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The Effect of ESG Risk Rating and Leverage on Stock Returns with Profitability as a Moderating Variable in Mining Sector Companies Listed on the Stock Exchange Indonesia's Impact 2020-2024

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Abstract

Stock returns in the mining sector on the Indonesia Stock Exchange (IDX) experienced high volatility during 2020-2024 due to commodity price fluctuations and the impact of the pandemic. This study aims to analyze the effect of ESG Risk Rating and leverage on stock returns, with profitability (ROE) as a moderating variable in mining companies listed on the IDX. Using quantitative explanatory research with panel data from 15 purposive sample companies (ANTAM, INCO, etc.), secondary data from financial reports, Sustainalytics ESG ratings, and daily stock prices were analyzed through EViews panel regression (Random Effects Model). The results show that ESG Risk Rating has a positive but insignificant effect (β=0.021966, p=0.0578), leverage (DER) has no significant effect (p=0.5248), and ROE fails to moderate both relationships (p>0.05). The model only explains 3.83% of the return variation (Adjusted R^2=0.038). In conclusion, external factors dominate mining stock returns compared to internal financial metrics in the volatile Indonesian commodity market.

INTRODUCTION

The mining sector plays a crucial role in the Indonesian economy as a contributor to foreign exchange and a major driver of the capital market. However, mining company stock returns on the Indonesia Stock Exchange (IDX) experienced significant fluctuations from 2020 to 2024 due to the dynamics of global commodity prices such as coal and nickel, domestic macroeconomic conditions, and the COVID-19 pandemic, which exacerbated sector volatility (Empiris et al., 2024; Ulandari, 2025). This volatility was evident in the energy sector index's 27.54% growth followed by a sharp decline, creating uncertainty for investors in portfolio management (Andika Budhiananto, 2024; Shanaev & Ghimire, 2022).

This phenomenon is further complicated by the fact that internal company factors, such as ESG risk management and capital structure, have not been fully integrated into investment strategies in the mining sector, which faces high environmental risks. Stock returns, as the primary outcome, often depend more on market sentiment than fundamental metrics, although the ESG Risk Rating from Sustainalytics is increasingly being considered by global investors (Tjun et al., 2024; Sugiarto, n.d.).

Problems arise because ESG Risk Ratings, which measure exposure and management of environmental, social, and governance risks, have not consistently impacted stock returns in the Indonesian mining sector, where a high rating is a positive long-term signal but is often pressured

by adaptation costs. Leverage through the Debt-to-Equity Ratio (DER) also poses high financial risks due to reliance on debt for expansion, with no guarantee of increased returns amid commodity fluctuations (Megawati et al., 2021; Iskandar, 2025). Profitability (ROE), as a potential moderator, often fails to strengthen this relationship, as profit efficiency is more influenced by external factors than internal ones.

Empirical constraints are increasingly apparent in the regression model's limited explanation of stock return variations, where external factors dominate, while the literature is limited on ROE moderation in the post-pandemic BEI mining context (Aresteria et al., 2024; Nurrahman, 2025). This creates a research gap regarding the interaction of these internal variables.

This study aims to analyze the effect of ESG Risk Rating and leverage on stock returns, with ROE as a moderating variable, in 15 mining companies on the Indonesian Stock Exchange (IDX) in 2020-2024 using panel regression. The study's urgency lies in the need for investors to understand return drivers in this volatile sector for sustainable portfolio decisions, particularly following the OJK regulation on ESG reporting. The study's novelty lies in testing the moderation of ROE specifically on ESG Risk Rating Sustainalytics and DER in the mining sector, complementing the literature with a focus on recent panel data rarely explored in Indonesia (Dwimayanti et al., 2023; Rahmania, 2025).

LITERATURE REVIEW

1. Stakeholder Theory

Stakeholder theory explains the relationship between individuals and groups that are influenced or capable of influencing a company's operational processes in achieving its focus or goals (Freeman, 1984). Companies are required to observe and generate profits or benefits for stakeholders, as their existence influences and is influenced by the decisions made by the company during its business processes (Bani-Khalid et al., 2017). Companies are required to meet the expectations and demands of stakeholders.(Gharchia & Mindosa, 2023)

2. Signaling Theory

Based on signaling theory, companies with high ESG Risk Ratings send a negative signal to investors that the company is experiencing poor sustainability and governance, which can erode market confidence and lead to lower stock returns. High leverage can also be considered a negative signal because it indicates significant financial risk and the company's potential inability to meet its obligations, which can ultimately reduce investor interest.(Rifka Alkhilyatul Ma'rifat, I Made Suraharta, 2024)

3. Agency Theory

Agency theory examines the dynamics between corporate management acting as agents and capital owners acting as principals. This theory was first proposed by Alchian and Demsetz (1972) and expanded upon by Jensen and Meckling (1976), who stated that an agency relationship arises when an individual or group, known as the principal, employs another individual, known as the agent, to perform a service and grants them decision-making authority.(Sutisna et al., 2024).

4. ***Trade-off Theory***

Trade-off theory explains the relationship between taxes, bankruptcy risk, and debt use as a result of corporate financing decisions. Optimal debt use depends on the balance between benefits, such as tax advantages, and drawbacks, such as bankruptcy risk. As long as debt provides benefits, its use is permissible; however, if the risks outweigh the benefits, debt is no longer beneficial.(Megawati et al., 2021).

Share

Shares can be defined as proof of ownership by an individual or business entity of a portion of a company's capital. By owning shares, shareholders have a claim on the company's assets and income and the right to participate in company decision-making through voting rights at the General Meeting of Shareholders (GMS). According to Tannadi (2020), shares are proof of capital ownership in a company, indicating the percentage of ownership an individual holds in the company.(Safitri, 2022)

Stock Returns

Return is an investor's primary goal when investing, which can be achieved in the form of dividends or capital gains. According to Subramanyam and Wild (2009), return is the distribution of investor capital from company profits, either through profit distribution or reinvestment. Hermawan (2012) emphasized that investors generally monitor a company's condition before investing to achieve the expected return. In principle, high returns are accompanied by high risks.(Metasari & Marlinah, 2021).

1. Environmental, Social, and Governance

According to Sormin et al. (2023), companies with good ESG implementation will have a keen understanding of long-term strategic issues, enabling them to manage their long-term goals. ESG information can direct analytical estimates to be more targeted and realistic. Company management also has the possibility of more precise information to handle and results that can exceed market targets (Sormin et al., 2023). ESG is a framework consisting of three aspects: environmental, social, and governance.(Minister of Health, 2024).

2. Environmental, Social, and Governance Risk Rating

Environmental, Social, and Governance (ESG) Risk Rating is a scoring system used to measure a company's risk level related to environmental, social, and corporate governance aspects. This assessment takes into account the company's exposure to ESG risks that have the potential to negatively impact business value and sustainability, as well as the effectiveness

of the company's mitigation strategies to manage these risks. ESG Risk Ratings are typically categorized into several levels, ranging from low, medium, to high and severe risks, which describe the severity of the risk's impact on the environment and society as well as the financial implications for the company.(Aresteria et al., 2024)

3. Leverage

Leverage is used to describe the extent to which a company's assets are financed by debt compared to equity, where higher leverage indicates greater investment risk. Leverage is usually measured using the Debt to Equity Ratio (DER), which shows the comparison between total debt and equity. Besides DER, another frequently used proxy for leverage is the Debt to Asset Ratio (DAR), which is the ratio of total debt to a company's total assets. In this study, leverage is measured using the Debt to Equity Ratio (DER), which is the comparison between the amount of long-term debt and equity, which indicates the company's ability to meet its obligations with its equity.(Sambora et al., 2014).

Profitability

Profitability is a measure of a company's performance, indicating its ability to generate profits over a specific period at a given level of sales, assets, or share capital. The Committee on Terminology defines profitability as the amount derived from subtracting the cost of goods manufactured, other costs, and losses from operating income. According to the APB Statement, profitability is the excess (deficit) of income over expenses during an accounting period (Harahap, 2001). In this study, profitability acts as a moderating variable that can strengthen or weaken the influence of ESG Risk Rating and leverage on stock returns.(Priatna, 2016).

METHODS

This study adopts a quantitative approach with an associative-causal method to empirically test the influence and moderation relationships. This explanatory research aims to identify the causality between ESG Risk Rating and leverage on stock returns, with profitability (ROE) as a moderating variable in mining sector companies listed on the Indonesia Stock Exchange (IDX) for the 2020-2024 period (Sugiyono, 2023; Creswell & Creswell, 2021). This approach allows for causality analysis through secondary panel data that integrates cross-sectional and time-series dimensions, in accordance with standard practice in empirical financial studies in Indonesia.

The research instrument consisted of secondary data from annual financial reports, sustainability reports, and the Sustainalytics ESG Risk Rating, with stock returns calculated from the IDX's daily closing price data via Yahoo Finance and Stockbit. The independent variables included the ESG Risk Rating (continuous scale 0-100) and leverage proxied by the Debt to Equity

Ratio (DER), while the dependent variables were annual stock returns and ROE moderation using ESG×ROE and DER×ROE interactions (Emzir, 2022; Sudaryono, 2021). Data analysis techniques included panel data regression with EViews using the Chow-Hausman-LM test for model selection, classical assumption tests (multicollinearity VIF <10, Breusch-Pagan heteroscedasticity), and moderated regression analysis for interaction testing.

The study population comprised all 204 mining companies listed on the Indonesia Stock Exchange (IDX) for the 2020-2024 period. Fifteen companies were selected through purposive sampling based on consistency of financial reporting and ESG disclosure over five consecutive years (criteria: ANTAM, INCO, INKP, INTP, MDKA, SMGR, TINS, TKIM, TPAC, AKRA, BUMI, INDY, ITMG, MEDC, PTBA). This technique ensured a dominant representation of the coal, nickel, and gold subsectors, eliminating 189 companies due to incomplete data (Sugiyono, 2023; Creswell & Creswell, 2021).

The research procedure was carried out in stages, starting from six months of documentary data collection, cleaning outlier data using winsorizing 1-99%, logarithmic transformation for normality, Random Effects model estimation (based on the Hausman test with a probability >0.05), multilevel moderation testing (direct effect, interaction term, incremental F-test), and robust validation with alternative fixed effects (Emzir, 2022; Sudaryono, 2021). All stages followed standard panel regression protocols to minimize endogeneity bias and ensure the generalizability of the findings to the Indonesian capital market context.

No	Criteria	Sample
1	Mining companies listed on the Indonesia Stock Exchange in 2020-2024.	204
2	Mining Companies that do not consecutively publish Financial Reports in 2020-2024.	(1)
3	Mining companies that have not consistently disclosed their Environmental, Social, Governance (ESG) Risk ratings in their sustainability reports for 5 consecutive years.	(188)
	Amount	**15**

List of Mining Company Samples based on purposive sampling in 2020-2024.

1	ANTM	Aneka Tambang Tbk.
2	INCO	Vale Indonesia Tbk.
3	INKP	Indah Kiat Pulp & Paper Tbk.
4	INTP	Indocement Tunggal Prakarsa Tbk.
5	MDKA	Merdeka Copper Gold Tbk.

6	SMGR	Semen Indonesia (Persero) Tbk.
7	TINS	Timah Tbk.
8	TKIM	Tjiwi Kimia Paper Factory Tbk.
9	TPIA	Chandra Asri Pacific Tbk.
10	AKRA	AKR Corporindo Tbk.
11	EARTH	Bumi Resources Tbk.
12	INDY	Indika Energy Tbk.
13	ITMG	Indo Tambangraya Megah Tbk.
14	MEDC	Medco Energi Internasional Tbk
15	PTBA	Bukit Asam Tbk.

RESULTS

Model selection test

1. **Chow Test**

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.226403	(14,56)	0.9981
Cross-section Chi-square	4.074204	14	0.9950

Prob value 0.9 > 0.05, meaning the selected model is CEM

2. **Hausman test**

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.595723	3	0.8974

The probability value is 0.89 > 0.05, meaning the selected model is REM.

3. **lm test**

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	5.418030	0.009821	5.427851
	(0.0199)	(0.9211)	(0.0198)

Prob value 0.01 < 0.05, meaning the selected model is REM

Based on the model test, the best model selected in this study is REM.

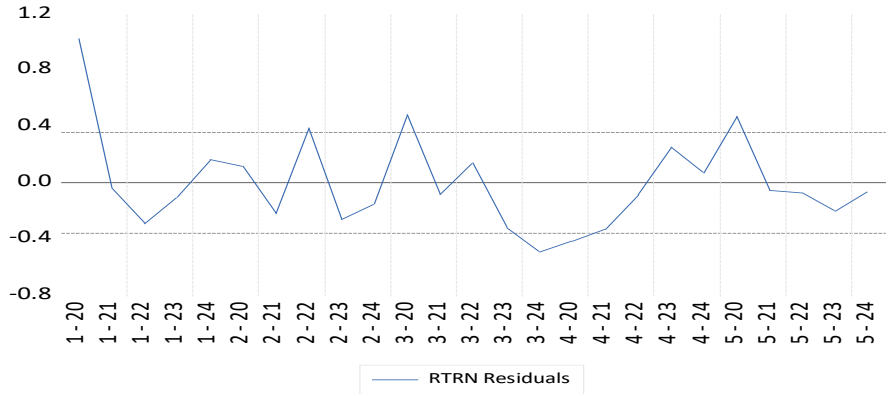
Classical Assumption Test

1. **Multicollinearity**

	ESG	DER	ROE
ESG	1.000000	0.465018	-0.219186
DER	0.465018	1.000000	-0.651976
ROE	-0.219186	-0.651976	1.000000

The results of the multicollinearity test show that the correlation between ESG and DER is 0.465 < 0.85, ESG and ROE is -0.2191 < 0.85, DER and ROE is -0.651, so it can be concluded that it passes the multicollinearity test.

2. Heteroscedasticity



From the residual graph, it can be seen that no residual values exceed the limits (500 and -500), meaning that the residual variances are the same. Therefore, the model passes the heteroscedasticity test.

Moderation of Variable Z on the Influence of X1 on Y

To test the existence of Z whether it is a pure moderator, quasi moderator or not a moderating variable.

1. OUTPUT

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 15:49
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.531213	0.371821	-1.428681	0.1574
ESG	0.020368	0.011315	1.800133	0.0760

Effects Specification		
	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.666600	1.0000

Weighted Statistics

R-squared	0.049554	Mean dependent var	0.123615
Adjusted R-squared	0.036534	S.D. dependent var	0.626633
S.E. of regression	0.615080	Sum squared resid	27.61760
F-statistic	3.806064	Durbin-Watson stat	2.856875
Prob(F-statistic)	0.054906		

2. OUTPUT 1

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 15:08
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.645737	0.381609	-1.692142	0.0949
ESG	0.021769	0.011302	1.926034	0.0580
ROE	0.621287	0.519056	1.196955	0.2353

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.662295	1.0000

Weighted Statistics			
R-squared	0.071181	Mean dependent var	0.123615
Adjusted R-squared	0.045381	S.D. dependent var	0.626633
S.E. of regression	0.612250	Sum squared resid	26.98917
F-statistic	2.758915	Durbin-Watson stat	2.819381
Prob(F-statistic)	0.070067		

3. OUTPUT 2

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 15:44
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.598040	0.463580	-1.290047	0.2012
ESG	0.020522	0.013251	1.548650	0.1259
ROE	0.141848	2.648901	0.053550	0.9574
ESGZ	0.013196	0.071467	0.184638	0.8540

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.668064	1.0000

Weighted Statistics			
R-squared	0.071705	Mean dependent var	0.123615
Adjusted R-squared	0.032481	S.D. dependent var	0.626633
S.E. of regression	0.616372	Sum squared resid	26.97396
F-statistic	1.828104	Durbin-Watson stat	2.816671
Prob(F-statistic)	0.149838		

Moderation of Variable Z on the Influence of X2 on Y

1. OUTPUT

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 16:01
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.107792	0.088489	1.218131	0.2271
DER	0.033084	0.085755	0.385798	0.7008

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.679057	1.0000

Weighted Statistics			
R-squared	0.002362	Mean dependent var	0.123615
Adjusted R-squared	-0.011304	S.D. dependent var	0.626633
S.E. of regression	0.630165	Sum squared resid	28.98889
F-statistic	0.172832	Durbin-Watson stat	2.741339
Prob(F-statistic)	0.678827		

2. OUTPUT 1

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 16:02
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.035696	0.111132	0.321202	0.7490
DER	0.049802	0.086960	0.572705	0.5686
ROE	0.573121	0.536770	1.067721	0.2892

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.677344	1.0000

Weighted Statistics

R-squared	0.020362	Mean dependent var	0.123615
Adjusted R-squared	-0.006850	S.D. dependent var	0.626633
S.E. of regression	0.628776	Sum squared resid	28.46585
F-statistic	0.748273	Durbin-Watson stat	2.699912
Prob(F-statistic)	0.476826		

3. OUTPUT 2

Dependent Variable: RTN
Method: Panel EGLS (Cross-section random effects)
Date: 01/01/26 Time: 16:04
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (unbalanced) observations: 73
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.042223	0.111522	0.378610	0.7061
DER	0.034888	0.095086	0.366910	0.7148
ROE	0.321424	0.628346	0.511540	0.6106
DERZ	4.61E-07	7.53E-07	0.612372	0.5423

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.677709	1.0000

Weighted Statistics

R-squared	0.019706	Mean dependent var	0.107974
Adjusted R-squared	-0.022915	S.D. dependent var	0.616743
S.E. of regression	0.623769	Sum squared resid	26.84704
F-statistic	0.462356	Durbin-Watson stat	2.720283
Prob(F-statistic)	0.709480		

Regression Equation

Dependent Variable: RTRN
Method: Panel EGLS (Cross-section random effects)
Date: 11/25/25 Time: 07:22
Sample: 2020 2024
Periods included: 5
Cross-sections included: 15
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.685013	0.389511	-1.758650	0.0829
ESG	0.021966	0.011391	1.928420	0.0578
DER	0.054769	0.085693	0.639133	0.5248
ROE	0.682532	0.531782	1.283482	0.2035

Effects Specification		
	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.667183	1.0000

Weighted Statistics			
R-squared	0.077315	Mean dependent var	0.123735
Adjusted R-squared	0.038328	S.D. dependent var	0.626597
S.E. of regression	0.614471	Sum squared resid	26.80783
F-statistic	1.983101	Durbin-Watson stat	2.822279
Prob(F-statistic)	0.124272		

DISCUSSION

The estimation results using the Random Effect Model show that the ESG variable has a positive coefficient of 0.021966 with a t-statistic value of 1.928420 and a significance level of 0.0578. These results indicate that ESG has a positive but not statistically significant effect at the 5% level, although it is in the category of near-significant (marginal effect). This means that an increase in a company's ESG score tends to increase stock returns, but the statistical evidence obtained is not strong enough to confirm this effect at the 95% confidence level.

The DER variable shows a positive coefficient of 0.054769 with a probability value of 0.5248, indicating that DER has no significant effect on stock returns. Therefore, the company's leverage level is not proven to be a determinant of stock returns in this model. This may indicate that investors during the study period did not view debt-based funding structures as a primary factor in determining investment returns.

Return on Equity (ROE) is positioned as a moderating variable representing a company's ability to generate profits from its equity. Estimation results show that ROE directly has a positive, but statistically insignificant, coefficient on returns. This indicates that company profitability, on its own, is not strong enough to explain variations in returns in this model.

The F-test results show a probability value of 0.124272, indicating that ESG, DER, and ROE simultaneously have no significant effect on stock returns. Furthermore, the Adjusted R-squared value of 0.038328 indicates that only about 3.83% of the variation in stock returns can be explained by the independent variables in the model, while the remainder is influenced by other factors outside the model such as market conditions, investor sentiment, macroeconomic risk, and other external factors. Therefore, this model has relatively low predictive ability regarding stock return variations.

For the Moderation Calculation, the results above found that the influence of ROE as a moderating variable on RTN and on the first output (0.23 > 0.05) and the influence of the ESGZ interaction variable on output 2 (0.85 > 0.05) was not significant in both, which means that the ROE variable is not a moderating variable between ESG and the RTN variable.

From the results above, it was also found that the influence of ROE as a moderating variable between DER and the RTN variable, on the first output (0.28 > 0.05) and the influence of the interaction variable DERZ output 2 (0.54 > 0.05) was not significant in both, which means that the ROE variable is not a moderating variable between DER and the RTN variable.

CONCLUSION

This study found that ESG Risk Rating showed a positive but insignificant effect on stock returns (coefficient 0.021966, p=0.0578), indicating that improved sustainability risk management tends to increase returns although it has not reached statistical significance at the 5% level. Leverage through the Debt to Equity Ratio (DER) also had no significant effect (p=0.5248), indicating that debt structure was not a major determinant of returns in the IDX mining sector for the 2020-2024 period. ROE as a moderating variable failed to strengthen the relationship between ESG-return and DER-return (p>0.05 for the interaction term), with the overall model only explaining 3.83% of the variation in stock returns (Adjusted R^2=0.038), indicating the dominance of external factors such as commodity price volatility.

Limitations of the study include the small sample size (15 companies), the volatile post-pandemic analysis period, and the reliance on Sustainalytics data, which may not fully reflect the local Indonesian context. Recommendations for future research include expanding the sample across sectors, adding macroeconomic control variables, and using a GARCH model to capture volatility. Practically, investors are advised to prioritize commodity analysis and market sentiment

over ESG-DER metrics for mining portfolios, while company management can focus on optimizing operational profitability to increase capital market attractiveness.

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