Determinants Of Efficiency At Pt Perusahaan Listrik Negara (Persero) In 2019-2023 Using Two Stage Data Envelopment Analysis (Dea) Model

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Abstract

Operational efficiency is a major challenge for PT PLN (Persero) in ensuring resource optimization amidst the dynamics of the energy industry. This study used descriptive verification with a population of PT PLN (Persero) financial reports and a purposive sampling technique that includes PT PLN (Persero) financial reports from 2019 semester 1 to 2023 semester 2. This study aimed to analyze the development of Return on Assets (ROA), Debt to Equity Ratio (DER), and Total Asset Turnover (TATO), and measure the level of efficiency of PT PLN (Persero) in the period 2019-2023. In addition, this study examined the effect of ROA, DER, and TATO on company efficiency partially and simultaneously. The method used was Data Envelopment Analysis (DEA) for the first stage and Multivariate Tobit Regression Analysis for the second stage.

Keywords: *two stage data envelopment analysis; efficiency; return on assets; debt to equity ratio; total asset turnover*

1. INTRODUCTION

PT Perusahaan Listrik Negara (Persero) "PLN" is a state-owned electricity company responsible for providing electricity throughout Indonesia. PLN is authorized by the government to manage the electricity business with efficiency and public benefit. The company is the only state-owned enterprise engaged in the electricity sector and thus manages most of the electricity supply in Indonesia. This makes PLN play an important role in providing electricity to communities and industries throughout the country, because electricity is a vital need in the continuation of all community activities (PLN, 2023) .

Based on the Company Profile PLN (2023) , at the end of 2022, transforming through the establishment of Holding-Subholding and innovative energy including aspects of human resources, business processes, and technology. PLN's transformation program is carried out with 4 pillars, namely green, lean, innovative, customer focused, in order to bring electricity for a better life.

PT PLN (Persero) categorizes its business activities into 5 Portfolio Clusters that reflect the company's main focus in energy and electricity management. The first cluster, Primary Energy, focuses on managing the supply of primary energy for electricity generation, which is managed by PLN Energi Primer Indonesia. The second cluster, Electricity Generation, is responsible for the electricity generation process to meet national needs, which is run by PLN Indonesia Power and PLN Nusantara Power.

Furthermore, the third cluster, Regional Business, handles regional business with a focus on providing electricity in certain areas, which is currently managed by PLN Batam. The fourth cluster, Beyond KWh, develops digital-based services and innovations outside the conventional electricity sector, with management under PLN Icon Plus. Finally, the fifth Cluster, Business Solutions, plays a role in providing business solutions and additional services related to electricity, which are run by several PLN entities, namely PLN Tarakan, PLN Haleyora Power, PLN Energy Management Indonesia, and PLN Enjiniring. The existence of these 5 PLN Portfolio Clusters reflects the company's commitment to improve efficiency, innovation, and expand its business reach to provide better electricity services for the people and industries in Indonesia.

Based on a progress report on energy transition in Indonesia by IESR (2023) Indonesia's electricity sector is still heavily reliant on coal-fired power plants, with capacity expected to increase to 73 GW by 2030.

Despite commitments in the Just Energy Transition Partnership (JETP) to reduce emissions from the power sector, the latest National Electricity General Plan (RUKN) does not include an option for early

retirement of coal-fired power plants. In terms of energy transition readiness, Indonesia still faces various challenges, especially in terms of investment and financing.

Until 2023, renewable energy investment realization only reached 29.4% of the 2023 investment target in the second quarter. Some of the factors hindering this transition include policy uncertainty, barriers to investment freedom, as well as low national lending rates. Overall, despite various initiatives to accelerate the energy transition, Indonesia still faces major challenges in achieving its Net Zero Emission (NZE) target by 2060. More progressive policy changes and increased investment in the renewable energy sector are key factors to accelerate the shift from fossil fuels to more sustainable energy.

The following is the development of the financial statements of PT Perusahaan Listrik Negara (Persero) from 2019 to 2023 as follows:

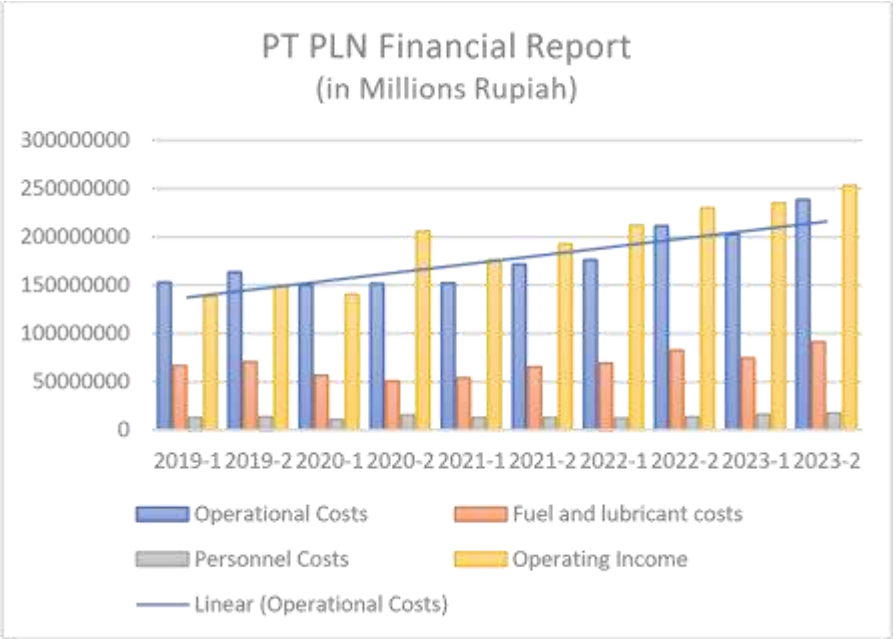

Figure 1 PLN Revenues and Costs 2019-2023
Source: PT PLN (Persero) Financial Report 2019-2023

Based on Figure 1 displayed in the graph, there is a general trend of increasing operating costs over time, as shown by the linear trend line that continues to rise. However, in 2019-2, there is a trend where operating costs have increased at a higher rate than operating income. This suggests that during this period, the company faced greater financial pressure due to rising operating costs that were not matched by sufficient revenue growth. In addition, fuel and lubricant costs also appear to have increased, which is likely to be one of the main factors causing the imbalance or inefficiency between costs and revenues. This imbalance reflects inefficiency, where the company has not been able to optimize the use of resources in generating revenue proportional to the costs incurred. Inefficiency can be caused by various factors, such as ineffective cost management, uncontrollable fluctuations in fuel prices, or dependence on a high cost structure without an appropriate mitigation strategy. In addition, an increase in costs that is not accompanied by an increase in productivity can also indicate constraints in production and distribution efficiency. Therefore, it is important for companies to evaluate their cost structure and operational strategies to ensure better efficiency and long-term financial sustainability.

Moreover, this study departs from the development of findings from Frans et al. (2024) , where the research issues raised in that study focused on the uncertainty regarding how capital expenditure (CapEx) prioritization affects the financial and operational performance of PT PLN (Persero). Given the large scale

of investment required to support the company's infrastructure and operations, inappropriate capital expenditure allocation can lead to inefficiencies, decreased profitability, or imbalances in asset development.

Based on a review of previous literature, various studies have been conducted to measure the efficiency of the electricity sector using the Data Envelopment Analysis (DEA) method. Navarro-Chávez et al. (2020) examined the efficiency of the electricity sector in Mexico with the DEA network model and found that the highest efficiency was found in the transmission sector, while other sectors showed variations in the level of operational efficiency. Raheli et al. (2017) used the Two Stage DEA model to evaluate energy efficiency and sustainability in tomato production in Iran. The study showed that factors such as farmers' education level, land size, and use of organic fertilizers significantly contributed to efficiency improvement. Another study by Kyshakevych et al. (2024) used DEA to analyze energy efficiency in several European countries and highlighted the importance of energy transition to renewable sources to improve efficiency and reduce dependence on fossil energy. Meanwhile, Moutinho & Madaleno (2021) developed a two-stage DEA model to evaluate economic and environmental efficiency in the EU energy sector, emphasizing that reducing carbon emissions and investing in renewable energy have a significant impact on improving efficiency.

However, most of the studies that have been conducted focus on analyzing efficiency at the national or regional level without considering the specific efficiency dynamics of electricity companies in a country in terms of financial performance, especially in the context of developing countries such as Indonesia. In addition, research using the Two Stage DEA model is still limited in identifying the determinants of efficiency in state electricity companies. Koç & Seçkiner (2024) , for example, applied DEA in analyzing energy efficiency in the building sector and health facilities, but did not directly address the electricity sector. Similarly, research by Neves et al. (2020) which examines the role of renewable energy in improving the efficiency of transportation systems, but does not focus on the challenges faced by electricity companies in the face of the energy transition.

In this study, DEA measurement uses inputs rather than efficiency, namely operational costs, staffing costs, and fuel and lubricant costs, where the reflection in these inputs is the cost burden that must be borne by the company in carrying out its business processes, in line with research Zeng et al. (2020) . Then the output in this study is operating income, where the income obtained from a company's business process is obtained through expenses arising from company operations, the efficiency process at the processing stage has a score of 0 to 1 (Chen et al., 2019; Pérez-Reyes & Tovar, 2021).

Furthermore, this study analyzes the determinants of efficiency including Return on Assets (ROA), Debt to Equity Ratio (DER), and Total Asset Turnover (TATO) as the main indicators in measuring company efficiency. Return on Assets (ROA) is a financial performance indicator that shows the company's ability to generate profits from its total assets. In line with Arhinful & Radmehr research (2023), ROA helps evaluate the effectiveness and efficiency of management in utilizing company assets to generate profits. A low ROA indicates that assets have not been optimally utilized, which reflects management inefficiency. Conversely, a high ROA indicates that assets are well utilized, reflecting efficiency in the management of the company. Furthermore, Debt to Equity Ratio (DER) measures the proportion between total debt and equity in the company's capital structure. This ratio illustrates the extent to which the company uses debt as a source of funding compared to its own capital.

In the non-financial sector, especially in the energy industry, the use of well-managed debt can support operational efficiency through optimal funding of expansion and investment. Habib et al. (2022) found that high DER reflects a large leverage risk, which can negatively impact firm efficiency, as was the case for non-financial companies in Pakistan during the period 2012-2017. In addition, Rizky & Aryani (2020) identified a significant negative relationship between DER and profit changes in construction subsidiaries listed on the Indonesia Stock Exchange during the 2016-2019 period. Finally, Total Asset Turnover (TATO) measures the extent to which a company can utilize its total assets to generate sales. This ratio is obtained by dividing net sales by average total assets in a certain period. Cahyani (2024) found that TATO has a significant influence on ROA, which indicates that increasing efficiency in the use of assets can contribute to increasing company profitability. In addition, research by Sunaryo et al. (2022) showed that high TATO reflects fast asset turnover, which directly contributes to improving the company's operational efficiency.

In the Indonesian context, a report from IESR (2023) shows that the power sector is still heavily reliant on coal-fired power plants, with capacity projected to increase to 73 GW by 2030. The imbalance between PLN's operating costs and revenues in 20192 also reflects financial pressures that could potentially affect the company's operational efficiency. Despite initiatives such as the Just Energy Transition Partnership (JETP), barriers to renewable energy investment and policy uncertainty remain key challenges to improving the efficiency of Indonesia's power sector.

Against this background, this study examines the operational efficiency of PT Perusahaan Listrik Negara (PLN) in the 2019-2023 period through a Two Stage Data Envelopment Analysis (DEA) approach to measure technical and allocative efficiency and identify the determinant factors that influence it. As a state-owned company that plays a strategic role in the provision and distribution of electrical energy in Indonesia, PLN faces various challenges from economic dynamics, regulatory changes, to technological developments. The Two Stage DEA method applied in this study not only optimizes the company's operational input-output analysis, but also explores internal factors such as the company's financial performance and its influence on efficiency. The results of the study are expected to provide strategic recommendations for improving the efficiency and performance of PLN, which in turn supports government decision-making and the development of a more optimized national energy sector. Practically, the results of this study can be used by PT PLN and other electricity companies as a basis for improving operational efficiency. By knowing the factors that affect efficiency, companies can formulate strategies to optimize the use of resources, reduce operational costs, and increase productivity in electricity production and distribution.

2. METHOD Type of Research

This study used a quantitative research design. The quantitative approach used in this study included two stages, the first stage with non-parametric means that it did not require special criteria in measurement Charnes et al. (1978) in Koç & Ulusam Seçkiner (2024) and the second stage with parametric according to Chen et al. (2019) and Ameur et al. (2024) to determine the effect of ROA, DER, TATO variables on efficiency scores at PT PLN (Persero) companies in 2019-2023.

Population and Sample

The population in this study included all PT PLN (Persero) units operating in Indonesia during the period from semester 1 of 2019 to semester 2 of 2023 which are listed in the financial statements of PT PLN (Persero) during the period from semester 1 of 2019 to semester 2 of 2023. The research sample was selected using purposive sampling method, taking into account certain criteria, namely the main financial statements of PT PLN (Persero) which cover all entities and complete financial and operational data during the period semester 1 of 2019 - semester 2 of 2023. **Data Collection and Data Sources** The steps taken in this study summarize:

1. Literature study, which was a technique of collecting data by analyzing and understanding from various relevant sources such as journals, books, reports, websites, and other types of literature relevant to the problem being studied.
2. Preliminary Research, namely conducting a general review and research in order to obtain information and find out the problems discussed in the research.
3. Secondary data collection is the publication of financial reports on a semester basis for 20192023 obtained through the official website of PT PLN.

Data Analysis Techniques 1. Problem Identification:

This research begins with the problem identification stage carried out through a preliminary study of the financial statements of PT PLN (Persero) from 2019 to 2023. Researchers examine the issue of efficiency in company operations as the main basis for formulating research problems.

2. Research Variables:

The variables in this study consisted of inputs and outputs in the first stage and dependent and independent variables in the second stage. Inputs include operational costs, staffing costs, and fuel and lubricant costs. The output used is operating income. Meanwhile, in the second stage, the DEA efficiency score was used as the dependent variable, and ROA, DER, and TATO as the independent variables.

3. Data Analysis Techniques:

Data analysis was conducted in two stages. The first stage uses the DEA method with *Constant Return to Scale* (CRS) and *Variable Return to Scale* (VRS) models, input-oriented. Calculations were carried out using MAXDEA software. The second stage used multivariate Tobit regression to analyze the factors influencing efficiency scores. The selection of the Tobit model is adjusted to the nature of the efficiency score whose value is in the range of 0 to 1. **Research Stages**

This research consists of two main stages. In the first stage, the Data Envelopment Analysis (DEA) method was applied by considering several input variables, namely operational costs (BIOP), staffing costs (BIWA), and fuel and lubricant costs (BIKAR). Meanwhile, the output variable used is operating income (PENDOP). Furthermore, to analyze the influence of independent variables on efficiency obtained from the second stage, the efficiency results obtained through DEA were further analyzed using the Multivariate Tobit Regression Analysis method. Tobit regression was chosen because the efficiency score produced by DEA has a limited range between 0 and 1. In this stage, the efficiency score acts as the dependent variable (Y), while Return on Assets (ROA), Debt to Equity Ratio (DER), and Total Asset Turnover (TATO) are used as independent variables (X1, X2, X3) to test the factors that influence the efficiency of the company.

3. RESULT AND DISCUSSION

In this study, descriptive statistical data analysis was carried out to find out the general description of the data as a sample used in this study. In this study, the variables used include the dependent variable, namely efficiency. Furthermore, the independent variables are financial ratios which include Return On Asset (ROA), Debt to Equity Ratio (DER), Total Asset Turnover (TATO) at PT Perusahaan Listrik Negara (PLN) in period 2019-2023. The following are descriptive statistics of all variables, both dependent and independent, which are presented in the table below:

Table 1 Descriptive Statistics of Research Variables

Variables	Obs.	Mean	Std Dev.	Min.	Max
Efficiency	40	0.917	0.106	0.74	1
DER	40	0.66	0.03	0.62	0.73
TATO	40	0.11	0.02	0.08	0.02
ROA	40	0.72	0.49	0.01	1.57

Source: Data Processed (2025)

The efficiency variable which is the dependent variable in this study has a total of 40 observations with an average value of 0.917 and a standard deviation of 0.106. The minimum value of efficiency was recorded at 0.74, while the maximum value was 1. This indicates that in general the operational efficiency of PT PLN during the 2019-2023 period was at a fairly high and stable level, with some small fluctuations below the perfect value.

Research Results

1. Efficiency Result Analysis

Table 2 Analysis of CRS and VRS Efficiency Results

Year	CRS	VRS
2019-1	0.701191	0.769743
2019-2	0.710282	0.710470
2020-1	0.788222	1.000000
2020-2	1.000000	1.000000
2021-1	0.908561	0.992466
2021-2	0.910344	0.912089
2022-1	1.000000	1.000000
2022-2	0.955911	1.000000

2023-1	0.928640	1.000000
2023-2	0.873076	1.000000
Average	0.877623	0.938477

Source: MaxDEA 8 Data Processing Results

Based on the results of the research, table 4.2 results of efficiency data processing using the Data Envelopment Analysis (DEA) method with the Constant Return to Scale (CRS) and Variable Return to Scale (VRS) approaches, obtained an overview of the efficiency performance of PT PLN during the period 2019 to 2023 presented in semi-annual format. In general, the efficiency value based on the VRS approach shows a higher performance than CRS, with an average of 0.9385 and 0.8776 respectively. This shows that technically and managerially, PT PLN tends to be able to manage inputs efficiently, although in some periods it has not been fully optimized on a production scale.

In 2019, both CRS and VRS efficiency were still at low levels, with scores below 0.77, indicating significant inefficiencies in resource use. This condition started to improve in 2020, especially in the second semester where PT PLN managed to achieve a perfect efficiency score (1.000) for both approaches. This achievement reflects a significant improvement in operational efficiency, likely as a result of the company's strategic adjustments in the face of the initial impact of the COVID-19 pandemic. 2021 showed relatively stable and near-perfect efficiency, especially in the VRS approach, signaling the effectiveness of input management even though the scale of operations has not been fully optimized. The year 2022 recorded the best performance, where in the first semester PT PLN achieved full efficiency in both CRS and VRS, and maintained perfect managerial efficiency in the second semester despite a slight decline in scale efficiency. Meanwhile, in 2023, the VRS efficiency score remained at the maximum level (1,000) throughout the year, indicating that the company was operating managerially highly efficiently. However, a slight decline in the CRS score in the second half of 2023 indicates that there is room for improvement in terms of production scale optimization. Overall, the semi-annual efficiency trend shows a consistent and significant improvement in performance over time, reflecting the company's success in improving internal processes, cost efficiency, and overall resource management.

2. Normality Test

The normality test is conducted to determine whether the residual data in the regression model is normally distributed, which is one of the important classical assumptions in regression analysis. In this study, the test was carried out using the Jarque-Bera method and the results are presented in Figure 2.

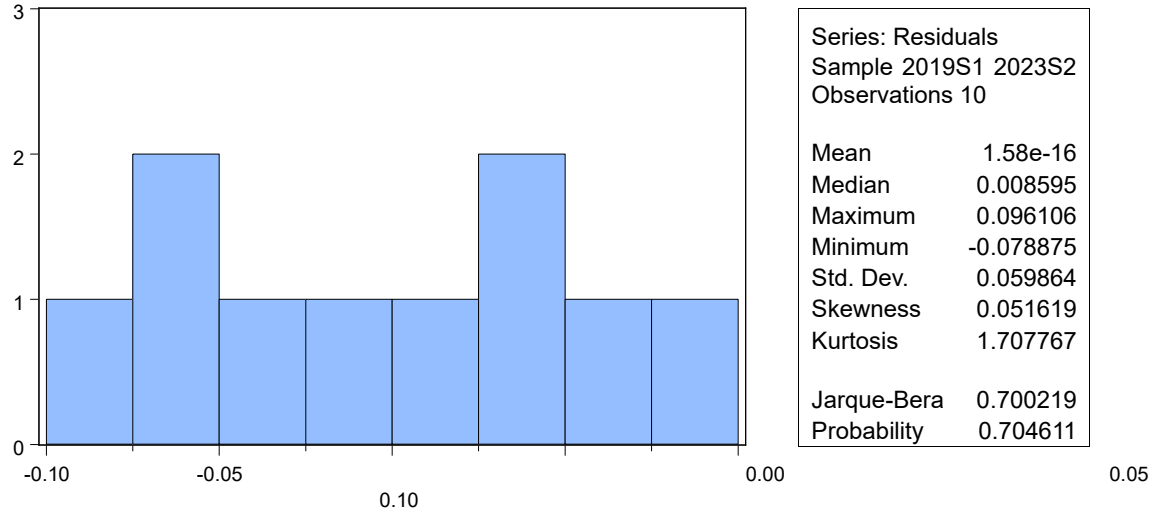

Figure 2 Normality Test

Source: Data Processed

Based on the Jarque-Bera test results, the statistical value is 0.700219 with a probability level of 0.704611>0.05. Since the probability value (p-value) is greater than 0.05, it can be concluded that there is not enough evidence to reject the null hypothesis (H_0). Thus, the residuals in the model are normally distributed.

3. Multicollinearity Test

The multicollinearity test aims to determine whether there is a strong linear relationship between the independent variables in the regression model. High multicollinearity can cause the estimation results to be unstable and interfere with the interpretation of regression coefficients. In this study, the multicollinearity test was conducted by looking at the correlation value between the independent and dependent variables, which is presented in Table 3.

Table 3 Multicollinearity Test Results

Variables	VIF
DER	4.813333
ROA	9.095439
TATO	3.620789

Source: Data Processed

To test for multicollinearity, the Variance Inflation Factor (VIF) is calculated as a quantitative indicator to assess the level of multicollinearity between independent variables. The test results show that the VIF value for ROA is 9.095, close to the critical threshold of 10, while TATO has a VIF value of 3.621 and DER of 4.813. Based on these values, it can be concluded that in general there is no serious multicollinearity in the model, because all VIF values are still below the maximum tolerance limit (VIF < 10).

4. Heteroscedasticity Test

Table 4 Heteroscedasticity Test

Variables	Residuals		
	Coefficient	t-Statistic	Sig.
Constant	0.329	0.754	0.479
ROA	0.008	0.131	0.899
TATO	-0.526	-0.635	0.5488
DER	-0.332	-0.522	0.620

Source: Data Processed

The heteroscedasticity test is conducted to identify whether the regression model contains inconsistencies in the variance of residuals or prediction errors (error terms) between observations. One commonly used method to detect the presence of heteroscedasticity is the Glejser Test, which is performed by regressing the residual value on the independent variables in the model. If the regression results show that the independent variables have a significant effect on the absolute value of the residuals (indicated by a significance value below 0.05), it can be concluded that there are symptoms of heteroscedasticity in the model.

Based on the results of data processing displayed in Table 4.4, it is found that the significance value (pvalue) for each independent variable > 0.05. The significance value for ROA is 0.899, for TATO is 0.549, and for DER is 0.620. In addition, the constant value in the model is also insignificant with a p-value of 0.479. These results indicate that there is no significant relationship between the independent variables and the absolute value of the residuals, so there is no evidence of heteroscedasticity symptoms in the regression model.

5. Analysis of Multivariate Tobit Regression Model Estimation Results

In this study, the Multivariate Tobit Regression model was used to analyze the influence of financial variables on the level of efficiency. The Tobit model was chosen because the dependent variable, i.e. efficiency, has a limited nature (censored), i.e. its value is only in the range of 0 to 1. This model is considered more appropriate than ordinary linear regression because it can provide more accurate and unbiased parameter estimates for limited data.

The results of data processing displayed in Table 4.5 show the estimated regression coefficient for each independent variable, namely Return on Assets (ROA), Total Asset Turnover (TATO), and Debt to Equity Ratio (DER), on the efficiency of PT PLN during the period 2019-2023. The coefficient value and significance level of each variable are as follows:

Table 5 Multivariate Tobit Regression Test Results

Variables	Efficiency		
	Coefficient	z-Statistics	Sig.
Constant	1.101	1.341	0.1798
ROA	-0.153	-1.738	0.0821
TATO	5.263	4.864	0.0000
DER	-1.052	-0.949	0.3422

Source: Data Processed

Based on the estimation results, the Total Asset Turnover (TATO) variable has a positive and statistically significant influence on efficiency at the 1% significance level (p-value = 0.0000). The coefficient of 5.263 indicates that every one unit increase in TATO will increase the efficiency score significantly. This shows that the higher the company's ability to utilize its assets to generate revenue, the higher its efficiency, which is in line with the principle of operational management that effectively rotated assets contribute to the optimization of output.

Meanwhile, the Return on Assets (ROA) variable has a negative coefficient of -0.153 and a p-value of 0.0821. Although not statistically significant at the 5% level, it is close to significance at the 10% level, so it can be interpreted as a weak negative influence on efficiency. This result suggests that an increase in profitability does not always go hand in hand with an increase in technical efficiency, which in the case of PT PLN could be due to the role of regulation, high fixed costs, or different orientations of financial performance versus operational performance.

The Debt to Equity Ratio (DER) variable shows a negative coefficient of -1.052 and is not significant (pvalue = 0.3422), indicating that the company's financing structure between debt and equity has no direct effect on efficiency in this model. This insignificance could be due to the nature of the utility sector which tends to have a heavy and long-term capital structure, where the effect of debt on efficiency is more longterm or indirect.

Overall, the results of this Tobit Regression analysis show that asset turnover (TATO) is the main factor affecting the efficiency level of companies in the observation period. This finding confirms the importance of optimal asset management in improving the company's operational efficiency, especially in the capitalintensive energy and utility industry such as PT PLN. Based on the simultaneous analysis, the insignificant constant value (p-value = 0.1798), it can be concluded that simultaneously the three independent variables (ROA, TATO, and DER) have no significant effect on efficiency. This means that the model as a whole is not significant in explaining variations in the efficiency of PT PLN during the 2019-2023 period.

6. Analysis of t Test Results

In Table 4.5, the results of the statistical z test show that of the three independent variables tested, only Total Asset Turnover (TATO) is proven to have a significant effect on efficiency, with a p value = 0.0000 (below 0.01). The z-statistic value of 4.864 indicates that the TATO coefficient is statistically significantly different from zero, and the direction of the effect is positive. This means that the higher the asset turnover, the higher the operational efficiency of the company. This finding is consistent with financial theory which states that high asset turnover indicates effective use of assets to produce output.

Meanwhile, the Return on Assets (ROA) variable has a p value of 0.0821, which means it is not significant at the 5% level but close to significance at the 10% level. This indicates that ROA has a weak and negative influence on efficiency, but it is not statistically strong enough to be concluded as a definite influence. Practically, this may indicate that high levels of profitability are not always followed by increased efficiency, especially in state-owned enterprises that focus on public services rather than profit.

The Debt to Equity Ratio (DER) shows a p-value = 0.3422 and z-statistic -0.949, which means it is not significant at any level of significance. This indicates that DER has no appreciable influence on efficiency in this model. The negative coefficient indicates the opposite direction of the relationship, but since it is not significant, the effect cannot be conclusively concluded.

Overall, the t-test results confirm that the TATO variable is the only significant predictor of efficiency in this model, while the ROA and DER variables show no statistically significant effect. This finding

reinforces the importance of asset management in driving PT PLN's operational efficiency, while profitability and capital structure have not shown a strong direct role in achieving efficiency.

Research Discussion

a. The effect of Return on Asset (ROA) on efficiency

The analysis shows that ROA has a negative but insignificant influence on efficiency, with a coefficient value of -0.153 and a significance value of 0.0821. Although not significant at the 95% confidence level, this value is close to the significance threshold at the 10% level, which indicates a weak influence. Thus, ROA is not the main indicator in explaining the operational efficiency of companies in this observation period.

b. Effect of Debt-to-Equity Ratio (DER) on efficiency

The DER variable also shows a negative influence on efficiency with a coefficient value of -1.052, but this influence is not statistically significant (p-value = 0.3422). Therefore, this result shows that the level of debt to equity has not played a significant role in determining the level of operational efficiency, which is more influenced by internal factors such as asset management and human resources. c. The effect of Total Asset Turnover (TATO) on efficiency

Unlike the previous two variables, Total Asset Turnover (TATO) is proven to have a positive and significant influence on efficiency, with a coefficient value of 5.263 and a significance level of 0.0000. This result shows that the higher the company's ability to turn its assets to generate revenue, the higher the efficiency level. In the operational context, this reflects that PT PLN has successfully optimized its fixed assets, such as power plants and distribution networks, to create output more productively. This finding is in line with the findings of Frans et al. (2024) which states that along with better asset utilization, PT PLN can maximize the output of each existing asset unit, increasing overall productivity. Furthermore, Bukit & Yunita (2025) also reinforces that efficient TATO can improve financial performance in petroleum industry companies, this is because the transformation process of operational assets that are used properly will reduce production and sustainability costs. Furthermore, Wahyuningtyas et al. (2023) added the development of asset infrastructure which can then be transformed into asset digitalization, so that the initiation of digital orientation can make a design for transition change which has an impact on more efficient costs, simplified bureaucracy, and innovation among employees.

4. CONCLUSION

The research results can be summarized as follows:

1. Return on Assets (ROA) has no significant effect on the efficiency of PT PLN during the 20192023 period.
2. Debt to Equity Ratio (DER) has no significant effect on company efficiency.
3. Total Asset Turnover (TATO) has significant effect on the efficiency of PT PLN.
4. ROA, DER, TATO on efficiency at PT PLN (Persero) in 2019-2023 have no simultaneous influence.

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