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The Effect of Carbon Accounting Disclosure, Environmental Performance, and CEO Characteristics on Financial Performance: The Role of Firm Size as a Control Variabel

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A B S T R A C T

This study investigates the effect of carbon accounting disclosure, environmental performance, and CEO characteristics (education, tenure, and gender) on the financial performance of energy sector entities recorded on the Indonesia Stock Exchange from 2021 to 2023, with firm size as a control variable. Using secondary data and panel data regression analysis processed with Stata 17, the findings reveal that only CEO gender significantly influences financial performance, albeit negatively. Other variables, including carbon accounting disclosure, environmental performance, CEO education, CEO tenure, and firm size, show no significant effects. These results highlight the complexity of financial performance determinants, emphasizing the need for improved carbon disclosure quality and long-term environmental strategies.

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INTRODUCTION

Climate change has become one of the most critical global challenges in the last three decades, surpassing other sustainability issues such as biodiversity loss, deforestation, poverty, overpopulation and drinking water scarcity (Maama & Gani, 2022). A wide range of scientific evidence shows that climate change poses a serious threat to the survival of life on earth (Keith et al., 2019). This phenomenon has encouraged companies to change their perspective from viewing climate change as a burden to a business opportunity, given that financial markets and investors now give more appreciation to companies that are proactive in addressing climate change issues (Bui et al., 2020).

Indonesia, as one of the countries with significant levels of carbon emissions, faces serious challenges in controlling emissions. Based on the GHG Emissions of All World Countries Report findings, Indonesia's greenhouse gas emissions grew by 10% in 2022, marking the highest percentage increment globally (Crippa et al., 2023). Responding to this situation, the Indonesian government has set ambitious targets to reduce emissions intensity by 29% by 2030 and achieve net-zero emissions by 2060 (Effendy & Winarsih, 2024), including the implementation of a carbon trading system starting in September 2023 (MenLHK, 2023).

In this context, carbon accounting emerges as a critical instrument for companies to measure, monitor and manage their carbon emissions. Although still largely voluntary, carbon emissions disclosure practices are increasingly being adopted by companies to reduce information asymmetry and demonstrate commitment to social and environmental issues (Adhikari & Zhou, 2022).

The dynamics of the relationship between carbon emissions disclosure and financial performance is still debated among academics. Some studies show that disclosure of carbon emissions can increase operating costs and reduce profitability (Yang et al., 2021). However, other studies reveal that carbon disclosure actually has a positive impact on financial performance because it increases stakeholder confidence (Alsaifi et al., 2020).

Environmental performance has also become an increasingly important focus of attention in recent decades. Benkraiem et al. (2023) note that various stakeholders, ranging from governments to investors, are increasingly paying attention to companies' environmental management activities. Environmental performance in Indonesia is measured through the PROPER initiative led by the Ministry of Environment and Forestry, featuring a five-level color system from gold (highest) to black (lowest) at both regional and national levels (Jaya & Nugraheni, 2024).

The characteristics of CEOs as key decision-makers also play a vital role in the implementation of corporate environmental policies. Elsayih et al. (2021) emphasize that CEOs have a major responsibility in controlling greenhouse gas emissions and responding to stakeholder expectations regarding carbon management and reporting. Pratiwi (2018) emphasized that carbon management and reporting are used to assess business risks related to climate change and identify business potential. Understanding how CEO characteristics influence

environmental decisions and financial performance is becoming increasingly relevant in this context.

In the context of this study, company size is included as a control variable as it has the potential to be significant in influencing the relationship between key variables and financial performance. Large firms have easier access to external funding sources and better ability to compete in the industry (Evelyn et al., 2022). Furthermore, large-sized companies have a broader stakeholder base, so their policies have a greater impact on public interests compared to small companies (Jumantari et al., 2022).

This study makes significant contributions to knowledge development in several aspects. First, this study enriches the literature by integrating the perspectives of carbon accounting, environmental performance, and CEO characteristics in one comprehensive analytical framework, which is still rare in the context of developing countries. Second, this study provides empirical evidence on the role of firm size in moderating the relationship between environmental variables and financial performance, providing a deeper understanding of this dynamic in the energy sector. Third, the findings of this study can provide practical implications for policy makers in designing more effective regulations related to carbon disclosure and environmental management.

Based on the above description, this study aims to analyze how carbon accounting disclosures, environmental performance, and CEO characteristics affect the financial performance of energy sector entities, considering firm size as a control variable, in the specific context of Indonesia and global dynamics related to climate change.

LITERATURE REVIEW

Legitimacy Theory

Legitimacy theory views companies as part of a social system that is influenced and affects the surrounding community, focusing on the community's perception of the compatibility of company activities with social values, norms and beliefs (Putri & Murtanto, 2023). This concept is based on the social contract between companies and society, which requires companies to conduct business responsibly and transparently (Melja et al., 2023). The inability of companies, particularly in the energy sector, to disclose credible environmental information, such as carbon emissions, can undermine their legitimacy (Datt et al., 2020).

Stakeholder Theory

Stakeholder theory emphasizes that a firm's sustainability depends on its ability to meet the expectations of stakeholders, which include all parties who have an interest in the company's business activities (Bouguerra et al., 2023). This theory emphasizes the importance of transparency in the disclosure of environmental, social, and strategic information, such as carbon emissions, to meet stakeholder expectations and promote corporate sustainability (Putri & Murtanto, 2023).

Upper Echelon Theory

This theory explains that top management characteristics, such as age, education, professional experience, and social background, significantly influence strategic decision-making and organizational outcomes (Ahmad et al., 2022). CEO characteristics, like educational background also experience, influence the interpretation of the situation and the strategies taken, which have an impact on organizational performance, including in environmental management and carbon accounting implementation (Alfianto et al., 2024). Although external factors such as industry and environment also affect organizational performance, this theory provides an important perspective in understanding how strategic decisions taken by CEOs can determine the direction of the company, especially in the energy sector that faces sustainability challenges (Kaur & Singh, 2019).

Carbon Accounting Disclosure

Carbon accounting is a concept that integrates the measurement, reporting, and mitigation of carbon emissions into corporate financial reporting as part of environmental accounting to support sustainability (Melja et al., 2023). Based on legitimacy theory and stakeholder theory, carbon disclosure helps companies gain social legitimacy and meet societal expectations (Putri & Murtanto, 2023). However, research shows mixed results regarding its impact on financial performance. Desai et al. (2022) found potential cost savings through green technology investments, but Handoko & Santoso (2023) noted large costs that affect short-term profitability. Meanwhile, Kumar & Firoz (2018) stated that carbon emissions may increase the company's funding costs.

H1: Carbon accounting disclosure negatively affects the company's financial performance.

Environmental Performance

Environmental performance reflects a firm's efforts to manage and preserve the environment in its area of operation, often measured through programs such as PROPER (Corporate Performance Rating Program in Environmental Management) (Angelina & Nursasi, 2021). Based on legitimacy theory, companies that are committed to environmental conservation can maintain their legitimacy and gain support from society and stakeholders (Crossley et al., 2021). Saputra (2020) notes that positive responses from stakeholders to good environmental performance can increase sales and Return on Assets (ROA), while Dewi (2019) shows that good environmental performance contributes to the legitimacy of the company in the eyes of society and investors.

H2: Environmental performance has a positive effect on the company's financial performance.

CEO Characteristics

CEO characteristics play an important role in determining the financial performance of the company. Upper Echelon Theory states that CEOs' individual characteristics, such as education, tenure, and gender, influence how they make strategic decisions and manage the company (Ahmad et al., 2022). CEOs' higher

education, particularly in business, economics or accounting, is associated with more effective firm management and better performance (Zaidi et al., 2021). A longer tenure allows the CEO to understand the business in depth, which can improve the company's financial achievements, although too long a tenure can bring certain risks (Kaur & Singh, 2019). In addition, CEO gender also has a mixed influence on performance, with some studies showing that female CEOs tend to be more cautious in their decision-making, which may affect the financial outcomes of the firm (Mbekomize et al., 2021).

H3: CEO education has a positive effect on corporate financial performance.
H4: CEO tenure has a positive effect on company financial performance.
H5: CEO gender has a positive effect on company financial performance.

Firm Size

Company size describes the scale of the company which can be measured based on revenue, total assets, or total equity (Sembiring et al., 2024). Company size also plays an important role in financial performance because large companies tend to be more profitable and have sufficient resources to support better operations and decision making (Jumantari et al., 2022). In addition, company size can be used as a control variable to ensure that the influence of other factors on the company's financial performance remains stable and undistorted (Eriyana & Wulandari, 2024).

H6: Firm size positively controls carbon accounting disclosure, environmental performance, and CEO characteristics on firm financial performance.

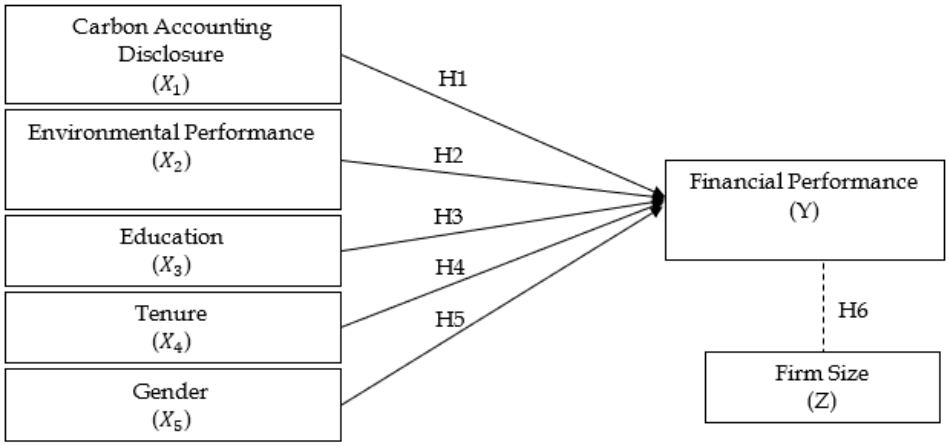

Figure 1. Conceptual Framework

METHODOLOGY

This research employs a quantitative methodology using an associative approach, focusing on energy companies that were registered on the Indonesia Stock Exchange (IDX) between 2021 and 2023 as its study population. Samples were selected using purposive sampling technique, with the criteria that companies are consistently listed on the IDX, report complete annual and sustainability reports, and disclose carbon emissions and participate in PROPER assessments. The data used is secondary data obtained from company annual

reports, sustainability reports, and related official websites. The analysis technique used is multiple linear regression with panel data, which is processed using the Stata 17 program.

RESEARCH RESULT

Panel Regression Model Analysis

Chow Test

The selection between Fixed Effect Model and Common Effect Model for panel data estimation is determined through the application of a Chow test. Based on the results of the chow test that has been carried out using Stata 17, it shows that the probability value is 0.0000 > 0.05, which means that the null hypothesis (H_0), namely the Common Effect Model in this test is rejected and the alternative hypothesis (H_1), namely the Fixed Effect Model, is accepted. So, the research continued with the Lagrange Multiplier Test.

Lagrange Multiplier Test

The comparative analysis between Random Effect and Common Effect Models is conducted through the application of a Lagrange Multiplier Test. Based on the results of the Lagrange Multiplier Test which has been carried out using Stata 17, it shows that the probability value of the Lagrange Multiplier Test is smaller than the significance value (0.0000 < 0.05). So, statistically H_0 Common Effect Model (CEM) is rejected and H_1 Random Effect Model (REM) is accepted. This research then continued with the Hausman Test.

Hausman Test

The Hausman test is used to decide whether the Fixed Effect Model (FEM) or the Random Effect Model (REM) is more suitable for use. Based on the Hausman Test that has been carried out with Stata 17, it shows that the probability value of the Hausman Test is greater than the significance value (0.0736 > 0.05). So, statistically H_1 Fixed Effect Model (FEM) is rejected and H_0 Random Effect Model (REM) is accepted. Thus, the more appropriate model to use in this study is the Random Effect Model (REM).

Classical Assumption Test

The Classical Assumption Tests required in panel data regression include the multicollinearity test and the heteroscedasticity test.

Multicollinearity Test

This test aims to identify any correlation between the independent variables in the regression model. The model is considered free of multicollinearity if the Variance Inflation Factor (VIF) value is below 10. Multicollinearity test is mandatory for any model selected. In this study, data centering was carried out to overcome multicollinearity problems. Presented below are the findings of the Multicollinearity Test conducted in this study:

Table 1. Multicollinearity Test Results

Variable	*Collinearity Statistics*	
	VIF	**1/VIF**
CAD	1.62	0.619183
EP	1.58	0.634783
EDU	5.72	0.174781
TNR	2.26	0.441658
GDR	1.05	0.952754
Ln_SIZE	7.20	0.138878
***Mean* VIF**	3.24	

Source: Processed Researcher from Stata 17, 2024

Based on table 1, the results of multicollinearity testing in this study are VIF values smaller than 10 and 1/VIF values greater than 0.10. It can be concluded that all independent variables have met the requirements and are free from multicollinearity problems.

Heteroscedasticity Test

The heteroscedasticity test is conducted to analyze whether the panel data regression model is exposed to heteroscedasticity problems, namely the inequality of the variance of the residual value between observations in the linear regression model. Because this study uses the Random Effect Model, which is a model that uses Generalized Least Squares (GLS) as its estimation technique, and is robust to the model, which means that this model has overcome the problem of heteroscedasticity in the research conducted. So, it can be concluded that this study has passed the heteroscedasticity test.

Hypothesis Test

There are three hypothesis tests, namely the Coefficient of Determination Test (R^2), T Statistical Test (Partial Test), and F Statistical Test. The following are the results of the research hypothesis test using the Random Effect Model (REM).

Coefficient of Determination (R-Squared/R^2)

The coefficient of determination test is carried out to measure the extent to which the contribution of the independent variable describes the dependent variable in this study. The following are the results of the coefficient of determination or R^2 test:

Table 2. Coefficient of Determination Test Result

Number of obs	75
R-*Square*	0.0017

Source: Processed Researcher from Stata 17, 2024

Table 2 shows the overall R-Squared value of 0.0017 or 0.17%. This value indicates that the independent variables, namely Carbon Accounting Disclosure, Environmental Performance and CEO Characteristics (Education, tenure, and gender) have an ability of 0.17% in describing the dependent variable, namely

financial performance (ROA). Meanwhile, 0.9983 or 99.83% of the Financial Performance (ROA) variable is explained by other factors not included in the model.

T Statistical Test (Partial Test)

The magnitude of influence between each independent variable and the dependent variable is evaluated through a t statistical test, or Partial Test. The following are the results of the t statistical test using the Random Effect Model (REM) regression model.

Table 3. T Statistical Test Results (Partial Test)

Variable	*Coefficient*	*Robust Std. Err*	z	P>|z|
CAD	0.0279392	0.0815434	0.34	0.732
EP	-0.0016712	0.030812	-0.05	0.957
EDU	-0.0228871	0.0622961	-0.37	0.713
TNR	-0.0032139	0.0030806	-1.04	0.297
GDR	-0.1157607	0.0242665	-4.77	0.000
Ln_SIZE	0.0099788	0.0349653	0.29	0.775
Cons	-0.0016619	0.7125389	-0.00	0.998

Source: Processed Researcher from Stata 17, 2024

Table 3 highlights the t-test results, interpreted using the probability values. For the CAD variable, the probability value is 0.732, exceeding the significance threshold of 0.05, indicating no significant effect. Meanwhile, the coefficient value of 0.0279392 reflects a positive direction, suggesting that Carbon Accounting Disclosure does not significantly impact Financial Performance; thus, H1 is rejected.

The EP variable yields a probability value of 0.957, which is higher than the 0.05 significance level, confirming no significant impact. Despite a coefficient value of -0.0016712, suggesting a negative trend, Environmental Performance does not significantly influence Financial Performance, leading to the rejection of H2.

The EDU variable shows a probability value of 0.713, surpassing the significance threshold of 0.05, indicating no significant effect. Its coefficient value of -0.0228871 implies a negative relationship. As a result, CEO Education does not significantly impact Financial Performance, and H3 is rejected.

For the TNR variable, the probability value stands at 0.297, which is greater than 0.05, showing no significant effect. Although the coefficient value is -0.0032139, implying a negative tendency, CEO tenure does not significantly affect Financial Performance, and H4 is rejected.

The GDR variable presents a probability value of 0.000, which is below the significance level of 0.05, demonstrating a significant effect. However, with a coefficient value of -0.1157607, indicating a negative influence, CEO Gender significantly impacts Financial Performance in a negative direction. Nevertheless, H5 is rejected as the influence contradicts the hypothesis.

Lastly, the SIZE control variable produces a probability value of 0.998, far exceeding the significance level of 0.05, meaning it has no significant effect. Despite the coefficient value of 0.0099788 indicating a positive relationship, Company Size does not serve as a significant control variable for Financial Performance, and H6 is rejected.

DISCUSSION

The Effect of Carbon Accounting Disclosure on Financial Performance

The test results show that Carbon Accounting Disclosure does not have a significant influence on the company's Financial Performance, so H1 is rejected. Although carbon accounting disclosure is a manifestation of the company's commitment to the environment and an effort to meet stakeholder expectations as described in legitimacy and stakeholder theory, its implementation raises significant financial trade-offs. In accordance with the findings of Kumar & Firoz (2018), carbon disclosure can increase the company's funding costs, both in terms of equity and debt. This indicates that the market has not fully appreciated carbon disclosure efforts in the form of better financial valuation.

The absence of significant effect can be explained by the voluntary nature of carbon disclosure in Indonesia. As stated by Syabilla et al. (2021), this practice has only been carried out by a limited number of companies in Indonesia. This voluntary nature leads to variations in the quality and quantity of disclosures, which in turn makes it difficult for the market to consistently assess their economic impact.

Although Soewarno et al. (2018) argue that carbon emissions disclosures can increase sales through increased consumer awareness of environmentally friendly products, the results of this study show that the effect is not yet strong enough to create a significant positive impact on overall financial performance.

The Effect of Environmental Performance on Financial Performance

The test results show that Environmental Performance has no significant effect on Financial Performance, so H2 is rejected. This result opposes the expectations of legitimacy theory, which suggests that strong environmental performance ought to elicit a favorable reaction from stakeholders (Crossley et al., 2021) and the findings of Saputra (2020) which indicate a positive relationship between environmental performance and financial performance. This insignificance may be due to several factors: although the government has implemented PROPER as a standardized rating system since 2002 (Jaya & Nugraheni, 2024), the financial impact of environmental investments tends to be long-term and not immediately visible in short-term financial metrics; moreover, the significant implementation costs of environmental programs may offset the potential financial benefits derived from enhanced corporate reputation and legitimacy, thus showing no statistically significant effect on financial performance within the observation period.

The Effect of CEO Characteristics on Financial Performance

The test results show that the three aspects of CEO characteristics have different patterns of influence on financial performance. CEO education and

tenure do not show a significant effect, in contrast to the predictions of Upper Echelon Theory and the findings of Ghardallou et al. (2020) and Emestine & Setyaningrum (2019). This indicates that in the context of this study, the CEO's formal education level and experience may not be the main determinant factors in determining financial performance. Meanwhile, CEO gender shows a negative significant effect, in line with the findings of Kaur & Singh (2019) which indicate that female CEOs tend to be more risk-averse in decision-making than men, which may limit the growth potential of the company's financial performance.

The insignificant effect of CEO education and tenure, as well as the negative effect of CEO gender, may reflect the complexity of the CEO role in the modern business context, where success is determined not only by individual characteristics, but also by contextual factors such as industry dynamics, macroeconomic conditions, and the effectiveness of the management team as a whole. As Ahmad et al. (2022), CEO characteristics may indeed shape the strategic direction of the firm, but their influence on financial performance may be mediated or moderated by a variety of more complex organizational and environmental factors.

Firm Size as a Control Variable on Financial Performance

The test results show that company size as a control variable has no significant effect on financial performance, contrary to previous findings which state that large companies have strategic advantages in their operations. Although Evelyn et al. (2022) and Anaima & Trisnaningsih (2021) state that large companies have easier access to external funding sources and better ability to compete in the industry, and Sembiring et al. (2024) indicated a correlation between company size and increased profitability, the results of this study indicate that company size is not a determinant factor in determining financial performance in the sample studied, indicating that the success of financial performance is more determined by the effectiveness of management in managing available resources, regardless of the scale of the company.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this study, it can be concluded that of the six variables studied, only CEO Gender shows a significant influence on the company's financial performance with a negative direction, while Carbon Accounting Disclosure, Environmental Performance, CEO Education, CEO Tenure, and Company Size Control Variables do not show a significant influence. To improve the effectiveness of corporate management, it is recommended that companies: (1) improve the quality of carbon accounting disclosure through more structured reporting standardization, (2) optimize environmental management programs by considering long-term cost-benefit aspects, (3) consider gender balance in corporate leadership while still prioritizing competence, and (4) focus on improving operational efficiency and strategic innovation regardless of company size, given that financial performance is more determined by the effectiveness of management in managing available resources.

ADVANCED RESEARCH

This study has limitations in sample coverage which only includes energy sector companies in Indonesia for the period 2021-2023, so the findings may not apply to other sectors. In addition, the quality of voluntary data on carbon accounting disclosures and environmental performance may affect the results, and this study has not considered external factors such as regulation or market dynamics. Further research is recommended to expand sample coverage, improve data standardization, and integrate contextual factors for more in-depth results.

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