International Journal of Business and Applied Economics (IJBAE)
Vol. 3, No. 3, 2024: 477-490

Analysis of the Efficiency Level of Islamic Commercial Banks in Indonesia using the Stochastic Frontier Analysis (SFA) Method for the 2021-2023 Period

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ARTICLEINFO

Keywords: Efficiency, SFA, Third Party Funds, Total Assets, Labor Costs

Received : 28, March
Revised : 20, April
Accepted: 25, May

ABSTRACT

This study aims to determine the efficiency level of Islamic Commercial Banks (BUS), especially at Regional Government Islamic Commercial Banks and National Private Islamic Commercial Banks in Indonesia for the 2021-2023 period, using the Stochastic Frontier Analysis (SFA) method. This research is a quantitative study with panel data and secondary data used, namely third-party funds, total assets, labor costs, and financing. The results of this study indicate that the efficiency level of the Regional Government BUS is 0.9757 and the National Private BUS is 0.95451. This shows that each Bank is efficient and performs its intermediary function well. Therefore, there is no significant difference between the efficiency of Regional Government BUS and National Private BUS with the Mann Whitney U-Test difference test.

INTRODUCTION

In running their business, banks are referred to as intermediary institutions that rely on public funds and trust both at home and abroad (Fikri, 2018)). Banks play a significant role in the nation's economy, with a banking market share that reaches 80% of the current financial system. According to Law No. 10 of 1998, there are two types of banking, namely conventional banks and Islamic banks. Islamic Commercial Bank (BUS) is a financial institution that operates based on Sharia principles both when channeling and collecting funds, as well as providing other services. Every year, Islamic banking is increasing and growing. Based on Islamic banking statistics published by OJK in December 2023, there were 13 BUS, 20 UUS, and 173 Islamic BPRs. The increasing number of Islamic banks causes competition to become tighter. It can cause the most critical problem, namely how the quality of performance and health of Islamic commercial banks, so banks are required to improve their performance of these banks. Efficiency is one of the components to measure the quality of performance.

Theoretically, all company performance is based on efficiency as one of its performance parameters (Rabbaniyah & Afandi, 2019). The expected measure of bank performance is the Bank's ability to maximize output with its inputs, by knowing how inputs and outputs, bank performance needs to be further examined to find inefficiencies. It is expected that an efficient bank can generate maximum profits, have many funds, and improve its services for the community. Examination of efficiency is critical because the extent of fund collection and distribution that ignores the element of efficiency will affect the profits of the Bank concerned (Rahmawati et al., 2019). If a company can produce greater output with fewer inputs or the same output with fewer inputs, then the company is considered efficient (Nurjanah, 2020).

The level of efficiency can be measured by two approaches, namely parametric and non-parametric approaches. According to Hadad & Wimboh Santoso (2003), the analysis of banking efficiency evaluation is appropriate when using parametric or non-parametric evaluation. Stochastic Frontier Analysis (SFA) is used as a parametric approach in this study. According to (Aigner et al., 2023), the SFA method has advantages over other methods. First, there is a disturbance term that represents interference, measurement error, and exogenous surprises that are out of control. Second, environmental variables are more accessible to treat, allow hypothesis testing using statistics, and make it easier to find outliers. SFA modifies the standard production function to allow inefficiency to be included in the error term (Tahir & Haron, 2008). When using the SFA approach, the efficiency value ranges between 0 and 1. When the efficiency value of a bank is one, then for a particular sample period, the Bank is the most efficient. On the other hand, a bank is less efficient if the value is close to 0. (Nurjanah, 2020) showed that using the SFA method, 13 Islamic commercial banks were classified as less efficient. Meanwhile, research by (Sary, Friska Tyas., 2016) shows how BUS is still unstable even though it has reached the efficiency level. There has been no research analyzing the level of efficiency between Local Government BUS and National Private BUS in Indonesia.

Based on this background, researchers are interested in conducting research and analyzing the efficiency level of local government Islamic commercial banks and national private Islamic commercial banks in Indonesia for the 2021-2023 period using the Stochastic Frontier Analysis (SFA) method. In order to further improve the efficiency of Islamic banks, this research is expected to be helpful in determining decisions and become a source of information regarding the level of efficiency of these banks.

LITERATURE REVIEW

Basically, banks are institutions that raise funds from the public by carrying out the role of financial intermediaries (Aminulloh et al., 2023). In Law No. 21 of 2008 concerning Islamic banking, it is stated that "Islamic banks are banks that carry out their business activities based on sharia principles". With the development of Islamic banking in Indonesia, good performance is needed at the Islamic Commercial Bank. Efficiency is one of the factors used to measure the quality of financial performance. According to (Davis, 2018), the efficiency of a firm consists of two components, namely technical efficiency and allocative efficiency. Technical efficiency is the Bank's ability to achieve maximum output with available inputs (Tahir & Haron, 2008), while allocative efficiency shows the ability of an organization to optimize the use of its inputs through price structure and production technology. This study uses the intermediation approach in determining output-input variables.

According to Muharam and Pusvitasari, there are three approaches to measuring efficiency including (Wahab, 2015):

1. Ratio Approach

   In measuring efficiency, this approach is used to calculate the ratio of inputs and outputs. This method is considered high efficiency if it has minimal input with maximum output results.

$$\text{Efficiency} = \frac{Output}{Input}$$

2. Regression Approach

   This approach uses a model to measure profits at various input levels based on the efficiency of a particular output level. The equation of the model is:

$$Y = f(X1,X2,X3,X4,.....Xn)$$

With Y = output and X = input

3. Frontier Approach

   There are two frontier approaches to measuring efficiency, namely:

a. Parametric frontier approach

   This approach imposes specific requirements on the characteristics of the population under study. Approaches that use parametric methods, such as Distribution Free Analysis (DFA) and Stochastic Frontier Analysis (SFA). The advantage

of the SFA method is the ability to calculate random errors and is used in hypothesis testing (Maula, 2022).

b. Non-parametric frontier approach

Statistical tests in this approach do not require certain conditions about the population parameters of the research sample. Data Envelopment Analysis (DEA) is one method to measure the non-parametric frontier approach.

According to Hadad & Wimboh Santoso (2003), in parametric and non-parametric methods in banking, there are three approaches used including:

1. Asset Approach

This approach describes financial institutions as credit creators of loans.

2. Production Approach

The production approach views financial institutions as producers of deposit accounts and credit accounts and considers labor, capital expenditure on fixed assets, and other materials as outputs.

Intermediation Approach

3. Intermediation Approach

The Intermediation Approach considers financial institutions as mediators to convert assets from surplus units to deficit units.

METHODOLOGY

This research uses quantitative analysis method with parametric approach. The samples in this study are Local Government Islamic Commercial Banks, namely Bank Aceh Syariah and Bank NTB Syariah, and National Private Islamic Commercial Banks, namely Bank Mega Syariah, Bank Panin Dubai Syariah, Bank BCA Syariah, Bank BTPN Syariah, and Bank BJB Syariah which are registered with the Financial Services Authority (OJK) and have published their quarterly financial reports for the 2021-2023 period. The type of data used is secondary data in panel form. Secondary data in this study, namely third-party funds, total assets, labor costs, and financing. According to (Subekti, 2011) panel data consists of a combination of time series data with cross section data. The data collection method in this research is Field Research and Library Research. Below that data analysis used in this study:

Descriptive Statistical Analysis

Descriptive statistical analysis is a statistic used to analyze data by describing the data that has been collected as it is.

Measuring Efficiency with Stochastic Frontier Analysis (SFA)

The efficiency value is determined by a score from 0 to 1. Banks are efficient if they are closer to 1, and vice versa; banks are inefficient if they are closer to 0. The SFA method uses U (controllable error) to get the efficiency value. Frontier 4.1 software was used to process the data. The general (log) form of the SFA standard function through the production function is as follows:

$$Ln\ (Q1\ ) = \beta 0 + \beta 1\ \ln(P1\ ) + \beta 2\ \ln(P2\ ) + \beta 1\ \ln(P3\ ) + \dots\dots\dots + \beta n\ \ln(Pn\ ) + En$$

As for third-party funds (P1), total assets (P2), and labor costs (P3) at bank n. Q1, on the other hand, is financing at Bank n. The error term, En, of the two functions, is the following equation:

$$En = Vi - Ui$$

Ui = controllable random factor (inefficiency)

Vi = uncontrollable random factor (random noise)

The criteria for acceptance and rejection of the hypothesis with the calculation of efficiency using SFA in this study, namely if an Islamic Commercial Bank is declared optimally efficient if it is worth 1 or 100%, while it is declared inefficient or inefficient if it is closer to 0.

Normality Test and Homogeneity Test

The normality test is carried out to determine whether the data distribution follows or is almost the same as the normal distribution (Nurhasanah, 2016). Normality tests can be done through the Kolmogorov-Smirnov test and the Shapiro-Wilk test by looking at the level of significance. If the significance value> significance value (α = 0.05), then the data is normally distributed. Conversely, if the significance value < the significance value (α = 0.05), the data is not normally distributed for data processing of normality test and homogeneity test using SPSS Statistic 26 software.

Mann Whitney U-Test

The Mann-Whitney test is equivalent to the Wilcoxon rank sum test. The Mann Whitney test is an alternative to the t test of two independent samples (Kadirisman, 2021). The Mann Whitney test is commonly used if normality and homogeneity conditions are not met and this test is also a non-parametric version of the independent t-test (Teti Sofia Yanti, 2007). The difference test in this study aims to verify the truth or error of the hypothesis. The basis for decision making, namely th,e Sig value. (2-tailed) > 0.05 then H0 is accepted, and H1 is rejected, otherwise if the Sig value. (2-tailed) <0.05 then H0 is rejected and H1 is accepted The hypothesis used is:

H0: There is no difference in the efficiency value between Local Government Islamic Commercial Banks and National Private Islamic Commercial Banks in Indonesia for the period 2021-2023.

H1: There is a difference in the efficiency value between Local Government Islamic Commercial Banks and National Private Islamic Commercial Banks in Indonesia for the period 2021-2023.

RESEARCH RESULT

Descriptive Statistical Analysis

Determination of variables used before measuring the efficiency value of Local Government BUS and National Private BUS in Indonesia is carried out. Based on the intermediation approach, the input variables used are third party funds, total assets, labor costs, while the output variable is financing. The following is a description of each variable used.

Third-Party Funds (DPK)

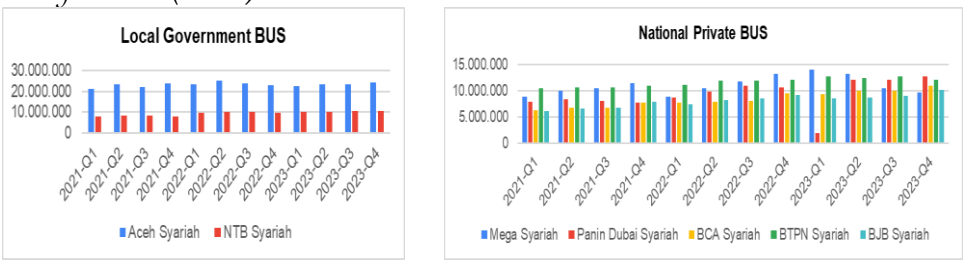

Figure 1. Third-party funds of Local Government BUS and National Private BUS

Based on the figure above, it is concluded that the development of third party funds in the National Private BUS varies, the value of third party funds with the highest average is owned by BTPN Syariah bank and the lowest average value of third party funds is obtained by Bank BJB Syariah. These results indicate that the third-party funds of the National Private BUS tend to increase in each sample bank. Meanwhile, the value of third party funds with the highest average in local government BUSs is owned by Bank Aceh Syariah and the lowest average is owned by Bank NTB Syariah. Based on the explanation above, it can be seen that banks can obtain funds from third parties quite ideally.

Total Assets

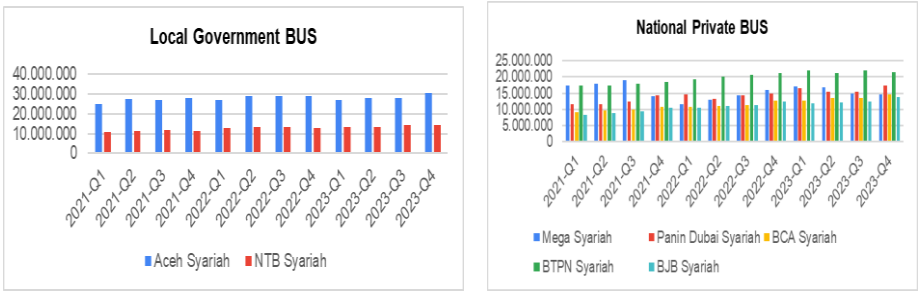

Figure 2. Total assets of Local Government BUS and National Private BUS

The graph above illustrates that the highest total assets were obtained by the Regional Government BUS, namely Bank Aceh Syariah. Meanwhile, the total assets of the National Private BUS are less, with a maximum of 16 T rupiah. One way to measure the possibility of a company surviving in the long term is the amount of its assets.

Labor Cost

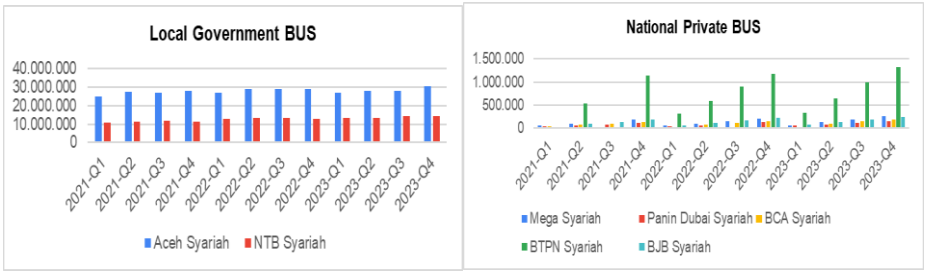

Figure 4. Labor cost of local government BUS and national private BUS

Based on the figure above shows that the highest labor cost value is owned by the National Private BUS, namely BTPN Syariah. Meanwhile, the lowest value of third party funds is owned by Panin Dubai Syariah bank. The

value of third party funds in the Regional Government BUS is still higher than that of other National Private BUS banks which have a maximum third party fund value of 135 million rupiah.

Financing

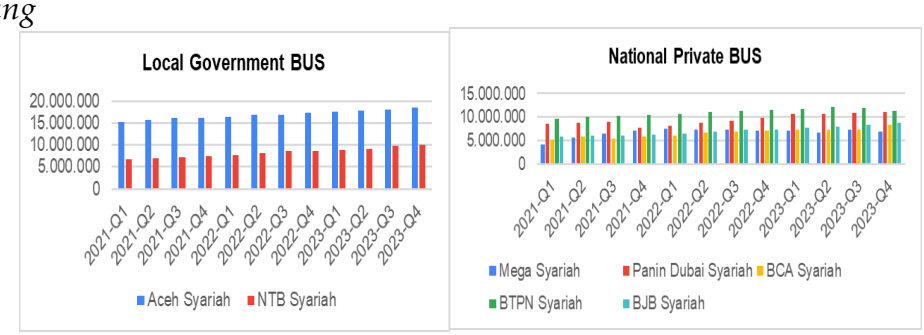

Figure 4. Financing of Local Government BUS and National Private BUS

Based on the figure above, it is found that the value of financing in Regional Government BUS is greater than that of National Private BUS. This result is based on the graph above, which shows that financing on Regional Government BUS reaches 16 T owned by Aceh Syariah Bank, compared to the National Private BUS, which only reaches a maximum of 11 T owned by BTPN Syariah Bank. The efficiency value of a bank can be influenced by its financing. A bank will have an optimal efficiency value if its financing is high and its deposits are also high (Maula, 2022).

Efficiency Measurement with Stochastic Frontier Analysis

SFA Test of Local Government BUS

Table 1. SFA test results of Islamic commercial banks in local government

Period		Aceh Syariah Bank	NTB Syariah Bank
2021	1st Quarter	0,97538	0,97439
	2nd Quarter	0.97465	0,97473
	3rd Quarter	0,97581	0,97524
	4th Quarter	0,97507	0,97631
2022	1st Quarter	0,98387	0,9734
	2nd Quarter	0,97313	0,97370
	3rd Quarter	0,97596	0,97610
	4th Quarter	0,97675	0,97545
2023	1st Quarter	0,97718	0,97536
	2nd Quarter	0,97708	0,97391
	3rd Quarter	0,97736	0,97524

	4th Quarter	0,97572	0,97594
Average		0,97666	0,97499
Overall Average			0,975728

Based on the table, it is found that the average efficiency value for each research period is the highest in the Regional Government BUS, namely Bank Aceh Syariah, which has an average efficiency of 0.97666, and the lowest average efficiency is owned by Bank NTB Syariah, with an average value of 0.97499. Then, the overall average of local government Islamic commercial banks is 0.975728. The efficiency value, which is quite optimal, indicates that the conventional commercial banks in Indonesia have good intermediation functions. The highest efficiency value obtained by Bank Aceh Syariah also indicates that Bank Aceh Syariah can achieve a more optimal level of efficiency, although the average per Bank is almost the same.

National Private BUS SFA Test

Table 2. SFA test results of local government Islamic commercial banks.

Period		**Mega Syariah Bank**	**Panin Dubai Syariah Bank**	**BCA Syariah Bank**	**BTPN Syariah Bank**	**BJB Syariah Bank**
2021	1st Quarter	0,93933	0,95984	0,95286	0,95398	0,95576
	2nd Quarter	0,94705	0,95902	0,95359	0,95463	0,95556
	3rd Quarter	0,94956	0,95567	0,95204	0,95496	0,95514
	4th Quarter	0,9507	0,95795	0,95152	0,95487	0,9533
2022	1st Quarter	0,95644	0,95684	0,95279	0,95518	0,9547
	2nd Quarter	0,95294	0,95774	0,95398	0,95496	0,954
	3rd Quarter	0,95009	0,95234	0,95508	0,95534	0,95476
	4th Quarter	0,94764	0,95429	0,95404	0,95543	0,95545
2023	1st Quarter	0,94569	0,97433	0,95467	0,95498	0,95613
	2nd Quarter	0,94532	0,95405	0,95343	0,95599	0,95647
	3rd Quarter	0,95296	0,95393	0,95332	0,95519	0,95817
	4th Quarter	0,95301	0,9537	0,95501	0,95502	0,95724
Average		0,9492275	0,957475	0,953528	0,95504	0,95556
Overall Average						0,95451

Based on the table, it is found that the highest average efficiency value for each research period in the National Private BUS, namely Bank Panin Dubai Syariah, which has an average efficiency of 0.97433, and the lowest average efficiency is owned by Bank BCA Syariah with an average value of 0.95508. Then, the overall average of national private Islamic commercial banks is 0.95451. The efficiency value, which is quite optimal, indicates that the conventional commercial banks in Indonesia have good intermediation functions.

Normality Test

The normality tests used in this study are Kolmogorov-Smirnov and Saphiro-Wilk tests. The results of the normality test with SPSS software are as follows.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Bank	Statistic	df	Sig.	Statistic	df	Sig.
Tingkat Efisiensi Bank	BUS Pemerintah Daerah	.353	24	.000	.660	24	.000
	BUS Swasta Nasional	.511	60	.000	.327	60	.000

Source: Data processed by researchers, 2024

Based on the table above, it can be seen that both the Kolmogorov-Smirnov and Saphiro-Wilk values of each Bank are 0.000 <0.05 (less than the value of the degree of error), it can be concluded that the data is not normally distributed.

Homogeneity Test

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Tingkat Efisiensi Bank	Based on Mean	52.975	1	82	.000
	Based on Median	19.227	1	82	.000
	Based on Median and with adjusted df	19.227	1	58.664	.000
	Based on trimmed mean	53.075	1	82	.000

Source: Data processed by researchers, 2024

A data homogeneity test is one of the requirements that must be met before conducting a different test. The results of the Levene statistic based on mean (sig. value) show a value of 0.000 <0.05, so it can also be seen that the data is not homogeneous. So, the different test used is the Mann-Whitney test because it does not fulfill the two requirements of the T-test.

Mann Whitney U-Test

The normality test and homogeneous test conducted previously show that neither condition has not been met, so the Mann-Whitney test is used. The difference test is conducted to determine whether there is a significant difference between existing samples. One of the non-parametric tests used to distinguish two samples and independent of each other in terms of variables is the Mann-

Whitney Test. The following are the results of the Mann-Whitney test for the efficiency data of Local Government BUS and National Private BUS in Indonesia.

Test Statistics[a]

	Tingkat Efisiensi Bank
Mann-Whitney U	719.000
Wilcoxon W	1019.000
Z	-.010
Asymp. Sig. (2-tailed)	.992

Based on the figure above, the Asymp, Sig (2-tailed) value is 0.992 > 0.05, so the research decision shows that H0 is accepted and H1 is rejected. These results indicate that there is no significant difference between the average efficiency values of Local Government Islamic Commercial Banks and National Private Islamic Commercial Banks.

DISCUSSION

Efficiency Level Analysis of Local Government Islamic Commercial Banks

By using the intermediation approach, the parametric method is used to calculate the efficiency of Stochastic Frontier Analysis (SFA) on local government Islamic commercial banks in Indonesia, namely Bank Aceh Syariah and Bank NTB Syariah. Based on the results of data processing using the parametric method of Stochastic Frontier Analysis software 4.1, it was found that the efficiency value of local government Islamic commercial banks was quite good. This can be seen in the highest average obtained by Bank Aceh Syariah, with an average value of 0.97666, and the lowest average owned by NTB Syariah Bank, with an average value of 0.97499. Each of these banks is classified as having a very efficient efficiency value even though it has not reached the optimum efficiency value, which is one. Meanwhile, based on the overall average, the efficiency value of local government Islamic commercial banks in Indonesia is 0.97572. The local government Islamic commercial banks can be categorized as having an optimal efficiency value even just by looking at the average value of their overall efficiency.

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having an optimal efficiency value even just by looking at the average value of their overall efficiency.

Analysis of Differences in the Efficiency Level of Regional Government Islamic Commercial Banks and National Private Islamic Commercial Banks

To determine the difference between local government Islamic commercial banks and national private Islamic commercial banks for the 2021-2023 period, the Mann-Whitney t-test is used using the results of data processing on the efficiency of local government Islamic commercial banks and national private Islamic commercial banks. Based on the results of the normality test and homogeneity test carried out, the results are not normal and not homogeneous, which means that they do not meet the requirements for the T-Test test, so the test used is the Mann-Whitney test. The result obtained in the test is that the sig (2-tailed) value is more than the alpha value, which indicates that H0 is accepted and H1 is rejected, so there is no significant difference in efficiency value between local government Islamic commercial banks and national private Islamic commercial banks for the 2021-2023 period. This is because the results of the calculation of the efficiency value between local government Islamic commercial banks are not too different from those of national private Islamic commercial banks. In the Regional Government BUS, the average efficiency value is 0.9757, while the National Private BUS is 0.9545, this is what causes there to be no significant difference.

CONCLUSIONS AND RECOMMENDATIONS

The results of the comparative analysis of the efficiency of Local Government Islamic Commercial Banks and National Private Islamic Commercial Banks for the 2021-2023 period using the Stochastic Frontier Analysis (SFA) method are as follows:

1. On average, the efficiency level of the Local Government Islamic Commercial Bank (BUS) during the 2021-2023 period using the SFA method was 0.9757; Bank Aceh Syariah at an average efficiency level of 0.97666; and Bank NTB Syariah at an average efficiency level of 0.97499.

2. Using the SFA method, the National Private Islamic Commercial Bank (BUS) during the 2021-2023 period has an average efficiency level of 0.95451; Bank Mega Syariah has an average efficiency level of 0.94922; Bank Panin Dubai Syariah has an average efficiency level of 0.95747; Bank BCA Syariah has an average efficiency level of 0.95747, Bank BTPN Syariah has an average efficiency level of 0.95504; and Bank BJB Syariah has an average efficiency level of 0.95556.

3. Based on the results of the difference test using the non-parametric Mann-Whitney U-Test method, by looking at the sig value. (2-tailed) 0.992> 0.05 (H0 accepted), then there is

no significant difference in the level efficiency between the efficiency of Regional Government Islamic Commercial Banks and National Private Islamic Commercial Banks in Indonesia during the period 2021-2023. This result also shows that all banks have carried out their intermediary function well, even though each BUS has not reached the efficiency level of 1 or 100%.

Based on the results of the analysis and findings that have been presented previously, some suggestions can be given, namely for bank management to further optimize its efficiency level to reach the maximum optimal level by focusing on the variables that have been determined and that further researchers should be able to increase the research observation period.

ADVANCED RESEARCH

The limitation of this study is the lack of previous research references regarding the objects used. Further researchers can examine this with more observation periods and different variables.

ACKNOWLEDGMENT

The researcher would like to thank Allah SWT. and all those involved in the success of this research.

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