The effect of firm performance on the cost of capital for JSE listed mining companies

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Abstract— This study examines the influence of firm performance on the cost of capital (CoC) among mining firms listed on the Johannesburg Stock Exchange (JSE). Employing a panel dataset covering the period from 2018 to 2022, the study utilizes Panel Least Squares regression models to explore whether indicators such as return on assets (ROA), return on equity (ROE), firm size, leverage, book-to-market ratio, and market beta significantly impact CoC. Although the analysis identifies a negative relationship between firm performance and CoC, the association is not statistically significant. These findings underscore the nuanced role that firm-level financial performance may play in determining financing costs in South Africa's capital-intensive mining sector. The paper contributes to the broader corporate finance literature and provides practical insights for improving financial strategies in extractive industries.

Keywords— Cost of capital, Firm performance, Mining, Return on Assets, Return on Equity

1. INTRODUCTION

The Cost of Capital (CoC) is a cornerstone concept in corporate finance for financial management and investment decision making. It represents the return that investors expect for committing their capital to a firm and reflects the firm's risk profile. In the context of capital-intensive sectors such as mining, the CoC plays a vital role in determining the feasibility of long-term investments and sustainability.

This study seeks to determine how firm performance affects CoC for mining companies listed on the Johannesburg Stock Exchange (JSE). Financially robust firms are presumed to pose less risk to investors, thus lowering the cost of securing funding. However, empirical findings in the literature are inconclusive. By focusing specifically on the mining sector over a five-year period, this research addresses a gap in South African empirical finance and adds sector-specific insights.

2. LITERATURE REVIEW: THEORETICAL AND EMPIRICAL PERSPECTIVES ON THE RELATIONSHIP BETWEEN FIRM PERFORMANCE AND THE COST OF EQUITY CAPITAL

The cost of capital (CoC) plays a foundational role in firm-level decision-making, shaping how firms allocate resources, evaluate investments, and sustain long-term financial growth. Among the various components of CoC, the cost of equity capital (Ke) is particularly sensitive to market perceptions of firm risk, performance, and transparency. The link between firm performance- measured using return on assets (ROA), return on equity (ROE) and similar metrics- and Ke has been widely theorized but remains empirically contested, particularly in emerging market settings such as South Africa. This literature review integrates the major theoretical foundations and empirical

findings, with a particular emphasis on studies relevant to capital markets, financial disclosures and mining sector dynamics.

2.1. *Theoretical Literature*

This study anchored in four major theoretical paradigms within corporate finance and capital structure theory – Trade Off Theory, Pecking Order Theory, Agency Theory and Signaling Theory. This theoretical framing allows for a nuanced understanding of how firm-level performance influences investor expectations and cost of equity capital, especially within sectors like ming that face heightened environmental and operational scrutiny.

2.1.1. Trade-Off Theory

The trade-off theory posits that firms seek an optimal capital structure by balancing the tax advantages of debt against the costs of potential financial distress [1]. From this standpoint, higher-performing firms are presumed to have greater debt capacity and lower risk of default, which can lead to reduced Ke. The implication is that firm performance mitigates perceived investment risk, both on the debt and equity side. Munjal et al. [2] extend this view by noting that firms with strong operating performance often demonstrate better resilience in times of economic uncertainty, further reducing investor-required returns.

In mining sectors, which face higher exposure to commodity price shock and regulatory volatility, investors may reward consistent performance with more favourable capital pricing. However, this assumption often ignores the external volatility and sector-specific risks that could overshadow internal performance in investors' risk assessments [3].

2.1.2. Pecking Order Theory

Myers and Majluf [4] introduced the pecking order theory, suggesting that firms prefer internal funds (retained earnings) over external financing (debt or equity) due to asymmetric information between managers and investors. High-performing firms, by generating greater internal capital, can minimize their reliance on costly external equity, which is typically associated with higher required returns due to investor uncertainty [5].

This theory implies that firms with strong ROA and ROE are less exposed to equity market volatility, and thus have a lower Ke. Empirical implications of this theory are clear: as performance improves, the need for and cost of equity capital should decline [6]. However, the theory is often criticized for assuming stable financial environments- an assumption that may not hold in developing economies or sectors with high environmental, social and governance (ESG) risks, such as mining [3].

2.1.3. Agency Theory

Jensen and Meckling [7] provides another perspective, emphasizing the conflict of interest between management and shareholders. High-performing firms are typically more transparent and accountable, reducing agency costs and investor concerns. These firms are more likely to produce high-quality financial disclosures, adhere to corporate governance norms, and align managerial incentives with shareholder interests.

In such cases, investors may interpret performance as a signal of lower agency risk, resulting in lower equity return expectations [8]. Importantly, agency theory also relates to disclosure practices- firms that reduce information asymmetry through transparent reporting often enjoy a reduced CoC [9].

2.1.4. Signaling Theory

Spence [10] asserts that firms convey private information to investors through observable actions, including financial performance indicators. ROA and ROE can act as such signals, reflecting managerial effectiveness and operational health. Investors who view high performance as a credible signal of stability and future profitability are likely to lower their risk premiums, leading to a reduced Ke [11].

In volatile sectors, such as mining, the credibility of signals becomes even more important. Firms with high performance but poor ESG or disclosure records may not receive the expected capital cost benefits due to credibility gaps in the signal [12].

2.1.5. Integrating Theories in Practice

While each theory offers a distinct explanation of how firm performance influences Ke, their collective message is clear: strong performance should reduce investor-perceived risk, lowering required equity returns. Yet, several intervening variables- such as firm size, market beta, financial leverage, and disclosure quality- can moderate or override this relationship [13] [14]. Furthermore, context matters: sector-specific dynamics, institutional quality, and market development level can all influence how these theoretical relationships play out in practice [15] [16].

2.2. *Empirical Literature*

2.2.1. International Evidence on Firm Performance and Cost of Equity Capital (Ke)

Numerous studies in developed markets affirm a negative relationship between firm performance and Ke. Botosan [17] found that firms with better financial disclosures and performance metrics attracted lower equity costs. Fama and French [18] noted that profitability was inversely related to expected returns, confirming that investors reward stable, high-performing firms with lower return expectations.

Dhaliwal et al. [19] also demonstrated that high-performing US firms with better corporate social responsibility (CSR) reporting and earnings quality experienced lower CoC. These studies highlight that in transparent and efficient markets, ROA and ROE serve as valid proxies for risk reduction in investors' eyes.

However, several contradictory findings emerge in emerging and less efficient markets. For instance, Belkhir et al. [20] found that during periods of low liquidity and high volatility, even high-performing firms faced elevated CoC. This suggests that macro-environmental uncertainty can dilute the risk-reducing effects of performance metrics.

2.2.2. South African Context and JSE Studies

In South Africa, the link between firm performance and capital costs remains relatively underexplored. In a study of JSE listed mining firms, Ngcobo [21] found no significant relationship between ROE and CoC, contradicting conventional theory. The study attributed this to investor skepticism, policy instability and weak corporate governance practices, which often diminish the credibility of firm-level financial indicators.

Johnson [22] emphasized the role of ESG disclosures and integrated reporting in shaping investor behaviour on the JSE. His findings suggested that performance alone is insufficient; capital markets in South Africa respond more strongly to non-financial signals- such as sustainability metrics and governance quality- when determining capital pricing.

Ganda and Milondzo [23] similarly found that financial leverage and firm size played a more significant role than profitability in influencing the CoC for South African firms. These findings imply that while performance remains a relevant factor, it does not operate in isolation in the JSE context.

2.2.3. Role of Control Variables

Numerous studies have emphasized the importance if control variables in any model exploring Ke:

- Firm size: Dang et al. [24] and Delmas et al. [25] show that larger firms tend to have lower Ke due to perceived stability and resource advantages.
- Financial leverage: Tzouvanas [26] and Thaib and Dewantoro [27] suggest that debt levels affect financial risk perceptions, often influencing Ke more strongly than performance.
- Book-to-market ratio: Chai et al. [28] found this metric to be a strong predictor of Ke, especially in undervalued or distressed firms.
- Market beta: Khlif et al. [13] emphasized that beta remains a core component of Capital Asset Pricing Model (CAPM)-based Ke estimations, often overpowering internal performance effects.

These findings reinforce the idea that firm performance must be interpreted alongside these other metrics to fully understand its effect on capital costs.

2.3. *Synthesis and identified Gap*

Theoretical literature largely argues that firm performance should reduce the cost of equity capital by lowering perceived risk, improving transparency, and minimizing information asymmetries [7] [9] [10]. However, empirical studies produce mixed results, particularly in emerging markets where financial systems are less efficient and disclosure standards are less uniform [12] [29].

In South Africa, and particularly within the mining sector, these inconsistencies become more pronounced due to:

- The high volatility of commodity markets [3],
- Exposure to ESG risks [22], and
- Investor concerns over regulatory and political uncertainty [20] [21].

Most local studies (e.g., [21] [22]) suggest that traditional performance indicators like ROA and ROE may not carry the same weight in determining Ke as they do in developed markets. Moreover, the interaction of financial and non-financial disclosures is often overlooked in empirical models, despite evidence that integrated reporting and ESG transparency can significantly influence capital market responses [30].

Therefore, while theory predicts an inverse relationship between firm performance and CoC, the magnitude, direction, and significance of this relationship in JSE listed mining firms remain unclear. No known study has holistically examined this dynamic using recent (2018-2022) panel data, incorporating both financial performance and firm-specific control variables within the South African mining context.

3. LITERATURE METHODOLOGY

This study adopts a quantitative research design which is appropriate for examining cause-and-effect relationships between firm performance and the cost of equity capital [31]. The study specifically focuses on JSE listed mining firms over the period 2018-2022, employing panel data regression analysis to exploit both time-series and cross-sectional variation.

The population comprised all mining firms listed on the JSE. A total of 32 firms were sampled using purposive sampling, ensuring that only firms with complete annual data for the 5-year period were included. Financial data

were sourced from Bloomberg, McGregor (IRESS) and firms' integrated annual reports. This approach ensured reliability and comparability with prior empirical studies such as Delmas et al. [25] and Ngcobo [21].

3.1. *Regression Model*

The regression model used in this study is designed to estimate the relationship between firm performance and the cost of capital, controlling for key firm specific variables. The model adopts a panel data approach, allowing for both cross-sectional and time-series variation. The formulation of the model is guided by prior literature that links firm-specific financial indicators to variations in financing costs [13] [32].

Specifically, the cost of equity (KE) is modeled as a function of return on assets (ROA), firm size (Size), leverage (Lev), book-to-market ratio (BP), and market beta (MB). This structure reflects how profitability, firm scale, capital structure, market valuation, and systematic risk jointly influence the return investors demand. The regression equation is expressed as:

$$KEit = C + \beta 1\ ROAit + \beta 2\ Sizeit + \beta 3\ LEVit + \beta 4\ BPit + \beta 5\ MBit + \varepsilon it$$

Where:

- $KEit$: Cost of equity capital for firm i at time t, serving as the dependent variable.
- ROA: Return on assets, used as a proxy for firm operational performance.
- Size: Firm size measured as the natural log of total assets, representing scale effects.
- Lev: Financial leverage or debt-to-equity ratio, indicating capital structure risk.
- BP: Book-to-market ratio, serving as a measure of market valuation.
- MB: Market beta, capturing firm-specific exposure to systematic risk.
- εit: Error term accounting for unobserved effects.

This model helps identify how each determinant contributes to the variation in CoC across mining firms over time. The inclusion of multiple firm-level characteristics helps to reduce omitted variable bias, increasing the robustness of the results. The regression was estimated using both fixed and random effects to compare how time-invariant and time-variant firm attributes influence capital costs, with the Hausman test guiding the final model specification.

3.2. *Variable Measurement*

This study measured variables with careful attention to both theoretical rigor and empirical consistency, particularly focusing on the cost of equity capital (Ke) as the dependent variable. The justification for using Ke over the aggregate cost of capital lies in its sensitivity to equity market perception and firm-specific disclosures [17] [19] [33]. Equity investors often react swiftly to performance signals and environmental risks, especially in the resource-intensive mining sector, where reputational and operational risks can heavily impact future earnings [33] [34].

Cost of Equity (Ke) was calculated suing the Capital Asset Pricing Model (CAPM) which is broadly endorsed for its practically and empirical dominance in estimating required returns on equity [29] [33]. CAPM was expressed as:

$$KE = Rf + \beta\ (Rm - Rf)$$

Where:

- Rf = risk-free rate (proxied by the 10-year South African government bond yield),
- β = firm's beta from Bloomberg (systematic risk),

- Rm = expected return on the market portfolio (FTSE/JSE All Share Index average return).

Firm performance was measured using two key accounting-based indicators:

- ROA: Net income / Total assets, reflecting operational efficiency.
- ROE: Net income / Shareholders' equity, indicating the firm's return to shareholders.

These indicators capture short-term and long-term financial performance, respectively [25] [26].

Control Variables:

- Firm size: Natural log of total assets, indicating resource capacity and stability [24].
- Leverage (Lev): Debt-to-equity ratio, reflecting financial risk [27].
- Book-to-market ratio (BP): Book value of equity / market value of equity, assessing firm valuation [28].
- Market beta (MB): Beta coefficient indicating sensitivity to market returns [13].

All financial data were sourced from Bloomberg and McGregor (IRESS) website, with integrated reports supplementing missing firm-level metrics.

3.3. *Estimation Technique*

This study employed panel data regression analysis to evaluate the relationship between firm performance and the cost of capital. Panel data methodology is appropriate due to its ability to capture both cross-sectional and time-series dynamics, controlling for unobservable heterogeneity across firms and time [35].

Two panel regression models were tested using:

- Fixed effects model, which accounts for firm-specific time-invariant factors by controlling for omitted variable bias.
- Random effects model, which assumes uncorrelated firm-specific effects and is more efficient under certain conditions [36].

The selection between fixed effects and random effects was based on the Hausman test, where the null hypothesis favours random effects. In both regression specifications, the Hausman test yielded p-values above 0.05, suggesting that the fixed effects model was more appropriate for controlling firm-specific effects over the study period [37] [38].

Data was tested for stationarity using the Levin-Lin-Chu panel unit root test. All variables were found to be stationary at level, ensuring the suitability for regression analysis. Multicollinearity was tested using Variance Inflation Factors (VIFs), all of which were under 10, confirming no multicollinearity concerns [39]. Statistical analysis was conducted using EViews, with robust standard errors applied to mitigate potential heteroskedasticity and autocorrelation issues.

4. **RESULTS**

4.1. *Descriptive Statistics*

Descriptive statistics provide a foundational overview of the dataset's characteristics and distribution. Table 1.1 provides a summary of the central tendencies and dispersion measures for the dependent, independent, and control variables over the 2018-2022 period.

Variables	Mean	Median	Maximum	Minimum	Standard Deviation
ROA	12.08200	11.64000	59.52000	-43.95000	16.51483
ROE	13.93400	15.72000	77.27000	-77.70000	22.40707
Size	16.61737	17.23871	19.00929	12.48877	1.807536
Lev	0.558267	0.430000	1.890000	0.080000	0.408863
BP	1.716667	1.350000	5.720000	0.400000	1.104096
MB	1.133404	1.228600	2.161400	-1.296800	0.690302
KE	14.93409	15.55440	21.05180	0.463800	4.124661

Table 1. 1 Descriptive Statistics of the Variables

Source: Researcher's Deductions

The mean ROA of 12.08% indicates a moderate level of operational efficiency across the mining firms. The wide standard deviation (16.51%) and extreme values suggest variability in firm profitability. ROE also showed substantial fluctuation, with a mean of 13.93% and a range from -77.70% to 77.27%. These variations may reflect differences in capital structure and strategic investment outcomes among the sampled firms.

The cost of equity capital averaged 14.93%, demonstrating differing investor expectations across firms. The dispersion in Ke is largely consistent with fluctuations in firm-specific risks, including financial leverage, firm size and beta values. These descriptive statistics validate the use of panel regression methods by confirming the presence of variation across firms and over time, a key requirement for effective panel analysis [40].

4.2. *Correlation Matrix*

Strong positive correlation between ROA and ROE ($r=0.85$, $p<0.01$). Moderate correlations observed between CoC and size, beta and book-to-market ratio.

4.3. *Unit Root and Multicollinearity*

All variables were stationary ($p<0.05$). VIF scores < 10 indicated no multicollinearity.

4.4. *Regression Findings*

Variable	Coefficient	Std. Error	P-value
Constant	3.5629	9.9030	0.7204
ROA	-0.0003	0.0086	0.9728
LEV	-0.8654	0.7772	0.2703
Size	0.3618	0.6024	0.5506
BP	-0.4371	0.1867	0.0229
MB	5.8201	0.2706	0.0000
Effects specification			
Cross-section fixed			

R-squared	0.974536
Adjusted R-squared	0.965740
Total panel (balanced) observations	75

Table 1.2 Regression results

Source: Researcher's Deductions

- ROA and ROE both displayed negative coefficients with CoC but lacked statistical significance.
- Firm size and leverage showed a marginal positive relationship.
- Market beta and book-to-market ratio had mixed effects.

5. RESULTS

The negative, though statistically insignificant association between firm performance and CoC aligns with some existing literature [4] [32]. However, the absence of strong significance may reflect the unique risk profile of the mining sector, where factors such as commodity price volatility and regulatory exposure play a larger role.

Furthermore, the absence of significant effect could be due to the homogeneity of the firms in terms of size and operational structure. Future research could explore cross-sectoral differences or consider the moderating role of environmental, social and governance (ESG) factors.

6. CONCLUSION

This study examined the relationship between firm performance and the cost of capital among JSE-listed mining firms. Although the findings revealed a negative relationship, the effect was not statistically significant, suggesting that investors may place greater emphasis on external factors such as market risk and investor sentiment than on firm-specific performance when determining the cost of equity capital in the mining sector. These findings highlight the importance of enhancing transparency through financial and ESG disclosures, strengthening risk management practices to reduce exposure to systematic risk, and improving investor engagement through integrated reporting. Such measures may contribute to more favourable investor perceptions and financing conditions. Future research could extend this analysis by incorporating qualitative factors, including ESG ratings, corporate governance measures, and investor sentiment, to provide a more comprehensive understanding of the determinants of the cost of capital.

REFERENCES

[1] A. Kraus and R. H. Litzenberger, "A state-preference model of optimal financial leverage," *J. Finance*, vol. 28, no. 4, pp. 911–922, 1973.

[2] S. Munjal, I. Requejo, and S. K. Kundu, "Offshore outsourcing and firm performance: Moderating effects of size, growth and slack resources," *J. Bus. Res.*, vol. 103, pp. 484–494, 2019.

[3] A. Trinks, G. Ibikunle, M. Mulder, and B. Scholtens, "Carbon intensity and the cost of equity capital," *The Energy Journal*, vol. 43, no. 2, pp. 181–214, 2022.

[4] S. C. Myers and N. S. Majluf, "Corporate financing and investment decisions when firms have information that investors do not have," *J. financ. econ.*, vol. 13, no. 2, pp. 187–221, 1984.

[5] H. Abubakar, M. Ruslan, and S. Suriani, "The role of competitor analysis, market orientation, and service quality in working capital management and operational leverage as links to financial stability of manufacturing companies listed on the IDX: A qualitative approach," *Atestasi: Jurnal Ilmiah Akuntansi*, vol. 7, no. 1, pp. 459–495, 2024.

[6] M. Z. Frank and V. K. Goyal, "Testing the pecking order theory of capital structure," *J. financ. econ.*, vol. 67, no. 2, pp. 217–248, 2003.

[7] M. C. Jensen and W. H. Meckling, "Theory of the firm: Managerial behavior, agency costs and ownership structure," in *Corporate governance*, Gower, 2019, pp. 77–132.

[8] R. Garzón-Jiménez and A. Zorio-Grima, "Effects of carbon emissions, environmental disclosures and CSR assurance on cost of equity in emerging markets," *Sustainability*, vol. 13, no. 2, p. 696, 2021.

[9] R. E. Verrecchia, "Essays on disclosure," *Journal of accounting and economics*, vol. 32, no. 1–3, pp. 97–180, 2001.

[10] M. Spence, "Job market signaling," in *Uncertainty in economics*, Elsevier, 1978, pp. 281–306.

[11] L. Li, Q. Liu, J. Wang, and X. Hong, "Carbon information disclosure, marketization, and cost of equity financing," *Int. J. Environ. Res. Public Health*, vol. 16, no. 1, p. 150, 2019.

[12] S. El Ghoul, O. Guedhami, and Y. Kim, "Country-level institutions, firm value, and the role of corporate social responsibility initiatives," *J. Int. Bus. Stud.*, vol. 48, no. 3, pp. 360–385, 2017.

[13] H. Khlif, K. Samaha, and M. Soliman, "Internal control quality, voluntary disclosure, and cost of equity capital: The case of an unregulated market," *International Journal of Auditing*, vol. 23, no. 1, pp. 144–160, 2019.

[14] C. A. Botosan and M. A. Plumlee, "Assessing alternative proxies for the expected risk premium," *The accounting review*, vol. 80, no. 1, pp. 21–53, 2005.

[15] R. La Porta, F. Lopez-de-Silanes, and A. Shleifer, "The economic consequences of legal origins," *J. Econ. Lit.*, vol. 46, no. 2, pp. 285–332, 2008.

[16] D. Anginer, A. Demirgüç-Kunt, H. Huizinga, and K. Ma, "How does corporate governance affect bank capitalization strategies?," *European Banking Center Discussion Paper*, no. 2013–011, 2013.

[17] C. A. Botosan, "Disclosure and the cost of capital: what do we know?," *Accounting and business research*, vol. 36, no. sup1, pp. 31–40, 2006.

[18] E. F. Fama and K. R. French, "The cross-section of expected stock returns," *J. Finance*, vol. 47, no. 2, pp. 427–465, 1992.

[19] D. S. Dhaliwal, O. Z. Li, A. Tsang, and Y. G. Yang, "Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting," *The accounting review*, vol. 86, no. 1, pp. 59–100, 2011.

[20] M. Belkhir, M. Saad, and A. Samet, "Stock extreme illiquidity and the cost of capital," *J. Bank. Financ.*, vol. 112, p. 105281, 2020.

[21] B. Ngcobo, "The Impact of Integrated Reporting on Cost of Capital and Analysts' Forecasts: A Study of Johannesburg Stock Exchange (JSE) Listed Mining Firms," 2020, *University of KwaZulu Natal*.

[22] R. Johnson, "The link between environmental, social and corporate governance disclosure and the cost of capital in South Africa," *Journal of Economic and Financial Sciences*, vol. 13, no. 1, pp. 1–12, 2020.

[23] F. Ganda and K. S. Milondzo, "The impact of carbon emissions on corporate financial performance: Evidence from the South African firms," *Sustainability*, vol. 10, no. 7, p. 2398, 2018.

[24] C. Dang, Z. F. Li, and C. Yang, "Measuring firm size in empirical corporate finance," *J. Bank. Financ.*, vol. 86, pp. 159–176, 2018.

[25] M. A. Delmas, N. Nairn-Birch, and J. Lim, "Dynamics of environmental and financial performance: The case of greenhouse gas emissions," *Organ. Environ.*, vol. 28, no. 4, pp. 374–393, 2015.

[26] P. Tzouvanas, "Climate Change and Financial Performance ," 2019.

[27] I. Thaib and A. Dewantoro, "The effect of profitability and liquidity on firm value with capital structure as an intervening variable," 2017.

[28] D. Chai, M. Chiah, and A. Zhong, "Decomposing value: Changes in size or changes in book-to-market?," *Pacific-Basin Finance Journal*, vol. 64, p. 101467, 2020.

[29] F. Bancel and U. R. Mittoo, "The gap between the theory and practice of corporate valuation: Survey of European experts," *Journal of Applied Corporate Finance*, vol. 26, no. 4, pp. 106–117, 2014.

[30] R. G. Eccles and M. P. Krzus, "The Nordic model: An analysis of leading practices in ESG disclosure," *Nordic Journal of Business*, vol. 67, no. 2, pp. 4–24, 2018.

[31] J. W. Creswell and J. D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.

[32] W. Drobetz, S. El Ghoul, O. Guedhami, and M. Janzen, "Policy uncertainty, investment, and the cost of capital," *Journal of Financial Stability*, vol. 39, pp. 28–45, 2018.

[33] J. R. Graham and C. R. Harvey, "The theory and practice of corporate finance: Evidence from the field," *J. financ. econ.*, vol. 60, no. 2–3, pp. 187–243, 2001.

[34] T. R. Berry-Stölzle and J. Xu, "Enterprise risk management and the cost of capital," *Journal of Risk and Insurance*, vol. 85, no. 1, pp. 159–201, 2018.

[35] C. Hsiao, *Analysis of panel data*, no. 64. Cambridge university press, 2022.

[36] B. Chen and J. Pearl, "Regression and causation: a critical examination of six econometrics textbooks," *Real-World Economics Review, Issue*, no. 65, 2013.

[37] A. Androniceanu and I. Georgescu, "The impact of CO2 emissions and energy consumption on economic growth: a panel data analysis," *Energies (Basel).*, vol. 16, no. 3, p. 1342, 2023.

[38] M. Sani, S. Suleiman, and M. Isyaku, "Robust Hausman pretest for panel data model in the presence of heteroscedasticity and influential observations," *Journal of Basics and Applied Sciences Research*, vol. 1, no. 1, pp. 27–35, 2023.

[39] N. Shrestha, "Detecting multicollinearity in regression analysis," *Am. J. Appl. Math. Stat.*, vol. 8, no. 2, pp. 39–42, 2020.

[40] B. H. Baltagi, "Limited dependent variables and panel data," in *Econometric analysis of panel data*, Springer, 2021, pp. 291–335.