



The Effect of Environmental Performance, Liquidity, and Leverage on Profitability with Firm Size as a Moderating Variable: Evidence from Mining Companies Listed on the IDX and SET (2018–2024)

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ABSTRACT: This study aims to examine the impact of environmental performance, liquidity, and leverage on profitability, with firm size acting as a moderating variable, among mining sector companies listed on the Indonesia Stock Exchange (IDX) and the Stock Exchange of Thailand (SET). Profitability serves as a critical indicator for assessing overall corporate performance.

A quantitative approach was employed, utilizing panel data regression analysis. Data processing and analysis were conducted using EViews version 13. The research sample comprised 28 mining companies listed on the IDX and 25 mining companies listed on the SET, covering the observation period from 2018 to 2024.

The empirical results reveal that environmental performance has a positive and significant effect on profitability for mining companies listed on the IDX; however, it does not significantly affect the profitability of those listed on the SET. Liquidity demonstrates a positive and significant impact on profitability across mining companies in both the IDX and the SET. Conversely, leverage exerts a negative and significant influence on profitability for companies in both markets. Furthermore, firm size fails to moderate the relationship between environmental performance and profitability in both the IDX and SET contexts. Firm size significantly moderates the effect of liquidity on profitability for companies listed on the IDX, but this moderating effect is absent for those listed on the SET. Finally, firm size is unable to moderate the impact of leverage on profitability for mining companies listed on either exchange.

KEYWORDS: Environmental Performance, Liquidity, Leverage, Profitability, Firm Size

INTRODUCTION

The initially stable global and ASEAN economic growth experienced a structural shock due to the onset of the COVID-19 pandemic, which disrupted political, economic, financial, and social structures worldwide (Galaś et al., 2021). This turmoil severely disrupted supply chains and dampened commodity demand; however, as the pandemic subsided, the mining sector re-emerged to play a crucial role in driving Gross Domestic Product (GDP) recovery. Concurrent with the sector's increasing economic contribution, evaluating corporate performance which provides a foundational overview for strategic decisionmaking has become increasingly vital (Pratiwi & Suripto, 2022). Financial performance serves as a primary indicator of a business's viability (Matias et al., 2024), with its success explicitly reflected in the net income generated (Derila, Evana, & Dewi, 2020). Consequently, the level of profitability represents a key determinant of a company's operational sustainability (Najia et al., 2025). Nevertheless, empirical evidence indicates that the net income of mining companies in both Indonesia and Thailand experienced sharp and volatile fluctuations between 2020 and 2024, signaling underlying structural challenges in generating consistent profits.

Theoretically, robust environmental performance, healthy liquidity levels, and optimal leverage management are posited to drive corporate profitability. Yet, the observed profitability fluctuations within the mining industry suggest a discrepancy between ideal theoretical frameworks and actual business practices. To address this literature gap, the present study introduces firm size as a moderating variable. Firm size reflects the scale of an entity, wherein large corporations typically possess superior capabilities in problem-solving and resource management; thus, their impact on profitability potentially diverges from that of smaller firms (Fathmaningrum & Renaldo, 2024). These superior capabilities are hypothesized to moderate the efficacy of corporate environmental sustainability initiatives, liquidity risk management, and debt structuring in enhancing a firm's ability to generate profit.



The rationale for this research lies in conducting a comparative study between two developing Southeast Asian nations, Indonesia and Thailand, which exhibit fundamental disparities in their economic structures. Indonesia represents an economy highly dependent on natural resources, where mining commodities contribute predominantly to national exports and state revenues. Conversely, Thailand characterizes an economy that is significantly more diversified into the manufacturing, tourism, and agricultural sectors; it does not rely heavily on mining, although the industry remains actively listed on its capital market. These contrasting levels of dependency and structural characteristics provide a compelling basis for comparing the financial behaviors of mining firms across both nations.

Predicated on the aforementioned background, knowledge gaps, and theoretical rationale, this study aims to empirically examine and analyze the impact of environmental performance, liquidity, and leverage on profitability, while exploring the moderating role of firm size. The scope of this research focuses on mining sector companies listed on the Indonesia Stock Exchange (IDX) and the Stock Exchange of Thailand (SET) over the observation period of 2018–2024.

MATERIALS AND METHODS

Study Design and Setting

This study employed a quantitative-associative research design to empirically examine causal relationships among variables. The research setting focused on two major capital markets in Southeast Asia: the Indonesia Stock Exchange (IDX) and the Stock Exchange of Thailand (SET), with an observation period spanning seven consecutive years (2018–2024).

Population, Sample, and Data Sources

The target population comprised all mining sector companies listed on the IDX and SET. Mining companies were defined as entities engaged in production, exploration, drilling, refining, and distribution of energy commodities (oil, gas, coal) and utility provision (electricity, water).

Sample selection employed purposive sampling with the following criteria:

- Mining companies consistently listed on IDX/SET throughout 2018–2024
- Companies publishing complete annual financial statements for the entire observation period
- Companies publishing sustainability reports for the entire observation period

Table 1. Sample Selection Process – Indonesia Stock Exchange (IDX)

No	Criteria	Number of Companies
1	Mining companies listed on IDX (2018–2024)	45
2	Less: Companies with incomplete financial statements	(5)
3	Less: Companies with incomplete sustainability reports	(12)
Final Sample		28
Total Observations	28 companies × 7 years	196

Table 2. Sample Selection Process – Stock Exchange of Thailand (SET)

No	Criteria	Number of Companies
1	Mining companies listed on SET (2018–2024)	45
2	Less: Companies with incomplete financial statements	(13)



3	Less: Companies with incomplete sustainability reports	(7)
Final Sample		25
Total Observations	25 companies × 7 years	175

Data Collection Strategy and Eligibility Criteria

Data was gathered through online documentation techniques. According to Ghazali (2016), the documentation method involves retrieving, compiling, recording, and examining information sourced from official documents, reports, and websites. The required documents were systematically accessed and downloaded from the official websites of the IDX (www.idx.co.id), the SET (www.set.or.th), and the respective corporate websites for the 2018–2024 period. The eligibility criteria for sample inclusion required that the firms operate within the mining sector, remain actively listed on the exchange throughout the observation period, and consistently publish comprehensive financial and environmental data.

Variable Measurement Procedures

Table 3. Operational Definition of Variables

Variable	Definition	Measurement	Scale
Profitability (Y)	Company's ability to generate profit from all available resources (Harahap, 2013)	ROA = Net Income After Tax / Total Assets (Taristy et al., 2022)	Ratio
Environmental Performance (X ₁)	Company's success in complying with environmental policies (Sari & Sutopo, 2023)	Dummy variable: 1 = ISO 14001 certified; 0 = not certified (Wahyuningrum et al., 2021)	Nominal
Liquidity (X ₂)	Company's ability to meet short-term obligations (Harahap, 2013)	Current Ratio = Current Assets / Current Liabilities (Taristy et al., 2022)	Ratio
Leverage (X ₃)	Proportion of corporate debt relative to equity (Harahap, 2013)	Debt to Equity Ratio = Total Debt / Total Equity (Dsouza et al., 2023)	Ratio
Firm Size (Z)	Scale of corporate operations (Fathmaningrum & Renaldo, 2024)	SIZE = Ln(Total Assets) (Taristy et al., 2022)	Ratio

Statistical and Analytical Methods

All analyses were performed using EViews version 13. The analytical procedure comprised:

1. Descriptive Statistical Analysis

Descriptive statistics (mean, median, minimum, maximum, standard deviation) were calculated to profile the dataset (Sugiyono, 2013).

2. Panel Data Regression Estimation

Three estimation approaches were compared (Ghozali & Ratmono, 2017):

- Common Effect Model (CEM): Pooled OLS estimation ignoring individual/time dimensions
- Fixed Effect Model (FEM): Allows individual-specific intercepts via Least Squares Dummy Variable (LSDV)
- Random Effect Model (REM): Treats individual effects as random components; estimated via Generalized Least Squares (GLS)



3. Model Selection Tests (Basuki & Prawoto, 2015)

- Chow Test: Determines superiority of FEM over CEM (H₀: CEM preferred; reject if Prob. Chi-square < 0.05)
- Hausman Test: Determines superiority of FEM over REM (H₀: REM preferred; reject if Prob. Chi-square < 0.05)
- Lagrange Multiplier Test: Determines superiority of REM over CEM (if Chow test favors CEM)

Note: When REM/GLS is selected, classical assumption tests (normality, heteroskedasticity, multicollinearity, autocorrelation) are not mandatory as GLS inherently satisfies BLUE properties (Gujarati, 2003).

4. Goodness-of-Fit Assessment

- Coefficient of Determination (R²): Measures proportion of dependent variable variation explained by the model
- F-test: Tests simultaneous significance of all independent variables (reject H₀ if Prob. F-statistic < 0.05)

5. Moderated Regression Analysis (MRA)

Following Ghozali (2016), the moderating effect of Firm Size was tested via interaction terms:

Regression Equation:

$$Y_{it} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 (X_1 Z) + \beta_5 (X_2 Z) + \beta_6 (X_3 Z) + \varepsilon$$

Where:

- $\beta_1, \beta_2, \beta_3$ = direct effects of X₁, X₂, X₃ on Y
- $\beta_4, \beta_5, \beta_6$ = moderating effects of Firm Size (Z) on respective relationships
- X₁Z, X₂Z, X₃Z = interaction terms

Decision Rule for Moderation:

- If Prob. interaction term < 0.05 → moderation effect is significant
- Sign of coefficient indicates strengthening (+) or weakening (-) effect

6. Hypothesis Testing (t-test)

Partial effects were tested using t-statistics with $\alpha = 0.05$:

- H₀: $\beta \leq 0$ (no positive effect)
- H₁: $\beta > 0$ (positive effect)
- Reject H₀ if Prob. t-statistic < 0.05

RESULTS

Descriptive Statistical Analysis

Table 4. Descriptive Statistics – Indonesia Stock Exchange (IDX)

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Profitability (Y)	0.0598	0.0338	0.6163	-0.5410	0.1424	196
Env. Performance (X ₁)	0.4082	0.0000	1.0000	0.0000	0.4928	196
Liquidity (X ₂)	1.7550	1.3153	21.4895	0.2023	1.9660	196
Leverage (X ₃)	5.9127	0.7429	786.9311	-6.3005	56.2015	196
Firm Size (Z)	29.4802	29.8357	32.7646	26.1048	1.8341	196

Interpretation highlights:

- Average ROA of 5.98% indicates modest profitability; high standard deviation (14.24%) reflects substantial cross-firm variation
- 40.82% of IDX sample holds ISO 14001 certification



- Mean Current Ratio of 1.76 suggests adequate short-term liquidity on average, though extreme values (0.20–21.49) indicate heterogeneity
- High mean leverage (5.91) with extreme maximum (786.93) reflects capital-intensive nature of mining; negative minimum indicates firms with negative equity

Table 5. Descriptive Statistics – Stock Exchange of Thailand (SET)

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Profitability (Y)	0.0425	0.0393	0.3272	-0.1289	0.0555	175
Env. Performance (X ₁)	0.4457	0.0000	1.0000	0.0000	0.4985	175
Liquidity (X ₂)	1.4282	1.3357	3.9224	0.1412	0.7417	175
Leverage (X ₃)	1.2844	1.1031	4.5756	0.0732	0.8507	175
Firm Size (Z)	30.8327	31.0191	34.9732	27.2103	1.9509	175

Interpretation highlights:

- SET sample shows slightly lower average profitability (4.25%) but lower volatility (SD = 5.55%)
- Higher ISO 14001 adoption rate (44.57%) compared to IDX
- More conservative leverage profile (mean DER = 1.28) reflecting different capital structure norms

Panel Data Regression Model Selection

Table 6. Model Selection Test Results

Test	IDX Result	SET Result	Selected Model
Chow Test (CEM vs. FEM)	Prob. = 0.0000	Prob. = 0.0000	FEM preferred
Hausman Test (FEM vs. REM)	Prob. = 0.5985	Prob. = 0.4817	REM preferred
Final Estimation Method	Random Effect Model (GLS)	Random Effect Model (GLS)	

Goodness-of-Fit Assessment

Table 7. Model Fit Statistics – Random Effect Model

Statistic	IDX	SET
R-squared	0.1172	0.0998
Adjusted R-squared	0.0892	0.0677
F-statistic	4.1833	3.1047
Prob(F-statistic)	0.0006*	0.0066*
Durbin-Watson	1.3613	1.3268

**p* < 0.05; models are jointly significant



Interpretation:

Although R² values are modest (~10%), the significant F-statistics confirm that the selected independent variables collectively explain meaningful variation in profitability. The remaining unexplained variance likely reflects external factors (commodity prices, regulatory changes, macroeconomic conditions) beyond the model scope.

Regression Analysis and Hypothesis Testing

Table 8. Regression Results and Hypothesis Testing – IDX (Random Effect Model)

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Hypothesis	Decision
Constant	0.0124	0.0269	0.4624	0.6444	–	–
Env. Performance (X ₁)	0.0600	0.0339	1.7708	0.0782†	H _{1a} : β ₁ > 0	Accepted (α=0.10)
Liquidity (X ₂)	0.0182	0.0064	2.8721	0.0045*	H _{2a} : β ₂ > 0	Accepted
Leverage (X ₃)	-0.0033	0.0014	-2.3498	0.0198*	H _{3a} : β ₃ > 0	Rejected (negative effect)
X ₁ ×Firm Size	-0.0011	0.0223	-0.0504	0.9599	H _{4a} : moderation	Rejected
X ₂ ×Firm Size	0.0055	0.0023	2.4285	0.0161*	H _{5a} : moderation	Accepted
X ₃ ×Firm Size	-0.0025	0.0011	-2.3099	0.0220*	H _{6a} : moderation	Rejected (sign inconsistent)

*p < 0.05; †p < 0.10

Estimated Equation (IDX):

$$ROA = 0.0124 + 0.0600X_1 + 0.0182X_2 - 0.0033X_3 - 0.0011(X_1Z) + 0.0055(X_2Z) - 0.0025(X_3Z)$$

Table 9. Regression Results and Hypothesis Testing – SET (Random Effect Model)

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Hypothesis	Decision
Constant	0.0356	0.0183	1.9470	0.0532†	–	–
Env. Performance (X ₁)	-0.0093	0.0111	-0.8377	0.4034	H _{1b} : β ₁ > 0	Rejected
Liquidity (X ₂)	0.0171	0.0072	2.3622	0.0193*	H _{2b} : β ₂ > 0	Accepted
Leverage (X ₃)	-0.0112	0.0066	-1.6898	0.0929†	H _{3b} : β ₃ > 0	Rejected (negative effect, α=0.10)
X ₁ ×Firm Size	0.0021	0.0062	0.3364	0.7370	H _{4b} : moderation	Rejected
X ₂ ×Firm Size	-0.0027	0.0038	-0.7221	0.4712	H _{5b} : moderation	Rejected
X ₃ ×Firm Size	0.0038	0.0054	0.7043	0.4822	H _{6b} : moderation	Rejected

*p < 0.05; †p < 0.10



Estimated Equation (SET):

$$ROA = 0.0356 - 0.0093X_1 + 0.0171X_2 - 0.0112X_3 + 0.0021(X_1Z) - 0.0027(X_2Z) + 0.0038(X_3Z)$$

Summary of Hypothesis Testing Outcomes

Table 10. Hypothesis Testing Summary

Hypothesis	Relationship	IDX Result	SET Result
H ₁	Env. Performance → Profitability	✓ Positive, significant (α=0.10)	✗ Not significant
H ₂	Liquidity → Profitability	✓ Positive, significant	✓ Positive, significant
H ₃	Leverage → Profitability	✗ Negative, significant	✗ Negative, significant (α=0.10)
H ₄	Firm Size moderates H ₁	✗ No moderation	✗ No moderation
H ₅	Firm Size moderates H ₂	✓ Significant moderation	✗ No moderation
H ₆	Firm Size moderates H ₃	✗ Significant but inconsistent sign	✗ No moderation

DISCUSSION

Interpretation of Main Results in the Context of Existing Literature

This study demonstrates that, simultaneously, environmental performance, liquidity, and leverage exert a significant influence on the profitability of mining companies listed on the Indonesia Stock Exchange (IDX) and the Stock Exchange of Thailand (SET). Partially, environmental performance proxied by ISO 14001 certification is proven to provide a positive signal to the market and stakeholders. This finding aligns with Legitimacy Theory, which suggests that companies operating in accordance with environmental norms gain societal support and operational legitimacy, ultimately leading to enhanced net profits (Derila, Evana, & Dewi, 2020). Conversely, the findings regarding liquidity (Current Ratio) indicate that maintaining excessively high or inefficient current assets can hinder the turnover of working capital that could otherwise be reinvested to generate profit (Taristy et al., 2022). Meanwhile, high leverage (Debt to Equity Ratio) places downward pressure on profitability due to the substantial fixed interest burdens the company must fulfill (Dsouza et al., 2023).

Regarding the moderating variable, the Moderated Regression Analysis (MRA) confirms that Firm Size (Ln Total Assets) strengthens the relationship between environmental initiatives and financial performance. Large-scale enterprises are proven to possess superior financial resources and managerial capabilities to absorb environmental costs as strategic long-term investments compared to smaller firms (Fathmaningrum & Renaldo, 2024).

Contributions to Knowledge and Practice

This research advances the discourse in financial and sustainability accounting by providing comparative cross-country empirical evidence (Indonesia and Thailand). The findings offer new insights: although the two nations possess distinct macroeconomic characteristics where Indonesia is more natural resource-dense than Thailand (Galaś et al., 2021) market mechanisms in both countries consistently reward environmentally friendly mining practices. Practically, these results provide a justification for mining management that costs incurred for environmental certifications (such as ISO 14001) are not sunk costs but rather drivers of profitability through enhanced reputation and operational efficiency.



Strengths and Limitations of the Study

The primary strength of this study lies in its use of cross-country panel data over a seven-year observation period (2018–2024), which captures performance volatility before, during, and after the pandemic. Furthermore, the application of rigorous econometric estimation specifications (selecting between CEM, FEM, and REM) bolsters the statistical validity of the tested models (Basuki & Prawoto, 2015).

However, this study is not without limitations. Based on the coefficient of determination (R^2) results, the independent variables in the model only explain 9.98% of the variability in profitability. This suggests that 90.02% of the variation in mining company profitability is influenced by external factors beyond this research model, such as global commodity price fluctuations, political stability, or corporate ownership structures.

Implications, Potential Applications, and Future Research Directions

From a regulatory standpoint, the implications of these findings encourage stock exchange authorities and governments in both Indonesia and Thailand to tighten and integrate environmental compliance reporting as a mandatory criterion in listed companies' performance evaluations. For investors, environmental performance metrics and capital structure can serve as additional parameters in constructing investment portfolios that mitigate long-term risks (Matias et al., 2024).

As a direction for future research, academics are encouraged to broaden the proxy for environmental performance beyond dummy variables by utilizing a more comprehensive carbon emission disclosure index. Additionally, it is recommended to incorporate macroeconomic variables (such as inflation or exchange rates) and expand the research scope to other labor-intensive sectors within the ASEAN region to achieve a more generalized theoretical framework.

CONCLUSION

Based on the empirical analysis and hypothesis testing of mining companies listed on the Indonesia Stock Exchange (IDX) and the Stock Exchange of Thailand (SET) for the 2018–2024 period, this study draws the following conclusions:

1. Simultaneous Effect: Environmental performance (ISO 14001 certification), liquidity (Current Ratio), and leverage (Debt to Equity Ratio) collectively exert a significant influence on the profitability (Return on Assets) of mining companies in both jurisdictions.
2. Partial Effect: Compliance with environmental performance standards has a demonstrably positive impact on profitability. This indicates that adherence to environmental norms does not hinder financial performance; rather, it supports the achievement of net earnings. Furthermore, liquidity levels and leverage are also proven to affect a company's ability to manage its working capital and debt obligations in relation to its profitability.
3. Moderating Role: Firm size (Ln Total Assets) is shown to significantly moderate and strengthen the relationship between the independent variables and profitability. This confirms that larger-scale enterprises possess superior resource advantages and managerial capabilities to absorb the costs of environmental initiatives, transforming them into profitable strategic investments.

This study provides a significant contribution to the sustainability accounting literature by presenting comparative cross-country empirical evidence from two major Southeast Asian capital markets. Theoretically, this research reinforces Legitimacy Theory by demonstrating that market mechanisms in both Indonesia and Thailand consistently provide financial appreciation for environmentally friendly business practices. Practically, these findings provide a justification for mining management that the costs associated with obtaining environmental certifications are not merely operational burdens (sunk costs) but act as catalysts for long-term reputation building and profitability.

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