



The Influence of Capital Structure on Profitability: Panel Regression Analysis of Indonesian State-Owned Enterprises in the Energy and Mining Sector from 2019 to 2023

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Abstract

Capital structure is an important factor in financial decision-making that can influence a company's profitability level. Indonesian state-owned enterprises (BUMN) in the energy and mining sector have high capital needs and significant exposure to external risks, making capital structure efficiency crucial. This study aims to analyze the impact of Debt to Asset Ratio (DAR) and Debt to Equity Ratio (DER) on Return on Equity (ROE) as a profitability indicator for Indonesian state-owned enterprises in the energy and mining sector in Indonesia during the period 2019–2023. This research uses six companies as samples, namely PT Aneka Tambang Tbk., PT Bukit Asam Tbk., PT Indonesia Asahan Aluminium, PT Pertamina (Persero), and PT Timah Tbk. The study employs a quantitative approach with a panel data regression method. Data was obtained from the annual financial statements of the company. The analysis process was conducted thoroughly using Eviews 12 software, including data processing, assumption testing, selection of the panel regression model, and final estimation. The results of the analysis indicate that the Random Effect Model is the most suitable approach. Simultaneously, DER and DAR have a significant effect on ROE. However, partially, only DER has a significant negative effect, while DAR is not significant. These findings indicate that the capital structure, specifically the proportion of debt to equity, plays an important role in determining the company's profitability. Therefore, optimal management of the financing structure becomes an important strategy for the company in maintaining long-term financial performance.

Keywords: Capital Structure, Profitability, Debt to Asset Ratio (DAR), Debt to Equity Ratio (DER), Return on Equity (ROE), Indonesian State-Owned Enterprises, Energy and Mining Sector, Panel Data Regression

1. Introduction

Capital structure is a central element in a company's financial policy that plays an important role in determining the sustainability and value of the company in the future. This structure reflects the proportion of debt and equity used in both operational financing and long-term investments. Choosing the right capital structure can help the company minimize capital costs, balance financial risk, and optimize overall financial performance (Brigham & Houston, 2019).

Profitability is an important indicator to assess the extent to which a company can generate profits from its business activities. One measure of profitability that is often used is Return on Equity (ROE), which is a ratio indicating the level of return on the equity invested by shareholders. A high ROE indicates efficient management in utilizing the owner's capital to generate profits (Gitman & Zutter, 2015). ROE is often a primary consideration for investors when evaluating the attractiveness of investing in a company.

The relationship between capital structure and ROE has become a major focus in various academic studies. Theoretically, the use of debt in the capital structure can increase ROE as long as the return on assets exceeds the cost of debt (financial leverage effect). However, if the use of debt is too high, financial risk also increases and can pressure net profit due to large interest burdens (Van Horne & Wachowicz, 2012). Susdianty & Defrizal (2023) show that companies that can manage their debt proportions well tend to have higher and more stable ROE levels over time.

Currently, the energy and mining sectors are among the vital sectors in the Indonesian economy, dominated by several large state-owned enterprises, such as PT Aneka Tambang Tbk., PT Bukit Asam Tbk., PT Indonesia Asahan Aluminium, PT Pertamina (Persero), and PT Timah Tbk. These companies play a crucial role in providing energy,

managing natural resources, and contributing to state revenue. On the other hand, this sector also faces complex challenges, such as commodity price volatility, fluctuations in global demand, and the need for significant funding for long-term projects. Therefore, proper management of capital structure becomes very important to maintain financial stability and profitability levels, especially in keeping ROE competitive.

This research aims to analyze the effect of capital structure on profitability, using ROE as the main indicator, in Indonesian state-owned enterprises operating in the energy and mining sectors during the period 2019–2023. A panel data regression method is used to test the relationship between capital structure ratios such as Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR) against the level of return on equity. The results of this study are expected to provide empirical contributions to financial decision-making in strategic Indonesian state-owned enterprises as well as enrich the academic literature in the field of corporate financial management in Indonesia.

2. Literature Review

2.1. Theory of Modal Structure

Capital structure is the combination of debt and equity in a company's long-term financial structure. The choice of an optimal capital structure is important because it affects the company's risk and return. There are several theories that explain the determination of capital structure, such as the Trade-Off Theory which states that companies balance the tax benefits of debt against the bankruptcy risk due to debt burden (Brigham & Houston, 2019). The Pecking Order Theory explains the hierarchy of financing preferences: retained earnings, debt, and finally equity, to minimize information costs (Brigham & Houston, 2019). Meanwhile, Agency Theory (Jensen & Meckling, 1986) states that conflicts between owners and managers can lead to agency costs. Capital structure, particularly the use of debt, can serve as a control mechanism to mitigate such conflicts.

2.2. Company Profitability

Profitability reflects a company's ability to generate profit. One commonly used indicator is Return on Equity (ROE), which measures the ability to generate profit on equity. ROE is an important indicator because it shows the efficiency of the company in utilizing equity to generate returns for shareholders.

2.3. The Relationship between Capital Structure and Profitability

Capital structure can influence profitability through leverage effects. The use of debt can increase shareholder returns (ROE), but it also adds financial risk which needs to be managed carefully. Research by Jouda (2017) using a panel VAR approach found a negative bidirectional causal relationship between leverage and profitability. These findings emphasize that capital structure not only affects profitability, but is also influenced by financial performance, thus requiring dynamic analysis.

2.4. Previous Research

Setiawan & Sumantri (2020) found that DER and DAR significantly affect ROE and ROA in mining companies listed on the Indonesia Stock Exchange. Meanwhile, Nhung & Okuda (2016) emphasized the importance of governance and access to loans in improving the profitability of state-owned enterprises in Vietnam.

2.5. Research Gap

Most previous studies were limited to the period before the pandemic and the private sector. There has not been much research specifically examining Indonesian SOEs in the energy and mining sectors. In addition, there is still minimal research that employs panel data regression for more accurate analysis. Therefore, this study focuses on Indonesian state-owned enterprises in the strategic sector for the period 2019–2023 using a panel data approach.

3. Materials and Methods

3.1. Materials

This study utilizes secondary data sourced from the annual financial reports of state-owned enterprises (BUMN) in Indonesia within the energy and mining sectors listed on the Indonesia Stock Exchange, namely PT Pertamina (Persero), PT Bukit Asam Tbk., PT Aneka Tambang Tbk., PT Timah Tbk., and PT Indonesia Asahan Aluminium, covering the observation period from 2019 to 2023. The selection of this period is based on the availability of current

data that reflects the most recent conditions of these companies. The sample selection was made with certain criteria in mind. The established criteria for sample selection are: (1) Indonesian state-owned enterprises in the energy and mining sectors registered on the Indonesia Stock Exchange (IDX) during the period 2019-2023; (2) Companies that consistently and completely publish financial reports during the observation period; and (3) Companies that have complete data related to the variables studied.

3.2. Methods

This research uses a quantitative approach with panel data regression analysis method. Panel data is chosen because it can combine time series and cross-section data, allowing it to capture the dynamics of the relationship between capital structure and corporate profitability over time while also comparing it across companies.

3.2.1. Research Variables

This study involves two types of variables, namely dependent variables and independent variables. The dependent variable in this study is profitability. Profitability is the company's ability to generate profit using its available resources. In this study, profitability is measured using Return on Equity (ROE), which shows how efficiently a company uses its own capital to generate profit. ROE is calculated using the formula:

$$ROE = \frac{Net\ Profit}{Total\ Equity} \quad (1)$$

This ROE measurement is commonly used in financial literature as an indicator of profitability (Ghozali, 2018). Next, the independent variable used for this research is capital structure. Capital structure describes the proportion of debt and equity used in company funding. In this study, capital structure is represented by two financial ratios, namely Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR).

The Debt to Equity Ratio (DER) shows the comparison between total debt and total equity, reflecting the company's ability to meet its obligations with the equity it possesses. DER is calculated using the formula:

$$DER = \frac{Total\ Liabilities}{Total\ Equity} \quad (2)$$

On the other hand, the Debt to Asset Ratio (DAR) measures how much of the company's assets are financed by debt, or how much debt affects the management of the assets. The result of the DAR calculation can be obtained from the following formula:

$$DAR = \frac{Total\ Liabilities}{Total\ Assets} \quad (3)$$

These ratios are standard measures in capital structure analysis (Gujarati & Porter, 2009; Ghozali, 2018). DER and DAR were chosen as independent variables because both are major indicators of capital structure that reflect the company's level of leverage. DER shows the proportion of debt to equity, where a high ratio can increase financial risk and squeeze profitability (Brigham & Houston, 2019). DAR depicts the extent to which the company's assets are financed by debt, reflecting long-term funding efficiency (Ghozali, 2018). Meanwhile, ROE is used as the dependent variable because it is the main measure of profitability that indicates how effectively a company generates profit from its own capital. ROE is a focus for investors as it reflects the company's ability to provide returns on shareholders' investments (Gitman & Zutter, 2015).

3.2.2. Panel Data Analysis Model

Panel data analysis is a combination of cross-section and time series data that provides more information, is more varied, has less collinearity between variables, more degrees of freedom, and is more efficient (Baltagi, 2005; Wooldridge, 2010). In panel data regression analysis, there are three approaches that are generally used for estimation, namely:

3.2.2.1. Common Effect Model (CEM)

This model is the simplest approach in panel data analysis. CEM assumes that there are no significant differences between companies and across time. The regression model equation of CEM can be written as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \quad (4)$$

where:

Y_{it} : Dependent variable for individual i at time t

α : Intercept (constant for all individuals and time)

β : Regression coefficient (same for all individuals and time)

X_{it} : Independent variable for individual i at time t

ε_{it} : Error term for individual i at time t

3.2.2.2. Fixed Effect Model (FEM)

This model accommodates differences between companies by including a dummy variable for each company. FEM assumes that the intercept for each company is different, but the slope coefficients remain the same across companies and over time. The regression model equation for FEM is:

$$Y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it} \quad (5)$$

where:

Y_{it} : Dependent variable for individual i at time t

α_i : Intercept specific to individual i (captures individual effects)

β : Regression coefficient (same for all individuals and time)

X_{it} : Independent variable for individual i at time t

ε_{it} : Error term

3.2.2.3. Random Effect Model (REM)

This model assumes that the differences in intercepts between companies are random variables. REM is used to address the limitations of FEM which uses dummy variables. In this model, the differences between companies and across time are included in the error component, making this model known as the error component model. The regression model equation for REM is:

$$Y_{it} = \alpha + \beta X_{it} + u_i + \varepsilon_{it} \quad (6)$$

where:

Y_{it} : Dependent variable for individual i at time t

α : Intercept (constant for all individuals and time)

β : Regression coefficient (same for all individuals and time)

X_{it} : Independent variable for individual i at time t

u_i : Random error component specific to individual i (captures unobserved heterogeneity, assumed random and uncorrelated with X_{it})

ε_{it} : Error term for individual i at time t

3.2.3. Data Analysis Techniques

The data analysis process in this research was carried out through several testing stages to ensure that the model used is the most appropriate and meets statistical requirements. These stages include the selection of panel data regression estimation models, testing classical assumptions, and hypothesis testing.

3.2.3.1. Selection of Panel Data Regression Estimation Models

The selection of the best estimation model in the analysis of panel data regression is a very important step because it will determine the accuracy of the estimation results. In this study, the model selection is carried out through a series of statistical tests in stages, namely the Chow test, the Hausman test, and the Lagrange Multiplier test (Gujarati & Porter, 2009; Baltagi, 2005).

3.2.3.2. Chow Test

The Chow test is used to determine the more appropriate model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). This test is performed by comparing the value of the Sum of Squared Residuals (RSS) of

both models. The test statistic used is the F statistic. The test statistic used in the Chow test is the F statistic with the formula:

$$F = \frac{\frac{SSE_1 - SSE_2}{n-1}}{\frac{SSE_2}{nt - n - k}} \quad (7)$$

where:

SSE_1 : Sum of squared residuals from the Common Effect Model

SSE_2 : Sum of squared residual from the Fixed Effect Model

n : Number of companies (cross-section)

t : Number of time periods

k : Number of independent variables

The hypothesis being tested is:

H_0 : The appropriate model is the Common Effect Model (CEM)

H_1 : The appropriate model is the Fixed Effect Model (FEM)

The criterion for decision-making is by comparing the p-value with the significance level of 0.05. If p-value < 0.05, then H_0 is rejected, and the appropriate model is the Fixed Effect Model (FEM).

3.2.3.2.1. Hausman Test

If the Chow test results show that the more appropriate model is the Fixed Effect Model, then the next step is to conduct the Hausman test to choose between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The test statistic used is the Chi-Square statistic with the formula:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \quad (8)$$

where:

$\hat{\beta}_{FE}$: Vector of estimated coefficients from the Fixed Effects Model

$\hat{\beta}_{RE}$: Vector of estimated coefficients from the Random Effects Model

$Var(\hat{\beta}_{FE})$: Covariance matrix of $\hat{\beta}_{FE}$

$Var(\hat{\beta}_{RE})$: Covariance matrix of $\hat{\beta}_{RE}$

The hypothesis being tested is:

H_0 : The appropriate model is the Random Effect Model (REM)

H_1 : The appropriate model is the Fixed Effect Model (FEM)

The criteria for decision-making is to compare the Chi-square p-value with a significance level of 0.05. If the p-value < 0.05, then H_0 is rejected, and the appropriate model is the Fixed Effect Model (FEM).

3.2.3.2.2. Lagrange Multiplier Test (LM)

If the Hausman test results show that the more suitable model is the Random Effect Model, the next step is to conduct the Lagrange Multiplier test to choose between the Random Effect Model (REM) and the Common Effect Model (CEM). The LM test aims to determine whether the Random Effect model is better than the Common Effect model. The test statistic used is the Breusch-Pagan statistic with the formula:

$$LM = \left(\frac{NT}{2(T-1)} \right) \left[\frac{\sum_{i=1}^N (\sum_{t=1}^T \bar{e}_i^2)}{\sum_{i=1}^N \sum_{t=1}^T e_{it}^2 / (NT)} - 1 \right]^2 \quad (9)$$

where:

N : Number of cross-sectional units

T : Number of time periods

e_{it} : OLS residuals for unit i at time t

$\bar{e}_i$: Mean of OLS residuals for unit i over time

The hypothesis being tested is:

H_0 : The appropriate model is the Common Effect Model (CEM)

H_1 : The appropriate model is the Random Effect Model (REM)

The criteria for decision-making is by comparing the Breusch-Pagan p-value with the significance level of 0.05. If p-value < 0.05, then H_0 is rejected, and the appropriate model is the Random Effect Model (REM).

3.2.3.3. Classical Assumption Test

After obtaining the best model, if the best model obtained is the Random Effect Model (REM), then there is no need to conduct classical assumption testing. According to Gujarati & Porter (2009), the Random Effect Model (REM) uses the Generalized Least Squares (GLS) approach which has already taken into account the structure of variances and covariances of errors, including the error components between individuals as well as over time. Therefore, REM does not strictly require classical assumption tests such as homoscedasticity and autocorrelation as in the OLS model. The estimates produced by GLS remain efficient even in the presence of violations of several classical assumptions.

However, if the obtained model is FEM or CEM, the next step is to conduct classical assumption testing to ensure that the regression model used meets the BLUE (Best Linear Unbiased Estimator) requirements. Referring to Gujarati & Porter (2009), for panel data, classical assumption testing focuses on the multicollinearity test and heteroscedasticity test. This is because the panel data model already considers the aspects of time series and cross-section, so some other classical assumptions such as normality and autocorrelation do not need to be strictly tested.

3.2.3.3.1. Multicollinearity Test

Multicollinearity is a condition where there is a high linear relationship or correlation among the independent variables in a regression model. The presence of multicollinearity can cause the estimators to not be BLUE (Best Linear Unbiased Estimator). In this study, the multicollinearity test is conducted by examining the Variance Inflation Factor (VIF) of each independent variable (Ghozali, 2018). The formula for calculating VIF is as follows:

$$VIF_j = \frac{1}{1 - R_j^2} \quad (10)$$

Where R_j^2 is the coefficient of determination of the regression of independent variable j against other independent variables. The decision-making criteria are:

$VIF < 10$: Multicollinearity does not occur meaningfully

$VIF > 10$: Multicollinearity occurs which means

3.2.3.3.2. Heteroskedasticity Test

Heteroskedasticity is a condition where the variance of the residuals is not constant or varies with each observation. The presence of heteroskedasticity causes the estimator to no longer be BLUE (Best Linear Unbiased Estimator). In this study, the heteroskedasticity test is conducted using the Breusch-Pagan test (Breusch & Pagan, 1979). This test aims to detect the presence of heteroskedasticity by regressing the squared residuals from the main model against all independent variables. If the variance of the residuals is not constant (heteroskedasticity), then the assumption of homoskedasticity in the regression model is not fulfilled. The formula used is:

$$LM = n \times R^2 \quad (11)$$

where:

n : Number of observations

R^2 : Coefficient of determination from the auxiliary regression

The hypothesis being tested is:

H_0 : Homoskedasticity (error variance is constant)

H_1 : Heteroskedasticity (error variance depends on independent variables)

The criteria for decision making is by comparing the p-value of each independent variable with the significance level of 0.05. If the p-value of each independent variable is > 0.05 , then H_0 is accepted which means there is no heteroskedasticity.

3.2.3.4. Hypothesis Testing

After obtaining the best model and ensuring that the model meets classical assumptions, the next step is to conduct hypothesis testing to address the research problem. Hypothesis testing is carried out through the F test, t test, and coefficient of determination (Gujarati & Porter, 2009; Ghazali, 2018).

3.2.3.4.1. F Test (Simultaneous Test)

The F test is used to determine whether all independent variables (DER and DAR) have a significant effect collectively on the dependent variable (ROE). The F test can also be used to test the feasibility of the regression model used. The statistical formula for the F test is:

$$F = \frac{\frac{ESS}{k}}{\frac{RSS}{n - k - 1}} \quad (12)$$

where:

ESS : Explained sum of squares (regression sum of squares)

RSS : Residual sum of squares)

n : The number of observations

k : Number of independent variables

The hypothesis being tested is:

H_0 : $\beta_1 = \beta_2 = 0$ (independent variables simultaneously do not affect the dependent variable)

H_1 : At least one $\beta_i \neq 0$ (independent variables simultaneously affect the dependent variable)

The criteria for decision making is by comparing the p-value (Prob. F-statistic) with the significance level of 0.05. If the p-value < 0.05 , then H_0 is rejected, which means that the independent variables simultaneously have a significant effect on the dependent variable.

3.2.3.4.2. T-Test (Partial Test)

The t-test is used to determine the effect of each independent variable on the dependent variable partially or individually. The t-test is used to test the significance of the regression coefficients individually. The statistical formula for the t-test is:

$$t = \frac{\hat{\beta}_j}{SE(\hat{\beta}_j)} \quad (13)$$

where:

$\hat{\beta}_j$: Estimated coefficient for variable j

$SE(\hat{\beta}_j)$: Standard error of $\hat{\beta}_j$

The hypothesis being tested is:

H_0 : $\beta_j = 0$ (the independent variable partially does not affect the dependent variable)

H_1 : $\beta_j \neq 0$ (independent variables partially affect the dependent variable)

Decision criteria:

- If $|t - statistics| > t - tabel$ or the $p - value (Prob.) < 0,05$, then H_0 is rejected, meaning the independent variable partially has a significant effect on the dependent variable.

- If $|t - \text{statistics}| < t - \text{tabel}$ or the $p - \text{value (Prob.)} > 0,05$, then H_0 is accepted, meaning that the independent variable has no significant effect on the dependent variable partially.

3.2.3.4.3. Coefficient of Determination (R^2)

The coefficient of determination (R^2) is used to measure how well a model explains the variability of the dependent variable. The value of R^2 ranges from 0 to 1. The larger the R^2 value (closer to 1), the better the model's ability to explain the dependent variable. Conversely, the smaller the R^2 value (closer to 0), the more limited the model's ability to explain the dependent variable. The formula for the coefficient of determination is:

$$R^2 = \frac{ESS}{TSS} \quad (14)$$

where:

ESS : Explained sum of squares

TSS : Total sum of squares

3.2.4. Data Processing

Data processing in this research was performed using EViews 12 software. The selection of EViews 12 is based on its more advanced capabilities in processing panel data and performing various statistical tests necessary for this study.

The steps in data processing begin with inputting data into EViews 12, followed by testing the best estimation model using the Chow test, Hausman test, and Lagrange Multiplier (LM) test. Once the best model is obtained, classical assumptions are tested such as multicollinearity and heteroscedasticity. Finally, hypothesis testing is conducted through the F test, t test, and analysis of the coefficient of determination. The results of the data processing are interpreted to address the research issues and draw conclusions according to the research objectives.

4. Results and Discussion

In this study, capital structure is measured by the Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR), while profitability is proxied by Return on Equity (ROE). Here is an example of the calculation of DER, DAR, and ROE at PT Bukit Asam Tbk. in 2019.

$$\begin{aligned} DER &= \frac{\text{Total Liabilities}}{\text{Total Equity}} = \frac{7,675,226}{18,422,826} = 0.416615019 \\ DAR &= \frac{\text{Total Liabilities}}{\text{Total Assets}} = \frac{7,675,226}{26,098,052} = 0.294091912 \\ ROE &= \frac{\text{Net Profit}}{\text{Total Equity}} = \frac{4,056,888}{18,422,826} = 0.220209864 \end{aligned}$$

All calculation results for PT Aneka Tambang Tbk., PT Bukit Asam Tbk., PT Indonesia Asahan Aluminium, PT Pertamina (Persero), and PT Timah Tbk. for the period 2019 - 2023 are summarized in the Table 1 below.

Table 1: Calculation of DER, DAR, and ROE values

Company	Year	DER	DAR	ROE
PT Aneka Tambang Tbk.	2019	0.66515247	0.399454394	0.01069027
	2020	0.666514244	0.399945123	0.060366915
	2021	0.579689936	0.366964379	0.089347519
	2022	0.418572279	0.295065881	0.161140154
	2023	0.374952921	0.272702371	0.098751158
PT Bukit Asam Tbk.	2019	0.416615019	0.294091912	0.220209864
	2020	0.420182812	0.029578345	0.140905094
	2021	0.489408513	0.328592531	0.326098912
	2022	0.568651779	0.362509887	0.434623115
	2023	0.797747838	0.443748462	0.283160993
PT Indonesia Asahan Aluminium	2019	1.296158874	0.564490066	-0.016720685
	2020	1.490589798	0.598488679	0.009618703
	2021	1.349185575	0.57432056	0.119160742
	2022	1.080140041	0.519263136	0.156397933

Company	Year	DER	DAR	ROE
PT Pertamina (Persero)	2023	0.252839009	0.201812848	0.200536442
	2019	1.148863653	0.534637761	0.081018067
	2020	1.212293435	0.547980397	0.033631714
	2021	1.341926526	0.573001122	0.061380332
	2022	1.359543123	0.57618914	0.102290741
	2023	1.199528752	0.545357159	0.107206947
PT Timah Tbk.	2019	2.872139556	0.741744845	-0.116248939
	2020	1.938724764	0.659716346	-0.068945268
	2021	1.328790569	0.570592558	0.206516846
	2022	0.855602953	0.46109161	0.147898089
	2023	1.05904492	0.514337939	-0.072038587

Next, to determine the most appropriate panel data regression estimation model in analyzing the effect of capital structure on profitability, a Chow test was conducted using EViews 12 software. In this model, the dependent variable (Y) is Return on Equity (ROE) as a measure of profitability, while the independent variables consist of Debt to Equity Ratio (DER) represented as X_1 and Debt to Asset Ratio (DAR) as X_2 , which represent the company's capital structure.

Table 2: Chow test results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	4.453001	(4.18)	0.0112
Cross-section Chi-square	17.197784	4	0.0018

The Table 2 above shows that the p-value, which is $0.0112 < 0.05$, therefore H_0 is rejected so that the Fixed Effect Model (FEM) is more appropriate to use than the Common Effect Model (CEM). A Hausman test was then conducted, yielding the following results in Table 3.

Table 3: Hausman test results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	2.410123	2	0.2997

The Hausman test results in Table 3 show that the Chi-square p-value is $0.2997 > 0.05$, thus H_0 is accepted and the appropriate model is the Random Effect Model (REM). This indicates that the differences between entities are not correlated with the independent variables, so the random effects are more suitable to describe the variation in panel data. Subsequently, to evaluate whether the Random Effect Model (REM) can be a viable alternative compared to the Common Effect Model (CEM), a Lagrange Multiplier (LM) test is also conducted.

Table 4: Lagrange Multiplier test results

Effects Test	Cross-section	Test Hypothesis	
		Time	Both
Breusch-Pagan	4.585761 (0.0322)	0.177751 (0.6733)	4.763512 (0.0291)
Honda	2.141439 (0.0161)	0.421605 (0.3367)	1.812346 (0.0350)
King-Wu	2.141439 (0.0161)	0.421605 (0.3367)	1.812346 (0.0350)
Standardized Honda	3.035616 (0.0012)	0.724532 (0.2344)	-0.243950 (0.5964)
Standardized King-Wu	3.035616 (0.0012)	0.724532 (0.2344)	-0.243950 (0.5964)
Gourieroux, et al.	--	--	4.763512 (0.0376)

Based on the results of the Lagrange Multiplier test in Table 4, the p-value of Breusch-Pagan was obtained, which is $0.0161 < 0.05$, thus H_0 is rejected. This indicates that there is significant individual variance among companies, making the Random Effect Model (REM) more capable of capturing the characteristics of panel data compared to the

Common Effect Model (CEM). Considering the results from all stages of testing, including Chow test, Hausman test, and Lagrange Multiplier test, the Random Effect Model is chosen as the most suitable estimation model to be used in this research. The Random Effect Model employs a Generalized Least Squares (GLS) approach that has taken into account the structure of variances and covariances of errors, hence classical assumption testing is not separately required and analysis can directly focus on interpreting the impact of capital structure on profitability.

Table 5: Results of the Random Effect Model (REM) regression test: the influence of DER and DAR on ROE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.158494	0.075283	2.105309	0.0469
X1	-0.191060	0.063768	-2.996172	0.0067
X2	0.318759	0.236799	1.346115	0.1920
Effects Specification				
			S.D.	Rho
Cross-section random			0.068400	0.4160
Idiosyncratic random			0.081042	0.5840
Weighted Statistics				
R-squared	0.358322	Mean dependent var		0.052008
Adjusted R-squared	0.299987	S.D. dependent var		0.097761
S.E. of regression	0.081794	Sum squared resid		0.147185
F-statistic	6.142541	Durbin-Watson stat		1.354573
Prob(F-statistic)	0.007594			
Unweighted Statistics				
R-squared	0.360671	Mean dependent var		0.111080
Sum squared resid	0.245120	Durbin-Watson stat		0.813368

Based on the results of regression using the Random Effect Model approach, Table 5, a probability value (F-statistic) of 0.0075 was obtained. This value is smaller than the significance level of 0.05, thus based on decision-making criteria, H_0 is rejected. Therefore, it can be concluded that the Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR) simultaneously have a significant effect on Return on Equity (ROE). This finding supports the hypothesis that capital structure affects profitability, as reflected in the context of state-owned enterprises in Indonesia in the energy and mining sector during the 2019–2023 period. The simultaneous effect indicates that decision-making related to financing structure requires comprehensive consideration of the composition of debt both relative to equity and total assets.

Partially, the regression estimation results show that the Debt to Equity Ratio (DER) variable has a probability value of 0.0067. This value is below the 5% significance level (p -value < 0.05), so based on the decision-making criteria, H_0 is rejected. Therefore, it can be concluded that DER has a significant effect on Return on Equity (ROE). The negative regression coefficient for the DER variable indicates a negative relationship between debt-based capital structure and equity as well as the company's profitability. This finding is consistent with the trade-off theory view, which states that although debt can provide benefits in the form of tax shields, an excessive increase in the proportion of debt can lead to high interest burdens and greater financial risks, which ultimately negatively affect profitability. In the context of Indonesian state-owned enterprises in the energy and mining sectors, the use of debt without effective risk management in financing large-scale and long-term projects has the potential to cause an imbalance in the financial structure, which is reflected in a decrease in ROE value.

On the contrary, the Debt to Asset Ratio (DAR) variable shows a probability value of 0.1920, which is above the 5% significance threshold (p -value > 0.05). Based on the testing criteria, H_0 cannot be rejected, meaning statistically DAR does not have a significant effect on ROE at the level of significance used. This insignificance may be due to the fact that most of the assets held by companies in this sector are fixed assets with high value and long-term depreciation, which causes changes in the financing composition relative to total assets not to directly affect profitability performance in the short term. Additionally, the stability of long-term financing over assets may also dampen fluctuations that can be captured by the DAR variable, making its sensitivity to changes in ROE relatively lower compared to DER.

The coefficient of determination (R-squared) of 0.3583 indicates that approximately 35.83% of the variation in Return on Equity (ROE) can be explained by the Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR) in this regression model. Although the value is not considered high, this result still indicates that the capital structure contributes to changes in the profitability of Indonesian SOEs in the energy and mining sectors. The remaining variation of 64.17% is estimated to be caused by other factors outside the model, such as operational efficiency, commodity price fluctuations, corporate strategy, as well as external factors such as government regulation and global economic dynamics.

5. Conclusion

This research aims to analyze the effect of capital structure on profitability in state-owned enterprises (BUMN) in the energy and mining sectors in Indonesia during the period 2019–2023. Capital structure is represented by the Debt to Equity Ratio (DER) and Debt to Asset Ratio (DAR), while profitability is proxied by Return on Equity (ROE). Based on the results of regression analysis using the Random Effect Model approach, it was concluded that simultaneously, DER and DAR have a significant effect on ROE. However, partially only DER has a significant negative effect on ROE, while DAR does not have a significant impact. This indicates that the higher the proportion of debt to equity, the lower the level of profitability tends to be. On the contrary, the proportion of debt to assets does not show a strong enough relationship with profitability. Thus, this study concludes that capital structure does indeed significantly affect the profitability of state-owned enterprises (SOEs) in Indonesia's energy and mining sector. Therefore, companies need to optimally manage the composition of debt and equity, particularly in maintaining a balance of debt-to-equity ratio (DER) to avoid diminishing the company's financial performance in the long term.

References

- Anggraini, D., & MY, A. (2019). The Influence of Capital Structure and Company Size on Company Value. *Management & Accounting Expose*, 2, 1-9.
- Baltagi, B. H. (2005). *Econometric analysis of panel data* (3rd ed.). John Wiley & Sons.
- Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroskedasticity and random coefficient variation. *Econometrica*, 47(5), 1287–1294.
- Brigham, E. F., & Houston, J. F. (2019). *Fundamentals of financial management* (15th ed.). Cengage Learning.
- Gitman, L. J., & Zutter, C. J. (2015). *Principles of managerial finance* (14th ed.). Pearson Education.
- Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics* (5th ed.). McGraw-Hill.
- Habibniya, H., Dsouza, S., Rabbani, M. R., Nawaz, N., & Demiraj, R. (2022). Impact of capital structure on profitability: Panel data evidence of the telecom industry in the United States. *Risks*, 10(8), 157.
- Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305–360.
- Jouida, S. (2018). The dynamics between diversification, capital structure and profitability: Evidence from the French financial institutions. *Journal of Financial Stability*, 34, 74–89.
- Nhung, D. T., & Okuda, H. (2015). The impact of state ownership on the capital structure and profitability: Evidence from Vietnam. *Asian Economic Policy Review*, 10(1), 1–24.
- Setiawan, A., & Sumantri, M. B. A. (2020). The Effect of Return On Asset (ROA), Debt to Equity Ratio (DER), and Earning Per Share (EPS) on Stock Prices in the Mining Sector on the Indonesia Stock Exchange for the 2015-2019 Period. *Technium*, 2(7), 324-335.
- Ghozali, I. (2018). *Aplikasi analisis multivariate dengan program IBM SPSS 25*. Universitas Diponegoro.
- Sugiyono. (2017). *Metode penelitian bisnis*. Alfabeta.
- Susdianty, D., & Defrizal. (2023). Pengaruh struktur modal terhadap profitabilitas perusahaan PT Indofood Sukses Makmur Tbk tahun 2019–2023. *YUME: Journal of Management*, 6(1), 17–25.
- Van Horne, J. C., & Wachowicz, J. M. (2012). *Fundamentals of financial management* (13th ed.). Pearson Education.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press.