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The influence of Environmental, Social, Governance (ESG) and leverage on the cost of capital (empirical study on mining companies listed on the Indonesia Stock Exchange for the 2022-2024 period)

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ABSTRACT

The primary objective of this investigation centers on evaluating the impact exerted by Environmental, Social, and Governance (ESG) factors together with leverage upon capital costs among mining corporations listed on the Indonesia Stock Exchange spanning the 2022–2024 interval. A quantitative methodology was employed, drawing upon secondary datasets sourced from audited annual reports, dedicated sustainability disclosures, and publicly available financial documentation. Through purposive sampling criteria, a cohort of 14 mining entities was delineated, yielding 42 firm-year observations for empirical scrutiny. ESG efficacy was quantified via a composite index aligned with Global Reporting Initiative (GRI) Disclosure Standards 2021, leverage was operationalized through the Debt-to-Equity Ratio (DER), and capital costs were proxied by the Weighted Average Cost of Capital (WACC). Rigorous preprocessing incorporated classical assumption validations, culminating in multiple linear regression analysis facilitated by IBM SPSS Statistics version 25. Empirical outcomes revealed that ESG disclosures manifest no discernible influence on capital costs, standing in stark juxtaposition to leverage, which demonstrated a negative and statistically robust association therewith. Collectively, ESG alongside leverage were found to significantly shape financing expenses, underscoring a synergistic explanatory mechanism. These results illuminate the preeminence of strategic debt management over sustainability signaling in modulating capital costs within Indonesia's mining landscape during the study window a nuance attributable to sectoral capital intensity and nascent ESG differentiation. By furnishing substantive evidence on the interplay of financial engineering and non-financial governance metrics, this inquiry enriches theoretical discourse on cost determinants within emerging market contexts, offering actionable insights for corporate treasurers navigating volatility-prone resource sectors.

Keywords: cost of capital; environment; governance; leverage; social

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1. INTRODUCTION

The increasingly dynamic development of the global economy makes companies face a higher level of uncertainty and risk, especially in terms of funding. Macroeconomic conditions such as global inflation, interest rate fluctuations, geopolitical tensions, and financial market volatility encourage investors and creditors to be more cautious in investing. In this situation, cost of capital It is an important indicator because it reflects the minimum rate of return that investors and creditors expect on the funds they invest in the company. The higher the perceived risk, the higher the cost of capital that the Company must bear (Aharon & Yagil, 2019).

In mining sector companies, the issue of cost of capital is becoming increasingly crucial. This sector is known as a capital-intensive sector, has high operational risks, and is highly dependent on global economic conditions and commodity prices. In addition, mining activities have a large environmental and social impact, so investors' attention to sustainability aspects is increasing. In recent years, the Weighted Average Cost of Capital (WACC) trend of mining companies in Indonesia has shown a relatively high and fluctuating value, indicating an increasing risk perception from investors and creditors towards the sector (Janah & Purwanto, 2024; Kurniasih et al., 2022; Widowati et al., 2025).

In the context of Indonesia, the WACC of public companies is generally relatively high compared to other countries in the Southeast Asian region. Various empirical studies show that the average WACC of companies in Indonesia is in the range of 11%-12%, depending on the estimation approach and observation period used. This high WACC is influenced by relatively high equity costs in emerging markets and moderate debt-based funding structures. Furthermore, macroeconomic factors such as high market risk premiums, volatility of the rupiah exchange rate against the US dollar, and regulatory and tax uncertainty contribute to investors' risk perceptions. Research by Widowati et al., (2025) and Kurniasih et al., (2022) shows that the characteristics of systematic risk in Indonesia contribute significantly to the high cost of capital compared to other countries in the region.

Based on general guidelines in valuation analysis, the reasonable WACC range for established companies is generally within a relatively narrow range, around 2%-3% between the lower and upper limits. For example, the range of 6%-9% or 10%-12% is still considered representative. In contrast, too wide a range of WACCs, such as 5%-10% or 5%-15%, is considered less representative of the risk environment and indicates a high level of uncertainty. However, in the context of developing countries such as Indonesia, adjustments to this range are acceptable given the country's high risks, inflation, and capital market volatility. Therefore, WACC in the range of 9%-12% is still considered reasonable and in accordance with the characteristics of the domestic market. Below are the capital costs of several mining sector companies for the 2022-2024 period, See Table 1

Table 1. Trend Weighted Average Cost Of Capital (WACC) of several mining companies in the 2022-2024 period

Code	Company Name	Year	WACC
ANTM	PT Aneka Tambang Tbk	2022	15%
		2023	17%
		2024	14%
BESS	Batulicin Nusantara Maritim Tbk	2022	16%
		2023	15%
		2024	16%
TINS	PT Timah Tbk	2022	12%
		2023	13%
		2024	16%

Table 1 shows an increase in the Weighted Average Cost of Capital (WACC) trend in several mining companies in Indonesia during the 2022–2024 period. Where on average, the above companies

have a WACC value that ranges above >12% (has a large level of risk), including PT Aneka Tambang Tbk (ANTM) with a Weighted Average Cost of Capital (WACC) of 15%-17% in 2022-2023 which indicates an increase in risk perception from investors and creditors to the company's funding costs in that year. However, in 2024 the WACC decreased again to 14%, indicating an improvement in financing conditions and a reduction in financial risk pressure. In contrast to PT Aneka Tambang Tbk (ANTM), Batulicin Nusantara Maritim Tbk (BESS) showed fluctuations in WACC which moved from 16% in 2022 to 15% in 2023, but again rose to 16% in 2024. This shows that the level of financing risk of Batulicin Nusantara Maritim Tbk (BESS) is unstable, and the increase in WACC in 2024 shows that the company faces increased operational and financial risks so that investors demand higher returns. Meanwhile, PT Timah Tbk (TINS) showed a consistent upward trend in WACC from 12% in 2022 to 13% in 2023, and a significant increase to 16% in 2024. This sustained increase indicates that the company's financing risk is getting higher from year to year, which can be caused by global tin industry pressures, production uncertainty, and increased capital requirements. Overall, the increase in WACC in each company shows that the higher the WACC, the greater the financing risk that the company must bear in obtaining funds for operations and investments. The WACC's rise suggests that the cost of funding companies is increasing as investors and creditors demand higher rates of return as compensation for greater risk.

Environmental, Social, and Governance (ESG) factors are increasingly recognized as key non-financial elements in corporate risk assessment. The level of corporate responsibility across environmental stewardship, social accountability, and robust governance practices is captured by ESG metrics. Transparency is enhanced and information gaps between executives and shareholders are minimized through comprehensive ESG reporting. Firms exhibiting strong ESG performance are generally viewed in capital markets as lower-risk entities, which may lead to reduced costs of capital.(Arhinful & Radmehr, 2023; Gonçalves et al., 2022.).

In addition to ESG, internal financial factors that affect the cost of capital are leverage. Leverage reflects the extent to which a company uses debt in its capital structure. The use of debt can provide benefits in the form of tax savings, but on the other hand increases the risk of bankruptcy if it is not managed optimally. Therefore, an imbalanced level of leverage can affect the risk perception of investors and creditors, ultimately impacting the cost of capital (Haag & Koziol, 2023; Khanchel & Lassoued, 2022; Pradana, 2024).

Previous research results related to the influence of ESG and leverage on cost of capital still show inconsistent findings. Some studies have found that ESG and leverage have a negative effect on the cost of capital, while other studies show a positive or insignificant effect (Battisti et al., 2020; Utami, 2021). These differences in results show that there is a research gap, especially in mining sector companies in Indonesia that have different risk characteristics and capital structures from other sectors. Based on these conditions, this study is important to re-examine the influence of ESG and leverage on the cost of capital in mining companies listed on the Indonesia Stock Exchange for the 2022–2024 period.

1.1. Hypothesis Formulation

1.1.1. The Influence of Environmental, Social, Governance (ESG) on the Cost Of Capital

Corroborative Corroborative evidence from Pradana (2024) documents a statistically significant negative association between Environmental, Social, and Governance (ESG) disclosures and overall capital costs. Firms that provide more comprehensive ESG information tend to experience lower financing expenses because such disclosures improve corporate transparency and strengthen investor confidence in the firm's long-term sustainability. Through clearer reporting of environmental initiatives, social responsibility practices, and governance mechanisms, companies are perceived as having stronger risk management capabilities and more stable operational frameworks. As a result, investors and creditors tend to assign lower risk premiums, which ultimately reduces the firm's overall cost of capital.

Similarly, Arditiyan and Purwanto (2025) substantiate the negative influence of ESG performance on debt financing expenses, which constitute an important component of capital costs. Their findings suggest that companies with stronger ESG practices are viewed by lenders as having lower default risk and more responsible managerial behavior, thereby enabling them to access funding at more favorable interest rates. In addition, ESG engagement enhances corporate reputation and signals long-term commitment to sustainable business practices, which further reduces perceived investment risk. Consequently, improved ESG disclosure and performance may contribute to lowering the weighted average cost of capital by reducing both equity and debt financing costs.
H1: Environmental, Social, and Governance (ESG) affects the cost of capital.

1.1.2. The Effect of Leverage on the Company's Cost of Capital

Empirical evidence from Arhinful (2023) demonstrates that heightened debt utilization reduces WACC through debt-related tax advantages. Optimal leverage levels are highlighted by Kontus (2023) as effective in driving WACC downward prior to substantial bankruptcy risks emerging. Comparable insights are offered by Topyan (2021), who observes that leverage escalation up to a threshold optimizes capital structure efficiency and correspondingly diminishes WACC.
H2 : Leverage affects the cost of capital

1.1.3. The Influence of Environmental, Social, Governance (ESG) And Leverage on the Cost of Capital

In this conceptual model, ESG and leverage are positioned as separate predictors, with capital costs serving as the primary outcome variable. Established theories and empirical studies consistently affirm an inverse linkage between these factors and funding expenses, fueled by greater openness, lessened reputational threats, and restored investor trust (Friede et al., 2015). Evidence from Chen (2004), confirms that carefully balanced leverage refines capital structures through tax-deductible advantages, methodically lowering weighted average costs a pattern especially evident in capital-heavy industries where equilibrated debt-equity mixes safeguard shareholder value during market turbulence.
H3: Environmental, Social, Governance (ESG) and Leverage simultaneously affect the company's cost of capital. (See Figure 1)

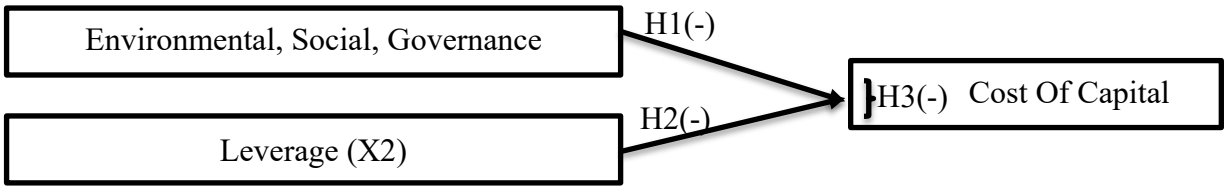

Figure 1. Hypothesis Chart

2. METHODOLOGY

A quantitative methodology with a causal-associative design has been employed in this study to examine the impact of Environmental, Social, and Governance (ESG) factors alongside leverage on corporate capital costs. Causal linkages between independent and dependent variables are rigorously tested through numerical data measurements.

Secondary data have been sourced from annual reports and sustainability disclosures of mining companies listed on the Indonesia Stock Exchange (IDX) spanning 2022–2024, supplemented by financial statements accessible via the official IDX platform.

The study population encompasses all mining firms listed on the IDX during the observation period. Samples were selected via purposive sampling, targeting companies that provide comprehensive

annual and sustainability reports disclosing ESG metrics aligned with Global Reporting Initiative (GRI) 2021 standards, yielding qualified firms across three annual observations.

Independent variables consist of ESG quantified through a dichotomous disclosure index per GRI 2021 (1 for disclosed items, 0 otherwise) and leverage, gauged by the debt-to-equity ratio reflecting total liabilities relative to shareholders' equity. The dependent variable, capital cost, is assessed via weighted average cost of capital (WACC), incorporating both debt and equity components based on prevailing capital structures.

Data were gathered through documentation, involving systematic extraction from financial statements, annual reports, and sustainability documents of selected firms, followed by statistical processing.

Analytical procedures include descriptive statistics to characterize the dataset, classical assumption tests (normality, multicollinearity, heteroscedasticity), and multiple linear regression to evaluate ESG and leverage effects on capital costs. Partial effects were assessed via t-tests, simultaneous impacts via F-tests, with all computations performed using specialized statistical software.

3. RESULTS AND DISCUSSION

3.1. Overview of Research Objects

Mining sector companies listed on the Indonesia Stock Exchange (IDX) spanning 2022–2024 were designated as the focal subjects of this investigation. The mining sector was purposefully selected owing to its capital-intensive operations, pronounced operational and environmental hazards, and dependence on enduring long-term funding frameworks. Moreover, this industry garners heightened scrutiny regarding sustainability matters, stemming from its immediate involvement in natural resource exploitation and resultant ecological repercussions.

Fourteen mining firms were pinpointed via purposive sampling protocols detailed in the methodological framework, each meeting stringent benchmarks such as reliable issuance of annual and sustainability reports coupled with comprehensive financial records vital for deriving study variables. Across the three-year timeframe, these selections generated 42 analytical observations. The resultant dataset was then scrutinized to evaluate the impacts of Environmental, Social, and Governance (ESG) elements alongside leverage on firms' capital expenditures.

3.2. Descriptive Statistics of Research Variables

A preliminary overview of the data characteristics utilized in this study was provided through descriptive statistical analysis. Key metrics such as minimum, maximum, mean, and standard deviation values for each variable were computed, enabling a clear understanding of data distributions and central tendencies across the examined constructs (See Table 2)

Table 2. Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Red	Std. Deviation
ESG	42	0,24	1,00	0,79	0,21
Leverage (DER)	42	0,11	1,68	0,64	0,39
Cost of Capital (WACC)	42	0,08	0,17	0,13	0,03

Descriptive statistics for the Environmental, Social, and Governance (ESG) variable revealed a mean score of 0.7896, indicative of robust implementation and disclosure practices across the sampled mining enterprises, though not uniformly achieving maximal transparency benchmarks. This aggregate performance signifies commendable adherence to sustainability protocols within Indonesia's extractive sector, tempered by the recognition that sector-wide maturity remains developmental rather than optimal. The standard deviation of 0.20810 further illuminates moderate heterogeneity in ESG execution, underscoring divergent organizational commitments and capacities that influence the depth

and authenticity of sustainability reporting a critical consideration for stakeholders evaluating long-term viability amid evolving regulatory landscapes.

Leverage, quantified through the Debt-to-Equity Ratio (DER), exhibited an average of 0.6442, reflecting a pronounced debt orientation characteristic of capital-intensive mining operations necessitating substantial long-term investments in exploration, extraction, and infrastructure. Peak DER observations reaching 3.20 highlight instances of aggressive financial structuring, which elevate bankruptcy risk premia and potentially distort investor perceptions of capital costs, thereby warranting vigilant financial oversight. With a standard deviation of 0.39459, substantial inter-firm variability emerges, mirroring strategic heterogeneity in balance sheet management that aligns with diverse project maturity profiles and market positioning strategies prevalent in resource industries.

The cost of capital, proxied by Weighted Average Cost of Capital (WACC), registered a mean of 0.1261 or 13%, emblematic of elevated financing risk premiums intrinsic to Indonesian mining ventures characterized by geological uncertainties, commodity price volatility, and operational complexities. Ranging from a low of 8% denoting exemplary capital efficiency to a high of 17%, where heightened risk compels elevated return expectations from capital providers, these metrics encapsulate differential risk exposures across the sample. The comparatively modest standard deviation of 0.03 suggests stable dispersion in financing costs, implying consistent market pricing of sector-specific hazards while highlighting opportunities for superior performers to gain competitive advantage through refined capital structuring and risk mitigation frameworks.

3.3. Classic Assumption Testing

Before multiple linear regression analysis is performed, the research data is first tested to ensure that the regression model meets classical assumptions. Classical assumption testing aims to ensure that the results of regression estimates are unbiased, efficient, and consistent.

3.4. Data Normality Test

The normality evaluation serves to verify whether regression constructs including dependent outcomes, independent predictors, and associated covariates conform to Gaussian distributional properties essential for parametric modeling validity. A regression framework is deemed robust and suitable for hypothesis scrutiny only when empirical data exhibit normal or near-normal dispersion patterns across all components. Within this investigation, distributional adequacy was ascertained through Kolmogorov-Smirnov testing, with decision-making predicated on asymptotic significance thresholds a methodological cornerstone ensuring unbiased inference and reliable parameter recovery in analyses of capital cost dynamics among resource sector entities (See Table 3)

Table 3. Results of the Kolmogorov-Smirnov Test Data Normality Test

		Unstandardized Residual
N		42
Normal Parameters, b	Red	.0000000
	Std. Deviation	.01792260
Most Extreme Differences	Absolute	.075
	Positive	.075
	Negative	-.056
Test Statistic		.075
Asymp. Sig. (2-tailed)		.200c,d

From the assessment detailed in Table 3, the Kolmogorov-Smirnov test produced an asymptotic significance (2-tailed) of 0.200, which notably surpasses the standard $\alpha = 0.05$ threshold. This result confirms the Gaussian distribution characteristics of regression residuals, thereby satisfying the essential normality prerequisite that underpins the reliability of parametric statistical procedures. As such, the empirical dataset meets all necessary conditions for advanced multiple linear regression modeling, guaranteeing the robustness of hypothesis assessments, coefficient interpretations, and interval estimations in analyzing capital cost drivers across Indonesian mining operations. (Eisenhardt, 1989; Jensen & Meckling, 1976; Kraus & Litzenberger, 1973).

3.5. Multicollinearity Test

The next classical assumption test is the multicollinearity test. This test aims to test whether the regression model finds a correlation between independent variables See Table 4

Table 4. Multicollinearity Test Results Coefficients

Coefficients			
Models		Collinearity Statistics	
		Tolerance	VIVID
1	Environmental, Social, Governance (ESG)	.997	1.003
	Leverage	.997	1.003

Source : IBM SPSS 25 output, Data processed (2025).

From the diagnostics outlined in Table 4, tolerance coefficients were recorded at 0.997 for both the Environmental, Social, and Governance (ESG) construct and leverage, substantially surpassing the established cutoff of 0.10. Complementarily, Variance Inflation Factor (VIF) metrics registered at 1.003 for each predictor, remaining well below the conservative threshold of 10.00. These favorable indicators collectively substantiate the absence of multicollinearity concerns within the dataset, affirming statistical independence among explanatory variables critical for unbiased coefficient estimation and valid hypothesis inference. Such methodological assurance strengthens the regression framework's integrity, enabling confident attribution of capital cost variations to distinct ESG and leverage effects within Indonesia's mining sector, where predictor orthogonality underpins reliable empirical generalizations.

Heteroscedasticity Test

The heretoscedasticity test is a test that aims to test whether variance inequality occurs in the regression model.

Table 5. Heteroscedasticity Test Results

Coefficient						
Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.011	.007		1.538	.132
	Environmental, Social, Governance (ESG)	-.011	.008	-.045	-.293	.771

		.002				
	Leverage	.008	.004	.267	1.726	.092

Source: IBM SPSS 25 output, Data processed (2025).

From the findings summarized in Table 5, significance probabilities were recorded at 0.771 for the Environmental, Social, and Governance (ESG) construct and 0.092 for leverage, both comfortably exceeding the conventional threshold of 0.05. This statistical profile confirms the absence of heteroscedasticity symptoms within the dataset, validating the homoscedastic nature of regression residuals essential for unbiased and efficient parameter estimation. Such methodological rigor ensures that variance stability across fitted values supports reliable hypothesis testing and generalizable inferences regarding capital cost determinants in Indonesia's mining sector, where data heterogeneity could otherwise compromise empirical credibility.

3.6. Multiple Linear Regression Analysis

Multiple linear regression analysis was conducted to assess the impact exerted by Environmental, Social, and Governance (ESG) factors alongside leverage on capital costs within mining corporations. Empirical findings from the regression framework reveal that both independent constructs ESG and leverage demonstrate substantive influence on financing expenses, manifesting through both individual partial effects and collective simultaneous contributions. This dual-layered validation underscores the complementary roles of sustainability metrics and debt structuring in shaping cost dynamics, providing a robust foundation for strategic financial decision-making in capital-intensive sectors characterized by elevated risk profiles and long-term investment horizons.

Table 6. Results of Multiple Linear Regression Analysis

Variable	Coefficients		t-count	ig.
Constant	.163		13.619	,000
ESG	-.010		-.752	,457
Leverage	-.044		-6.093	,000

Based on Table 6, it can be concluded that the multiple linear regression equation is as follows:

Y = 0.163 - 0.010X1 - 0.044X2 + ε

The regression equation derived from the tabular results reveals negative coefficients for both Environmental, Social, and Governance (ESG) factors and leverage in relation to capital costs. This configuration suggests that enhanced ESG disclosure quality is associated with diminished financing expenses, while increments in optimally calibrated leverage similarly contribute to reduced capital burdens through structural efficiencies. Such directional relationships underscore the potential dual leverage points sustainability signaling and debt optimization—for mining enterprises seeking competitive cost advantages, although empirical significance testing remains essential to confirm practical magnitude within Indonesia's resource sector dynamics.

Hypothesis Testing

From the evaluation detailed in Table 6, the critical t_{tabel} threshold was calculated via the $t(\alpha/2; n-k)$ distribution, producing a value of 2.021 corresponding to degrees of freedom $df = n - k = 42 - 2 = 40$, wherein n signifies aggregate observations and k independent predictors. The resultant t_{hitung} for Environmental, Social, and Governance (ESG) elements (X1) stood at 0.752 deficient relative to the t_{tabel} benchmark of 2.021 accompanied by a p-value of 0.457 surpassing the 0.05 criterion.

Accordingly, the null hypothesis (H_0) was upheld as the alternative (H_1) failed substantiation, thereby concluding that ESG transparency manifests no statistically substantive bearing on capital costs. This determination highlights how, notwithstanding ESG advancements, prevailing sectoral uniformity undermines risk-differential signaling for investors and lenders, constraining its capacity to recalibrate financing premia amid Indonesia's mining landscape.

Conversely, leverage (X2) produced a t_{hitung} of 6.093 substantially surpassing t_{tabel} 2.021 with significance at 0.000 well below 0.05, leading to rejection of H_0 and acceptance of H_1. A negative and substantial association was thus confirmed between leverage and capital costs, indicating that elevated debt proportions within optimized capital structures mitigate financing expenses rather than amplify risk when prudently managed. This dynamic underscores tax shield benefits and structural efficiencies, positioning leverage as a dominant lever for cost minimization in mining operations, particularly within Indonesia's resource-intensive sector where financial engineering often overshadows sustainability signaling in short-term capital pricing.

Table 7. Simultaneous Hypothesis Test (f-test)

Models	Sum Of Squares		Coefficients		F-count	Sig.
Regression	.013		.006		19.182	.000 [b]
Residual	.013		.000			
Total	.026		-.044			

Source: IBM SPSS 25 output, Data processed (2025).

From the data summarized in Table 7, the F-test produced a calculated statistic of 19.182, coupled with a significance probability of 0.000 far below the standard 0.05 benchmark while exceeding the critical F_{tabel} threshold of 4.08. This robust statistical profile affirms the appropriateness and predictive validity of the regression framework utilized, conclusively establishing that Environmental, Social, and Governance (ESG) elements (X1) alongside leverage (X2) jointly impose a substantial effect on capital costs (Y).

Collective assessment further illuminates the complementary roles of ESG indicators and debt composition in shaping financing burdens, demonstrating that cost structures in mining operations emerge from interdependent dynamics rather than singular drivers. Non-financial sustainability attributes synergize with financial leverage strategies to account for cost variability, affirming a holistic paradigm of capital pricing that integrates governance excellence with optimized funding mixes. These insights not only validate multivariate modeling approaches but also guide policy formulation for resource firms seeking competitive cost advantages amid Indonesia's regulatory evolution.

3.7. Discussion of Research Results

A satisfactory level of Environmental, Social, and Governance (ESG) disclosure was observed across the majority of sample enterprises, characterized by consistently robust reporting practices. Notably, the modest standard deviation in ESG scores indicates minimal variability among firms, reflecting a landscape of relative homogeneity in sustainability metrics that fails to create discernible differentiation for investors and creditors when assessing risk profiles. Such uniformity implies that ESG profiles do not substantially alter perceptions of expected returns, thereby limiting their role as pivotal determinants of financing costs. Consequently, ESG transparency exerts no statistically meaningful influence on capital costs, aligning with empirical findings from Janah and Purwanto (2024), who similarly documented the absence of significant ESG effects on financing expenses within comparable contexts.

In marked contrast, leverage was empirically demonstrated to reduce capital costs effectively, underscoring the benefits of balanced debt utilization within the researched firms. Enterprises exhibiting elevated leverage ratios were interpreted as maintaining optimal capital structures, which systematically lower overall financing burdens through strategic debt deployment and tax shield advantages. Conversely, entities dependent on lower leverage tend toward equity-heavy financing—a costlier alternative that elevates weighted average capital expenses due to higher equity return expectations. This pattern reveals that judicious leverage escalation need not amplify corporate risk profiles; rather, when debt is prudently managed, it delivers structural efficiencies that diminish capital costs substantially. Thus, within this study's framework, leverage manifests a substantive negative association with capital expenditure requirements, reinforcing traditional capital structure theory.

4. CONCLUSION

The objectives of this research encompass an examination of how Environmental, Social, and Governance (ESG) factors, alongside leverage, impact the cost of capital among mining firms listed on the Indonesia Stock Exchange over the 2022–2024 timeframe. Through comprehensive data processing and hypothesis evaluation, several key insights have been derived as outlined below.

The ESG profiles of mining enterprises were assessed as satisfactory overall, reflecting robust practices across environmental stewardship, social responsibility, and governance frameworks. Similarly, leverage positions within these firms were characterized as well-balanced, indicative of prudent financial structuring that supports operational stability without excessive risk exposure. Such conditions underscore the sector's alignment with contemporary sustainability expectations while maintaining fiscal discipline.

Individually, ESG dimensions were found to exert no statistically meaningful influence on the cost of capital, suggesting that current disclosure levels fail to serve as a primary differentiator in risk assessments by investors or lenders. This pattern implies that uniform ESG reporting across competitors does not sufficiently alter perceptions of required returns, even when average performance is commendable; consequently, enhancements in ESG transparency have yet to translate into tangible reductions in capital expenses. In contrast, leverage demonstrated a negative and substantial association with the cost of capital, whereby optimized debt utilization—when managed effectively—lowers overall financing costs. This outcome is attributed to tax shield advantages and optimized capital structure dynamics, which collectively diminish the weighted average cost of capital (WACC) and enhance firm valuation in competitive markets.

Collectively, ESG elements and leverage were determined to significantly shape the cost of capital, highlighting the interplay between non-financial sustainability metrics and debt-related financial strategies in explaining variability within mining operations. Although ESG lacks isolated potency, its integration with leverage amplifies explanatory power, revealing a multifaceted driver of financial performance that aligns with modern integrated reporting paradigms.

In synthesis, empirical evidence affirms that strategic leverage optimization plays a more pivotal role in mitigating capital costs compared to ESG disclosure maturity during the observed period. Accordingly, mining entities are advised to prioritize sophisticated debt oversight while progressively elevating ESG reporting standards to foster enduring investor trust and competitive positioning within Indonesia's evolving capital markets.

Ethical approval

Not Applicable

Informed consent statement

Not applicable.

Authors' contributions

SA conceptualized the study, developed the research design and variables (liquidity, solvency, profitability, and company value), compiled the 2019–2023 panel data from Indonesia Stock Exchange retail sub-sector firms, conducted the purposive sampling and SPSS-based multiple linear regression analysis, and drafted the manuscript. APEP contributed to data verification and cleaning, supported the operationalization of indicators, assisted in interpretation of statistical outputs, and improved the structure of the results and discussion sections. AKS assisted in literature review and theoretical framing, reviewed the methodology and robustness of the analysis, and performed critical revision and final editing. All authors have read and approved the final version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data presented in this study are available on request from the corresponding author due to privacy reasons.

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