a company is responsible for the environment. Companies will be motivated and take the initiative to disclose carbon emissions if they have good environmental performance (Dewi & Rifan, 2023). Environmental performance can be measured through company's achievements in participating in Environmental Performance Rating Program (PROPER). According to the Regulation of the Minister of Environment of the Republic of Indonesia Number 1:2021, PROPER is an evaluation of performance of business and/or activity operators in the field of environmental management. PROPER program is a relevant proxy for assessing environmental performance in context of carbon emission disclosure because it encompasses areas such as pollution prevention, energy efficiency, also sustainable resource utilization (Sherly et al., 2025).

Leverage

Leverage represents proportion of a company's assets financed through debt relative to equity. Yunaida & Lestari (2020) define leverage as the total debt employed to support business activities compared to internally generated capital. A high leverage ratio indicates heavy reliance on external financing. This financial structure can significantly influence management's decision regarding voluntary disclosures such as carbon emissions reporting. Companies burdened with substantial debt often prioritize debt servicing and other financial obligations over voluntary reporting initiatives.

Financial Slack

Financial slack indicates excess cash after a company meets all its core needs (Suryani & Laela, 2019). The availability of financial resources can be utilized to enhance environmental performance, particularly in facing climate change. A company's financial slack implementing carbon emission disclosure practices. Information regarding the availability of financial slack becomes an important consideration for companies before allocating resources to voluntary environmental disclosure activities (Aini et al., 2022).

Firm Size

Measured through total assets, sales volume, or market capitalization, providing insight into a company's operational capacity and visibility. Larger companies are subject to greater scrutiny and pressure from external stakeholders to disclose environmental information, including carbon emissions, than smaller firms (Rahmah et al., 2024). Firms with extensive operations face more intensive social expectations and regulatory oversight. Consequently, such companies are more inclined to address environmental issues proactively to sustain their legitimacy (Rahmawati et al., 2024).

Effect of Environmental Performance on Carbon Emission Disclosure

Grounded in legitimacy theory, firms are expected to align with social and environmental norms to gain community approval (Amaliyah & Solikhah, 2019). Companies demonstrating strong environmental performance are therefore more likely to disclose carbon emissions, signaling accountability and compliance with societal expectations (S. D. A. Putri & Amin, 2022). Empirical evidence from Meiryani et al. (2023) confirms that environmental performance positively and significantly influences carbon emission disclosure.

H₁: Environmental Performance has positive effect on Carbon Emission Disclosure

Effect of Leverage on Carbon Emission Disclosure

Voluntary carbon emission disclosure imposes additional costs on companies, potentially hindering their ability to meet obligations to creditors. Companies with low leverage ratios have greater capacity to disclose carbon emissions, as lower financial obligations allow them to allocate resources to environmental disclosure practices. Ratmono et al. (2021) found that leverage negatively affects carbon emission disclosure.

H₂: Leverage has negative effect on Carbon Emission Disclosure.

Effect of Financial Slack on Carbon Emission Disclosure

To carry out various social responsibility activities, companies need to allocate adequate funds and resources. Financial slack is often associated with corporate social responsibility disclosure because it can raise awareness among internal parties as stakeholders to use financial slack as a funding function in performing social responsibility (Rafailov, 2017). Consistent with this view, Aini et al. (2022) demonstrated that financial slack has positive impact on carbon emission disclosure.

H₃: Financial Slack has positive effect on Carbon Emission Disclosure

Effect of Environmental Performance on Carbon Emission Disclosure Moderated by Firm Size

Firm size indicates both availability of resources and the level of public exposure. Large corporations typically possess the capacity to manage environmental concerns more effectively and are motivated to enhance transparency through disclosure (Padila et al., 2025). Good environmental performance should encourage companies to be more active in carbon emission disclosure. However, this effect is expected to be stronger in large companies due to higher legitimacy demands compared to small companies (S. D. A. Putri & Amin, 2022).

H₄: Firm Size weakens effect of Environmental Performance on Carbon Emission Disclosure

Effect of Leverage on Carbon Emission Disclosure Moderated by Firm Size

Large size of a company reflects its financial capacity and better access to external funding (Laksani et al., 2020). Companies with high leverage levels usually face constraints in voluntary disclosures, including carbon emission disclosure. However, in large companies, pressure from stakeholders and regulators can mitigate the negative effects of leverage, thereby encouraging company to disclose carbon emissions (Florescia & Handoko, 2021).

H₅: Firm Size strengthens the influence of Leverage on Carbon Emission Disclosure

Effect of Financial Slack on Carbon Emission Disclosure Moderated by Firm Size

Financial slack provides financial flexibility for companies to support sustainability programs, including carbon emission disclosures. However, not all companies utilize this slack optimally (Rafailov, 2017). Large companies have higher exposure to the public, so the use of financial slack is more directed towards activities that enhance legitimacy and transparency (Rahmatika et al., 2024). Firm size can be used as a moderating variable because it indicates the magnitude of resources, the level of public scrutiny, and the regulatory pressures faced by company (Pande et al., 2023). Larger companies generally have a stronger motivation to maintain legitimacy and provide positive signals to stakeholders through sustainability information disclosures, including carbon emission disclosures (Rosa et al., 2024).

H₆: Firm Size strengthens influence of Financial Slack on Carbon Emission Disclosure

Based on the explanation above, the conceptual framework of the research can be described as follows.

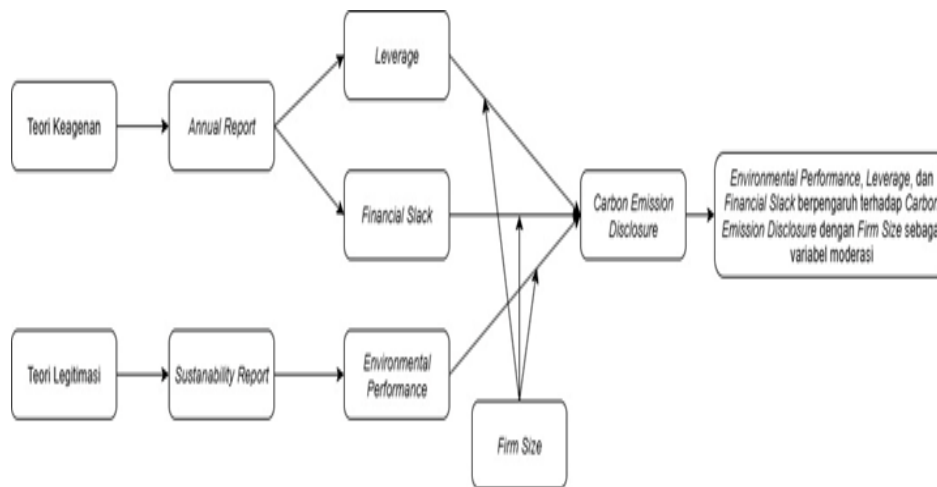


Figure 1. Conceptual Framework

METHODOLOGY

Research adopts a correlational design intended to analyze the association between independent also dependent variables. Population comprises all basic materials sector firms listed on IDX 2019–2024. Sampling technique by purposive sampling, which was applied based on predefined criteria aligned with objectives of study. Complete procedure for selecting the research sample:

Table 1. Sample Selection Using Purposive Sampling

Criteria	Sample
Basic materials sector IDX 2019-2024.	109
Basic materials sector companies that are inconsistent in publishing sustainability reports during the 2019-2024 period.	(94)
Basic materials sector companies not listed in PROPER ranking by Ministry of Environment also Forestry during the 2019-2024 period.	(5)
Number of research samples that meet the criteria	10
Research period	6
Amount	60

Table 2 below details the operationalization of the variables.

Table 2. Operasional Variabel

Variable	Indicator	Reference
Environmental Performance	Score PROPER: Gold (5) Green (4) Blue (3) Red (2) Black (1)	(Meiryani <i>et al.</i> , 2023)

Variable	Indicator	Reference
Leverage	Debt to Equity Ratio: $\frac{\text{Total Liabilities}}{\text{Total Equities}}$	(Yunaida & Lestari, 2020)
Financial Slack	Cash and Cash Equivalents $\frac{\text{Total Sales}}$	(Aini <i>et al.</i> , 2022)
Carbon Emission Disclosure	Carbon Emission Disclosure Index: $\frac{\sum \text{the disclosed item}}{\sum \text{max. disclosure item}} \times 100\%$	(Bae Choi <i>et al.</i> , 2013)
Firm Size	logaritma natural (total assets)	(Pratiwi <i>et al.</i> , 2021)

The data analysis technique used is parametric statistics, which includes classical assumptions multiple regression tests, partial correlation tests, and multiple correlation tests. To test the moderating variable hypothesis in this study, the MRA regression analysis application was used. According to Ghazali (2021:251), MRA (Moderated Regression Analysis) is a specific regression application where the regression equation contains an interaction element (the multiplication of two or more independent variables).

RESEARCH RESULT & DISCUSSION

Descriptive statistical analysis was conducted to obtain a general description of the data regarding the variables contained in the study. The following table shows the results of the descriptive statistical tests of this study.

Table 3. Descriptive Statistic Results

	N	Minimum	Maximum	Mean	Std. Deviation
Carbon Emission Disclosure	60	.278	.611	.405	.099
Environmental Performance	60	3	5	3.78	.783
Leverage	60	.148	2.872	.954	.611
Financial Slack	60	.013	.766	.249	.210
Firm Size	60	28.252	32.880	30.825	1.270
Valid N (listwise)	60				

Source: SPSS 27 Output Results, 2025

Results indicate that carbon emission disclosure scores range between 0.278 and 0.611, average value 0.405 also standard deviation of 0.099, showing deviation is smaller than mean. Environmental performance scores fall between 3 and 5, with a mean of 3.78 also standard deviation 0.783, where deviation also remains below mean. Leverage values vary from 0.148 to 2.872, yielding an average 0.954 also standard deviation 0.611, again demonstrating that variability is lower than the mean. Financial slack ranges from 0.013 to 0.766, producing an average 0.249 also standard deviation 0.210, suggesting relatively stable data dispersion. Lastly, firm size values lie between 28.252 and 32.880, with an average

30.825 also standard deviation 1.270, confirming standard deviation is smaller than mean.

Table 4. Classical Assumption Test Results

No	Classical Assumption Test	Output	Detail
1	Data Normality Test	Asymp. Sig. (2-tailed) value 0.200	Normally distributed
2	Multicollinearity Test	Tolerance values; Environmental Performance = 0.908 Leverage = 0.946 Financial Slack = 0.570 Firm Size = 0.527 VIF values; Environmental Performance = 1.101 Leverage = 1.057 Financial Slack = 1.755 Firm Size = 1.897	From the obtained results, Tolerance > 0.1 also VIF < 10, indicating multicollinearity does not occur.
3	Heteroscedasticity Test	Significance value (Glejser test) Environmental Performance = 0.929 Leverage = 0.467 Financial Slack = 0.321 Firm Size = 0.272	Based on the results obtained, significance Glejser test is > 0.05, no indication of heteroscedasticity.
4	Autocorrelation Test	Durbin-Watson Value = 2.135 $dU < Dw < 4 - dU$ $1.7274 < 2.135 < 4 - 1.7274$ $1.7274 < 2.135 < 2.2726$	No Autocorrelation

Source: SPSS 27 Output Results, 2025

Equation:

$$Y = 0.273 + 0.045 EP - 0.056 LEV + 0.058 FSLACK - 0.058 EP_SIZE - 0.019 LEV_SIZE + 0.39 FSLACK_SIZE$$

The interpretation of the regression equation above described :

1. Constant of regression model 0.273, which if values of environmental performance, leverage, financial slack, also firm size variables are considered constant or equal to 0, then carbon emission disclosure 0.273 or 27.3%.
2. Coefficient for environmental performance 0.045, signifying that a one-unit increase in environmental performance will lead to a 0.045-unit rise in carbon emission disclosure, provided that leverage, financial slack, and firm size remain unchanged.

3. Coefficient for leverage -0.056, meaning that a one-unit increase in leverage will reduce carbon emission disclosure by 0.056 units, assuming environmental performance, financial slack, and firm size are constant.
4. Coefficient for financial slack 0.058, implying that when financial slack increases by one unit, carbon emission disclosure will increase 0.058 units, holding environmental performance, leverage, and firm size constant.
5. The coefficient for interaction between firm size and environmental performance -0.058, suggesting that a one-unit increase in moderating effect of firm size on environmental performance leads to 0.058 units decline in carbon emission disclosure, assuming other variables remain constant.
6. Coefficient for interaction between firm size also leverage -0.019, indicating that a one unit increase in moderating effect of firm size on leverage results in 0.019 units decrease in carbon emission disclosure, with other variables held constant.
7. Coefficient for interaction between firm size also financial slack 0.039, meaning that a one unit increase in moderating influence of firm size on financial slack leads to 0.039 units increase in carbon emission disclosure, assuming environmental performance, leverage, also firm size are constant.

Table 5. Coefficient of Determination Analysis Results

R	R ²	Adjusted R ²	Standar Error of Estimate
.695 ^a	.483	.414	.076382

a. Predictors: (Constant), Financial Slack*Firm Size, Leverage*Firm Size, Environmental Performance, Firm Size, Leverage, Environmental

Performance*Firm Size, Financial Slack

Dependent Variabel: Carbon Emission Disclosure

Source: Researcher, 2025

R Square value is recorded at 0.483 or 48.3%. This indicates that the variables of environmental performance, leverage, financial slack, as well as the moderating variables, namely the interaction of environmental performance with firm size, the interaction of leverage with firm size, and the interaction of financial slack with firm size used in this study, are able to explain 48.3% of variation in carbon emission disclosure, while remaining variation is influenced by other variables that were not identified in research.

Tabel 6: T Statistical Test Results

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.273	.061		4.483	.000
	Environmental Performance	.045	.014	.355	3.141	.003
	Leverage	-.056	.018	-.344	-3.074	.003
	Financial Slack	.058	.053	.122	1.097	.277
	Environmental Performance*Firm Size	-.058	.015	-.14.880	-3.847	.000

	Leverage*Firm Size	-.019	.015	-3.422	-1.214	.230
	Financial Slack*Firm Size	.039	.064	2.668	.615	.541

Source: Researcher 2025

DISCUSSION

Effect of Environmental Performance on Carbon Emission Disclosure

Environmental performance has positive also significant effect on carbon emission disclosure, with significance level 0.003, below 0.05 threshold, thereby confirming hypothesis H₁. This is in line Meiryani *et al.* (2023), which states that environmental performance has significant positive effect on carbon emission disclosure. Companies with good environmental performance can engage in more environmental activities and expand the quality of carbon emission disclosure information. According to legitimacy theory, companies need to comply with societal norms by protecting the environment to gain legitimacy. Differ Nurjanah & Mulyandini (2024), who showed that environmental performance doesn't have significant effect on carbon emission disclosure.

Effect of Leverage on Carbon Emission Disclosure

Leverage has negative also significant impact on carbon emission disclosure, significance level 0.003, below 0.05 threshold, thereby confirming hypothesis H₂. This aligns with Ratmono *et al.* (2021), who stated that leverage negatively affects carbon emission disclosure. Companies with high leverage focus more on fulfilling obligations to creditors and reduce voluntary disclosure as they must prioritize debt repayment. The average leverage in the sample companies is considered moderate (0.954), indicating that carbon emission disclosure activities are constrained by high leverage. Differ from Devi *et al.* (2024), which showed that leverage has positive effect on carbon emission disclosure.

Effect of Financial Slack on Carbon Emission Disclosure

This study found that financial slack doesn't have significant effect on carbon emission disclosure, with significance 0.277, below 0.05 threshold, thus rejecting hypothesis H₃. The average financial slack in the sampled companies is relatively low at 0.249, and therefore insufficient to encourage carbon emission disclosure. Disclosure decisions are more influenced by stakeholder pressure, regulations, and company business strategies. This finding differs from Aini *et al.* (2022), which indicated a significant positive relationship between financial slack also carbon emission disclosure.

Effect of Environmental Performance on Carbon Emission Disclosure Moderated by Firm Size

Coefficient for environmental performance variable moderated by firm size -0.058 with a calculated t-value -3.847 also significance 0.000 < 0.05, so H₀ is rejected also H₄ is accepted. Firm size variable is able to moderate environmental

performance on carbon emission disclosure in companies in basic materials sector Indonesia 2019-2024.

Firm size has been proven to weaken impact of environmental performance on carbon emission disclosure. Firm size will influence managers' decisions in using environmental performance to perform carbon emission disclosure. Large companies with good environmental performance may feel that they already have a good reputation and therefore do not need to disclose carbon emissions excessively. Meanwhile, small companies with good environmental performance are more motivated to disclose carbon emission information to enhance their legitimacy in the eyes of stakeholders.

Effect of Leverage on Carbon Emission Disclosure Moderated by Firm Size

Coefficient for leverage variable moderated by firm size -0.019, with a t-value -1.214 also a significance level $0.230 > 0.05$, hence H_0 is accepted also H_5 is rejected. Firm size variable is unable to moderate leverage on carbon emission disclosure in basic materials sector Indonesia 2019-2024.

Firm size is unable to strengthen or weaken leverage on carbon emission disclosure. This is due to the fact that average leverage in companies is 0.954. Because of this, both large and small companies with high leverage face financial pressures that limit their ability to make voluntary disclosures. The presence of debt in a company also does not have an impact because management is considered to have already accounted for the debt and therefore does not need to take additional steps to signal to stakeholders that company's condition is still good. Average company size is considered large. Thus, management has good managerial capability in meeting obligations, and company size has good level of confidence in debt management.

Effect of Financial Slack on Carbon Emission Disclosure Moderated by Firm Size

Coefficient for financial slack variable moderated by firm size 0.039, obtaining t-value 0.615 with a significance level $0.541 > 0.05$. Therefore, H_0 is accepted also H_6 is rejected. Firm size variable cannot moderate financial slack on carbon emission disclosure in basic materials sector companies IDX 2019-2024. Financial slack, measured using ratio of cash also cash equivalents to total sales, doesn't directly encourage companies, whether large or small, to conduct carbon emission disclosure. Even if a company has high level of cash relative to its sales, this does not guarantee increased transparency in carbon emission reporting. When companies carry debt, management tends to be more cautious in making policies that could affect their reputation in the eyes of stakeholders. Nevertheless, the level of financial slack, as reflected by cash and cash equivalents and company size, is not strong enough to drive the implementation of carbon emission disclosure, as disclosure decisions are more influenced by other factors such as stakeholder pressure, regulations, and the company's business strategy.

CONCLUSIONS AND RECOMMENDATIONS

This research investigates influence of environmental performance, leverage, also financial slack on carbon emission disclosure among basic materials sector firms listed on IDX 2019–2024, with firm size serving as a moderating variable. Carbon emission disclosure in these firms fluctuated throughout observed period.

Carbon emission disclosure levels among companies on the IDX range between 0.278 and 0.611, with an average score of 0.405 or 40.5%. Overall disclosure level in basic materials sector remains moderate, implying that greater efforts are needed to enhance transparency in environmental reporting. The average environmental performance score of these firms during 2019–2024 is 3.78, which indicates that most companies achieved the blue category under PROPER, reflecting satisfactory environmental management. Firms that demonstrate stronger environmental performance tend to disclose more information about carbon emissions as a way to maintain and enhance their legitimacy in the eyes of stakeholders.

During the same period, the average leverage ratio of basic materials sector companies listed on IDX was 0.954. This relatively high level of leverage shows that many firms focus primarily on meeting financial commitments to creditors, which can limit the resources available for voluntary initiatives such as carbon emission disclosure. The average financial slack value was found to be 0.249, suggesting that firms have limited financial flexibility to invest in sustainability initiatives, including environmental reporting. Meanwhile, the average firm size score of 30.825 reflects that larger companies generally possess more extensive resources and are subject to greater regulatory and public scrutiny. Consequently, bigger firms often experience higher expectations and external pressure to increase transparency of their environmental information.

The hypothesis testing results reveal that environmental performance has positive and significant impact on carbon emission disclosure. Finding implies that firms with superior environmental performance are more inclined to disclose carbon-related information to reinforce their legitimacy with stakeholders. Conversely, leverage has negative also significant influence on carbon emission disclosure, indicating that firms with higher debt levels tend to prioritize debt repayment over voluntary reporting practices. Financial slack, however, does not have a significant effect on carbon emission disclosure, suggesting that mere availability of financial resources doesn't necessarily encourage firms to disclose more carbon information, as disclosure behavior is largely shaped by stakeholder demands, regulatory factors, and strategic considerations.

In terms of moderating effects, firm size was found to moderate relationship between environmental performance also carbon emission disclosure, albeit in a weakening manner. Large firms with strong environmental performance may feel their reputations are already established, thus reducing the perceived need for extensive disclosure. In contrast, smaller firms with good environmental performance are more likely to disclose carbon information as a means of gaining

legitimacy. On the other hand, firm size does not moderate effect of leverage or financial slack on carbon emission disclosure. Regardless of company size, firms with high leverage remain constrained in voluntary disclosure, and greater financial flexibility alone does not automatically lead to enhanced transparency. Overall, the joint influence of environmental performance, leverage, financial slack, and firm size accounts for 48.3% of the variation in carbon emission disclosure among basic materials sector companies in Indonesia, while remaining variation is attributed to other factors beyond scope of research.

ADVANCED RESEARCH

Based on the conclusions and research results presented above, the following recommendations are provided:

1. This research focused on basic materials companies listed on the Indonesia Stock Exchange. Therefore, future research is recommended to expand the sample size to include companies from other sectors listed on the Indonesia Stock Exchange to compare carbon emission disclosure practices in other sectors with different operational characteristics.
2. Future research is recommended to use other measures of carbon emission disclosure, such as the Global Reporting Initiative (GRI) Standards, to provide a more comprehensive perspective on the quality of carbon emission disclosure.
3. Future research is recommended to expand the scope of other independent variables that determine carbon emission disclosure to ensure more accurate results and represent the overall conditions influencing carbon emission disclosure.
4. Future research is recommended to extend the observation period to capture the dynamics of changes in carbon emission disclosure practices over a longer period and identify more comprehensive disclosure trends.
5. Future research is recommended to use other moderating variables to provide a different perspective in understanding the factors that moderate the relationship between independent variables and carbon emission disclosure.

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