THE EFFECT OF MANAGERIAL ABILITY, ENVIRONMENTAL PERFORMANCE, AND BOARD OF COMMISSIONERS ON CARBON EMISSION DISCLOSURE

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ABSTRACT

This study aims to provide empirical evidence on the influence of managerial ability, environmental performance, and the board of commissioners on carbon emissions disclosure. The sampling in this study was conducted using the purposive sampling method, with a total of 71 companies from the industrial, basic materials, infrastructure, energy, transportation, and logistics sectors during the 2021–2023 period, resulting in a total of 213 observations. The secondary data utilized were obtained from annual reports and sustainability reports available on www.idx.com, the official websites of companies meeting the sample criteria, as well as from Refinitiv Eikon and the website of KLHK Indonesia. The analysis technique applied is multiple linear regression with panel data, using the EViews 12 software. The results of the study indicate that: (a) managerial ability has no effect on carbon emissions disclosure; (b) environmental performance has a positive effect on carbon emissions disclosure; and (c) the board of commissioners has a positive effect on carbon emissions disclosure

Keywords: managerial ability, environmental performance, board of commissioners, carbon emission disclosure

Introduction

Climate change has become an urgent threat that has a wide impact on communities, ecosystems, and the global economy. One proof is the significant increase in global temperatures. In 2023, the global average temperature is approaching 1.5°C above pre-industrial temperatures, making it the hottest year on record (World Meteorological Organization (WMO), 2024). This phenomenon has triggered disasters such as extreme heat waves in Asia and Europe and poses a threat to global food security. This temperature increase is primarily caused by human activities, such as fossil fuel combustion and excessive energy use.

Although industries contribute to economic growth, their environmental impact, particularly carbon emissions, is highly significant (Frianto et al., 2023). The government and global stakeholders are encouraging companies to consider environmental impacts in their performance, including reducing carbon emissions. The Indonesian government has set a target of achieving net zero emissions by 2050 as part of its efforts to address the impacts of global climate change. To fulfill this commitment, the government adopted Peraturan Presiden Nomor 18 Tahun 2020 tentang Rencana Pembangunan Jangka Menengah 2020-2024. However, Indonesia remains one of the ten largest carbon-emitting countries in the world, with total emissions reaching 700 million tons per year, according to the Global Carbon Project (GCP) report (Annur, 2023). This amount increased by 18.3% from the previous year, representing the highest rise among other countries.

According to the Climate Transparency Report 2022, energy combustion is the main contributor to carbon dioxide (CO_2) emissions, with the power generation sector being the largest contributor at 43%. The industrial sector accounts for 23% of emissions, while the agricultural sector has the smallest contribution. The level of carbon emissions of an entity or industry depends on the intensity of its operational activities the higher the activity, the greater

the emissions produced. This also applies to entities using technology such as production machinery and transportation modes. Carbon-intensive industries include the industrial, energy, basic materials, utilities, and transportation sectors, while the financial, services, and healthcare sectors are categorized as non-carbon-intensive. According to the Inventarisasi Emisi GRK Bidang Energi (2020) report, the industrial sector contributed 21.46% of the total greenhouse gas emissions in 2019, highlighting the need for effective measures to reduce carbon emissions.

One way to address this issue is by encouraging companies to measure, record, and report carbon emissions transparently. However, only 88% of Indonesian companies report climate-related risks and opportunities, indicating the need for increased awareness and action (PWC, 2023). Company executives, including managers, are increasingly pressured to manage environmental impacts and climate change, one of which is through carbon emissions disclosure (Gaganis et al., 2023; Luo et al., 2023). High carbon emissions and low emissions disclosure indicate low managerial ability, as such disclosure relies on managerial decisions. A lack of technical knowledge and environmental awareness among managers hinders effective emissions disclosure. Research shows that managers with high cognitive abilities are more likely to disclose environmental information effectively (Lee et al., 2023; Luo et al., 2023; Ng & Daromes, 2016). However, Hakim (2024) study states that managerial ability does not have a significant effect on carbon emissions disclosure. In Indonesia, research on the influence of managerial ability on carbon emissions disclosure remains limited, which serves as the motivation for this study.

To ensure good environmental sustainability, companies need to manage their environmental impacts effectively, which is reflected in carbon emissions disclosure. Companies with high environmental performance, as reflected in good PROPER ratings, tend to be more active in disclosing information about carbon emissions (Yesiani et al., 2024). Several studies have shown a positive relationship between environmental performance and carbon emissions disclosure (Dani & Harto, 2022; Rusmana & Purnaman, 2020; Triandini et al., 2019). This means that the better a company's environmental performance, the more disclosure it tends to make. However, other studies have shown no significant effect between the two (Amaliyah & Solikhah, 2019; Warsiati et al., 2023).

Carbon emissions disclosure is influenced by corporate governance factors, including the size of the board of commissioners, which plays a crucial role in ensuring the company's transparency and accountability regarding environmental matters (Grediani et al., 2020). A larger board of commissioners is more likely to support carbon emissions disclosure (Pratama, 2021; Zanra et al., 2020). This means that the more board members there are, the more extensive the carbon emissions disclosure tends to be. However, the findings of this study contradict the research by Kurniawan & Rusli (2020); Mustar et al. (2020); Puspita & Tanjaya (2022) which state that the board of commissioners has no effect on carbon emissions disclosure.

This study is motivated by the inconsistency of previous research findings and issues related to the variables of managerial ability, environmental performance, and the board of commissioners. The researcher aims to re-examine these three variables in carbon-intensive sector companies listed on the Indonesia Stock Exchange (IDX), specifically in the industrial, basic materials, infrastructure, energy, transportation, and logistics sectors. The purpose of this study is to provide empirical evidence on the influence of managerial ability, environmental performance, and the board of commissioners on carbon emissions disclosure. Since the accounting literature related to carbon emissions disclosure in Indonesia is still limited, this study is expected to make a significant contribution. This study is also the first to analyze managerial ability in carbon emissions disclosure in Indonesia, with references from

international studies. Based on the background described, the following hypothesis can be formulated:
1. Managerial ability has a positive effect on carbon emissions disclosure.
2. Environmental performance has a positive effect on carbon emissions disclosure.
3. The board of commissioners has a positive effect on carbon emissions disclosure

Research Method

This study uses a quantitative research approach. The population of this study consists of companies in the industrial, basic materials, infrastructure, energy, transportation, and logistics sectors listed on the Indonesia Stock Exchange during the 2021-2023 period. The data used in this study is secondary data obtained from annual reports and sustainability reports available on www.idx.com, the official websites of companies that meet the sample criteria, as well as from Refinitiv Eikon and the website of Kementerian Lingkungan Hidup dan Kehutanan (KLHK). The sampling technique used in this study is purposive sampling, which involves selecting samples that meet the criteria according to the research objectives. There are 367 companies in the population of this study, with 176 companies not publishing annual and sustainability reports during the 2021-2023 period, and 120 companies not using GRI 305: Emissions as the standard for carbon emissions disclosure. Based on the sample selection, 71 companies meet the criteria, with a 3-year observation period, so the total number of observations in this study is 213.

The dependent variable in this study is carbon emissions disclosure, and the independent variables are managerial ability, environmental performance, and the board of commissioners. The proxies used in this study are as follows:

Table 1. Variable Measurement

Variable	Proxy	Reference
Carbon Emission Disclosure (Y)	The content analysis method is based on the completeness of carbon emissions disclosure in the company's sustainability reports. There are 8 components of GRI 305 as follows: 1. Disclosure of management of the topic 2. Disclosure of 305-1 direct greenhouse gas (GHG) emissions (Scope 1) 3. Disclosure of 305-2 energy-related GHG emissions (Scope 2) indirect 4. Disclosure of 305-3 other indirect GHG emissions (Scope 3) 5. Disclosure of 305-4 GHG emissions intensity 6. Disclosure of 305-5 GHG emissions reduction 7. Disclosure of 305-6 ozone-depleting substance (ODS) emissions	(Kartikasary et al., 2023)

	8. Disclosure of 305-7 nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions Each component disclosed is given a score of 1. Companies that disclose all components receive a score of 8.	
Managerial Ability (X1)	DEA (Data Envelopment Analysis) with the following formula: $$Max\theta=\frac{Sales}{v1Cogs+v2Sga+v3Ppe+v4Inta}$$ Description: Ma = Managerial ability Sales = Firm sales CoGS = Cost of Good Sold Sga = Sales, general, and administrative expense Ppe = Property, plant, and equipment Intan = Intangible Assets	(Demerjian et al., 2012; Lee et al., 2023)
Environmental Performance (X2)	The PROPER ranking is as follows: 1. Gold is given a score of 5 2. Green is given a score of 4 3. Blue is given a score of 3 4. Red is given a score of 2 5. Black is given a score of 1 6. Not participating is given a score of 0	(Melja et al., 2023; Sukmawati & Fidiana, 2023)
Board of Commisioners (X3)	Board Size = Total Number of Board Members	(Pratama, 2021; Puspita & Tanjaya, 2022)

Source: Data processed by Researchers (2024)

The data analysis technique used in this study is panel data regression. The testing is conducted using EViews 12 software. The following is the panel data regression equation model used in this study:

$$Y=a+\beta_1 X1_{it}+\beta_2 X2_{it}+ \beta_3 X3_{it}+\varepsilon$$

Description:
Y = Carbon Emission Disclosure
X1 = Managerial Ability
X2 = Environmental Performance
X3 = Board of Commisioners
ε = *Error*

Result and Discussion

1. Descriptive Statistic Analysis

The following are the results of descriptive statistical analysis in this study:

	Pengungkapan Emisi Karbon	Kemampuan Manajerial	Kinerja Lingkungan	Dewan Komisaris
Mean	4,619718	0,677844	1,990610	5,042254
Median	4,000000	0,694973	2,000000	5,000000
Maximum	8,000000	1,474662	5,000000	15,00000
Minimum	1,000000	0,001577	0,000000	2,000000
Std. Dev.	2,255180	0,288395	1,961879	2,347841
Skewness	0,132232	0,057809	0,178440	1,457228
Kurtosis	1,800169	2,732592	1,392948	6,622102
Jarque-Bera	13,39714	0,753266	24,05108	191,8214
Probability	0,001233	0,686168	0,000006	0,000000
Sum	984,0000	144,3808	424,0000	191,8214
Sum Sq. Dev.	1078,197	17,63235	815,9812	0,000000
Observations	213	213	213	213

Figure 1. Descriptive Statistic Analysis Result
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the table of descriptive statistics analysis results above, for the carbon emissions disclosure variable, the minimum value of 1.000000 was obtained by PT Communication Cable Systems Indonesia Tbk. The maximum value of 8.000000 was obtained by PT ABM Investama Tbk, PT Indocement Tunggal Prakarsa Tbk, PT AKR Corporindo Tbk, PT Indika Energy Tbk, PT Indo Tambangraya Megah Tbk, and PT Vale Indonesia Tbk during the 2021-2023 period. The average value is 4.619718, while the standard deviation is 2.255180. This standard deviation is smaller than the average, indicating that the carbon emissions disclosure variable is homogeneous.

For the managerial ability variable, the minimum value of 0.001577 was obtained by PT Telkom Indonesia (Persero) Tbk in 2023. The maximum value of 1.474662 was obtained by PT AKR Corporindo Tbk in 2022. The average value is 0.677844, while the standard deviation is 0.288395. This standard deviation is smaller than the average, indicating that the managerial ability variable is homogeneous.

For the environmental performance variable, the minimum value of 0.000000 was obtained by 31 companies. The maximum value of 5.000000 was obtained by PT Adaro Energy Indonesia Tbk, PT Bukit Asam Tbk, PT Pertamina Geothermal Energy Tbk, and PT Timah Tbk during the 2021-2023 period. The average value is 1.990610, while the standard deviation is 1.961879. This standard deviation is smaller than the average, indicating that the environmental performance variable is homogeneous.

For the board of commissioner's variable, the minimum value of 2.000000 was obtained by PT Lancartama Sejati Tbk, PT Bakrie & Brothers Tbk, PT Panca Budi Idaman Tbk, and PT Avia Avian Tbk during the 2021-2023 period. The maximum value of 15.000000 was obtained by PT Chandra Asri Pacific Tbk in 2022 and 2023. The average value is 5.042254, while the standard deviation is 2.347841. This standard deviation is smaller than the average, indicating that the board of commissioner's variable is homogeneous.

2. Selection of the Panel Data Regression Model
a. Chow Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.950157	(70,139)	0.0000
Cross-section Chi-square	193.947278	70	0.0000

Figure 2. Chow Test Result
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the Chow test in the image above, it shows that the p-value is $0.0000 < 0.05$. Therefore, the regression model selected in this study is the fixed effect model, and further testing using the Hausman test is required.

b. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.077782	3	0.3798

Figure 3. Hausman Test Result
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the Hausman test in the image above, it shows that the p-value is $0.3798 > 0.05$. Therefore, the regression model selected in this study is the random effect model, and further testing using the Lagrange Multiplier test is required.

c. Lagrange Multiplier Test

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	31.10031 (0.0000)	92.27754 (0.0000)	123.3778 (0.0000)
Honda	5.576765 (0.0000)	9.606120 (0.0000)	10.73592 (0.0000)
King-Wu	5.576765 (0.0000)	9.606120 (0.0000)	10.40122 (0.0000)
Standardized Honda	5.871772 (0.0000)	12.08344 (0.0000)	5.846663 (0.0000)
Standardized King-Wu	5.871772 (0.0000)	12.08344 (0.0000)	10.22413 (0.0000)
Gourieroux, et al.	--	--	123.3778 (0.0000)

Figure 4. Lagrange Multiplier Test Results
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the Lagrange Multiplier test in the image above, it shows that the probability value of the cross-section Breusch-Pagan is < 0.05. Therefore, the regression model selected in this study is the random effect model.

3. Classical Assumptions Test
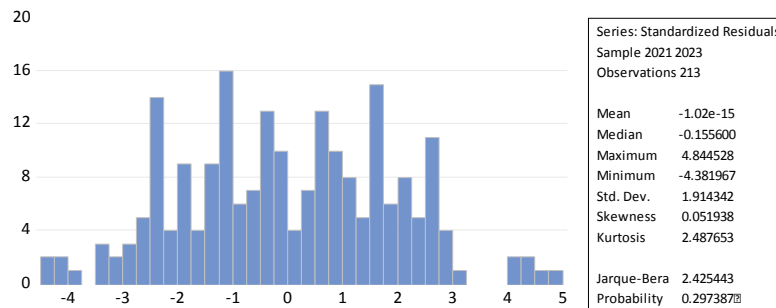### a. Normality Test

Figure 5. Normality Test Results
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the normality test in the image above, it shows that the probability value is $0.297387 > 0.05$. Therefore, the data in this study follows a normal distribution.

b. Multicollinearity Test

	X1	X2	X3
X1	1.000000	0.301401	-0.045915
X2	0.301401	1.000000	0.315496
X3	-0.045915	0.315496	1.000000

Figure 6. Multicollinearity Test Results
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the multicollinearity test in the image above, it is known that the correlation between managerial ability and environmental performance is 0.301401, between managerial ability and the board of commissioners is -0.045915, and between environmental performance and the board of commissioners is 0.315496. All these correlation values are below the tolerance limit of 0.90. This indicates that the regression model in this study is free from multicollinearity issues.

c. Heteroscedasticity Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	0.549020	0.315023	1.742795	0.0828
X2	-0.008473	0.049587	-0.170872	0.8645
X3	0.000170	0.039841	0.004270	0.9966
C	1.235577	0.299195	4.129672	0.0001

Figure 7. Heteroscedasticity Test
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the heteroskedasticity test in the image above, it is found that the probability values for each variable are greater than 0.05. Therefore, the regression model in this study does not indicate any signs of heteroskedasticity.

4. Panel Data Regression Analysis

The regression analysis estimates the relationship between the independent and dependent variables. This test is conducted to examine the effect of the independent variables in this study, namely managerial ability, environmental performance, and the board of commissioners, on the dependent variable, which is carbon emissions disclosure. Below is the panel data regression equation model used in this study:

$Y = 2{,}661543 + 0{,}244570X1 + 0{,}517503X2 + 0{,}151172X3 + \varepsilon$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	0.244570	0.594500	0.411388	0.6812
X2	0.517503	0.094751	5.461701	0.0000
X3	0.151172	0.076515	1.975724	0.0495
C	2.661543	0.571331	4.658498	0.0000

Figure 8. Data Panel Regression Analysis Results
Source: EViews 12 Output, Data processed by the Researcher (2024)

5. Hyphothesis Test
a. T Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	0.244570	0.594500	0.411388	0.6812
X2	0.517503	0.094751	5.461701	0.0000
X3	0.151172	0.076515	1.975724	0.0495
C	2.661543	0.571331	4.658498	0.0000

Figure 9. T Test Result
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the results of the t-test in the image above, the managerial ability variable has a probability value of $0.6812 >$ sig. 0.05 and a t-statistic of 0.411388 with a positive direction, which is smaller than the t-table value of 1.971. Therefore, the hypothesis stating that managerial ability has a positive effect on carbon emissions disclosure is **rejected**.

The environmental performance variable has a probability value of $0.0000 <$ sig. 0.05 and a t-statistic of 5.461701 with a positive direction, which is greater than the t-table value of 1.971. This indicates that the hypothesis stating that environmental performance has a positive effect on carbon emissions disclosure is **accepted**.

The board of commissioner's variable has a probability value of $0.0495 <$ sig. 0.05 and a t-statistic of 1.975724 with a positive direction, which is greater than the t-table value of 1.971. Therefore, the hypothesis stating that the board of commissioners has a positive effect on carbon emissions disclosure is **accepted**.

b. F Test

Weighted Statistics			
R-squared	0.188251	Mean dependent var	2.655283
Adjusted R-squared	0.176599	S.D. dependent var	1.650647
S.E. of regression	1.497821	Sum squared resid	468.8848
F-statistic	16.15623	Durbin-Watson stat	1.548354
Prob(F-statistic)	0.000000		

Figure 10. F Test Result
Source: EViews 12 Output, Data processed by the Researcher (2024)

Based on the F-test results in the image above, the F-statistic value is 16.15623 with a probability of 0.0000. Since the calculated F value of 16.15623 is greater than the F-table value of 2.6478, and the probability is well below 0.05, it can be concluded that the independent variables, namely managerial ability, environmental performance, and the board of commissioners, have a significant simultaneous effect on the dependent variable, which is carbon emissions disclosure.

c. The Coefficient of Determination Test

Weighted Statistics			
R-squared	0.188251	Mean dependent var	2.655283
Adjusted R-squared	0.176599	S.D. dependent var	1.650647
S.E. of regression	1.497821	Sum squared resid	468.8848
F-statistic	16.15623	Durbin-Watson stat	1.548354
Prob(F-statistic)	0.000000		

Figure 11. The Coefficient of Determination Test
Source: EViews 12 Output, Data processed by the Researcher (2024)

The results of the coefficient of determination test in Figure 9 show an Adjusted R-Square value of 0.1766. This means that managerial ability, environmental performance, and the board of commissioners explain 17.66% of carbon emissions disclosure, while the remaining 82.34% is influenced by factors outside of this study.

6. Discussions

a. The Effect of Managerial Ability on Carbon Emissions Disclosure

This study shows that managerial ability does not have a significant effect on carbon emissions disclosure. Although, according to agency theory, managers are expected to meet transparency demands, financial pressures and short-term priorities in carbon-intensive companies hinder this. The lack of binding regulations and external incentives, as well as weak governance, also contribute to the low motivation of managers to disclose carbon emissions (Guo & Pan, 2022). These findings are consistent with previous studies that state managerial ability does not always impact sustainability practices (Hakim, 2024). However, they contradict other research that shows managerial ability has a positive effect on carbon emissions disclosure (Daradkeh et al., 2023; Lee et al., 2023). This highlights the importance of stronger regulations and effective governance to encourage transparency in carbon emissions.

b. The Effect of Environmental Performance on Carbon Emissions Disclosure

This study shows that environmental performance has a positive effect on carbon emissions disclosure, meaning that the better a company's environmental performance, the greater the likelihood of the company transparently disclosing its carbon emissions. This disclosure reflects the company's commitment to meeting stakeholder expectations regarding environmental accountability and can attract support from various parties. These findings support stakeholder theory, which emphasizes the responsibility of companies to society, government, and the environment. By improving environmental performance and carbon emissions disclosure, companies can build trust and garner support, contributing to the sustainability of the company. This research aligns with studies by Widianto & Sari (2020); Zukarnaen (2022) which state that environmental performance positively affects carbon emissions disclosure. In contrast, research by Amaliyah & Solikhah (2019); Selviana & Ratmono (2019) found that environmental performance does not affect carbon emissions disclosure.

c. The Effect of the Board of Commissioners on Carbon Emission Disclosure

The study found that the board of commissioners has a positive effect on carbon emissions disclosure. The board of commissioners plays a crucial role in driving transparency and accountability regarding environmental issues. A larger board of commissioners has been shown to be more effective in supervision due to the diversity of knowledge and skills of its members. Furthermore, these findings support agency theory, where the board of commissioners is responsible for overseeing management to ensure shareholders' interests are met, reducing information asymmetry, and preventing conflicts of interest (Buertey et al., 2020; Wulandari, 2023). A larger board of commissioners can enhance transparency in risk management, including carbon emissions disclosure, and promote the application of sustainability principles in corporate decisions. This research aligns with studies by Grediani et al. (2020); Pratama (2021) which state that the board of commissioners positively affects carbon emissions disclosure, and contrasts with research by Puspita & Tanjaya (2022); Trufvisa & Ardiyanto (2019), which state that the board of commissioners does not affect carbon emissions disclosure.

Conclusion

This study found several key insights related to carbon emissions disclosure. First, managerial ability does not have a significant effect on carbon emissions disclosure, with factors such as financial pressure and a lack of regulations hindering transparency. Second, environmental performance has a positive impact on carbon emissions disclosure, reflecting the company's commitment to environmental accountability and its potential to attract stakeholder support. Third, the board of commissioners plays a critical role in enhancing transparency, particularly with a larger composition that can more effectively oversee management. These findings highlight that environmental performance, and the board of commissioners have a significant impact on carbon emissions disclosure, while stronger regulations and governance are needed.

This study focused only on carbon-intensive companies, so future research is expected to include companies from other sectors beyond the sample in this study to obtain more representative results. Additionally, expanding the observation period and adding other variables, such as financial performance and industry type, would be beneficial for future research.

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