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Liquidity and Leverage as Determinants of Capital Structure: Empirical Evidence from Energy Sector Companies Listed on the Indonesia Stock Exchange, 2020–2024

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Abstract

This study examines the effect of liquidity and leverage on capital structure in energy sector companies listed on the Indonesia Stock Exchange (IDX) during 2020–2024. Liquidity is proxied by the Current Ratio (CR), leverage by the Debt to Asset Ratio (DAR), and capital structure by the Debt to Equity Ratio (DER). Using a quantitative approach with secondary data from companies' annual financial statements, the sample was selected through purposive sampling, resulting in 14 companies observed over five years (70 observations). Panel data regression was conducted using the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), with Chow and Hausman tests applied to determine the most appropriate model. The Chow test favored FEM over CEM, while the Hausman test confirmed REM as the most suitable model. Results show that liquidity has a negative and significant effect on capital structure ($\beta = -0.1560$; $p = 0.050$), while leverage has a positive and significant effect ($\beta = 0.0384$; $p < 0.001$). Simultaneously, both variables significantly affect capital structure ($F = 12.184$; $p < 0.001$), with an R^2 of 0.2667, indicating that liquidity and leverage explain 26.67% of the variation in capital structure. These findings highlight the importance of effective liquidity management and optimal debt utilization in shaping capital structure decisions.

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INTRODUCTION

Capital structure is one of the strategic decisions in financial management, as it relates to the composition of debt and equity used to finance a company's operational and investment activities. Determining an optimal capital structure helps companies achieve a more efficient cost of capital, increase firm value, and maintain long-term business sustainability. Conversely, a suboptimal capital structure can increase financial risk due to high debt burdens and reduce a company's flexibility in obtaining funding sources.

In energy sector companies, capital structure decisions become increasingly important due to the industry's capital-intensive characteristics, its need for long-term investment, and its exposure to fluctuations in energy prices and dynamics of global economic conditions (Ariyanto et al., 2022).

The phenomenon of capital structure in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period presents an interesting condition worth examining.

Table 1. Average CR, DAR, and DER of Energy Sector Companies, 2020–2024

Year	Current Ratio (CR)	Debt to Asset Ratio (DAR) (%)	Debt to Equity Ratio (DER)
2020	2.11	48.65	2.08
2021	1.91	42.82	2.09
2022	1.70	43.97	1.94
2023	1.52	43.76	1.80
2024	1.66	44.99	1.76

Based on Table 1, the average Current Ratio (CR) of energy sector companies during the 2020–2024 period shows a declining trend, from 2.11 times in 2020 to 1.66 times in 2024. This decline indicates that the companies' ability to meet short-term obligations using their current assets tends to decrease. Although the Current Ratio value remains above one, this downward trend indicates a decline in liquidity levels that may potentially affect companies' decisions in determining funding sources.

On the other hand, the Debt to Asset Ratio (DAR) shows a fluctuating pattern. In 2020, the average DAR was 48.65%, then decreased to 42.82% in 2021, before increasing again to 44.99% in 2024. This condition indicates that the proportion of assets financed through debt changed from year to year. Meanwhile, the Debt to Equity Ratio (DER) shows a different trend, gradually decreasing from 2.08 times in 2020 to 1.76 times in 2024.

This phenomenon indicates an interesting phenomenon gap worth investigating. Based on Trade-off Theory, an increase in debt usage is expected to increase capital structure as reflected in the Debt to Equity Ratio. However, empirical data show that when the average Debt to Asset Ratio (DAR) increased again from 43.76% in 2023 to 44.99% in 2024, the Debt to Equity Ratio (DER) actually decreased from 1.80 times to 1.76 times. Furthermore, the decline in the Current Ratio (CR) was not always followed by an increase in DER as predicted by capital structure theory. This phenomenon indicates that the relationship between liquidity, leverage, and capital structure in energy sector companies does not always run linearly, thus requiring further empirical testing.

Previous research findings on the effect of liquidity and leverage on capital structure also remain inconsistent. Studies by Ariyanto et al. (2022), Nguyen et al. (2023), and Putri and Hidayat (2023) found that liquidity has a negative effect on capital structure, as companies with adequate internal funds tend to reduce their use of debt. Conversely, Dewi and Sudiartha (2022) found that liquidity has no significant effect on capital structure. Regarding the leverage variable, Khan et al. (2022) found that leverage has a positive effect on capital structure, while several other studies show different results depending on industry characteristics, firm size, and economic conditions. These inconsistent findings indicate that a research gap still exists and warrants further investigation, particularly in energy sector companies, which are characterized by capital intensity and relatively high levels of business uncertainty.

Based on this empirical phenomenon and research gap, this study aims to analyze the effect of liquidity and leverage on capital structure in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period. This study uses the Current Ratio (CR) as a proxy for liquidity, the Debt to Asset Ratio (DAR) as a proxy for leverage, and the Debt to Equity Ratio (DER) as a proxy for capital structure, using a panel data regression approach. The findings of this study are expected to contribute to the development of literature in the field of financial management and serve as a consideration for corporate management and investors in making decisions related to capital structure policy.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Liquidity is a company's ability to meet its short-term obligations using its current assets. A high level of liquidity indicates that a company has a good capacity to fulfill its financial obligations, resulting in a relatively lower risk of default. In this study, liquidity is proxied using the Current Ratio (CR) because it is able to describe a company's ability to cover current liabilities through its current assets. The higher the Current Ratio, the greater the company's ability to meet its short-term obligations, although an excessively high value may also indicate suboptimal utilization of current assets (Brigham & Houston, 2022; Nguyen et al., 2023).

Leverage is a ratio that shows the extent to which a company's assets are financed by debt. In this study, leverage is proxied using the Debt to Asset Ratio (DAR), which measures the proportion of total assets financed through the

company's liabilities. A higher DAR value indicates a greater dependence on debt-based financing, thereby increasing financial risk. However, optimal debt utilization can also enhance a company's capacity to expand its operational and investment activities when managed effectively (Ross et al., 2022; Khan et al., 2022).

Capital structure is a combination of funding sources derived from debt and equity that a company uses to finance its operational and investment activities. An optimal capital structure is expected to minimize the cost of capital while increasing firm value. In this study, capital structure is proxied using the Debt to Equity Ratio (DER), as this ratio reflects the comparison between a company's total debt and total equity. A high DER value indicates greater use of debt relative to equity, whereas a low DER value indicates that a company relies more on internal funding (Brealey et al., 2023).

Trade-off Theory explains that a company determines its optimal capital structure by considering the balance between the benefits of debt usage, such as tax shields, and the costs incurred, such as bankruptcy costs and agency costs. This theory states that debt usage can increase firm value up to a certain point; however, if the proportion of debt is too high, financial risk will also increase. Therefore, companies need to determine an optimal level of debt in order to maximize firm value (Kraus & Litzenberger, 1973; Brealey et al., 2023).

Pecking Order Theory explains that companies have a preference order in obtaining funding sources. Companies prioritize the use of internal funds derived from retained earnings before resorting to external funding in the form of debt or new stock issuance. When internal funds are insufficient, companies will choose debt as an alternative source of funding because it has lower information costs compared to stock issuance. Consequently, companies with high liquidity levels tend to rely on internal funds, thereby reducing their need for debt (Myers & Majluf, 1984; Nguyen et al., 2023).

HYPOTHESIS DEVELOPMENT

High liquidity reflects a company's ability to meet its short-term obligations while also indicating the availability of adequate internal funds. Based on Pecking Order Theory, companies prioritize the use of internal funds over external financing, so an increase in liquidity is expected to decrease debt usage in the capital structure. The findings of Nguyen et al. (2023), Ariyanto et al. (2022), and Dewi and Sudiartha (2022) show that liquidity has a negative effect on capital structure. Based on this description, the following hypothesis is proposed:

H1: Liquidity has a negative effect on capital structure in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period**.**

Leverage indicates the level of debt usage in financing a company's assets (Suharti & Purwanto, 2022). Based on Trade-off Theory, debt usage provides benefits in the form of tax savings but also increases financial risk when used excessively. The higher the Debt to Asset Ratio, the greater the proportion of assets financed by debt, which is expected to increase the Debt to Equity Ratio as a proxy for capital structure. Studies by Khan et al. (2022) and Putri and Hidayat (2023) show that leverage has a positive effect on capital structure. Based on this description, the following hypothesis is proposed:

H2: Leverage has a positive effect on capital structure in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period.

Capital structure decisions are influenced by various internal company factors, including liquidity and leverage. Liquidity determines a company's ability to provide internal funding, while leverage reflects the level of debt usage as a source of financing. Based on Trade-off Theory and Pecking Order Theory, these two variables jointly influence a company's decisions in determining an optimal funding composition. Previous research findings also indicate that liquidity and leverage simultaneously affect a company's capital structure (Nguyen et al., 2023; Khan et al., 2022). Based on this description, the following hypothesis is proposed:

H3: Liquidity and leverage simultaneously have a significant effect on capital structure in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period.

The research model of this study is as follows:

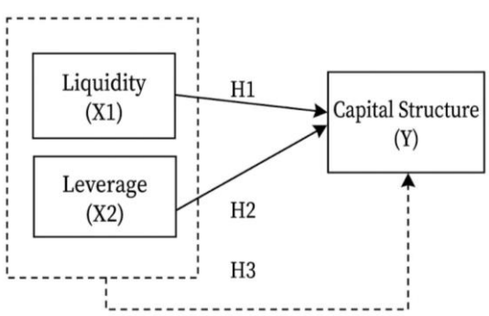


Figure 1. Research Model

METHOD

This study employs a quantitative approach with an explanatory research design, which aims to examine the causal relationship between independent and dependent variables through hypothesis testing. The quantitative approach was chosen because it is capable of objectively measuring the relationships between variables based on numerical data analyzed using statistical techniques (Sekaran & Bougie, 2020).

The population in this study consists of all energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 period. The sampling technique used is purposive sampling, namely sample selection based on specific criteria, including: (1) energy sector companies consistently listed on the IDX throughout the 2020–2024 period; (2) publishing complete annual financial statements; (3) having the data required in accordance with the research variables; and (4) not being delisted during the research period. Based on these criteria, 14 companies were obtained as the sample, with an observation period of five years, resulting in 70 data observations.

The data used are secondary data obtained from the companies' annual financial statements through the official website of the Indonesia Stock Exchange and the official websites of the respective companies. The dependent variable in this study is capital structure, proxied using the Debt to Equity Ratio (DER).

It consists of the research design (the method, the data, the data source, the data collecting technique, the data analysis technique, the variables measurement) that written in the form of a paragraph. The independent variables consist of liquidity, proxied by the Current Ratio (CR), and leverage, proxied by the Debt to Asset Ratio (DAR). The operational definitions of each variable are presented in Table 2.

Table 2. Operational Definition of Variables

Variable	Proxy	Measurement	Scale
Likuiditas (X1)	Current Ratio (CR)	Current Assets / Current Liabilities	Ratio
Leverage (X1)	Debt to Asset Ratio (DAR)	Total Debt / Total Assets × 100%	Ratio
Capital Structure (Y)	Debt to Equity Ratio (DER)	Total Debt / Total Equity	Ratio

Data analysis was conducted using panel data regression with the assistance of EViews 12 software. Panel data analysis was chosen because it is able to combine both cross-section (between companies) and time series (between periods) dimensions, thereby producing more efficient estimates compared to using cross-section or time series data separately (Gujarati & Porter, 2022; Baltagi, 2021). The analysis stages include descriptive statistical analysis and estimation of the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Subsequently, the Chow Test was conducted to select the best model between CEM and FEM, followed by the Hausman Test to determine the best model between FEM and REM. Based on the test results, the Random Effect Model (REM) was selected as the best model for testing the research hypotheses.

The panel data regression model used in this study is formulated as follows:

$$DER_{it} = \beta 0 + \beta 1\ CR_{it} + \beta 2\ DAR_{it} + \varepsilon_{it} \quad \ldots\ldots(1)$$

Where:
DER_{it} = Capital structure of company in year t
$\beta 0$ = Constant
$\beta 1, \beta 2$ = Regression coefficients
CR_{it} = Current Ratio of company in year t
DAR_{it} = Debt to Asset Ratio of company in year t
ε_{it} = Error term

Hypothesis testing was conducted through a partial test (t-test) to determine the effect of each independent variable on capital structure, a simultaneous test (F-test) to determine the combined effect of liquidity and leverage on capital structure, and the coefficient of determination (R^2) to measure the ability of the independent variables to explain the variation in capital structure. All tests were conducted at a significance level of 5% ($\alpha = 0.05$).

RESULT AND DISCUSSION

Descriptive statistical analysis was used to provide a general overview of the characteristics of the research data. The object of this study is 14 energy subsector companies listed on the Indonesia Stock Exchange during the 2020–2024 period, resulting in 70 panel data observations.

Table 3. Results of Descriptive Statistical Analysis

Variable	N	Min	Max	Mean	Std. Deviation
Current Ratio (X1)	70	0.22	8.28	1.782	1.568
Debt to Asset Ratio (X2)	70	10.89	83.80	44.835	18.039
Debt to Equity Ratio (Y)	70	0.75	5.89	1.937	1.159

Based on Table 1, the Current Ratio (CR) variable has a mean value of 1.782 with a standard deviation of 1.568, indicating a fairly wide variation in the liquidity levels of energy subsector companies. The Debt to Asset Ratio (DAR) variable has a mean of 44.835% with a standard deviation of 18.039%, indicating that, on average, nearly half of the companies' total assets are financed by debt. The Debt to Equity Ratio (DER) variable, as the dependent variable, has a mean of 1.937 with a standard deviation of 1.159, indicating a fairly high variation in leverage levels among companies.

Panel Data Regression Model Selection

Panel data regression estimation was conducted using three approaches, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The best model was selected through the Chow Test and Hausman Test.

Table 4. Common Effect Model (CEM) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Constant	0.3369	0.2756	1.222	0.226
Current Ratio (X1)	-0.2295	0.0646	-3.551	0.001
Debt to Asset Ratio (X2)	0.0448	0.0056	7.981	0.000
R-squared	0.5047			
F-Statistic	34.137			
Prob. (F-Statistic)	0.000			

The CEM regression equation is: DER = 0.3369 - 0.2295 CR + 0.0448 DAR. This model produced an R-Square of 0.5047, with both variables statistically significant.

Table 5. Fixed Effect Model (FEM) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Constant	1.3672	–	–	–
Current Ratio (X1)	-0.0975	0.096	-1.015	0.315
Debt to Asset Ratio (X2)	0.0279	0.0124	2.250	0.029
R-squared	0.7835			
F-Statistic	13.029			
Prob. (F-Statistic)	0.000			

The FEM regression equation is: DER = 1.3672 - 0.0975 CR + 0.0279 DAR + [fixed effects of 14 companies]. The R-Square increased to 0.7835; however, the CR variable became statistically insignificant (Sig. = 0.315).

Tabel 6. Random Effect Model (REM) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Constant	1.1993	–	–	–
Current Ratio (X1)	-0.156	0.0781	-1.998	0.050
Debt to Asset Ratio (X2)	0.0384	0.0081	4.749	0.000
R-squared	0.2667			
F-Statistic	12.184			
Prob. (F-Statistic)	0.000031			

The REM regression equation is: DER = 1.1993 - 0.1560 CR + 0.0384 DAR. In this model, both independent variables were statistically significant again, with an R-Square of 0.2667.

Table 6. Chow Test Results

Description	Value
F-statistic	5.350
F-table (df1 = 13; df2 = 54; α = 0.05)	1.906
Probability (Sig.)	0.000005

The calculated F-value (5.350) > F-table (1.906) with a probability of 0.000005 < 0.05, so H0 is rejected. Thus, the Fixed Effect Model is more appropriate to use than the Common Effect Model, and the testing is continued with the Hausman Test.

Table 7. Hausman Test Results

Description	Value
Calculated Chi-Square	2.336
Chi-Square Table (df = 2; α = 0.05)	5.992
Probability (Sig.)	0.311

The calculated Chi-Square value (2.336) < Chi-Square table (5.992) with a probability of 0.311 > 0.05, so H0 is accepted. Thus, the Random Effect Model (REM) is more appropriate to use than the Fixed Effect Model, and REM is established as the best model used for hypothesis testing in the next stage.

Hypothesis Testing

Based on the results of the Chow Test and Hausman Test, the Random Effect Model (REM) was established as the best model, so hypothesis testing was based on the REM estimation results: DER = 1.1993 - 0.1560 CR + 0.0384 DAR.

The t-test for the Current Ratio variable shows a t-value of -1.998 with a significance value of 0.050, which lies exactly at the 5% error tolerance threshold. Thus, H0 is rejected and H1 is accepted: the Current Ratio (CR) is proven to have a significant effect on the Debt to Equity Ratio (DER), with a negative coefficient direction, meaning that the higher a company's liquidity, the lower its leverage level.

The t-test for the Debt to Asset Ratio variable shows a t-value of 4.749 with a significance value of 0.000. Thus, H0 is rejected and H1 is accepted: the Debt to Asset Ratio (DAR) is proven to have a significant effect on the Debt to Equity Ratio (DER), with a positive coefficient direction, meaning that the higher the proportion of debt to total assets, the higher the company's leverage level relative to its equity.

The F-test shows an F-value of 12.184 with a significance probability of 0.000031. Thus, H0 is rejected and H1 is accepted: the Current Ratio and Debt to Asset Ratio are proven to simultaneously have a significant effect on the Debt to Equity Ratio in energy subsector companies listed on the Indonesia Stock Exchange during the 2020–2024 period.

The R-Square value of 0.2667 indicates that CR and DAR jointly explain 26.67% of the variation in DER, while the remaining 73.33% is explained by other factors outside the model, which are most likely specific characteristics of each company (unobserved heterogeneity) captured through the random effects component in the REM model.

DISCUSSION

The results of testing the first hypothesis show that the Current Ratio (CR) has a negative and significant effect on the Debt to Equity Ratio (DER). Companies with high liquidity levels have adequate current assets to meet their operational needs and short-term obligations, thereby minimizing their dependence on external financing in the form of debt. This finding is consistent with the results of Armanious and Zhao

(2024), who found that liquidity plays an important role in determining the leverage level chosen by company management.

The negative effect of liquidity on capital structure can also be interpreted in light of the conditions in the coal industry in 2022. Commodity prices in the Indonesian coal industry increased significantly during this period. In 2022, the average Indonesian Coal Benchmark Price (HBA) reached USD 276.58 per tonne, the highest in the last decade (Kementerian Energi dan Sumber Daya Mineral, 2022). The rise was attributed to strong global demand and disruptions to the global energy supply, especially after the Russia-Ukraine war. The better pricing environment offered improved revenue and cash generation potential for coal-related companies. PT Delta Dunia Makmur Tbk (DOID) recorded solid financial performance in its 2022 annual report, with total revenue amounting to USD 1.55 billion supported by strong operational activities. Such conditions demonstrate how very high coal prices can improve the liquidity position of energy companies through higher operating cash flows. The improved liquidity, in turn, may reduce the need for external debt financing, consistent with the negative relationship between liquidity and capital structure found in this study. This phenomenon is also consistent with Pecking Order Theory which states that firms with sufficient internally generated funds should favour internal financing over external debt. However, this phenomenon at the industry level should be taken as contextual evidence and not as direct causal evidence for all the companies in the research sample because the sample covers multiple energy subsectors..

The results of testing the second hypothesis show that the Debt to Asset Ratio (DAR) has a positive and highly significant effect on DER. Mathematically, DAR and DER are interrelated, as both reflect the proportion of debt in a company's funding structure; when the proportion of debt to assets increases, the proportion of equity relatively decreases, thereby also increasing the debt-to-equity ratio. This finding is consistent with the studies of Sitompul et al. (2021) and Effendi and Hariyono (2022), who found that solvency ratios such as DAR contribute significantly to increased financial risk and leverage.

The results of testing the third hypothesis show that CR and DAR simultaneously have a significant effect on DER, with an explanatory power of 26.67% of the variation in DER. This finding confirms that capital structure decisions in energy subsector companies result from the interaction between short-term liquidity capacity and the level of debt utilization relative to assets, a result also found in the study by Pradnyaswari and Dana (2022).

Compared to previous studies, these findings reinforce the results of Nursyamsiah and Wahyuni (2024), who found that CR and DER play an important role in predicting financial distress conditions, as well as Cielo and Manda (2021), who found that leverage ratios are an important determinant of financial risk in energy subsector companies. However, these results differ from the findings of Damajanti et al. (2021) in the retail trade sector, which showed that not all financial ratios consistently influence a company's financial condition. This difference indicates that the effect of financial ratios on capital structure is contextual and varies according to industry sector characteristics.

From a theoretical perspective, the finding that DAR has a significant positive effect on DER is consistent with trade-off theory, which explains that companies strive to achieve an optimal capital structure by weighing the tax-saving benefits of debt usage against the costs of financial distress (Wagisuwari & Sitorus, 2024). Meanwhile, the finding that CR has a negative effect on DER is in line with pecking order theory, which explains that companies with adequate internal funds tend to rely less on debt (Astuti & Giovanni, 2021). Thus, the funding behavior of energy subsector companies in Indonesia reflects a combination of both theories.

From a managerial perspective, these findings indicate that companies need to maintain adequate liquidity levels as a leverage control strategy, while also exercising caution in increasing the proportion of debt to assets in order to keep the capital structure healthy. For investors and creditors, the combination of CR and DAR can serve as one of the initial indicators for assessing the financial risk of energy subsector companies, although additional analysis of other factors remains necessary, given that these two ratios explain only 26.67% of the variation in DER.

CONCLUSION AND RECOMMENDATION

This study examined the effect of the Current Ratio (CR) and Debt to Asset Ratio (DAR) on the Debt to Equity Ratio (DER) in 14 energy subsector companies listed on the Indonesia Stock Exchange during the 2020–2024 period, using a panel data regression approach in which the Random Effect Model (REM) was selected as the best estimation model based on the Chow Test and Hausman Test, indicating that differences in characteristics among energy subsector companies are random and are more efficiently estimated using the Generalized Least Squares approach. The findings show that the Current Ratio has a significant negative effect on DER, the Debt to Asset Ratio has a significant positive effect on DER, and both variables

simultaneously have a significant effect on DER, explaining 26.67% of the variation in DER, while the remainder is explained by other factors outside the model.

Thus, all research hypotheses (H1, H2, and H3) are accepted. These findings further reinforce the relevance of trade-off theory and pecking order theory in explaining the capital structure behavior of energy subsector companies in Indonesia, in which debt usage decisions are influenced both by the availability of internal funds through liquidity and by efforts to achieve an optimal capital structure balance through asset leverage management. This study has limitations in terms of variable scope, which only covers CR and DAR, as well as a research object limited to a single subsector. Therefore, future research is recommended to include additional variables such as profitability and firm size, as well as to expand the sectoral scope in order to obtain a more comprehensive picture of the determinants of capital structure among companies in Indonesia.

Based on these findings, several recommendations are proposed: For Company Management. Management of energy sector companies should maintain an adequate level of liquidity as part of an effective capital structure control strategy, given that liquidity has been shown to significantly reduce dependence on debt. In addition, management needs to exercise prudence in increasing the proportion of debt to total assets, ensuring that debt utilization remains within an optimal range that balances the tax-saving benefits of debt against the risk of financial distress.

For Investors and Creditors, Investors and creditors are advised to consider both liquidity and leverage ratios as part of their initial assessment of financial risk when evaluating energy sector companies, while also taking into account other financial and non-financial factors, since CR and DAR together explain only 26.67% of the variation in capital structure.

For Future Researchers, Future studies are recommended to incorporate additional variables that may influence capital structure, such as profitability, firm size, asset structure, sales growth, and macroeconomic factors (e.g., interest rates and energy price fluctuations), in order to improve the explanatory power of the research model. Expanding the research object to cover multiple sectors or a longer observation period is also recommended to enhance the generalizability of the findings. Furthermore, future research may consider employing alternative analytical methods, such as moderation or mediation analysis, to gain a deeper understanding of the mechanisms underlying the relationship between liquidity, leverage, and capital structure.

AUTHOR CONTRIBUTIONS

Suharti: Conceptualization, Methodology, Investigation, Data analysis, Data curation, Writing – original draft, Visualization, and Project administration.

Siti Puryandani: Supervision, Validation, Research resources, Writing – review and editing, and Research coordination.

FINANCIAL DISCLOSURE

This study was conducted without external financial assistance or dedicated research funding.

CONFLICT OF INTEREST

The authors confirm that they have no competing interests that could have influenced the research process, interpretation of the findings, or publication of this article.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

The authors declare that generative artificial intelligence was not employed to generate the manuscript's content, formulate its arguments, or establish its conceptual framework.

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