

ANALYSIS OF THE EFFECT OF CO2 EMISSION DISCLOSURE, ENVIRONMENTAL PERFORMANCE, CAPITAL INTENSITY, SOCIAL PERFORMANCE, AND COMPANY SIZE ON FINANCIAL PERFORMANCE IN MINING COMPANIES LISTED ON THE INDONESIAN STOCK EXCHANGE

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Abstract

The purpose of this study is to analyze the effect of CO2 emission disclosure, environmental performance, capital intensity, social performance, and company size on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024. This study uses a quantitative approach with secondary data for a period of 5 years. The research population consisted of 63 companies using purposive sampling techniques, resulting in a sample of 17 data points used with panel data regression estimation analysis techniques. The results of this study indicate that CO2 emissions disclosure affects financial performance; environmental performance affects financial performance; capital intensity affects financial performance; environmental performance does not affect financial performance; and company size affects financial performance.

Keywords: *Disclosure of CO2 Emissions, Environmental Performance, Capital Intensity, Social Performance, and Company Size on Financial Performance.*

1. Introduction

In today's era of globalization, the economy has created fierce competition between companies. With this competition, companies are required to utilize all their capabilities in order to survive. One way for companies to obtain additional funding is to enter the capital market. This will attract more investors to invest in companies listed on the capital market. Companies are established with a purpose. The general purpose of a company is, of course, to make a profit.. (Sharma & Rastogi, 2024). One of the industries that is currently growing is the mining sector. Based on data from the Ministry of Energy and Mineral Resources, state revenue from the mineral and coal mining sector in 2022 is projected to reach IDR 127.90 trillion, or 301.88 percent of the 2022 revenue target of IDR 42.37 trillion. This figure is an increase compared to the 2021 period, where revenue from the mining sector was valued at Rp 75.48 trillion.

According to Fahmi (2016), financial performance is an analysis conducted to determine the extent to which a company has performed well and correctly using financial implementation rules. Financial performance measurement in this study uses return on assets (ROA). Return on assets (ROA) is a ratio that measures a company's ability to generate net income based on a certain level of assets (Hanafi, 2016). ROA aims to measure and evaluate the profit achieved from the assets used by a company, so that ROA is used by investors to obtain a clear picture of the rate of return on investments made in the company (Amartiya & Minan, 2022). The higher the return on assets ratio of a company, the greater the level of profit achieved by the company, so that the company's position will be better in terms of asset utilization (Mandasari, 2021). The following presents the development of financial performance as

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measured by Return On Assets in several mining companies in Indonesia listed on the Indonesia Stock Exchange for the period 2020-2024, as follows:

Table 1 Return on Assets of Mining Companies Listed on the Indonesia Stock Exchange for the Period 2020-2024

Company	2020	2022	2023	2023	2024
Indal Aluminium Industry Tbk.	0,29%	0,28%	-9,53%	-3,92%	-7,95%
Krakatau Steel Tbk.	0,65%	1,16%	0,72%	-4,62%	-5,13%
Vale Indonesia Tbk.	3,58%	6,70%	7,54%	9,38%	1,82%
Harum Energy Tbk.	12,09%	11,24%	29,70%	11,98%	3,02%
Energi Mega Persada Tbk.	6,94%	3,73%	5,59%	4,98%	3,46%

Source: www.idx.co.id (data processed by researcher, 2025).

Based on the table above, it can be seen that the financial performance of mining companies, as measured by Return On Assets (ROA), fluctuates annually and even experiences a continuous decline each year. Indal Aluminium Industry Tbk, for example, experienced a sharp decline from 0.29% in 2020 to -7.95% in 2024. Similarly, PT. Krakatau Steel Tbk experienced a sharp decline, from 0.65% in 2020 to -5.13%. PT. Vale Indonesia showed stable and positive performance from 3.58% in 2020 to 9.38% in 2023, but in 2024, the ROA value dropped to 1.82%. A similar situation occurred at PT. Harum Energy Tbk, which experienced a decline from 12.09% in 2020 to 3.02% in 2024. The decline in ROA at these companies could signal operational problems and suboptimal asset management. The decline in ROA also indicates that the companies are unable to effectively utilize their assets to generate profits. This needs further attention and monitoring to identify the main causes and formulate appropriate recovery strategies.

The first factor that can be used in measuring a company's financial performance is CO2 emissions disclosure. CO2 emissions are the process of releasing carbon into the atmosphere, either naturally or as a result of human activities, one of which is mining. This has become a rapidly growing and widespread issue in various countries because it causes extreme impacts in the form of climate change and threats to the survival of humans and companies, including in Indonesia. CO2 emissions disclosure is a component recorded in social and environmental accountability information, which is then included in company reports. The second factor affecting financial performance is environmental performance. In the current context, companies are required to have a strong commitment to the environment and society as an integral part of their operations, given that natural resource management has the potential to cause negative impacts, especially in operational areas. This commitment must be demonstrated through concrete actions that provide direct benefits to the community as one of the stakeholders (Lestari & Khomsiyah, 2023). The next factor that affects financial performance is Capital Intensity. According to Ross and Westerfield in Corporate Finance (2012), "Capital intensity describes how much capital a company has in the form of assets, both current and non-current assets, which is reflected in a ratio that shows the comparison between operating assets and the total sales obtained in a certain period." The capital intensity ratio plays an important role for company management because it can be used to determine the amount of company assets used to generate revenue (Safitri et al., 2023).

The next factor considered to influence a company's financial performance is its social performance, which is defined as a configuration of business organizational principles of social responsibility, social response processes, and policies, programs, and observable results as they relate to the company's relationship with the community. The expected outcome, of course, returns to the company in the form of public support and the strengthening of social factors towards the sustainable management and development of the community towards the company concerned (Mur & Hasyim, 2023). The next factor that affects financial performance is company size. Company size is one of the factors that investors consider when investing in a company. Company size is determined by the total assets owned by the company. Company size can also make it easier for companies to obtain funding (Petra & Rivandi, 2022).

2. Literature Review

This section must contain a state-of-the-art explanation. It can be explained in several ways. First, you can discuss several related papers, both about objects, methods, and their results. From there, you can explain and emphasize gaps or differences between your research and previous research. The second way is to combine theory with related literature and explain each theory in one sub-chapter.

2.1. Agency Theory

Agency theory is a theory used to explain the relationship between parties and agents (who receive authority) and principals (parties who grant authority) that is established so that the company's objectives can be achieved to the maximum extent possible. The essence of the agency relationship is the separation between ownership (principal/investor) and control (agent/manager). Ownership is represented by investors who delegate authority to agents, in this case managers, to manage the investors' assets. The main principle of this theory states that there is a working relationship between the party that grants authority, namely the investor, and the party that receives authority, namely the manager. This means that an agency relationship is a contract in which one or more persons (principals) engage another person (agent) to perform certain services on their behalf, which involves granting decision-making authority to the agent (Mustafa & Handayani, 2014).

2.2. Stakeholder Theory

According to Freeman (1984), stakeholder theory describes that the prosperity and success of a company is highly dependent on the company's ability to accommodate the various interests of its stakeholders. Companies that are able to establish good cooperation and relationships with stakeholders, pay attention to the environment they create, and keep accurate records will be able to improve their financial performance, as this will encourage investors to invest in the company (Wibowo *et al.*, 2022).

2.3. Legitimacy Theory

Legitimacy Theory is a theory that focuses on the interaction between companies, society, and the environment. Legitimacy Theory was originally a theory oriented towards organizational systems or entities that would be viewed as part of society and the environment if the activities and performance of those organizations were acceptable to the wider community (Prena, 2021).

2.4. Financial Performance

A company's financial performance is a description of its financial condition that can be analyzed using financial analysis tools to determine the financial health of a company, which reflects its performance over a certain period. Stakeholders need the results of a company's financial performance measurement to assess the company's condition and level of success in carrying out its operational activities (Chen *et al.*, 2023). Sawir (2003) states that in assessing financial performance using financial ratio analysis, it is necessary to know the financial ratio standards. With financial ratio standards, companies can determine whether their financial performance is good or not. This assessment is carried out by comparing the financial ratios obtained with the existing financial ratio standards. In general, a company's financial performance is categorized as good if the company's financial ratio is equal to or above the financial ratio standard (Wijaya, 2019).

$$\text{ROA} = \frac{\text{Net Profit}}{\text{Total Assets}} \times 100\%$$

2.5. Disclosure of CO2 Emissions

As explained by the Ministry of Environment and Forestry, several types of harmful gas emissions released by companies and human activities from the earth into the atmosphere can cause the greenhouse effect in the atmosphere. In addition to production activities, gases produced from the combustion of fuel, oil, coal, and others are also a major group of pollutants, known as carbon gases. Not all companies are concerned about the amount of carbon emissions they produce in a given period (Ariesta Putri, 2022). CO2 emissions disclosure is the voluntary disclosure of information by business entities and is included in annual reports on business entity activities related to CO2 emissions. The disclosure of CO2 emission information is a means of communication between business entities and their stakeholders regarding the types of business entity activities related to social and environmental activities.

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Through this means of communication, it is hoped that business entities can obtain input from stakeholders regarding environmental conservation efforts by business entities (Sembiring et al., 2024). Carbon emissions disclosure includes carbon emission intensity, energy consumption, corporate governance, climate change strategies, carbon emission reduction performance, and climate change risks and opportunities. Because carbon accounting requires significant costs and can reduce profits, not all companies agree to implement carbon accounting, so carbon emissions disclosure is still voluntary (Siddique et al., 2021).

$$CED = \frac{\text{Total Items Disclosed}}{\text{Total Items}} \times 100\%$$

2.6. Environmental Performance

Environmental performance is a company's effort to create a good environment by carrying out activities and using materials that do not damage the environment (Yastynda, 2020). Environmental performance is a performance carried out by companies to create a clean environment without pollution and in accordance with established requirements. According to Dura (2022), the definition of environmental performance is one of the performances related to all areas of human life, such as human activities related to the environment. Utomo (2019) states that environmental performance is a part of a company that cannot be ignored and must be included in the company's business activities. Environmental performance is efficiency carried out with the aim of creating a conducive and supportive environment.

Table 2 Environmental Performance Measurement Indicators

Color	Criteria	Score
Gold	Completely Obedient and Orderly	5
Green	Very orderly	4
Blue	Orderly	3
Red	Bad	2
Black	Very Bad	1

2.7. Capital Intensity

Capital intensity is the ratio of a company's investment activities related to investments in fixed assets (capital intensity) and inventories (inventory intensity). The capital intensity ratio can indicate the level of efficiency of a company in using its assets to generate sales (Sari et al., 2023). Capital intensity is one of the decisions made by a corporation. Corporate managers decide on this in order to increase the profits of the business entity. In corporate management, capital intensity is very important because this ratio can show how efficiently the corporation uses its assets to generate maximum income. Capital intensity shows the ratio of a company's fixed assets to its total assets (Liu et al., 2025).

$$\text{Capital Intensity} = \frac{\text{Total Net Fixed Assets}}{\text{Total Assets}}$$

2.8. Social Performance

Social performance is an assessment of a company's performance based on the social role it plays in the community through its CSR activities. Social performance includes customer satisfaction, employee satisfaction, capital provider satisfaction, and public sector satisfaction. The better a company implements CSR, the higher its social performance will be. Social performance refers to a company's activities in carrying out a form of social responsibility beyond its operational activities (Miyamoto, K., et al., 2025). Social performance is an important aspect of an organization's responsibility to society and the environment. By understanding and measuring social performance, companies and organizations can increase their positive impact, build a good reputation, and contribute to sustainable development. Good social performance is not only beneficial to society, but can also improve business performance and organizational competitiveness in the market (Thienemann et al., 2025).

$$CSP = \frac{\text{Total Items Disclosed}}{\text{Total Disclosure Items}} \times 100\%$$

2.9. Ukuran Perusahaan

According to Sawir (2004), company size is a scale by which companies can be classified as large or small in various ways, including total assets, log size, stock market value, and others. Basically, company size is divided into only three categories, namely large firms, medium-sized firms, and small firms. Company size is a scale that can then be classified as large or small, measured by various alternatives, including total assets, total sales, log size, number of employees, and so on (Puspitaningrum & Indriani, 2021). Company size can be classified as one of the elements of the work environment that will influence management's perception later on. Large companies tend to diversify their businesses more than small companies.

$$\text{Firm Size} = \ln (\text{Total Asset})$$

3. Materials & Method

The type of data in this study is quantitative. The data source in this study is secondary data. The population in this study is all companies listed on the Indonesia Stock Exchange, totaling 63 companies over a period of 5 years (2020-2024). The sampling technique was carried out through purposive sampling and obtained a sample of 17 companies. The sampling criteria are as follows:

1. Mining companies that do not participate in the Ministry of Environment and Forestry's Company Environmental Performance Rating Program (PROPER) for the periode 2020-2024.
2. Mining sector companies listed on the Indonesia Stock Exchange that do not have complete annual reports for the period 2020-2024.
3. Mining sector companies thar were delisted during the period 2020-2024.

Statistical Analysis

Panel Data Regression Analysis

This analysis combines time series data and cross-section data. Time series data consists of one or more variables that are observed in a single observation unit over a certain period of time. Cross-section data consists of observations from several observation units at a single point in time. Panel data analysis aims to identify differences in characteristics between individuals or entities over several periods of time that are the subject of the study.

4. Results and Discussion

Tabel 3 Descriptive Test Result

	Y	X1	X2	X3	X4	X5
Mean	0.088316	0.527407	3.000000	0.245471	0.357152	21.41593
Median	0.071822	0.555560	3.000000	0.209061	0.406593	20.96919
Maximum	0.281738	0.944440	5.000000	0.639034	0.725275	28.64461
Minimum	-0.095299	0.111110	3.000000	1.00E-06	0.065934	14.77600
Std. Dev.	0.090810	0.202310	0.821556	0.225211	0.191855	4.473904
Skewness	0.371553	-0.525356	0.616149	0.361900	-0.127941	0.113799
Kurtosis	2.441064	2.465844	1.772576	1.590835	1.929505	1.754101
Jarque-Bera	2.701927	4.341618	9.453530	7.842598	3.785735	5.012702
Probability	0.258991	0.114085	0.008855	0.019815	0.150639	0.081565
Sum	6.623664	39.55553	277.0000	18.41033	26.78637	1606.195
Sum Sq. Dev.	0.610240	3.028783	49.94667	3.753291	2.723817	1481.170

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Based on the table above, it is known that there are 85 data observations using six types of research instruments. X1 is used as a proxy for CO2 emissions disclosure, X2 is used as a proxy for environmental performance, X3 is used as a proxy for capital intensity, X4 is used as a proxy for social performance, X5 is used as a measure of the company, and Y is proxied as financial performance.

1. From the table above, it can be seen that the highest CO2 emission disclosure value is 0.94444, which indicates that there are companies that have achieved a near-perfect score. This value reflects that the company has disclosed almost all of its CO2 emission information or is close to the ideal disclosure standard. The lowest CO2 emission disclosure value is 0.11111. This figure indicates that the company has only disclosed a small portion of information related to its carbon emissions, or has provided insufficient information in its sustainability report or annual report. Meanwhile, the average CO2 emission disclosure value is 0.5274, which indicates that, in general, companies in the mining sector have disclosed around 52.74% of the total emission disclosure indicators used as a reference in this study.
2. It is known that the highest environmental performance score obtained by companies in this research sample is 5. This score indicates an excellent level of environmental performance and is generally given to companies that actively and consistently implement various environmental conservation programs and demonstrate compliance with applicable environmental regulations. The lowest score of 3 indicates that the company is still in the “fairly good” category according to national environmental assessment criteria. The table also shows an average environmental performance score of 3 with a standard deviation of 0.82155. This average indicates that the majority of companies are at a good level of environmental performance, with no extreme variation in scores between companies.
3. The highest capital intensity value is 0.6390, which indicates that there are companies that allocate nearly two-thirds of their assets or operational structure in the form of fixed capital. This is considered very high and reflects the characteristics of capital-intensive companies. The lowest value of 0.000001 is very close to zero, indicating that there are companies that allocate almost none of their resources to capital investment. Meanwhile, the average value of capital intensity is 0.245471 or 24.55% with a standard deviation of 0.225211.
4. The highest social performance value of 0.72527 indicates that, in the best observations, the company was able to demonstrate a high level of social contribution. The lowest value of 0.06593 reflects that at that time, the company showed almost no significant participation in social aspects. Meanwhile, the average value for social performance of 0.35715 or 35.72% indicates that, in general, companies are at a moderate level in terms of implementing corporate social responsibility (CSR).
5. The highest company size value of 28.6446 indicates that the company has a very large scale of operations in terms of assets, revenue, and total capital. The lowest value of 14.7660 shows that the smallest companies have a much lower scale. Meanwhile, the average value of 21.4159 or 21.41% shows that most companies are in the upper-middle category in terms of business scale.
6. It is known that the highest financial performance value of 0.28173 indicates that the company is performing well. The lowest value of -0.09529 indicates that there are companies experiencing losses or negative performance. Meanwhile, the average value of 0.08831 or 8.83% shows that, in general, the companies studied are in a healthy financial condition, with positive but still moderate profitability.

7.

Table 4 Result of Equation Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.191884	0.071784	-2.673086	0.0094
X1	0.110283	0.042183	2.614368	0.0110
X2	0.027496	0.013364	2.057372	0.0434
X3	0.087020	0.041134	2.115501	0.0380
X4	-0.057474	0.047030	-1.222067	0.2258
X5	0.005587	0.002616	2.135362	0.0363

Effects Specification

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	S.D.	Rho
Cross-section random	0.044035	0.5100
Idiosyncratic random	0.043160	0.4900

Weighted Statistics			
R-squared	0.433979	Mean dependent var	0.035455
Adjusted R-squared	0.392963	S.D. dependent var	0.054928
S.E. of regression	0.042796	Sum squared resid	0.126372
F-statistic	10.58072	Durbin-Watson stat	1.745414
Prob(F-statistic)	0.000000		

Based on the results of data processing using multiple regression analysis, the following regression equation was obtained:

$$Y = -0.191884 + 0.110283X_1 + 0.027496X_2 + 0.087020X_3 - 0.057474X_4 + 0.005587X_5 + e$$

The above equation shows the direction and magnitude of the influence of each independent variable on the dependent variable (financial performance). The constant (C) of -0.191884 indicates that if all independent variables are zero, financial performance (Y) will decrease by 0.191884. This confirms that the existence of independent variables is essential to drive improvements in financial performance. Variable X1 (CO2 Emission Disclosure) has a positive effect with a coefficient of 0.110283. This means that the higher the level of emission disclosure, the higher the company's financial performance. Variable X2 (Environmental Performance) has a positive effect with a coefficient of 0.027496, which means that an increase in environmental performance tends to drive improvements in financial performance. Variable X3 (Capital Intensity) has a positive coefficient of 0.087020. This shows that the higher the capital intensity of a company, the better its financial performance. Variable X4 (Social Performance) has a negative coefficient of -0.057474. This means that the higher the social performance of a company, the lower its financial performance, although this result is not yet statistically significant. Variable X5 (Company Size) has a positive coefficient of 0.005587. This means that the larger the size of the company, the better its financial performance, although the effect is relatively small.

5. Discussion

The Effect of CO2 Emission Disclosure on Financial Performance

Based on the results of the regression analysis, it shows that CO2 emissions disclosure has a positive and significant effect on financial performance. This finding indicates that the higher the CO2 emissions disclosure, the better the company's financial performance. This illustrates that transparency in managing environmental issues, particularly CO2 emissions, not only affects the company's reputation but can also increase investor confidence and have a positive financial impact on the company. This finding can be explained through legitimacy theory, which argues that companies seek to gain social and environmental legitimacy by conforming to the expectations and norms that prevail in society. Companies that disclose CO2 emissions are more transparent and can meet the expectations of various stakeholders, including the government, the public, and investors who care about environmental issues. Legitimacy theory is very important because it can help companies avoid reputational risks, increase investor confidence, and reduce the potential negative impacts arising from stricter environmental regulations or policies. CO2 emissions disclosure can be seen as a form of corporate strategy to obtain or maintain social legitimacy.

The Effect of Environmental Performance on Financial Performance

Based on the results of the regression analysis, it shows that environmental performance has a positive and significant effect on financial performance. This finding indicates that compliance with environmental regulations reflects good environmental performance, which tends to have a higher level of financial performance as well. This finding shows that effective environmental management practices are not only a form of compliance with government regulations, but can also be a strategic factor that provides economic benefits for companies. Theoretically,

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these results support the framework built on legitimacy theory and stakeholder theory. From the perspective of legitimacy theory, companies that actively maintain and improve their environmental performance will gain social legitimacy from the community and other stakeholders. This legitimacy can enhance the company's image, strengthen relationships with consumers, investors, and business partners, and reduce the risk of legal or regulatory claims. Therefore, companies must continuously make adjustments and improvements in terms of their environmental performance. By gaining legitimacy, companies will obtain indirect benefits such as an improved reputation, consumer loyalty, easier access to financing, and a stronger bargaining position in various aspects of business.

The Effect of Capital Intensity on Financial Performance

Based on the results of the regression analysis, it shows that capital intensity has a positive and significant effect on financial performance. This finding indicates that the higher the level of a company's investment in fixed assets and other productive assets, the greater the company's potential to generate revenue, operational efficiency, and better profitability. In other words, companies with high capital intensity tend to have greater production capacity, stronger economies of scale, and higher competitiveness in the industry in which they operate. This is in line with agency theory, where high capital intensity is an indicator of management effectiveness in managing resources entrusted by owners (principals). In this theory, it is assumed that there is a potential conflict of interest between management (agents) and company owners, where management may not always act in the interests of the owners. However, when a company increases its capital intensity through strategic investment in productive assets, this indicates management's efforts to allocate funds efficiently to create company value.

The Influence of Social Performance on Financial Performance

Based on the results of the regression analysis, it shows that social performance does not have a positive and significant effect on financial performance. This finding indicates that corporate social activities, such as the implementation of Corporate Social Responsibility (CSR) programs, involvement in social activities, or other efforts that reflect corporate social responsibility, have not been able to make a real or measurable contribution to improving financial performance in the period observed. The implementation of social performance can actually create additional costs for companies, especially if it is not managed strategically. Stakeholder theory emphasizes that the main objective of a company is to maximize profits for shareholders. Social activities that do not contribute directly to financial performance will be considered less relevant and will not have a strong correlation with improved financial performance. This is in contrast to the stakeholder theory approach, which sees social performance as an integral part of a sustainable business strategy.

The Effect of Company Size on Financial Performance

Based on the results of the regression analysis, it shows that company size has a positive and significant effect on financial performance. This finding indicates that companies with larger scales of operation tend to achieve higher financial performance than smaller companies. Company size, which is usually measured by total assets, number of employees, or total sales, reflects the capacity and resources that a company has in carrying out its operations. This finding is in line with agency theory, which states that large companies tend to have stronger monitoring mechanisms, thereby reducing conflicts of interest between management and owners and improving performance efficiency. However, in large companies, these agency conflicts tend to be easier to minimize due to the existence of a more comprehensive and rigorous monitoring system.

6. Conclusions

Based on the test results from research data using secondary data, it can be concluded that the results of this study:

1. CO2 emissions disclosure has a positive and significant effect on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024
2. Environmental performance has a positive and significant effect on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024.
3. Capital intensity has a positive and significant effect on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024.

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4. Social performance has a negative and insignificant effect on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024.
5. Company size has a positive and significant effect on the financial performance of mining companies listed on the Indonesia Stock Exchange for the period 2020-2024.
- 6.

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