

The Effect of Liquidity and Leverage on Z-Score as a Predictor of Financial Distress, with Profitability as a Mediating Variable (A Study of Coal Sub-Sector Companies Listed on the Indonesia Stock Exchange)

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ABSTRACT

This study aims “to analyze the influence of liquidity and leverage on the Z-score, as a predictor of financial distress, with profitability serving as a mediating variable.” The study population consists of 33 coal sub-sector companies listed on the IDX, with a sample of six companies selected using the purposive sampling method. Data analysis was conducted using panel data regression. The findings indicate that liquidity and leverage do not affect the Z-score, whereas profitability has a positive and significant effect. Liquidity does not influence profitability, while leverage has a positive and significant effect on profitability. Furthermore, profitability was found to mediate the influence of liquidity and leverage on the Z-score.

INTRODUCTION

When a business experiences financial difficulty, the company is facing financial problems that are likely to lead to bankruptcy. Companies often find themselves in this situation when facing increasingly fierce market competition. This intense competition forces them to continuously innovate in order to remain profitable and outperform their competitors. The company's inability to face that competition can lead to a decline in revenue, which in turn can worsen its financial condition. One of the main causes that trigger financial distress is the weak internal financial condition of the company. Therefore, external parties such as investors and creditors need to conduct analysis and predictions regarding the possibility of financial distress in a company before making decisions related to investment or loan provision.

The Energy Sector includes several companies that play a role in meeting the energy needs for industry, transportation, and households. One of the energy sectors is coal, which operates trade, shipping, and long-distance transportation. One part of this sector is the coal sub-sector, whose activities include trade, shipping, and long-distance transportation. The coal sub-sector is a major energy source used by many countries. In Indonesia, this sub-sector is supported by the abundant availability of coal natural resources, making it an important role in the national economy. Its role is not only as a major contributor to the country's revenue but also as a provider of jobs for the community and a supporter of domestic energy needs.

According to Tasrif (2024), coal production in Indonesia continues to increase every year, which has a significant impact on the country's economy. Thanks to the 40.24% increase in coal prices compared to the previous quarter, coal exports contributed 4.07% to Indonesia's GDP in the first quarter of 2022. Based on Indonesian government statistical data, the value of mining commodity exports in January 2023 reached US\$4.81 billion, an increase of 121.46% from the same month in the previous period. Then, in 2023, coal production reached 775.2 million tons, equivalent to 112% of the national target. These figures indicate that the coal subsector plays a crucial role in Indonesia's economic growth, exports, and foreign exchange earnings.

The financial condition of coal sub-sector companies listed on the IDX indicates signs of financial distress. This phenomenon is interesting because, although the Central Statistics Agency of Indonesia (2022) reported that the coal sub-sector contributed to economic growth with an increase of 4.07%, the financial performance of the companies, as proxied by ROA, indicates fluctuations. ROA increased from 0.11 in 2019 to 0.38 in 2022, but decreased to 0.21 in 2023 and further dropped to 0.16 in 2024. This decline raises concerns about the stability of the company's ability to convert its assets into profits, which could lead to financial difficulties.

Considering the importance of identifying signs of financial distress before it leads to business bankruptcy, this research uses these indicators as dependent variables. A popular tool for measuring the financial health of a business is the Altman Z-Score, which utilizes a number of financial ratios as proxies for financial distress.

This study proposes the hypothesis that liquidity, leverage, and profitability are variables that affect financial distress. Current Ratio (CR) is a measure of liquidity that indicates a company's capacity to settle its short-term obligations, while the Debt to Assets Ratio (DAR) shows the extent of debt used to finance the company's assets. One of the mediating elements is Return on Assets (ROA), which serves as a proxy for profitability because it reflects the company's capacity to generate profit from its assets. Previous research indicates that CR and DAR have an influence on the use of ROA as a mediating variable. toward financial distress still yields inconsistent findings.

Research related to "the influence of liquidity, leverage, and profitability on financial distress as proxied by the Altman Z-Score" has been extensively conducted, but the findings remain inconsistent. On the liquidity variable proxied by CR, the research by Rinofah et al. (2022), Afriyani (2023), Saputra et al. (2024), and Noviyana et al. (2024) emphasizes a significant positive effect on financial distress, while Azizah (2022) found a significant negative effect, and Adelia et al. (2022), Dewi et al. (2021), Diana (2023), Baghaskara (2023), and Sihombing (2024) stated no effect.

On the leverage variable proxied by DAR, Rinofah et al. (2022), Dewi et al. (2021), Antoniawati (2022), Baghaskara (2023), Margareta (2024), and Sihombing (2024) found a significant positive effect, while Pinastiti (2023) and Rojulumubin (2024) obtained a significant negative effect, and Hadi (2022) stated no effect.

Then, on the profitability variable proxied by ROA, Dewi et al. (2022), Rinofah et al. (2022), Saputra et al. (2024), Diana (2023), Margareta (2024), Burhanudin (2024), and Rojulumubin (2024) found a positive effect on financial distress, while Dewi (2021), Baghaskara (2023), and Hadi (2022) obtained a significant negative effect, and Azizah (2022), Antoniawati (2022), Ningsi (2024), and Rissi (2021) stated no effect.

The differences in the study findings above indicate a research gap, which makes this study offer novelty by using profitability proxied by ROA as a mediating variable in the relationship between liquidity and leverage on the Altman Z-Score as a prediction of financial distress in coal sub-sector companies listed on the IDX.

LITERATURE REVIEW

Signaling Theory

From the explanation of the signaling theory proposed by Spence (1973), investors benefit when the sender (the party with the information) gives a signal, such as data showing the company's condition. Based on this theory, when the company's financial condition is good, managers demonstrate it by using more lenient accounting methods; this is especially true during financial crises. Conversely, managers use more cautious accounting techniques when the company is experiencing financial problems and has poor prospects. Managers can act quickly in facing financial challenges by utilizing signaling theory to communicate information about the organization, both positive and negative (Margareta, 2024).

Agency Theory

The division of tasks between the company (as the principal) and its management (as the agent) gives rise to agency theory. According to Meckling (1976), the principal entrusts resources to the agent through the formation of an employment contract (Antoniawati, 2022). The owner is referred to as the principal, while the manager is referred to as the agent. The agency theory encourages agents to maximize the company's profit. In order to avoid cuts in their own performance bonuses, agents will strive hard to control the company's tax burden (Burhanudin, 2024).

Trade-off Theory

The trade-off theory explains the effort to achieve a balance between costs and benefits in determining the debt-to-equity composition (Modigliani & Miller, 1958). A company's capital structure is determined by the trade-off principle, which states that the benefits of tax savings must be balanced with the losses or risks resulting from increased debt financing. If the addition of debt results in tax savings, then the step is justified; however, if the company incurs losses after accounting for the debt burden, then increasing debt is not the right step (Burhanudin, 2024).

Financial Distress

Rhomdoni et al. (2020) state that financial distress is a period of financial difficulty that occurs before liquidation or bankruptcy. According to Diana et al. (2023), financial distress is a phase of business decline that occurs before bankruptcy and liquidation. Failure to meet debt obligations or indications of default while fulfilling obligations or renegotiating with creditors or other financial institutions are specific criteria that can be used to classify a company as experiencing financial distress based on default criteria. Financial problems arise when an organization's debt exceeds the value of its assets. One way to determine whether a company is experiencing financial problems is by using the Altman Z-Score algorithm. Diana et al. (2023) assert that the Altman Z-Score model, which utilizes several financial ratios to indicate the company's financial performance, is a reliable equation for predicting when a company will face bankruptcy.

Liquidity

A lack of liquidity can complicate, or even render a company unable to settle short-term debts when they are due. On the other hand, having excessive cash means that the funds are idle and not optimally utilized for the future (Noviyana, 2024). In the context of this research, the Current Ratio (CR) is applied as a proxy for liquidity.

Leverage

The potential for higher returns must be weighed against the increased risk of default that accompanies excessive use of leverage (debt usage). Therefore, to enhance long-term profitability and company value, management must be able to establish an appropriate level of leverage through a trade-off consideration between risk and return (Noviyana, 2024). The Debt to Total Assets (DAR) ratio is used as a proxy for leverage in this study.

Profitability

Kasmir (2020) states that profitability is the capacity of a business to generate profit over a certain period of time. Because profits fund growth, dividend payments, and efforts to attract investors, profitability becomes a crucial factor for the long-term survival of a company. From an investor's perspective, a higher level of profitability reflects a stronger capital position and improved operational performance. In the context of this study, Return on Assets (ROA) is applied as a profitability indicator.

Framework

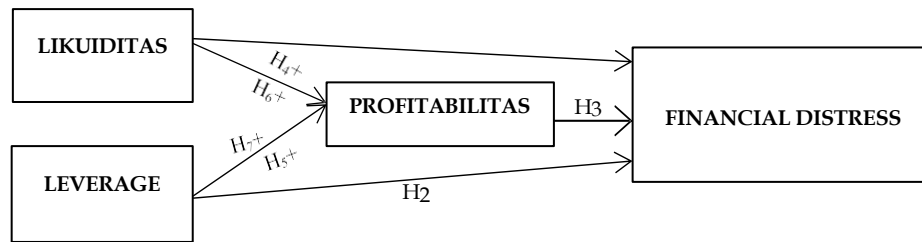


Figure 1. Theoretical Framework

METHODOLOGY

Using a causal research design and quantitative methods, this study examines the relationship between profitability, liquidity, and leverage on the Altman Z-Score, which is a measure used to predict financial failure. This study relies on secondary data covering the observation period from 2019 to 2024, obtained from the official IDX website as well as each company's website to compile annual financial statements of companies in the coal subsector.

The sample population includes 33 companies from the coal subsector listed on the IDX. The following criteria were used to select companies through purposive sampling: (1) companies listed on the IDX during the study period, (2) companies that have published financial statements consecutively from 2019 to 2024, (3) companies that recorded profits during the study period, and (4) no outlier data in these companies. The research sample consists of six companies selected based on these criteria.

The dependent variable in this study is financial distress, proxied by the Altman Z-Score. The independent variables consist of liquidity, proxied by the CR, and leverage, proxied by the DAR. Meanwhile, the mediating variable is profitability, measured by ROA.

Data analysis was conducted using the panel data regression method assisted by EViews 12. The analysis process included the use of descriptive statistics as well as the Chow, Hausman, and Lagrange Multiplier (LM) tests to determine the appropriate panel data regression model. Next, the model fit is examined through the analysis of partial variable effects using the t-test, R² value, and F-test. Referring to the methodology proposed by Ghozali (2021), the Sobel test is used to test the mediation effect. This stage involves determining the path coefficients a (from the independent variable to the mediating variable) and b (from the mediating variable to the dependent variable). The indirect effect is then obtained by multiplying these two coefficients (ab).

RESEARCH RESULT*Selection of Sub-Structural 1 Panel Data Regression Model*

Here are the findings of the Chow test for sub-structural 1 of the coal sub-sector for the period 2019-2024.

Table 1. Chow Test Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.849069	(5,28)	0.1356
Cross-section Chi-square	10.271610	5	0.0679

Source: Eviews 12 Output Results (2026)

From the Chow test findings, a probability score of $0.0679 > 0.05$ (5% significance level) was obtained, leading to the conclusion that "Ha is rejected and Ho is accepted." Therefore, the Common Effect model is considered more relevant to apply.

Selection of Sub-Structural 2 Panel Data Regression Model

Below are the Chow test results for sub-structure 2 of the Coal sub-sector for the period 2019-2024.

Table 2. Chow Test Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	10.223298	(5,27)	0.0000
Cross-section Chi-square	38.245115	5	0.0000

Source: Eviews 12 Output Results (2026)

From the Chow test findings, a probability score of $0.0000 < 0.05$ (5% significance level) was obtained. Which leads to "Ha accepted and Ho rejected." Therefore, the fixed effect model is considered relevant and can be conducted through the Hausman test.

Table 3. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. Statistic d.f.	Prob.
Cross-section random	1.324611	3	0.7233

Source: Eviews 12 Output Results (2026)

From the Hausman test findings, a probability score of $0.7233 > 0.05$ (5% significance level) was obtained, which leads to "Ho accepted and Ha rejected." Therefore, the random effect model is considered more relevant and can be continued with the LM test.

Table 4. Results of the Lagrange Multiplier Test

	Cross-section	Test Hypothesis Time.	Both.
Breusch-Pagan	21.71542 (0.0000)	0.352946 (0.5525)	22.06836 (0.0000)

Source: Eviews 12 Output Results (2026)

From the Lagrange Multiplier test findings, a probability value of 0.0000 < critical 0.05 (5% significance level) was obtained, leading to the conclusion that "Ha is accepted and Ho is rejected." Therefore, the random effect model is considered more relevant to apply in this study.

Analysis of Sub-Structural Regression Model 1

From the findings of the panel data regression model test on sub-structural 1, it was found that the Common Effect Model is the most relevant model from the panel data regression model selection test findings. The findings of the CEM estimation are detailed in Table 5.

Table 5. Common Effect Model Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.106142	0.149712	-0.708977	0.4833
CR	0.055528	0.031036	1.789136	0.0828
DAR	0.693033	0.281433	2.462519	0.0192

Source: Eviews 12 Output Results (2026)

From the CEM test findings, the Prob (F-statistic) score is 0.000487 (<0.05), indicating that the research model is suitable for application. The Adjusted R-squared score obtained is 0.472043 or 47.20%, indicating that the independent variables consisting of CR and DAR can explain the variation in ROA by 47.20%, and the remaining 52.80% is influenced by other factors outside the model. From the hypothesis test findings, the CR variable has a significance score of 0.0828 (>0.05), which means it does not affect ROA and hypothesis H4 is rejected. Then, the DAR variable has a significance score of 0.0192 (<0.05), which means it has a significant positive effect on ROA, leading to the acceptance of hypothesis H5.

Analysis of Sub-Structural 2 Regression Model

From the findings of the sub-structural 2 panel data regression model test, it can be concluded that REM is the most relevant model to be applied in this study.

Table 6. Random Effect Model Test

Variable	Coefficient	Std. Error	t-Statistic
C	4.410182	1.141213	3.864468
CR	-0.040335	0.247915	-0.162696
DAR	-4.760249	1.904139	-2.499948

Source: Eviews 12 Output Results (2026)

From the REM test findings, the score of Prob (F-statistic) is 0.000000 (<0.05), making the model suitable for use. The Adjusted R-squared score obtained is 0.699057 or 69.91%, indicating that the independent variables consisting of CR, DAR, and the mediating variable ROA can explain the variation in the Z-Score value as a prediction of financial distress by 69.91%, and the remaining 30.09% is influenced by other aspects outside the model.

From the hypothesis testing findings, the CR variable has a significance score of 0.8718 (>0.05), which means it does not affect the Z-Score and H1 is rejected. Then, the DAR variable has a significance score of 0.0177 (<0.05) and a

negative coefficient of -4.760249, which significantly negatively affects the Z-Score, and H2 is rejected. Meanwhile, the ROA variable has a significance score of 0.0000 (<0.05) and a positive coefficient of 6.557370, which significantly positively affects the Z-Score as a prediction of financial distress, so H3 is accepted.

Mediation Test

Table 7. T-test Results

Variable	Coefficient	Std. Error
CR - ROA	0.103189	0.036534
DAR - ROA	0.238129	0.220147
ROA - Z-SCORE	7.165746	1.105054

Source: Eviews 12 Output Results (2026)

Table 8. Mediation Test Results with Sobel Test

Variable	t-Statistic	Std.Error	P-Value
CR - ROA - Z-SCORE	2.48483484	0.1796791	0.01296116
DAR - ROA - Z-SCORE	2.88267638	0.55322681	0.00394312

Source: Eviews 12 Output Results (2026)

From the Sobel test findings, the indirect effect of CR on the Z-Score through ROA has a t-statistic score of 2.484835 and a probability score of 0.012961 (<0.05), which leads to the acceptance of H6. This finding confirms that profitability can mediate the effect of liquidity on the Z-Score as a prediction of financial distress.

Furthermore, the indirect effect of DAR on the Z-Score through Return on Assets (ROA) has a t-statistic score of 2.882676 and a probability score of 0.003943 (<0.05), which leads to the acceptance of H7. This finding confirms that profitability can also mediate the effect of leverage on the Z-Score as a prediction of financial distress.

DISCUSSION

From the analysis findings, "Current Ratio (CR) does not affect the Z-Score value which predicts financial distress," thus H1 is rejected. This condition emphasizes that the magnitude of liquidity cannot yet reflect the overall financial health of the company, especially in coal sub-sector companies where most of their current assets are allocated for operational needs and long-term investments. The existing findings support the Signaling Theory, which explains that information regarding liquidity may not necessarily be a significant signal for investors in assessing the risk of financial distress. The results are also relevant to the studies by Dewi et al. (2022) and Sri Dewi (2023).

The regression analysis shows that the "Debt to Assets Ratio (DAR) does not affect the Z-Score value as a prediction of financial distress," thus H2 is rejected. In coal sub-sector companies, the use of debt is a commonly applied financing policy due to the capital-intensive nature of the industry. Therefore, changes in the level of debt do not necessarily indicate the occurrence of financial distress. This condition is relevant to the Trade-Off Theory, which explains that

companies strive to balance the benefits and risks of using debt. The existing findings are relevant to the studies by Septiani et al. (2021), Hadi (2022), Sri Dewi (2023), and Handayani and Wuryani (2025).

Unlike the previous two variables, "Return on Assets (ROA) has been proven to have a positive and significant effect on the Z-Score value as a prediction of financial distress," thus H3 is accepted. A stronger financial position and reduced risk of financial distress are the results of the company's ability to generate income from its assets, which becomes more optimal when profitability is at a high level. These findings reinforce the Agency Theory, which states that a company's performance improves when its management has expertise in managing the company's assets. Pinastiti et al. (2023), Saputra et al. (2024), and Sihombing (2024) all reached similar conclusions.

Testing the relationship between CR and ROA confirms that "liquidity does not affect profitability," leading to the rejection of H4. The high liquidity in coal sub-sector companies is not always followed by an increase in profit because this industry has significant working capital and operational cost needs. Liquidity plays a more crucial role in maintaining operational continuity rather than increasing the company's profitability. These findings are relevant to the studies conducted by Gultom and Hasyim (2025) as well as Sumarni et al. (2025).

The research findings indicate that "Debt to Assets Ratio (DAR) has a positive and significant effect on Return on Assets (ROA)," thus H5 is accepted. Additional debt utilized to finance productive investments, such as exploration and mine development, can enhance the company's capacity to generate profits. These findings reinforce the Trade-Off Theory, which asserts that when benefits outweigh costs, optimal use of debt can enhance profitability. The findings of Prayoga et al. (2026) and Gultom and Hasyim (2025) support this conclusion.

Testing using the Sobel Test proves that "Return on Assets is able to mediate the effect of Current Ratio on the Z-Score value as a prediction of financial distress," thus H6 is accepted. The existing findings confirm that liquidity has an indirect effect on financial distress through the improvement of the company's profitability, rather than a direct effect. In line with previous research by Astuti and Sjarif (2022), Maulidya et al. (2023), and Rejeki et al. (2023), these results strengthen the Signaling Theory.

From the Sobel Test findings, "Return on Assets has been proven to mediate the effect of the Debt to Assets Ratio on the Z-Score value as a prediction of financial distress," thus H7 is accepted. Improving the company's profitability through good debt management can strengthen its financial position and reduce the risk of financial distress. In line with previous research by Gultom and Hasyim (2025) and Sumarni et al. (2025), these results strengthen the support for the Trade-Off Theory.

CONCLUSIONS AND RECOMMENDATIONS

The existing findings confirm that liquidity, proxied by CR, and leverage, proxied by DAR, do not have a direct effect on the Z-Score value as a prediction of financial distress in coal sub-sector companies listed on the IDX for the period 2019–2024. On the other hand, profitability as proxied by ROA has been proven

to have a positive and significant effect on the Z-Score value. Additionally, CR does not affect ROA, while DAR has a positive and significant effect on ROA. Findings from the mediation test also prove that ROA is capable of mediating the effect of both CR and DAR on the Z-Score value, thus profitability plays an important role in strengthening the company's financial condition and reducing the risk of financial distress.

Based on the existing findings, coal sub-sector companies are advised to prioritize improving profitability through more efficient asset management and optimizing debt usage at a healthy level to enhance profits and strengthen the company's financial condition. For investors, profitability, particularly Return on Assets (ROA), can be used as the main indicator in evaluating investment prospects because it has been proven to have the strongest influence on financial distress conditions. Then, other researchers are recommended to examine other variables, such as Firm Size, Sales Growth, and TATO, or to expand the objects and periods of study in order to obtain a more comprehensive model to explain the factors influencing financial distress.

ADVANCED RESEARCH

It should be noted that this study has limitations. First, this study only reviews coal-related companies listed on the IDX between 2019 and 2024, so the results cannot be generalized to other industries. Second, other variables that could potentially affect financial difficulties have not been included in the research model. These variables include the Current Ratio (CR), Debt to Assets Ratio (DAR), Return on Assets (ROA), and Z-Score. The model's ability to explain the phenomenon being studied may also be influenced by the sample size that meets the criteria, which is relatively small.

To obtain more comprehensive results, future research should expand the scope by including additional industry sectors or applying a longer observation period. Other characteristics that can be considered in future research as factors influencing financial distress include company size, sales growth, total asset turnover (TATO), cash flow, and good corporate governance. In addition to using panel data regression, future research can explore the use of other analytical tools, such as Structural Equation Modeling (SEM) or dynamic panel approaches, to better understand the factors contributing to financial distress.

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