

Does Carbon Emission Disclosure and Environmental Performance Affect the Cost of Debt with Profitability as an Intervening Variable? Evidence from Coal Sub sector Companies Listed on the Indonesia Stock Exchange (2024-2025)

Dede Yusuf Maulana ^(1*) Aditya Bayu Kusuma ⁽²⁾ Istikomah ⁽³⁾ Dharnita Chandra ⁽⁴⁾ Mardiman ⁽⁵⁾

^(1,2) Department of Management, Faculty of Economic, Universitas Kartamulia Purwakarta, Indonesia

⁽³⁾ Department of Business Administration, Faculty of Social and Political Sciences, Nurtanio University, Bandung, Indonesia

⁽⁴⁾ Department of Management, Prasetya Mandiri Maritime Institute, Bandar Lampung, Indonesia

⁽⁵⁾ Master of Business Administration Program, School of Postgraduate Studies, Universitas Pendidikan Indonesia, Indonesia

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* Corresponding author.

E-mail addresses: dedeyusuf@univkartamulia.ac.id

KEYWORDS	ABSTRACT
<p>Keywords: carbon emission disclosure, environmental performance, profitability, cost of debt, coal subsector.</p> <p>Conflict of Interest Statement: The author(s) declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.</p> <p>Copyright © 2026 AMAR. All rights reserved.</p>	<p>Purpose: This study aims to analyze the effect of carbon emission disclosure and environmental performance on the cost of debt in coal subsector companies listed on the Indonesia Stock Exchange during the 2024-2025 period, with profitability as an intervening variable. It hypothesizes that carbon emission disclosure (CED) and environmental performance (EP) affect cost of debt (COD) directly and indirectly through profitability (PROFIT).</p> <p>Research Design and Methodology: This research uses a quantitative causal-associative approach and analysis used panel data regression and mediation testing. The sampel consists of 21 coal subsector companies and using purposive sampling. The values of CED, EP, COD, and Profitability were obtained using proxy measures for data collection purposes.</p> <p>Findings and Discussion: The mediation test shows that PROFIT does not significantly mediate the relationship between CED and COD (P-value > 0.05, T-Statistic -1.0920 < T-value -2.0181), nor the relationship between EP and COD (P-value > 0.05, T-Statistic 0.5793 < T-value 2.0181). These results suggest that sustainability-related variables have limited influence on debt financing costs in the observed coal subsector firms.</p> <p>Implications: Companies should improve the quality, consistency, and credibility of environmental disclosure to strengthen stakeholder trust. Creditors and investors also need to consider broader environmental, financial, and governance indicators in assessing credit risk.</p>

Introduction

Sustainability has become a central issue in contemporary corporate governance because firms are increasingly exposed to climate-related risks, stakeholder pressure, and regulatory demands for more transparent environmental accountability ([Otoritas Jasa Keuangan, 2025](#)). In the financial reporting context, sustainability information is no longer viewed merely as voluntary ethical disclosure, but as decision-useful information for investors, creditors, and other capital providers. This development is consistent with the growing adoption of climate-related disclosure standards, particularly IFRS S2, which emphasizes the disclosure of climate-related risks and opportunities that may affect users' decisions in providing economic resources to an entity ([IFRS S2 Climate-Related Disclosures, 2023](#)). In Indonesia, the regulatory direction toward sustainability is also strengthened through the implementation of carbon economic value under Presidential Regulation No. 98 of 2021 and the development of the Indonesia Taxonomy for Sustainable Finance, which classifies economic

activities based on economic, environmental, and social considerations to support sustainable financing and the national net-zero emission agenda ([Pemerintah Indonesia, 2021](#)).

Within this context, carbon emission disclosure and environmental performance are important indicators of corporate sustainability practices ([Nasih et al., 2024](#)). Carbon emission disclosure reflects the extent to which companies communicate their greenhouse gas emission information, climate-related risks, and environmental responsibilities to stakeholders ([Abu Afifa et al., 2025](#)). Meanwhile, environmental performance reflects the actual quality of corporate environmental management. These two dimensions are relevant because creditors and investors increasingly assess environmental information as part of risk evaluation, particularly in determining whether a company has higher exposure to regulatory sanctions, transition risk, reputational risk, or operational inefficiency ([Sulemana et al., 2025](#)). From a sustainability-finance perspective, environmental disclosure may reduce information asymmetry between companies and creditors, while stronger environmental performance may signal better risk management and long-term business resilience ([Hou & Zhang, 2023](#)).

The theoretical foundation of this study is built on the integration of stakeholder, signaling, legitimacy, and resource-based perspectives ([Nasih et al., 2024](#)). Stakeholder-oriented research argues that companies respond to the expectations of capital providers, regulators, communities, and other stakeholders by improving the quality of sustainability disclosure ([Sulemana et al., 2025](#)). Signaling logic explains that carbon emission disclosure and environmental performance may act as credible signals of lower environmental risk and stronger managerial accountability, which can influence creditors' perception of default risk ([Al-Fakir Al Rabab'a et al., 2023](#)). Legitimacy-based reasoning further explains that firms operating in environmentally sensitive industries use environmental disclosure and performance improvement to maintain social acceptance and reduce external pressure ([Abu Afifa et al., 2025](#); [Mardiman et al., 2026](#)). In addition, the resource-based view suggests that environmental capability can become an organizational resource when it improves efficiency, reputation, and competitiveness, which may ultimately affect financial outcomes ([Davis & DeWitt, 2021](#)).

The coal subsector is a particularly relevant setting for examining this issue because it represents an economically strategic yet environmentally sensitive industry in Indonesia. Coal remains an important source of national energy supply, export earnings, and state revenue. The Ministry of Energy and Mineral Resources reported that Indonesia's coal production in 2024 reached approximately 836 million tons, while coal exports reached approximately 555 million tons ([The Ministry of Energy and Mineral Resources, 2025](#)). However, coal mining and coal combustion are closely associated with high greenhouse gas emissions, air pollution, and environmental degradation ([Pahlevi et al., 2024](#)). Therefore, coal companies face stronger scrutiny from regulators, creditors, investors, and society regarding their environmental responsibilities and transition risks ([Alta & Darmawati, 2025](#)).

The financial characteristics of the coal industry further strengthen the relevance of this study. Coal mining companies generally operate in a capital-intensive business environment that requires substantial external financing for exploration, production facilities, heavy equipment, transportation infrastructure, and reclamation obligations. Consequently, the cost of debt becomes a crucial financial indicator because it reflects creditors' assessment of firm risk ([Al-Fakir Al Rabab'a et al., 2023](#)). Companies with weak environmental disclosure or poor environmental performance may be perceived as having higher exposure to regulatory penalties, operational disruption, reputational damage, and transition risk. This perception can increase creditors' required return and lead to a higher cost of debt ([Chen, 2025](#)). Conversely, companies that disclose carbon emissions more transparently and demonstrate better environmental performance may reduce information asymmetry and risk perception, thereby potentially obtaining debt financing at a lower cost ([Hou & Zhang, 2023](#)).

Previous studies have examined the relationship between sustainability practices and corporate financial outcomes. ([Nasih et al., 2024](#)) found that carbon emission disclosure is associated with the cost of debt in Indonesia, indicating that environmental transparency can influence creditors' risk assessment. ([Al-Fakir Al Rabab'a et al., 2023](#)) also showed that corporate carbon performance affects the cost of debt in Asia-Pacific countries. In the context of heavy-polluting industries, ([Hou & Zhang, 2023](#)) demonstrated that ESG performance can reduce corporate debt financing costs through risk-

related mechanisms. In Indonesia, several studies have examined carbon emission disclosure, environmental performance, profitability, and firm value in energy or coal-related sectors (([Al Gamar & Widoretno, 2024](#)); ([Melja et al., 2023](#)); ([R. Lestari et al., 2025](#))). However, these studies have generally focused on firm value, financial performance, or determinants of carbon disclosure rather than positioning the cost of debt as the primary outcome in the coal subsector.

This indicates a clear research gap. First, prior research in Indonesia has not sufficiently examined the direct effect of carbon emission disclosure and environmental performance on the cost of debt specifically in coal subsector companies. Second, previous studies have rarely tested profitability as an intervening variable in the relationship between environmental sustainability practices and debt financing costs. Third, most existing studies tend to examine environmental disclosure and financial performance separately, without explaining the mechanism through which environmental information affects creditors' pricing decisions. As a result, the causal pathway connecting carbon emission disclosure, environmental performance, profitability, and cost of debt remains underexplored, particularly in an emission-intensive industry such as coal mining (([Alta & Darmawati, 2025](#)); ([Nasih et al., 2024](#)); ([Chen, 2025](#))).

Profitability is theoretically relevant as an intervening variable because it can function as a financial mechanism linking sustainability practices to creditors' assessment of risk. Better environmental performance may improve operational efficiency, reduce environmental costs, enhance reputation, and strengthen market confidence, which can contribute to higher profitability (([Ginting et al., 2025](#)); ([Dasman et al., 2025](#))). Carbon emission disclosure can also support profitability by reducing information asymmetry and strengthening stakeholder trust, although empirical findings may vary depending on industry characteristics and disclosure quality (([Fitriani, 2025](#)); ([Putri et al., 2025](#))). From the creditor's perspective, profitability is a key indicator of repayment capacity. Firms with stronger profitability are generally perceived as having lower default risk, which may reduce the cost of debt. Therefore, profitability may mediate the relationship between environmental sustainability practices and debt financing costs by translating environmental credibility into stronger financial capacity and lower perceived credit risk (([Kartobi & Gustiawaty Dewi, 2026](#)); ([Chen, 2025](#))).

The novelty of this study lies in its attempt to integrate environmental sustainability variables and debt financing outcomes through the mediating role of profitability in the Indonesian coal subsector. Unlike prior studies that primarily examine carbon emission disclosure as a determinant of firm value, financial performance, or disclosure behavior, this study places the cost of debt as the main dependent variable. This focus is important because the cost of debt directly reflects creditors' assessment of firm risk and is highly relevant for capital-intensive industries. Furthermore, by using profitability as an intervening variable, this study does not only test whether carbon emission disclosure and environmental performance affect the cost of debt, but also explains how and why such effects may occur through firm financial performance.

Accordingly, this study aims to analyze the effect of carbon emission disclosure and environmental performance on the cost of debt of coal subsector companies listed on the Indonesia Stock Exchange, with profitability as an intervening variable. This study contributes to the sustainability-finance literature by providing empirical evidence on the role of environmental transparency and environmental performance in corporate debt financing decisions. Practically, the findings are expected to help corporate managers design sustainability reporting strategies that are not merely compliance-oriented but also financially relevant. For creditors and investors, this study provides insight into how environmental information and profitability can be incorporated into credit risk assessment. For regulators, the study supports the importance of strengthening sustainability disclosure quality, particularly in high-emission sectors that play a major role in Indonesia's energy system and climate transition agenda.

Literature Review

Stakeholder Theory

Stakeholder Theory explains that corporate responsibility is not limited to shareholders, but also extends to various stakeholders, such as society, government, investors, and creditors ([Freeman & McVea, 2001](#)). Each stakeholder group has different expectations regarding corporate transparency

and environmental performance. Proper environmental disclosure and positive environmental performance can serve as a form of social legitimacy that shapes stakeholder decisions, especially creditors' assessments of credit risk (Nasih et al., 2024). Transparent environmental information also reflects a company's response to stakeholder expectations for environmental accountability (Sulemana et al., 2025).

Signaling Theory

Signaling Theory offers a perspective on how firms communicate information about carbon emissions disclosure as a strategic signal to external parties. This theory is based on the assumption that information asymmetry exists between management and outside parties (Spence, 1973). Therefore, credible and comprehensive information, including detailed emissions disclosure, can signal the quality of a firm's risk management practices. This signal may influence creditors' perception of risk and, in turn, affect the cost of debt (Nasih et al., 2024). In addition, Signaling Theory highlights that environmental quality disclosure functions as a managerial signal intended to reduce information gaps between internal and external parties, thereby shaping creditors' evaluation of corporate risk (Chen, 2025).

Resource-Based View Theory

The Resource-Based View (RBV) provides the foundation for the role of profitability as a mediating variable. RBV posits that a company's internal resources that are valuable, rare, and difficult to imitate including financial capacity reflected in profitability support the firm's ability to invest in superior environmental practices and implement effective environmental disclosure (Barney, 1991). High profitability can facilitate investment in clean technologies and comprehensive reporting, thereby influencing the relationship between CED, EP, and COD. Moreover, RBV considers profitability as reflecting the company's internal capacity to allocate resources toward effective environmental management and reporting, which in turn forms the basis for competitive advantage and financial legitimacy (Davis & DeWitt, 2021).

Carbon Emission Disclosure and Cost of Debt

Carbon Emission Disclosure (CED) refers to reporting practices that provide quantitative and qualitative information on greenhouse gas emissions and mitigation strategies. In addition to Stakeholder and Signaling Theories, Legitimacy Theory posits that firms seek social acceptance by aligning practices and reporting with prevailing norms. From this perspective, CED represents social legitimacy in meeting societal and regulatory expectations rather than merely formal reporting (Deegan, 2002).

Empirical studies support a negative relationship between CED and cost of debt (COD). (Nasih et al., 2024) found that higher CED reduces COD for Indonesian listed firms by decreasing information asymmetry and creditor risk perception. Similarly, (Abu Afifa et al., 2025) showed that disclosure quality such as adherence to international standards and third-party verification more effectively lowers COD than disclosure breadth alone. (Al-Fakir Al Rabab'a et al., 2023) also reported a negative correlation between comprehensive emissions disclosure and debt financing costs in ASEAN markets.

However, (Al Gamar & Widoretno, 2024) indicated that the CED-COD link becomes insignificant when controls like firm size and industry volatility are omitted, highlighting the need for consistent methodology and focus on disclosure quality rather than quantity. A research gap remains regarding the specific role of carbon disclosure quality and its signaling mechanism on creditor risk perception in the Indonesian capital market, particularly considering the mediating role of profitability.

Environmental Performance and Cost of Debt

Environmental Performance (EP) reflects a firm's actual management of operational environmental impacts, including emission intensity, waste management, and compliance with environmental standards. Relevant theories include Stakeholder and Signaling Theories, as well as the Resource-Based View (RBV), which emphasizes that internal environmental management capacity can generate long-term competitive advantage affecting credit risk (Oliver, 1991). Institutional Theory

further asserts that regulatory pressure, industry norms, and market expectations drive firms to improve EP, which creditors monitor as an indicator of long-term risk ([Chen, 2025](#)).

Global studies report a negative EP-COD relationship. ([Liebhard et al., 2025](#)) found that firms with superior EP tend to have lower debt costs due to reduced perceived environmental risk. ([Hou & Zhang, 2023](#)) similarly observed that environmental innovations raising EP scores negatively correlate with debt financing costs in emission-intensive industries. In Indonesia, ([Alta & Darmawati, 2025](#)) reported that EP alone does not significantly affect COD, but its effect emerges when combined with strong corporate reputation, indicating a conditional relationship between EP, reputation, and creditor risk perception.

These mixed findings suggest the EP-COD link is not strictly linear and is influenced by institutional and internal factors such as reputation and governance. A research gap exists in integrating EP with internal characteristics like profitability and reputation within models assessing its effect on COD, particularly in environmentally high-risk sectors such as the coal subsector.

Carbon Emission Disclosure and Profitability

Carbon Emission Disclosure (CED) is the practice of reporting greenhouse gas emissions to stakeholders and capital markets. The concept is closely linked to Legitimacy Theory and Stakeholder Theory. Stakeholder Theory posits that greater environmental transparency can enhance investor and customer trust, supporting product demand and corporate reputation, thereby positively affecting profitability. Conversely, Legitimacy Theory suggests that disclosure efforts may incur higher reporting and compliance costs, which can temporarily pressure operating profit and overall profitability.

Empirical studies on the CED-profitability relationship show mixed results. ([Nugraha, 2023](#)) found that profitability did not significantly affect CED in Indonesian energy firms during 2018-2022, although the positive coefficient indicates a potential but weak relationship. ([Putri et al., 2025](#)) reported that profitability partially contributes positively to CED in the energy sector, suggesting more profitable firms can allocate resources for more intensive emissions disclosure. ([Fitriani, 2025](#)) observed that CED's impact on profitability indicators operating profit, comprehensive income, and profit attributable to shareholders varies, with some indicators showing positive significant effects while others are inconsistent. These findings indicate that the CED-profitability mechanism is complex and may depend on how CED influences market perception and firm operations.

Environmental Performance and Profitability

Environmental Performance (EP) indicates a firm's effectiveness in managing the environmental impact of its operations, often measured through programs like PROPER or other standard environmental indicators ([Kartobi & Gustiawaty Dewi, 2026](#)). Theoretically, EP is grounded in Institutional and Stakeholder Theories, emphasizing that environmental activities reflect not only social responsibility but also factors considered by stakeholders, including investors and capital markets, in evaluating financial performance such as profitability. The institutionalist perspective asserts that regulatory pressures and social norms drive firms to improve EP as a legitimization strategy with potential economic effects ([Oliver, 1991](#)).

Empirical studies in Indonesia and internationally show that the EP-profitability relationship is not uniform. ([Dasman et al., 2025](#)) found that EP positively affects profitability for firms listed on the Indonesia Stock Exchange during 2020-2024, suggesting that effective environmental management supports operational efficiency and earnings. Similarly, ([Ginting et al., 2025](#)) reported that EP, together with environmental disclosure, influences profitability in the Indonesian consumer goods sector, although EP alone can sometimes exert a negative effect due to the complex interplay between environmental practices and cost efficiency.

Conversely, studies in different contexts show inconsistent results ([Kartobi & Gustiawaty Dewi, 2026](#)) observed a negative effect of EP on profitability in the energy sector during 2022-2024, indicating that environmental costs may outweigh short-term economic benefits. These variations highlight the complex dynamics between EP and profitability, influenced by industry characteristics, firm size, scale of environmental investment, and measurement methodology.

The Role of Profitability as a Mediating Variable

Profitability reflects a firm's ability to generate earnings from its total assets. Within the Resource-Based View framework, it serves as an indicator of internal resource capacity that can support effective environmental practices and disclosure. (Gunawan & Aryati, 2024) found that profitability significantly affects the intensity of CED and EP, suggesting that more profitable firms have greater capacity to implement strong environmental practices and reporting. This aligns with (M. Lestari et al., 2025), who reported that profitability strengthens the relationship between ESG scores and effective reporting quality.

Domestic empirical studies, including (Gunawan & Aryati, 2024), indicate that profitability significantly influences CED and EP, highlighting its role in determining the intensity and quality of environmental practices and disclosure. (R. Lestari et al., 2025) further observed that global ESG-finance research suggests that integrating ESG factors reduces cost of debt, with profitability enhancing corporate credibility in creditors' assessments.

(Hou & Zhang, 2023) noted that profitability can moderate the relationship between ESG scores and capital costs. However, few studies have examined profitability as a mediating variable between CED/EP and COD, creating a methodological gap, as prior research typically treats profitability as a control or moderator rather than a mediator explaining the internal mechanism through which environmental practices influence creditor risk perception.

Research Design and Methodology

This study employs a quantitative approach with a causal-associative research design. The objective of this study is to examine the effect of Carbon Emission Disclosure and Environmental Performance on the Cost of Debt, both directly and indirectly through Profitability as an intervening variable. A quantitative approach is appropriate because the study uses numerical financial and non-financial data obtained from annual reports, sustainability reports, PROPER ratings, and financial statements to test the relationships among variables using panel data regression. The use of panel data is relevant because it combines cross-sectional and time-series observations, allowing the study to capture differences across firms and changes over time.

The population of this study consists of coal subsector companies listed on the Indonesia Stock Exchange under the IDX-IC A121 classification. The sample is selected using purposive sampling based on the following criteria: companies classified as coal subsector companies; companies listed on the Indonesia Stock Exchange during the 2020-2025 observation period; companies that publish annual reports and/or sustainability reports; companies that provide complete financial data required to calculate profitability, control variables, and cost of debt; companies that disclose carbon emission-related information; companies with available environmental performance data, particularly PROPER ratings; and companies with interest expense and interest-bearing debt information needed to calculate the cost of debt. Companies with incomplete data are excluded from the sample to maintain consistency in panel data estimation.

The dependent variable in this study is the Cost of Debt. Cost of Debt reflects the financing cost borne by a company for the use of debt capital and represents creditors' perception of firm risk (Al-Fakir Al Rabab'a et al., 2023). In sustainability-finance studies, the cost of debt is commonly used to examine whether environmental performance and carbon-related information affect creditors' risk assessment (Nasih et al., 2024). In this study, Cost of Debt is calculated by dividing interest expense by average interest-bearing debt. Average interest-bearing debt is obtained from the average of beginning and ending interest-bearing debt during the fiscal year.

The independent variables consist of Carbon Emission Disclosure and Environmental Performance. Carbon Emission Disclosure is measured using a checklist-based Carbon Emission Disclosure Index. The index is calculated by dividing the number of carbon emission disclosure items reported by the company by the total number of disclosure items in the checklist (Nasih et al., 2024). This measurement is consistent with prior studies that assess carbon emission disclosure based on the extent of disclosed carbon-related information in corporate reports (R. Lestari et al., 2025). Environmental Performance is measured using the PROPER rating issued by the Ministry of Environment (The Ministry of Energy and Mineral Resources, 2025). PROPER evaluates corporate environmental

management performance using five color-based ratings: gold, green, blue, red, and black. These ratings are converted into numerical scores, namely gold = 5, green = 4, blue = 3, red = 2, and black = 1. This scoring method reflects the relative quality of corporate environmental compliance and beyond-compliance performance (Ginting et al., 2025).

Profitability is used as an intervening variable because it may serve as a financial mechanism through which environmental sustainability practices influence the cost of debt (Dasman et al., 2025). Better environmental performance and more transparent carbon emission disclosure may improve stakeholder trust, operational efficiency, corporate reputation, and risk management quality, which can contribute to stronger profitability (Ginting et al., 2025). From the creditor’s perspective, profitability is an important indicator of repayment capacity. Firms with stronger profitability are generally perceived as having lower default risk, which may reduce the cost of debt (Chen, 2025). Therefore, profitability is positioned as a mediating variable that connects environmental sustainability practices with creditors’ financing decisions (Kartobi & Gustiawaty Dewi, 2026). Profitability is proxied by Return on Assets, calculated by dividing net income by total assets.

Carbon Emission Disclosure is measured using a checklist-based Carbon Emission Disclosure Index. The index value is calculated by dividing the number of disclosed items by the total number of disclosure items. Environmental Performance is measured using PROPER ratings converted into numerical scores, namely gold = 5, green = 4, blue = 3, red = 2, and black = 1. Profitability is proxied by Return on Assets (ROA), calculated by dividing net income by total assets. The Cost of Debt is measured by dividing interest expense by average interest-bearing debt. The first equation is used to examine the effect of Carbon Emission Disclosure and Environmental Performance on Profitability: $Y = \alpha + p_{YX1}X_1 + p_{YX2}X_2 + e_1$. The second equation is used to examine the effect of Carbon Emission Disclosure, Environmental Performance, and Profitability on the Cost of Debt: $Z = \alpha + p_{ZX1}X_1 + p_{ZX2}X_2 + p_{ZY}Y + e_2$ where (X1) represents Carbon Emission Disclosure, (X2) represents Environmental Performance, (Y) represents Profitability, (Z) represents Cost of Debt, (Alpha) is the constant, (p) denotes the path coefficient, and (e) represents the error term.

This study applies panel data estimation consisting of the Common Effect Model, Fixed Effect Model, and Random Effect Model. The selection of the most appropriate panel model is conducted through several specification tests. The Chow test is used to compare the Common Effect Model and Fixed Effect Model. The Breusch-Pagan Lagrange Multiplier test is used to compare the Common Effect Model and Random Effect Model. The Hausman test is used to determine whether the Fixed Effect Model or Random Effect Model is more appropriate.

Several diagnostic tests are conducted to ensure the credibility and robustness of the findings. Multicollinearity is tested using the Variance Inflation Factor. Heteroskedasticity is tested using the Breusch-Pagan or modified Wald test, depending on the selected panel model. Autocorrelation is tested using the Wooldridge test for panel data (Beyaztas & Bandyopadhyay, 2020). Cross-sectional dependence is tested using the Pesaran CD test when the number of firms and periods allows the test to be performed. If heteroskedasticity, autocorrelation, or cross-sectional dependence is detected, the model is estimated using robust standard errors, clustered standard errors, or Driscoll-Kraay standard errors, depending on the nature of the problem (PolSELLI, 2023). These diagnostic tests are important because violations of classical assumptions may lead to inefficient estimates and unreliable statistical inference (Ferdiansyah et al., 2025).

Findings and Discussion

1. Results of the Best-Fit Model Selection for Substructure 1

Table 1. Results of the Chow Test on Substructure 1

Redundant Fixed Effects Tests Equation: Untitled Test cross-section fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.586700	(20,19)	0.8773

Cross-section Chi-square	20.199070	20	0.4455
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Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

The Chow test results indicate that the Probability Cross-section Chi-square value for Substructure I is 0.4455, which exceeds the 0.05 significance level. Accordingly, the null hypothesis is accepted, suggesting that the Common Effect Model (CEM) is more appropriate for this study. Therefore, the panel data estimation proceeds using the CEM approach, as the results do not indicate significant individual effects across the cross-sectional units.

Table 2. Results of the Hausman Test on Substructure 1

Correlated Random Effects - Hausman Test
 Equation: SUB_STRUKTUR1
 Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.468388	2	0.4799

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the results of the Hausman test, the Probability Cross-section random value for Substructure I is 0.4799, which is higher than the 0.05 significance level. This indicates that the null hypothesis is accepted, while the alternative hypothesis is rejected. Accordingly, the Random Effect Model (REM) is considered more appropriate than the Fixed Effect Model (FEM). These findings suggest that the individual effects are not significantly correlated with the independent variables in the model; therefore, the panel data estimation in this study is continued using the Random Effect Model approach.

Table 3. Results of the Hausman Test on Substructure 1

Lagrange Multiplier Tests for Random Effects
 Null hypotheses: No effects
 Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	1.965885 (0.1609)	0.757689 (0.3841)	2.723573 (0.0989)

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

The results of the Lagrange Multiplier (LM) test show that the Breusch-Pagan probability value for Substructure I is 0.1609, which is greater than the 0.05 significance level. Therefore, the null hypothesis is accepted, indicating that the Common Effect Model (CEM) is more appropriate than the Random Effect Model (REM). Accordingly, the panel data estimation in this study is conducted using the Common Effect Model approach.

Based on the results of the panel data model selection tests, including the Chow test, Hausman test, and Lagrange Multiplier test, the most appropriate model for Substructure I in this study is the Common Effect Model (CEM). This finding indicates that the panel data do not require the estimation of individual effects, either in the form of fixed effects or random effects. Accordingly, the panel data regression analysis in this study is conducted using the Common Effect Model approach.

2. Results of the Best-Fit Model Selection for Substructure 2

Table 4. Results of the Chow Test on Substructure 2

Redundant Fixed Effects Tests
 Equation: Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	6.794079	(20,18)	0.0001
Cross-section Chi-square	90.124089	20	0.0000

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

The results of the Chow test for Substructure II show that the Probability Cross-section Chi-square value is 0.0000, which is lower than the 0.05 significance level. Therefore, the null hypothesis is rejected, indicating that the Fixed Effect Model (FEM) is more appropriate than the Common Effect Model (CEM). Accordingly, the panel data estimation for Substructure II proceeds using the Fixed Effect Model approach.

Table 5. Results of the Hausman Test on Substructure 2

Correlated Random Effects - Hausman Test

Equation: SUB_STRUKTUR2

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	10.819256	3	0.0127

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the results of the Hausman test for Substructure II, the Probability Cross-section random value is 0.0127, which is lower than the 0.05 significance level. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. This indicates that the Fixed Effect Model (FEM) is more appropriate than the Random Effect Model (REM). The result suggests that the individual effects are significantly correlated with the independent variables in the model; therefore, the panel data estimation for Substructure II proceeds using the Fixed Effect Model approach.

Table 6. Results of the Hausman Test on Substructure 2

Lagrange Multiplier Tests for Random Effects

Null hypotheses: No effects

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	6.433137 (0.0112)	1.022414 (0.3119)	7.455551 (0.0063)

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the results of the Lagrange Multiplier (LM) test, the Breusch-Pagan probability value is 0.0112, which is lower than the 0.05 significance level. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. This indicates that the Random Effect Model (REM) is more appropriate than the Common Effect Model (CEM). The result further suggests the presence of significant random effects in the panel data; therefore, the model estimation in this study is more appropriately conducted using the Random Effect Model approach.

Based on the results of the panel data model selection tests, including the Chow test, Hausman test, and Lagrange Multiplier test for Substructure II, the Fixed Effect Model (FEM) was identified as the most appropriate model for this study. This model selection indicates that the

panel data in Substructure II contain individual effects that need to be accounted for in the estimation process. Accordingly, the panel data regression analysis for Substructure II was conducted using the Fixed Effect Model approach.

3. Results of The Classical Assumption Test For The Chosen Model (CEM) In Substructure 1

Table 7. Results of The Multicollinearity Test For Substructure 1

	X1	X2
X1	1.000000	0.223776
X2	0.223776	1.000000

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the multicollinearity test results for Substructure I, the correlation coefficient between Carbon Emission Disclosure and Environmental Performance is 0.2238. This value is lower than the correlation threshold of 0.85, indicating that there is no multicollinearity issue among the independent variables in the model. Therefore, Carbon Emission Disclosure and Environmental Performance can be included simultaneously in the regression model, as they do not exhibit a strong linear relationship.

Table 8. Results of The Heteroscedasticity Test For Substructure 1

Dependent Variable: ABS(RESID)
Method: Panel Least Squares
Date: 06/10/26 Time: 18:43
Sample: 2024 2025
Periods included: 2
Cross-sections included: 21
Total panel (balanced) observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.152787	0.116998	1.305896	0.1992
X1	0.195801	0.125267	1.563073	0.1261
X2	-0.051837	0.028359	-1.827921	0.0752

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

The heteroskedasticity test results for Substructure I show that the probability values of the independent variables, namely X1 at 0.1261 and X2 at 0.0752, are above the 5% significance level, or 0.05. This finding indicates that there is no evidence of heteroskedasticity in the regression model used. Accordingly, the model residuals have relatively homogeneous variance, suggesting that the Substructure I model satisfies the homoskedasticity assumption and is suitable for subsequent testing.

4. Results of The Classical Assumption Test For The Chosen Model (CEM) In Substructure 2

Table 9. Results of The Multicollinearity Test For Substructure 2

	X1	X2	Y
X1	1.000000	0.223776	-0.351045
X2	0.223776	1.000000	0.017096
Y	-0.351045	0.017096	1.000000

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

The multicollinearity test results for Substructure II indicate that all correlation coefficients among the independent variables are below the threshold of 0.85. Specifically, the correlation coefficient between Carbon Emission Disclosure and Environmental Performance is 0.2234, between Carbon Emission Disclosure and Profitability is -0.3510, and between

Environmental Performance and Profitability is 0.0171. These results suggest the absence of strong linear relationships among the independent variables. Therefore, the regression model for Substructure II can be considered free from multicollinearity issues.

Table 10. Results of The Heteroscedasticity Test For Substructure 2

Dependent Variable: ABS(RESID)
 Method: Panel Least Squares
 Date: 06/11/26 Time: 18:19
 Sample: 2024 2025
 Periods included: 2
 Cross-sections included: 21
 Total panel (balanced) observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.076453	2.09E-15	3.66E+13	0.0000
X1	-5.45E-15	1.78E-15	-3.060659	0.0673
X2	-1.52E-15	4.13E-16	-3.677138	0.0724
Y	0.000000	1.48E-14	0.000000	1.0000

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the heteroskedasticity test results for Substructure II, the probability values for each independent variable were obtained as follows: 0.0673 for Carbon Emission Disclosure, 0.0724 for Environmental Performance, and 1.000 for Profitability. All probability values exceed the 0.05 significance level, indicating the absence of heteroskedasticity in the regression model for Substructure II. These findings suggest that the model residuals exhibit relatively constant variance, confirming that the regression model satisfies the homoskedasticity assumption and is appropriate for subsequent inferential analyses.

5. Results of The Partial Hypothesis Test

Table 11. Results of The Partial Hypothesis Test For Substructure 1

Dependent Variable: Y
 Method: Panel Least Squares
 Date: 06/11/26 Time: 17:38
 Sample: 2024 2025
 Periods included: 2
 Cross-sections included: 21
 Total panel (balanced) observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.084255	0.018306	4.602491	0.0000
X1	-0.047861	0.019600	-2.441826	0.0193
X2	0.002920	0.004437	0.658165	0.5143

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the regression significance test for Profitability (Y), the Carbon Emission Disclosure variable exhibited a probability value of 0.0193, which is below the 0.05 significance level, and a calculated t-value of -2.4418, exceeding the critical t-value of -2.0181. This indicates that Carbon Emission Disclosure has a significant effect on Profitability. In contrast, the Environmental Performance variable showed a probability value of 0.5143, exceeding 0.05, and a t-value of 0.0658, which is below the critical t-value of 2.0181, indicating no significant effect on Profitability. Consequently, the analysis demonstrates that carbon emission disclosure plays a significant role in influencing corporate profitability, whereas environmental performance does not exert a statistically significant impact on this variable.

Table 12. Results of The Partial Hypothesis Test For Substructure 2

Dependent Variable: Z

Method: Panel Least Squares
 Date: 06/11/26 Time: 17:54
 Sample: 2024 2025
 Periods included: 2
 Cross-sections included: 21
 Total panel (balanced) observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.229857	0.553870	0.415001	0.6830
X1	-0.488593	0.472384	-1.034312	0.3147
X2	-0.017536	0.109565	-0.160053	0.8746
Y	4.802194	3.933611	1.220810	0.2379

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the results of the partial hypothesis test (t-test) examining the effect of independent variables on the dependent variable, Cost of Debt (Y), the analysis shows that Carbon Emission Disclosure (X1) has a probability value of 0.3147 (> 0.05) and a t-statistic of -1.0343 ($<$ critical t-value of -2.0181), while Environmental Performance (X2) exhibits a probability value of 0.8746 (> 0.05) and a t-statistic of -0.1601 ($<$ -2.0181). Profitability (Y) shows a probability value of 0.2379 (> 0.05) and a t-statistic of 1.2208 ($<$ critical t-value of 2.0181). These results indicate that, individually, none of the three independent variables significantly affect the Cost of Debt.

6. Results of The Simultaneous Hypothesis Test

Table 13. Results of The Simultaneous Hypothesis Test For Substructure 1

R-squared	0.132864	Mean dependent var	0.060714
Adjusted R-squared	0.088396	S.D. dependent var	0.033886
S.E. of regression	0.032354	Akaike info criterion	-3.955433
Sum squared resid	0.040824	Schwarz criterion	-3.831313
Log likelihood	86.06408	Hannan-Quinn criter.	-3.909938
F-statistic	2.987831	Durbin-Watson stat	0.789124
Prob(F-statistic)	0.062044		

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period

Based on the results of the simultaneous hypothesis test (F-test) for Substructure I, Carbon Emission Disclosure (X1) and Environmental Performance (X2) yielded an F-statistic of 2.99, which exceeds the critical F-value of 2.85; however, the associated probability value is 0.8721 (> 0.05). This indicates that, despite the F-statistic exceeding the critical value, the simultaneous effect of these two variables on the dependent variable, Profitability (Z), is not statistically significant at the 5% significance level.

Table 14. Results of The Simultaneous Hypothesis Test For Substructure 2

R-squared	0.436288	Mean dependent var	0.124762
Adjusted R-squared	-0.284010	S.D. dependent var	0.245965
S.E. of regression	0.278713	Akaike info criterion	0.578291
Sum squared resid	1.398258	Schwarz criterion	1.571246
Log likelihood	11.85588	Hannan-Quinn criter.	0.942248
F-statistic	0.605705	Durbin-Watson stat	3.818182
Prob(F-statistic)	0.872147		

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the results of the simultaneous hypothesis test (F-test) for Substructure II, Carbon Emission Disclosure (X1), Environmental Performance (X2), and Profitability (Y) yielded an F-statistic of 0.6057, which is below the critical F-value of 2.85, with a probability value of

0.8721 (> 0.05). This indicates that, collectively, the three independent variables do not have a significant effect on the dependent variable, Cost of Debt (Z), at the 5% significance level. In other words, carbon emission disclosure, environmental performance, and profitability together do not adequately explain variations in the firm's cost of debt, and thus the hypothesis of a simultaneous effect is not supported.

7. Results of The Coefficient Of Determination Analysis

Table 15. Results of The Coefficient Of Determination Analysis For Substructure 1

R-squared	0.132864	Mean dependent var	0.060714
Adjusted R-squared	0.088396	S.D. dependent var	0.033886
S.E. of regression	0.032354	Akaike info criterion	-3.955433
Sum squared resid	0.040824	Schwarz criterion	-3.831313
Log likelihood	86.06408	Hannan-Quinn criter.	-3.909938
F-statistic	2.987831	Durbin-Watson stat	0.789124
Prob(F-statistic)	0.062044		

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the analysis of Sub-structure II, the variables Carbon Emission Disclosure and Environmental Performance jointly contribute 8.84% to Profitability. These findings underscore the importance of identifying additional variables that could enhance the effectiveness of sustainability strategies in improving financial performance and provide a foundation for further research to explore more comprehensive determinants of profitability.

Table 16. Results of The Coefficient Of Determination Analysis For Substructure 2

R-squared	0.436288	Mean dependent var	0.124762
Adjusted R-squared	-0.284010	S.D. dependent var	0.245965
S.E. of regression	0.278713	Akaike info criterion	0.578291
Sum squared resid	1.398258	Schwarz criterion	1.571246
Log likelihood	11.85588	Hannan-Quinn criter.	0.942248
F-statistic	0.605705	Durbin-Watson stat	3.818182
Prob(F-statistic)	0.872147		

Source: Author's estimation using EViews 12, based on sustainability reports of coal subsector with the IDX-IC A121 classification during the 2024-2025 period.

Based on the analysis of Substructure II, Carbon Emission Disclosure (X1), Environmental Performance (X2), and Profitability (Y) collectively contribute -28.40% to the variation in Cost of Debt (Z). The negative contribution indicates that increases in carbon emission disclosure, environmental performance, and profitability tend to reduce the firm's overall cost of debt, although the magnitude of the effect is relatively moderate.

8. Results of Hypothesis Testing With A Mediating Variable

Table 17. Sobel Test Results: The Effect of X1 on Z Through Y as an Intervening Variable

Input:		Test statistic:	Std. Error:	p-value:
a	-0.047861	Sobel test: -1.09195003	0.21048381	0.27485507
b	4.802194	Aroian test: -1.02532976	0.22415989	0.30520762
s _a	0.019600	Goodman test: -1.17350952	0.19585509	0.24059154
s _b	3.933611	Reset all	Calculate	

Source: Authors' calculation using the Sobel Test Calculator by Preacher and Leonardelli (2001), based on the processed research data.

Based on the mediation analysis, the effect of Carbon Emission Disclosure (X1) on Cost of Debt (Z) through Profitability (Y) as an intervening variable yielded a P-value of 0.2749 (> 0.05) and a Test Statistic (t) of -1.0920, which is lower than the critical t-value of -2.0181.

These results indicate that profitability does not significantly function as a mediator in the relationship between carbon emission disclosure and the cost of debt. Therefore, the indirect effect of Carbon Emission Disclosure on Cost of Debt through Profitability is not statistically supported at the 5% significance level.

Table 17. Sobel Test Results: “The Effect of X2 on Z Through Y as an Intervening Variable”

Input:		Test statistic:	Std. Error:	p-value:
a	0.002920	Sobel test: 0.57929288	0.02420607	0.56239157
b	4.802194	Aroian test: 0.4698853	0.02984219	0.63843697
s _a	0.004437	Goodman test: 0.83604303	0.01677235	0.4031307
s _b	3.933611	Reset all	Calculate	

Authors' calculation using the Sobel Test Calculator by Preacher and Leonardelli (2001), based on the processed research data.

Based on the mediation analysis, the effect of Environmental Performance (X2) on Cost of Debt (Z) through Profitability (Y) as an intervening variable yielded a P-value of 0.5742 (> 0.05) and a Test Statistic (t) of 0.5793, which is below the critical t-value of 2.0181. These results indicate that profitability does not significantly mediate the relationship between environmental performance and the cost of debt. Therefore, the indirect effect of Environmental Performance on Cost of Debt via Profitability is not statistically supported at the 5% significance level.

Discussion

The data in this study were processed using panel data regression and mediation analysis. The analysis was divided into two substructures. The first substructure examined the effect of Carbon Emission Disclosure and Environmental Performance on Profitability. The second substructure examined the effect of Carbon Emission Disclosure, Environmental Performance, and Profitability on the Cost of Debt. Before hypothesis testing, the model was selected through the Chow test, Hausman test, and Lagrange Multiplier test. The Common Effect Model was selected for the first substructure, while the Fixed Effect Model was selected for the second substructure. The classical assumption tests also showed that the models did not indicate serious multicollinearity or heteroscedasticity problems. Therefore, the processed data were considered suitable for regression interpretation.

The first finding shows that Carbon Emission Disclosure affects Profitability. This result supports the basic idea of Stakeholder Theory and Signaling Theory. Carbon emission disclosure gives stakeholders clearer information about how a company manages its environmental risks. In the coal subsector, this information matters because the industry faces high environmental exposure and public scrutiny. Disclosure can function as a signal that the company has better transparency, risk awareness, and reporting discipline. These elements can influence financial performance because they may improve stakeholder trust, strengthen corporate reputation, and support internal accountability.

However, the direction of the coefficient is negative. This means that higher carbon emission disclosure is associated with lower profitability in the observed data. This result needs careful interpretation. Carbon disclosure may increase reporting, compliance, monitoring, and environmental management costs. In the short term, these costs can reduce profitability, especially in emission-intensive companies such as coal firms. Therefore, the finding does not mean that disclosure is harmful. It shows that disclosure may carry financial consequences before its reputational or efficiency benefits appear. This explanation is consistent with the legitimacy perspective, which views environmental disclosure as part of a company's effort to maintain social acceptance, even when the process requires additional costs.

The second finding shows that Environmental Performance does not affect Profitability. This result indicates that better PROPER ratings do not automatically translate into higher Return on Assets in the coal subsector during the 2024-2025 period. Theoretically, Environmental Performance should support profitability through operational efficiency, regulatory compliance, and stronger stakeholder trust. However, the processed data do not show that pattern. One possible explanation is that environmental

performance in coal companies may require large environmental expenditures, rehabilitation costs, monitoring systems, and compliance investments. These costs may weaken the short-term financial benefit of environmental performance. As a result, environmental performance may not directly appear in profitability within a short two-year observation period.

This finding partly contradicts the expectation derived from Stakeholder Theory and Institutional Theory. These theories suggest that stronger environmental performance should create economic benefits because companies respond to stakeholder pressure and regulatory norms. However, the result shows that the financial effect is not automatic. Environmental performance may need supporting factors, such as operational efficiency, corporate reputation, governance quality, firm size, and market conditions, before it can improve profitability. Thus, the result is reasonable because environmental performance in a high-impact sector may work through a longer and more complex mechanism.

The third finding shows that Carbon Emission Disclosure does not affect the Cost of Debt. The coefficient is negative, but the relationship is not strong enough to support the hypothesis. This means that higher disclosure tends to move in the expected direction by reducing debt costs, but the evidence is not sufficient to conclude that creditors use carbon disclosure as a decisive factor in pricing debt. In theory, Carbon Emission Disclosure should reduce information asymmetry and perceived credit risk. A company that discloses emission information more clearly may be viewed as more transparent and more accountable. This should reduce creditors' uncertainty. However, the processed data show that this mechanism does not clearly occur in the coal subsector during the research period.

This result suggests that creditors may still prioritize conventional financial indicators over environmental disclosure when determining debt costs. In coal companies, creditors may focus more on cash flow stability, collateral, leverage, firm size, interest coverage, commodity price exposure, and debt maturity structure. Carbon disclosure may improve transparency, but it may not directly change interest costs if lenders do not treat disclosure quality as a main credit-risk variable. Therefore, the result does not reject the relevance of Signaling Theory entirely. It shows that the signal from carbon disclosure may not be strong enough to influence debt pricing without support from financial strength and institutional credibility.

The fourth finding shows that Environmental Performance does not affect the Cost of Debt. This result means that PROPER-based environmental performance does not directly reduce or increase borrowing costs in the observed coal companies. Theoretically, better environmental performance should lower environmental risk and reduce creditors' risk perception. However, the result indicates that environmental ratings alone may not be sufficient for creditors to adjust debt pricing. In the coal subsector, environmental risks may already be perceived as structurally high. Therefore, even when a company has better environmental performance, creditors may still classify the sector as high risk because of regulatory pressure, climate transition risk, market volatility, and the long-term uncertainty of coal demand.

This finding corresponds with the view that the relationship between environmental performance and debt cost is conditional. Environmental performance may affect debt costs only when supported by other factors, such as strong reputation, consistent ESG reporting, stable profitability, lower leverage, and credible governance. Without these supporting factors, environmental performance may remain a compliance indicator rather than a credit-pricing determinant. This interpretation is aligned with prior discussions in the article, which explain that environmental performance may not have a linear relationship with the cost of debt and may depend on internal and institutional conditions.

The fifth finding shows that Profitability does not affect the Cost of Debt. This result is important because profitability was expected to represent internal financial capacity and lower credit risk. Based on the Resource-Based View, profitability reflects a company's ability to generate internal resources. A profitable company should have better capacity to pay interest, manage obligations, and invest in sustainability practices. However, the processed data do not support this expectation. This means that creditors may not use ROA alone as the main basis for debt pricing in coal subsector companies.

One possible explanation is that ROA only reflects accounting profitability, not necessarily cash availability, debt repayment capacity, or risk exposure. Cost of debt may respond more strongly to cash flow, leverage, interest coverage, credit rating, debt structure, collateral, and macroeconomic

interest rates. In coal companies, profitability can also fluctuate because of commodity prices. As a result, creditors may consider profitability unstable if it depends heavily on external market cycles. This explains why ROA does not clearly reduce the cost of debt in the model.

The simultaneous test in the first substructure shows that Carbon Emission Disclosure and Environmental Performance do not jointly explain Profitability at the 5 percent level. The Adjusted R-squared value of 0.088396 indicates that the two variables explain only about 8.84 percent of the variation in profitability. This means that most profitability variation is explained by other factors outside the model. This result supports a cautious interpretation. Sustainability disclosure and environmental performance can matter, but they do not dominate profitability formation in coal companies. Profitability may depend more on production volume, coal prices, operating costs, asset productivity, exchange rates, tax burden, and financing structure.

The simultaneous test in the second substructure shows that Carbon Emission Disclosure, Environmental Performance, and Profitability do not jointly explain the Cost of Debt. The Adjusted R-squared value is -0.284010. This negative value should not be interpreted as a negative contribution. It indicates that, after adjusting for the number of predictors and sample structure, the model has weak explanatory power and performs worse than a simpler baseline model. Therefore, the cost of debt in this study is not adequately explained by the three variables. This finding strengthens the argument that debt pricing in the coal subsector is likely shaped by broader financial, institutional, and market-based determinants.

The mediation test also shows that Profitability does not mediate the relationship between Carbon Emission Disclosure and the Cost of Debt. It also does not mediate the relationship between Environmental Performance and the Cost of Debt. This result means that the indirect mechanism proposed in the hypotheses is not supported. Carbon disclosure may affect profitability, but that profitability does not continue into a meaningful change in the cost of debt. Likewise, environmental performance does not affect profitability and does not indirectly affect debt costs through profitability. Therefore, the hypothesized pathway from sustainability practices to debt cost through profitability does not operate clearly in the observed data.

These findings partially support and partially contradict previous theoretical expectations. The result supports the idea that carbon disclosure has financial relevance, especially for profitability. However, it contradicts the expectation that carbon disclosure and environmental performance reduce the cost of debt through lower credit risk perception. The findings also weaken the expected mediating role of profitability under the Resource-Based View. In this study, profitability does not function as a bridge between sustainability variables and debt financing costs.

Overall, the discussion indicates that sustainability-related variables in the coal subsector have a limited direct role in explaining debt costs during the 2024-2025 period. Carbon Emission Disclosure has a clearer relationship with internal financial performance than with external financing costs. Environmental Performance does not directly influence profitability or the cost of debt. Profitability also does not explain debt pricing in the model. These results are reasonable because the cost of debt in coal companies may be driven more by credit fundamentals, debt structure, commodity risk, macroeconomic conditions, creditor policies, and the long-term transition risk attached to the coal industry. Future studies should include these variables to produce a more complete explanation of debt financing costs in emission-intensive industries.

Conclusion

Based on the comprehensive analysis, several key conclusions can be drawn. First, carbon emission disclosure has a significant direct effect on corporate profitability, indicating that transparency in emission reporting is an important determinant of financial performance. In contrast, environmental performance does not show a significant direct impact on profitability, and neither variable individually or simultaneously demonstrates a significant effect on the firm's cost of debt.

Second, the joint contribution of carbon emission disclosure and environmental performance to profitability is relatively limited, suggesting that the majority of variation in profitability is influenced by factors beyond these sustainability measures. Similarly, the combination of carbon emission disclosure, environmental performance, and profitability does not significantly explain variations in

the cost of debt, although observed trends indicate a moderate tendency for these factors to reduce debt financing costs.

Finally, profitability does not serve as a significant mediator in the relationships between carbon emission disclosure or environmental performance and the cost of debt. These findings imply that while enhancing carbon emission transparency can improve financial performance, additional internal and external factors must be considered to effectively manage corporate financing costs. The results highlight the need for future research to explore broader environmental, operational, and financial determinants that could strengthen the effectiveness of sustainability strategies in improving both profitability and capital structure management.

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