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# The Effect of Directors' Educational Background and Return on Assets on Carbon Emission Disclosure: Evidence from Non-Financial Companies in Indonesia

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***Abstract***

*Carbon emission disclosure has become a global issue as part of business sustainability practices. This study aims to examine the effect of directors' educational background on carbon emission disclosure in non-financial industries in Indonesia. Educational background is reflected in board diversity, particularly directors with financial education such as economics, management, and accounting. This research employs a quantitative approach using secondary data derived from annual reports and/or sustainability reports of non-financial companies in Indonesia from 2019 to 2025. The population consists of all companies listed on the Indonesia Stock Exchange during the period. The sample includes 72 non-financial companies from sectors such as basic materials, consumer non-cyclical, consumer cyclical, energy, industrials, infrastructure, property and real estate, as well as transportation and logistics, selected using purposive sampling. The results indicate that directors' educational background has a positive effect on carbon emission disclosure, as shown by a significance value of 0.0009 (< 0.05). Meanwhile, return on assets (ROA) has no significant effect on carbon emission disclosure, with a significance value of 0.9346 (> 0.05). These findings suggest that non-financial factors, particularly the educational background of directors, play a more important role in encouraging environmental disclosure. The study is expected to provide insights for companies in making strategic decisions, especially in considering the representation of directors with financial educational backgrounds as part of their commitment to business sustainability.*

*Keywords: Educational Background, Carbon Emission Disclosure, Financial Background, Non-Financial Companies*

## 1. Introduction

Greenhouse gas (GHG) emissions are currently regarded as one of the most serious threats to global environmental sustainability. The excessive accumulation of greenhouse gases in the atmosphere triggers an imbalance in the climate system, which ultimately leads to climate change and a significant increase in global temperatures. This phenomenon not only affects environmental conditions but also has wide-ranging consequences across various aspects of life. According to [1], long-term climate change and global warming have direct implications for humans, ecosystems, and physical assets. These impacts include a decline in labor productivity due to increasingly unfavorable environmental conditions, which in turn affects a country's economic performance, including a decrease in Gross Domestic Product (GDP) [2], [3]. Furthermore, climate change increases the risk of natural disasters, disrupts food security, and accelerates the degradation of natural resources [4].

The contribution to increasing carbon emissions largely originates from human (anthropogenic) activities [5]. Activities such as air transportation, the use of fossil fuels in the energy and industrial sectors, deforestation, and environmentally unfriendly industrial expansion are the main contributors to GHG emissions. In addition, rapid urbanization and rising energy consumption further exacerbate the condition [6]. Therefore, mitigation and adaptation efforts to climate change are essential and need to be implemented in an integrated manner to maintain environmental balance and ensure sustainable development in the future [7].

Indonesia contributes approximately 965.3 Mt $CO_2e$ (2.03% of global greenhouse gas emissions). A portion of these emissions comes from production activities, amounting to 114.4 Mt $CO_2e$ (0.24% of global emissions).

Indonesia has demonstrated a strong commitment to climate change mitigation through the ratification of the Kyoto Protocol on June 28, 2004, which was enacted through Law No. 17 of 2004. This step reflects Indonesia's active participation in global efforts to reduce greenhouse gas emissions. Furthermore, the government has implemented several strategic policies, including Presidential Regulation No. 61 of 2011 concerning the National Action Plan for Greenhouse Gas Emission Reduction (RAN-GRK) and Presidential Regulation No. 71 of 2011 regarding the implementation of the national greenhouse gas inventory. These policies aim to strengthen emission management systems through integrated measurement, reporting, and verification mechanisms [8].

In addition, Indonesia participated in the Paris Agreement in 2015 along with 196 countries as a form of collective commitment to addressing global climate change. As a result of this agreement, Indonesia has set a target to reduce carbon emissions by 29% by 2030 through various planned mitigation strategies. In this context, the increasing level of carbon emissions has also encouraged companies to disclose carbon emissions as part of their environmental accountability. Such disclosure serves as an important instrument to enhance transparency, comply with regulatory requirements, and support sustainable business practices.

Previous studies have extensively examined carbon emission disclosure by testing various determinants as research variables. These studies [9] indicate that the structure of the board of directors is associated with higher levels of carbon emission disclosure. This finding is supported by [10] who argue that diversity in directors' backgrounds can enrich perspectives and improve the quality of decision-making within the organization. Furthermore, [11] argue that variations in experience, expertise, and gender within the board of directors contribute to improving overall firm performance. However, empirical findings remain inconsistent. Kilic and Kuzey found that gender diversity has a negative effect on carbon emission disclosure. In contrast, [11] reported a positive and significant relationship between board diversity and carbon disclosure among Australian companies during the 2009–2012 period.

Board diversity can be examined through variations in both educational background and educational attainment among its members. Educational background includes fields such as finance, law, and science, while educational attainment refers to academic levels such as undergraduate (bachelor's), master's, and doctoral degrees. In line with the advancement of globalization, firms have become increasingly multicultural, leading to the perception that directors' educational background and level of education reflect distinct managerial styles. In this context, directors' educational background may influence their awareness of the importance of environmental information disclosure.

In addition, [12] in their study of large Australian firms during 2006–2008, found that corporate governance mechanisms are positively associated with the level of carbon emission disclosure. These inconsistent findings indicate that the relationship between board characteristics and carbon emission disclosure still requires further investigation, particularly by considering different institutional contexts and firm characteristics. The composition of the board of directors plays a crucial role in controlling and determining policies related to the information presented in a company's annual reports. As the main governing body, the board is fully responsible for managing and ensuring the continuity of operations, including maintaining transparency and accountability in reporting. Therefore, the characteristics of directors become important factors that may influence the quality and extent of information disclosed to stakeholders.

Research by [13] shows that the educational background and age of top management are positively related to the level of environmental information disclosure. This suggests that intellectual capacity and managerial experience can enhance awareness and commitment to sustainability issues. Accordingly, a financial educational background may represent an important aspect of board diversity that influences carbon emission disclosure. Thus, this study is conducted to examine whether the proportion of directors with financial education backgrounds such as economics, accounting, and management can encourage carbon emission disclosure in non-financial companies in Indonesia. Moreover, the topic of educational background remains relatively underexplored in the Indonesian context, providing an opportunity for research novelty.

## 2. Research Methods

Population refers to a generalization area that includes subjects or objects with specific characteristics and qualities determined by the researcher to be studied and from which conclusions are drawn [13]. In this study, the population consists of all companies listed on the Indonesia Stock Exchange during the 2019–2025 period. The selection of

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2019 as the starting year is based on data availability and relevance, particularly related to the implementation of the Global Reporting Initiative (GRI) 305 standards on emissions, which were introduced in 2018. Therefore, the use of data in year t+1 is expected to better reflect the implementation of these reporting standards.

The data used in this study are secondary data obtained from companies' annual reports and sustainability reports. The application of emission disclosure standards based on GRI 305 is an important consideration in determining the observation period, as it is directly related to the consistency and completeness of the disclosed information. Furthermore, 2025 is selected as the end of the observation period, considering that data collection was conducted comprehensively until mid-2026, ensuring the availability of complete and reliable data for analysis. A total of 72 companies that disclose carbon emissions were selected as the sample, resulting in 504 firm-year observations used in the analysis.

The measurement of variables in this study is based on GRI 305: Emissions. If a company discloses an item listed in the index, it is assigned a score of 1; otherwise, it is assigned a score of 0. The maximum score that can be obtained is 6, while the minimum score is 1. The total score is then converted into a decimal form by dividing it by the maximum score (6).

From an agency theory perspective, directors act as agents entrusted by shareholders to manage the company. In practice, agents tend to prioritize their own interests, potentially neglecting shareholders' interests, particularly in allocating resources for environmentally related activities. This condition may lead to a decline in shareholders' returns. To mitigate this issue, reducing information asymmetry is essential, one of which can be achieved through carbon emission disclosure.

From a stakeholder theory perspective, directors are not only accountable to the firm but also to its broader stakeholders. Accordingly, directors play a strategic role in determining and controlling voluntary information disclosed to the public.

The educational background variable in this study refers to directors with financial and business-related degrees (Accounting, Management, Economics, and Business). This study focuses on financial-related educational backgrounds because such graduates are considered to have a deeper understanding of business compared to non-financial graduates. The measurement of educational background follows [13], calculated as the proportion of directors with financial education to the total number of directors. The second variable, Return on Assets (ROA), is used to measure a company's ability to generate profit from its assets utilized in operational activities. In this study, ROA is calculated as net income divided by total assets [14].

Operational definitions describe the boundaries and characteristics of the variables employed in the study, including dependent, independent, and control variables. The detailed operational definitions and measurement of each variable are presented in Table 2.1 below.

**Table 2.1** Operational Definition Variables

| Variable Type | Variable | Indicator |
|---|---|---|
| Dependent Variable | Carbon Emission Disclosure (CED) | GRI Standard 305 |
| Independent Variable | Educational Background | Measured by the proportion of board members with a financial educational background relative to the total number of directors |
| | Return on Assets (ROA) | Return on Assets (ROA) is measured as the ratio of net income to total assets. |

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## 3. Results and Discussions

### Descriptive Statistic Analysis

The statistical measures used in this study include the minimum, maximum, mean, and standard deviation. The results of the descriptive analysis are presented in Table 3.1 as follows:

**Table 3.1** Descriptive Statistic Analysis

| | CED | EDU | ROA |
|---|---|---|---|
| Mean | 0.4270 | 0.5777 | 0.0334 |
| Median | 0.4600 | 0.6000 | 0.0453 |
| Maximum | 0.8900 | 1.0000 | 0.8104 |
| Minimum | 0.0700 | 0.0000 | -1.0500 |
| Std. Dev. | 0.3904 | 0.2329 | 0.1733 |
| Observations | 504 | 504 | 504 |

The results of the descriptive statistical analysis for the independent variable, directors' educational background, show a mean value of 0.5777 and a standard deviation of 0.2329. The mean value of 57.77% indicates that the majority of board members possess adequate business knowledge and skills. In addition, the mean value (0.5777) is lower than the median (0.6000), suggesting a positive skewness, where most of the sample values are below the average. The ROA variable has a mean value of 0.0334 and a standard deviation of 0.1733. The mean value (0.0334) is lower than the median (0.0453), indicating a positive skewness, which implies that most of the sample observations have ROA values below the average. The minimum ROA value recorded is -1.0500.

### Regression Analysis

This study employs panel data regression analysis to examine the relationship between the dependent variable (Y) and the independent variable (X). The regression model used in this study is formulated as follows:

$$CED_{it} = \alpha + \beta_1 EDU_{it} + \beta_2 ROA_{it} + e$$

Notes:

CED : Carbon Emission Disclosure,
α : Constant,
EDU : Educational Background,
ROA : Return on Assets

### Panel Data Estimation Model

This study employs panel data as the sample consists of multiple firms observed over different time periods. Furthermore, the combination of time series and cross-sectional data provides more varied information, increases the degree of freedom, and yields more efficient estimations. Panel data can be estimated using three main approaches, as follows:

1) **Common Effect Model (CEM)**
   The Common Effect Model is a panel data approach that combines cross-sectional and time-series data without accounting for heterogeneity across individuals or time.
2) **Fixed Effect Model (FEM)**
   The Fixed Effect Model captures differences across observational units while maintaining constant regression coefficients. In this model, each entity has its own intercept that remains constant over time, whereas the slope coefficients are assumed to be stable across periods.
3) **Random Effect Model (REM)**
   The Random Effect Model assumes that individual-specific and time-specific variations are incorporated into the error term, implying that the residuals may be correlated across entities and time.

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To determine the most appropriate panel data model, several tests are conducted. These tests aim to identify the best model that fits the characteristics of the data. The tests include:

1) Chow Test
   The Chow test is used to select between the Common Effect Model and the Fixed Effect Model. If the probability value of the F-statistic is less than 0.05, the Fixed Effect Model is preferred. Otherwise, if the probability value exceeds 0.05, the Common Effect Model is considered more appropriate.
2) Hausman Test
   The Hausman test is employed to choose between the Fixed Effect Model and the Random Effect Model. If the probability value of the Chi-square statistic is less than 0.05, the Fixed Effect Model is selected. Conversely, if the probability value is greater than 0.05, the Random Effect Model is preferred.
3) Breusch–Pagan Lagrangian Multiplier (LM) Test
   The Breusch–Pagan LM test is used to determine whether the Common Effect Model or the Random Effect Model is more appropriate. This test uses a significance level of 0.05, where the null hypothesis ($H_0$) is rejected if the p-value is less than 0.05. The hypotheses are formulated as follows:

$H_0$: The appropriate model is the Common Effect Model.

$H_1$: The appropriate model is the Random Effect Model.

**1) Chow Test**

The results of the Chow test in this study are presented in Table 3.2 as follows:

**Table 3.2** Chow Test

| Effects Test | Statistic | d.f. | Prob. |
|---|---|---|---|
| Cross-section F | 5.394028 | (71,323) | 0.0000 |
| Cross-section Chi-square | 289.407411 | 71 | 0.0000 |

The results of the Chow test presented in Table 3.2 show that the Prob. Cross-section Chi-square value is 0.0000, which is less than 0.05. Therefore, H0 (CEM) is rejected and H1 (FEM) is accepted. It can be concluded that the Fixed Effects Model (FEM) is the appropriate model to be used. The next step is to conduct the Hausman test.

**2) Hausman Test**

The results of the Hausman test are presented in Table 3.3 as follows:

**Table 3.3** Hausman Test

| Test Summary | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob. |
|---|---|---|---|
| Cross-section random | 9.234804 | 7 | 0.1040 |

Based on Table 3.3, the results of the Hausman test show that the Prob. Cross-section random value is 0.1040, which is greater than 0.05. Therefore, H0 (FEM) is rejected and H1 (REM) is accepted. It can be concluded that the Random Effects Model (REM) is the appropriate model to be used. Thus, the next step is to conduct the Breusch and Pagan Lagrangian Multiplier (LM) test.

**3) Breusch and Pagan Lagrangian Multiplier Test**

The results of the Breusch and Pagan Lagrangian Multiplier (LM) test are presented in Table 3.4 as follows:

**Table 3.4** Breusch and Pagan Lagrangian Multiplier test

| | Cross-section | Period | Both |
|---|---|---|---|
| Breusch-Pagan | 69.52789 | 6.428725 | 75.94345 |
| | (0.0000) | (0.0112) | (0.0000) |

Based on Table 3.4, the results of the Breusch and Pagan Lagrangian Multiplier test show that the Cross-section Breusch-Pagan value is 0.0000, which is less than 0.05. This indicates that the appropriate panel data estimation method to be used is the Random Effects Model (REM). [15]state that the Random Effects Model (REM) is

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estimated using the Generalized Least Squares (GLS) approach. Since GLS has accommodated classical assumption requirements, it can be concluded that this study does not require additional classical assumption tests.

**Coefficient Of Determination Test**

The coefficient of determination test is used to assess the extent to which independent variables explain the variation in the dependent variable. The value of the coefficient ranges from 0 to 1, where a value closer to 1 indicates a greater explanatory power of the independent variables on the dependent variable. The results of the coefficient of determination test in this study are presented in Table 3.5 below.

**Tabel 3.5** Coefficient Of Determination Test

| Coefficient Of Determination Test | Result |
|---|---|
| R-squared | 0.333324 |
| Adjusted R-squared | 0.324343 |
| S.E. of regression | 0.144566 |
| F-statistic | 14.86330 |
| Prob(F-statistic) | 0.000000 |

Based on Table 3.5, the Adjusted R-Square value of 0.324343 indicates that the independent variables, namely educational background and ROA, explain 32.24% of the variation in carbon emission disclosure. Meanwhile, the remaining 67,76% is explained by other factors outside the regression model used in this study.

**T-Test**

The t-test is used to examine the effect of each independent variable on the dependent variable. The criterion applied is a significance level of less than 0.05, indicating that the independent variable has a significant effect on the dependent variable. The results of the t-test in this study are presented in Table 3.5 as follows:

**Table 3.6** T-test

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.239290 | 0.320922 | 1.232323 | 0.2193 |
| EDU | 0.309329 | 0.067844 | 3.332333 | 0.0004 |
| ROA | 0.005555 | 0.081123 | 0.082145 | 0.9212 |

Based on the table above, there is an independent variable that has a positive and significant effect (sig < 0.05) on the dependent variable, carbon emission disclosure (CED), namely the educational background variable with a significance value of 0.0004. The educational background of directors has a significance value of 0.0004, which is less than 0.05. Based on this result, it can be concluded that directors' educational background has a positive effect on carbon emission disclosure; thus, the first hypothesis (H1) is accepted.

An educational background in finance-related fields such as business, accounting, management, and economics reflects an individual's ability to solve various problems. Directors with such backgrounds tend to have a stronger preference in making decisions related to investment and liability management, and they are more sensitive to disclosure practices. This is because they have received professional training in business management, possess better managerial skills, and are more capable of addressing complex issues to ensure business sustainability.

With these competencies, directors are also more open to innovation and more adaptive in responding to changes in the business environment. This finding is consistent with the study by [16] which shows that a financial educational background has a positive effect on environmental information disclosure. This is because, during their education, directors are exposed to various issues related to strategic management, business ethics, and business knowledge. Such learning processes shape directors' ability to recognize changes in the external environment and encourage them to respond more appropriately and effectively.

The ROA variable shows a significance value of 0.9192, which is greater than 0.05. This indicates that ROA does not have an effect on carbon emission disclosure. Therefore, a higher level of ROA does not determine the extent

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of carbon emission disclosure. This finding is consistent with the study by [2], [3] which states that ROA does not have a statistically significant effect on carbon emission disclosure, as companies do not necessarily need to have high profitability levels to engage in such disclosure practices.

## 4. Conclusion

Overall, this study indicates that internal company characteristics have different effects on carbon emission disclosure. Directors' educational background has a positive influence on carbon emission disclosure. namely the educational background variable with a significance value of 0.0004. The educational background of directors has a significance value of 0.0004, which is less than 0.05. Based on this result, it can be concluded that directors' educational background has a positive effect on carbon emission disclosure; thus, the first hypothesis (H1) is accepted. Suggesting that managerial competence and insights particularly in finance and business enhance awareness and responsiveness to environmental issues. In contrast, Return on Assets (ROA) is not found to influence carbon emission disclosure. The ROA variable shows a significance value of 0.9192, which is greater than 0.05. This indicates that ROA does not have an effect on carbon emission disclosure. Therefore, a higher level of ROA does not determine the extent of carbon emission disclosure. implying that a company's profitability is not a primary determinant of such practices. These findings suggest that carbon emission disclosure is more influenced by non-financial factors, such as cognitive capacity and managerial strategic perspectives, rather than financial performance. Theoretically, this study provides a reference for future research and contributes to the development of literature, particularly in the field of accounting. the Adjusted R-Square value of 0.324343 indicates that the independent variables, namely educational background and ROA, explain 32.24% of the variation in carbon emission disclosure. Meanwhile, the remaining 67,76% is explained by other factors outside the regression model used in this study.

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