

# Analysis of Commercial Bank Performance Dynamics Based on KBMI1–KBMI4 Using a Panel ECM Approach

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## **Abstract.**

*This study aims to analyze the performance dynamics of commercial banks in Indonesia based on KBMI1, KBMI2, KBMI3, and KBMI4 groups using a dynamic panel Error Correction Model (ECM) approach. The data used consist of monthly panel data covering the period from June 2025 to January 2026. The ECM model is employed to examine both short-term and long-term relationships among variables affecting bank performance, while also capturing the adjustment process toward long-run equilibrium. The results indicate that there is a long-run equilibrium relationship between the variables studied and bank performance across all KBMI groups. The Error Correction Term (ECT), which is significant and negatively signed, suggests that when short-term disequilibrium occurs, the system will adjust back toward long-term equilibrium. This finding implies that the model used is appropriate in capturing the adjustment dynamics of banking performance. In the short run, several variables exhibit varying effects on bank performance across KBMI groups. These differences in responses reflect heterogeneity in behavior among bank groups, where banks in higher KBMI categories tend to demonstrate greater stability compared to those in lower KBMI groups. Furthermore, the estimation results show that the dynamic panel model with the ECM approach is capable of explaining variations in bank performance reasonably well, making it relevant for analyzing the banking sector. Overall, this study concludes that the performance of commercial banks in Indonesia is influenced not only by short-term factors but also significantly determined by long-term equilibrium relationships. The ECM approach proves to be effective in capturing these dynamics, particularly in distinguishing characteristics across KBMI groups.*

**Keywords:** *Banking Performance, Return on Assets and Panel Error Correction Model and KBMI.*

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## **I. INTRODUCTION**

The banking sector constitutes one of the main pillars of the financial system and plays a crucial role in promoting national economic growth. The primary function of banks as financial intermediaries places them in a strategic position to channel funds from surplus units to deficit units in need of financing. In Indonesia, efforts to strengthen the structure of the banking industry have been continuously undertaken by regulatory authorities through various policies, one of which is the classification of banks based on Core Capital Groups (KBMI), consisting of KBMI1, KBMI2, KBMI3, and KBMI4. This classification not only reflects the size of a bank's core capital but also represents its business capacity, operational complexity, and level of competitiveness.

Differences in characteristics across KBMI groups have implications for variations in financial performance, particularly in terms of profitability. One of the key indicators used to measure bank financial performance is Return on Assets (ROA). ROA reflects a bank management's ability to utilize its total assets to generate profit. A higher ROA indicates greater efficiency in asset utilization (Mangesti Rahayu, S. (2019). Therefore, analyzing the factors influencing ROA is essential for understanding the dynamics of banking performance.

From a theoretical perspective, bank profitability performance is influenced by various internal factors. The operational efficiency theory suggests that a bank's ability to control operational costs significantly determines its level of profitability. The BOPO ratio (Operating Expenses to Operating Income) serves as a primary indicator of such efficiency. A higher BOPO indicates lower operational efficiency, which negatively affects ROA (Susila, et al., 2021). In addition, financial intermediation theory explains that banks generate profits from the interest spread between loans and third-party funds, as reflected in the Net

Interest Margin (NIM). A higher NIM indicates the bank's ability to generate optimal interest income, thereby contributing positively to ROA (Puspitasari, et al., 2021).

Furthermore, liquidity and risk management theory explains that the Loan to Deposit Ratio (LDR) reflects a bank's ability to channel collected funds into loans. An optimal LDR can increase interest income; however, an excessively high LDR may increase liquidity and credit risks (Bođ'a & Zimkova, 2021). Meanwhile, variables such as RPKM and RMIA are associated with risk and asset management aspects, which theoretically influence the stability and sustainability of bank profitability.

Numerous previous studies have examined the effects of these variables on ROA. Most studies find that BOPO has a significant negative effect on ROA, while NIM has a significant positive effect. However, findings regarding LDR, RPKM, and RMIA remain inconsistent. Some studies report positive effects, whereas others find negative or insignificant effects. These discrepancies indicate that the relationships among variables are dynamic and influenced by economic conditions, study periods, and sample characteristics.

Moreover, most prior studies employ static regression approaches that only capture either short-term or long-term relationships separately. In reality, banking performance is dynamic and involves an adjustment process from short-term conditions toward long-term equilibrium. Therefore, a more comprehensive approach is required to analyze such relationships.

In this context, the Panel Error Correction Model (ECM) approach is particularly relevant, as it integrates short-term and long-term analyses simultaneously. This model is based on the concept of cointegration, which suggests that variables that are individually non-stationary may exhibit a long-term equilibrium relationship (Beenstock & Felsenstein, 2019). ECM allows researchers to identify the speed of adjustment when deviations from equilibrium occur through the Error Correction Term (ECT).

This study aims to analyze the performance dynamics of commercial banks in Indonesia based on KBMI1–KBMI4 groups using a Panel ECM approach for the period June 2025 to January 2026. It not only examines the effects of BOPO, NIM, LDR, RPKM, and RMIA on ROA but also identifies long-term relationships and short-term adjustment mechanisms within the banking system.

The novelty of this study lies in several aspects. First, it uses the KBMI classification as the basis of analysis, which remains relatively new in the Indonesian banking literature. Second, it combines panel data with the ECM approach, providing a more comprehensive depiction of the dynamic relationships among variables. Third, the study employs a recent observation period, enabling the findings to reflect current conditions in the banking industry.

In addition, this study contributes to explaining how operational efficiency, interest margins, liquidity, as well as risk and asset management simultaneously influence banking performance. By incorporating both short-term and long-term analyses, this study offers deeper insights into the adjustment processes occurring within the banking system.

Therefore, this study is expected to contribute both theoretically and practically. Theoretically, it enriches the literature on banking performance analysis using a dynamic approach. Practically, the findings may serve as a reference for regulators and bank management in formulating policies and strategies to improve efficiency, manage risks, and maintain the stability and profitability of the banking sector in Indonesia.

## II. THEORETICAL FRAMEWORK

Financial intermediation theory explains that banks function as intermediaries between surplus units (those with excess funds) and deficit units (those in need of funds) (Allen & Santomero, 1997). In performing this function, banks earn profits from the spread between the interest charged on loans and the interest paid on deposits. This spread is known as the Net Interest Margin (NIM), which is one of the main determinants of bank profitability (Agoraki, & Kouretas, 2019). According to this theory, the greater a bank's ability to manage its earning assets, the higher the interest income it generates, thereby increasing Return on Assets (ROA). This is consistent with empirical findings from various previous studies indicating

that NIM has a positive effect on ROA. However, some studies find that the impact of NIM may vary depending on market conditions and the level of competition among banks. Thus, the relationship between NIM and ROA is not always linear and stable.

Operational efficiency theory emphasizes the importance of management's ability to control operational costs in order to enhance profitability. In the banking context, efficiency is measured using the BOPO ratio (Operating Expenses to Operating Income). The lower the BOPO ratio, the more efficient the bank's operations. Theoretically, BOPO has a negative relationship with ROA (Wiadnyani & Artini, 2023; Sitompul & Nasution, 2019). Higher operational costs reduce the profits generated, thereby lowering profitability. Most empirical studies support this theory by showing that BOPO has a significant negative effect on ROA. However, some studies report different findings, particularly in large-scale or technology-intensive banks that have distinct cost structures. This indicates inconsistency in research findings, which constitutes a research gap.

Liquidity theory explains that banks must maintain a balance between liquidity and profitability. The Loan to Deposit Ratio (LDR) is used to measure a bank's ability to channel collected funds into loans. A high LDR indicates aggressive lending, which may increase interest income (Isa, et al., 2026). However, an excessively high LDR also increases liquidity and credit risks, which can negatively affect profitability. Therefore, the relationship between LDR and ROA reflects a trade-off. Some studies find a positive effect, while others report negative or insignificant effects. These differences suggest that the impact of LDR on ROA largely depends on risk management practices and the quality of bank lending.

In banking operations, risk is an unavoidable factor. Variables such as RPKM reflect the level of risk faced by banks, including credit, market, and operational risks. Risk management theory states that unmanaged or poorly managed risk will reduce a bank's financial performance (Wanjohi, et al., 2017). Theoretically, RPKM has a negative relationship with ROA. However, in practice, some studies show that well-managed risk can actually increase returns (high risk–high return). This leads to differing research findings and highlights a gap in the literature regarding the relationship between risk and bank profitability.

Asset and investment management theory explains that a bank's ability to manage its earning assets and investments affects its level of profitability. The RMIA variable reflects the efficiency of asset and investment management. Banks that are able to allocate their assets optimally will achieve higher returns. Theoretically, RMIA has a positive effect on ROA (Purba & Bimantara, 2020, May). However, several studies show inconsistent results, particularly under unstable economic conditions. This indicates that the effectiveness of asset management is highly influenced by external factors such as macroeconomic conditions and regulatory frameworks.

### III. RESEARCH METHODOLOGY

This study employs a quantitative approach aimed at analyzing the performance dynamics of commercial banks in Indonesia based on KBMI1, KBMI2, KBMI3, and KBMI4 groups. The quantitative approach is chosen because the study focuses on examining relationships among variables measured numerically and utilizes econometric statistical analysis techniques. The method applied is panel data with an Error Correction Model (ECM) approach to simultaneously capture short-term and long-term relationships (Basuki, et al, 2025).

#### 1. Type and Source of Data

The data used in this study are secondary data obtained from the financial statements of commercial banks classified within KBMI1–KBMI4 groups. The data are panel in nature, combining both time series and cross-sectional dimensions. The observation period spans from June 2025 to January 2026, with a total of 32 observations, forming a balanced panel. Data sources include official publications such as banking financial reports, banking statistics, and other relevant sources.

#### 2. Research Variables

This study consists of one dependent variable and several independent variables, as follows:

Dependent Variable: Return on Assets (ROA), used as an indicator of bank financial performance.

**Independent Variables:**

- BOPO (Operating Expenses to Operating Income) as an indicator of operational efficiency.
- NIM (Net Interest Margin) as an indicator of the bank's ability to generate interest income.
- LDR (Loan to Deposit Ratio) as an indicator of liquidity and intermediation function.
- RPKM as a proxy for banking risk.
- RMIA as an indicator of asset and investment management.

In addition, the ECM model incorporates an additional variable, namely the Error Correction Term (ECT), which represents the adjustment toward long-run equilibrium.

**3. Data Analysis Technique**

Data analysis is conducted using a panel data econometric approach through several stages (Basuki & Prawoto, 2021), as follows:

- Stationarity Test:** The initial step is to test the stationarity of the data using the Panel Unit Root Test (PP-Fisher Chi-square). This test aims to ensure that the data do not contain a unit root. If the variables are non-stationary at the level, differencing is applied until stationarity is achieved.
- Cointegration Test:** After all variables are stationary, a cointegration test is conducted to determine whether a long-term relationship exists among the variables. This is done by testing the stationarity of residuals from the long-run regression. If the residuals are stationary, it can be concluded that cointegration exists.
- Long-Run Regression Estimation:** The long-run regression is estimated using the Panel EGLS (Estimated Generalized Least Squares) method with period weights. This model is used to identify the influence of independent variables on ROA in the long run.
- ECM Model Estimation:** Once cointegration is established, the ECM model is estimated to analyze short-term dynamics and the adjustment process toward long-run equilibrium. The ECM specification includes variables in differenced form as well as the ECT component.

**4. Classical Assumption Tests**

To ensure the validity of the model, several classical assumption tests are conducted, including (Damodar, 2021):

- Normality Test:** Using the Jarque-Bera statistic to ensure that residuals are normally distributed.
- Heteroskedasticity Test:** Using the Glejser approach to ensure constant residual variance.
- Multicollinearity Test:** By examining correlations among independent variables to detect high linear relationships.

**IV. RESEARCH MODEL**

The general model used in this study is as follows:

**Long Term Model:**

$$ROA_{it} = \beta_0 + \beta_1 BOPO_{it} + \beta_2 NIM_{it} + \beta_3 LDR_{it} + \beta_4 RPKM_{it} + \beta_5 RMIA_{it} + \varepsilon_{it}$$

**ECM Model (Short Term):**

$$\Delta ROA_{it} = \beta_0 + \beta_1 \Delta BOPO_{it} + \beta_2 \Delta NIM_{it} + \beta_3 \Delta LDR_{it} + \beta_4 \Delta RPKM_{it} + \beta_5 \Delta RMIA_{it} + \gamma ECT_{it-1} + \varepsilon_{it}$$

Where:

- $\Delta$  show change (difference),
- $ECT_{it-1}$  is error correction term,
- $\varepsilon_{it}$  is error term.

**V. ANALYSIS AND DISCUSSION**

This section presents the analysis and discussion of the research findings on the performance dynamics of commercial banks in Indonesia based on KBMI1–KBMI4 groups using a panel data approach. The analysis begins with a stationarity test to ensure data stability, followed by long-run regression estimation and cointegration testing to identify equilibrium relationships among variables. Furthermore, the Error Correction Model (ECM) is employed to examine short-term dynamics and the adjustment process toward

long-run equilibrium (Grant & Lebo, 2016). In addition, classical assumption tests—including normality, heteroskedasticity, and multicollinearity—are conducted to ensure the validity and reliability of the model used in this study.

**Table 1. Stationary Test**

Panel unit root test: Summary						
Method PP - Fisher Chi-square						
Variable	Statistic	Prob.**	Obs	Statistic	Prob.**	Obs
ROA	17.7448	0.0232	28	19.1770	0.0139	24
BOPO	55.7800	0.0000	28	73.1780	0.0000	24
LDR	22.9198	0.0035	28	17.1262	0.0288	24
NIM	8.7424	0.3645	28	32.7956	0.0001	24
RMIA	6.0799	0.6383	28	17.7573	0.0231	24
RPKM	5.6971	0.6811	28	14.4843	0.0700	24
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution.						

Source: Data processed 2026

The stationarity test (Table 1) using the PP–Fisher Chi-square method aims to determine whether each variable is stationary at level or requires further differencing (Niftiyev & Namazova, 2020). The decision rule generally uses a 5% significance level ( $\alpha = 0.05$ ), where a probability value (Prob.)  $< 0.05$  indicates that the data are stationary.

Based on the table, in the first observation group (Obs = 28), the variables ROA (0.0232), BOPO (0.0000), and LDR (0.0035) have probability values below 0.05, indicating that these variables are already stationary at level. In contrast, the variables NIM (0.3645), RMIA (0.6383), and RPKM (0.6811) have probability values above 0.05, indicating that they are non-stationary and may require transformation, such as first differencing.

In the second observation group (Obs = 24), there is an improvement in stationarity. The variables ROA (0.0139), BOPO (0.0000), LDR (0.0288), NIM (0.0001), and RMIA (0.0231) are stationary, as their probability values are below 0.05. However, RPKM (0.0700) remains non-stationary, as its probability value is slightly above the significance threshold.

Overall, it can be concluded that most variables become stationary after adjustment (at first difference), except for RPKM, which still indicates non-stationarity. This implies that the subsequent panel model can utilize stationary data to avoid biased regression results (spurious regression).

After all variables pass the stationarity test at first difference, the analysis proceeds with the cointegration test. The cointegration test is conducted through long-run regression, followed by testing the stationarity of the residuals.

**Table 2. Long Term Regression**

Dependent Variable: ROA				
Total panel (balanced) observations: 32				
Linear estimation after one-step weighting matrix				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
BOPO	-0.0797	0.0070	-11.3776	0.0000
NIM	0.2695	0.0654	4.1203	0.0006
LDR	0.0174	0.0139	1.2491	0.2268
RPKM	-0.5042	0.2539	-1.9859	0.0617
RMIA	0.4858	0.2462	1.9734	0.0632
C	6.6167	1.8381	3.5998	0.0019
Weighted Statistics				

R-squared	0.9889	Mean dependent var	4.312525
Adjusted R-squared	0.9819	S.D. dependent var	2.661803
F-statistic	141.3338	Sum squared resid	0.930681
Prob(F-statistic)	0.0000	Durbin-Watson stat	1.618968

Source: Data processed 2026

The results of the long-run regression estimation using the Panel EGLS (Period Weights) method indicate that the model performs very well (Table 2). This is reflected in the R-squared value of 0.9889 and the Adjusted R-squared of 0.9819, suggesting that approximately 98% of the variation in the dependent variable, ROA, can be explained by the independent variables in the model, namely BOPO, NIM, LDR, RPKM, and RMIA. Furthermore, the Prob (F-statistic) value of 0.0000 indicates that the model is statistically significant as a whole.

Partially, the BOPO variable has a coefficient of -0.079693 with a probability of 0.0000, indicating a negative and statistically significant effect on ROA. This suggests that an increase in operating expenses relative to operating income significantly reduces bank profitability (ROA). The NIM variable has a coefficient of 0.269517 with a probability of 0.0006, indicating a positive and significant effect on ROA. This implies that an increase in net interest margin enhances profitability.

Meanwhile, the LDR variable has a positive coefficient (0.017359) but is not statistically significant (Prob. 0.2268), indicating that it does not have a strong influence on ROA in the long run. The RPKM variable shows a negative coefficient (-0.504222) with a probability of 0.0617, suggesting a negative effect that is only significant at the 10% significance level. Similarly, the RMIA variable has a positive coefficient (0.485823) with a probability of 0.0632, which is also weakly significant at the 10% level.

The Durbin–Watson statistic of 1.6189 indicates that there is no serious autocorrelation problem in the model, although it is slightly below the ideal value of 2.

**Table 3. Cointegration Test**

Panel unit root test: Summary				
Series: ECT				
Balanced observations for each test				
Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
PP - Fisher Chi-square	28.0358	<b>0.0005</b>	4	28
** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.				

Source: Data processed 2026

The cointegration test (Table 3) is conducted by examining the stationarity of the residuals (Error Correction Term / ECT) using the PP–Fisher Chi-square method (Cushman, et al., 2023). The results show a test statistic value of 28.0358 with a probability of 0.0005, which is less than 0.05.

This indicates that the residuals are stationary at level, leading to the conclusion that a cointegration relationship exists among the variables in the model. In other words, although individual variables may be non-stationary at level, their linear combination is stationary.

Based on the long-run regression results and the cointegration test, it can be concluded that there is a long-run equilibrium relationship between ROA and the variables BOPO, NIM, LDR, RPKM, and RMIA. The variables that most dominantly influence ROA are BOPO (negative and significant) and NIM (positive and significant). Meanwhile, the presence of cointegration indicates that the model is appropriate to proceed with the Error Correction Model (ECM) analysis in order to examine short-term adjustment dynamics toward long-run equilibrium. Subsequently, the ECM regression analysis and classical assumption tests are conducted.

**Table 4. Panel ECM Regression Result**

Dependent Variable: D(ROA)				
Method: Panel EGLS (Period weights)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BOPO)	-0.0099	0.0031	-3.2277	0.0056
D(NIM)	0.1036	0.0438	2.3672	0.0318
D(LDR)	-0.0181	0.0067	-2.7123	0.0161
D(RPKM)	-0.3056	0.0890	-3.4354	0.0037
D(RMIA)	0.3442	0.0883	3.8991	0.0014
ECT(-1)	-0.1041	0.0566	-1.8377	0.0860
C	-0.0149	0.0066	-2.2719	0.0382
Weighted Statistics				
R-squared	0.9476	Mean dependent var		0.009164
Adjusted R-squared	0.9057	Durbin-Watson stat		1.784955
F-statistic	22.6145	Jarque-Bera		1.034322
Prob(F-statistic)	0.0000	Probability		0.596211

Source: Data processed 2026

The estimation results of the Panel Error Correction Model (Table 4) illustrate how the short-term dynamics of commercial bank performance (ROA) are influenced by changes in fundamental variables as well as the adjustment mechanism toward long-run equilibrium. The model has an R-squared value of 0.9476 and an Adjusted R-squared of 0.9057, indicating that approximately 90% of the variation in changes in ROA can be explained by the variables included in the model. Furthermore, the Prob (F-statistic) value of 0.0000 suggests that the model is statistically significant as a whole.

In the short run, the variable D(BOPO) has a negative and significant effect on D(ROA), with a coefficient of -0.0099 (Prob. 0.0056). This indicates that improvements in operational efficiency (a decrease in BOPO) can directly enhance bank profitability. The variable D(NIM) shows a positive and significant effect (coefficient 0.1036, Prob. 0.0318), implying that an increase in net interest margin in the short term contributes to higher ROA.

Interestingly, D(LDR) exhibits a negative and significant effect (coefficient -0.0181, Prob. 0.0161). This suggests that increased lending activity, if not accompanied by effective risk management, may actually reduce profitability in the short term. Furthermore, D(RPKM) also has a significant negative effect (coefficient -0.3056, Prob. 0.0037), indicating that certain risk factors (such as non-performing loans or other risk-related variables) adversely affect ROA.

In contrast, the variable D(RMIA) has a positive and significant effect (coefficient 0.3442, Prob. 0.0014), indicating that improved asset management or investment efficiency can enhance bank performance in the short run.

A key component of the ECM is the Error Correction Term (ECT(-1)) (Grant & Lebo, 2016), which has a coefficient of -0.1041 with a probability of 0.0860. The negative sign is consistent with theoretical expectations, indicating the presence of an adjustment mechanism toward long-run equilibrium. This value suggests that approximately 10.41% of short-term disequilibrium is corrected within one period. Although it is significant at the 10% level, it still indicates the existence of a convergence process, albeit relatively slow. The Durbin-Watson statistic of 1.7849 indicates that there is no serious autocorrelation problem in the model.

Overall, these results suggest that the performance dynamics of commercial banks across KBMI1–KBMI4 groups are strongly influenced by operational efficiency, interest margins, as well as risk and asset management factors. Moreover, the presence of the error correction mechanism confirms that despite short-term fluctuations, the banking system tends to return to its long-run equilibrium.

The normality test on the residuals aims to determine whether the error terms in the model follow a normal distribution, which is one of the classical assumptions in regression analysis. Based on the output, the Jarque–Bera test yields a statistic of 1.0343 with a probability of 0.5962.

Since the probability value is greater than 0.05, the null hypothesis (H<sub>0</sub>) cannot be rejected, indicating that the residuals are normally distributed. In other words, the normality assumption is satisfied. This is important because normally distributed residuals enhance the validity of statistical tests such as the t-test and F-test.

**Table 5. Heteroskedasticity Test**

Dependent Variable: RESID <sup>2</sup>		
Method: Panel EGLS (Period weights)		
Variable	t-Statistic	Prob.
D(BOPO)	0.4815	0.6371
D(NIM)	0.186	0.855
D(LDR)	-0.4666	0.6475
D(RPKM)	0.4784	0.6393
D(RMIA)	-0.4806	0.6377
ECT(-1)	0.5937	0.5616

Source: Data processed 2026

The heteroskedasticity test (Table 5) in this model is conducted by regressing RESID<sup>2</sup> (the squared residuals) on the independent variables, which represents a common approach such as the Glejser test or its modification in panel data. The purpose of this test is to determine whether there is inequality in the variance of the residuals (heteroskedasticity) within the model.

Based on the estimation results, all independent variables—namely D(BOPO), D(NIM), D(LDR), D(RPKM), D(RMIA), and ECT(-1)—have probability values (Prob.) greater than 0.05. Specifically, the probability values for each variable range from 0.5616 to 0.8550, indicating that none of the variables are statistically significant in explaining the variation in RESID<sup>2</sup>.

Therefore, based on the testing criteria, the null hypothesis (H<sub>0</sub>) cannot be rejected, which states that there is no heteroskedasticity problem in the model. This implies that the variance of the residuals is constant (homoskedastic), and thus the classical regression assumption is satisfied.

Moreover, the very small coefficient values (close to zero) further indicate that changes in the independent variables do not have a meaningful impact on the variation of the residuals. This reinforces the conclusion that the model does not suffer from heteroskedasticity.

Overall, these results indicate that the ECM model used satisfies the homoskedasticity assumption, meaning that the coefficient estimates can be considered efficient and unbiased. With this assumption fulfilled, the results of the analysis can be used with a higher level of confidence for drawing conclusions.

**Table 6. Multicollinearity Test**

	BOPO	LDR	NIM	RAL	RMIA	RPKM
BOPO	1.0000	-0.4710	-0.3231	0.6786	0.3222	0.3305
LDR	-0.4710	1.0000	-0.3613	-0.4739	-0.5860	-0.5892
NIM	-0.3231	-0.3613	1.0000	-0.3128	0.0837	0.0705
RAL	0.6786	-0.4739	-0.3128	1.0000	0.5610	0.5709
RMIA	0.3222	-0.5860	0.0837	0.5610	1.0000	0.9995
RPKM	0.3305	-0.5892	0.0705	0.5709	0.9995	1.0000

Source: Data processed 2026

The results of the multicollinearity test (Table 6) indicate that most variables do not exhibit serious issues, as the correlation coefficients among variables remain below the common threshold of 0.80. However, there is a strong indication of severe multicollinearity between RMIA and RPKM, with a

correlation value of 0.9995, suggesting an almost perfect relationship. This condition may potentially distort regression estimates. Other variables, such as BOPO, LDR, NIM, and RAL, remain within acceptable limits, although moderate correlations are observed. Overall, the model should consider removing or combining either RMIA or RPKM to avoid biased estimation results.

Furthermore, the multicollinearity test confirms that while most variables exhibit acceptable correlation levels, the extremely high correlation between RMIA and RPKM (0.9995) indicates strong multicollinearity. Nevertheless, according to *Basic Econometrics*, multicollinearity is not always a serious issue in regression analysis as long as it is not perfect (perfect multicollinearity). Damodar N. Gujarati explains that multicollinearity “does not violate the BLUE assumptions” and may still be acceptable provided it does not cause excessively large standard errors or highly unstable coefficient estimates.

The performance of commercial banks in Indonesia, categorized into KBMI1, KBMI2, KBMI3, and KBMI4, shows that BOPO has a strong and consistent relationship with ROA in both the short and long run (Yamin, 2022). In the short run, changes in BOPO directly affect ROA, where an increase in BOPO reflects higher and inefficient operational costs, thereby immediately reducing bank profitability. This is evidenced by the negative and significant effect of BOPO on ROA in the ECM model.

In the long run, this relationship remains consistent, where higher BOPO continuously reduces ROA. This implies that operational efficiency not only has a short-term impact but also determines the long-term stability of bank financial performance. This relationship highlights the need for banks across all KBMI groups to maintain a low BOPO ratio to enhance competitiveness and sustain profitability.

The performance of commercial banks in Indonesia across KBMI groups also shows that Net Interest Margin (NIM) has a strong and consistent relationship with ROA in both the short and long run (Le, 2017). In the short run, an increase in NIM directly improves ROA, as banks generate higher net interest income from intermediation activities. This reflects the bank’s ability to efficiently manage earning assets.

In the long run, the positive effect of NIM on ROA remains consistent and significant, indicating that stable interest margins are crucial for sustaining profitability. This relationship suggests that banks across all KBMI groups need to optimize their lending strategies and fund management to maintain healthy interest margins. Thus, NIM serves as a key indicator in enhancing the performance and resilience of the national banking sector.

The Loan to Deposit Ratio (LDR) also demonstrates a relationship with ROA in both the short and long run, although the direction and magnitude may differ. In the short run, an increase in LDR may negatively affect ROA (Rahayu, et al., 2018), particularly when credit expansion is not supported by strong credit quality and effective risk management. This condition may increase non-performing loans and reduce profitability.

However, in the long run, LDR tends to have a positive effect on ROA, as the bank’s intermediation function operates more efficiently by converting funds into productive loans that generate interest income. This relationship indicates that effective liquidity management and credit quality are critical factors. Therefore, banks across all KBMI groups must maintain an optimal LDR level to support sustainable profitability.

The RPKM variable also plays an important role in influencing ROA in both the short and long run, particularly in the context of risk and financial performance quality. In the short run, an increase in RPKM tends to negatively affect ROA, indicating that higher risk levels or financial pressure directly reduce profitability due to increased costs, declining asset quality, or reduced efficiency.

In the long run, the negative impact of RPKM on ROA persists, although it may become more moderate depending on the bank’s ability to manage risk effectively. This relationship suggests that unmanaged risk will have a lasting negative impact on financial performance, thereby weakening profitability stability.

These short-term and long-term relationships highlight the importance for banks across all KBMI groups to strengthen risk management, improve asset quality, and maintain operational stability. Effective

control of RPKM is therefore essential to balance risk and return, ensuring that ROA remains optimal over time.

The RMIA variable also shows a strong relationship with ROA in both the short and long run. In the short run, an increase in RMIA has a positive effect on ROA, indicating that better asset management or investment efficiency enables banks to improve income generation and resource utilization, thereby enhancing profitability.

In the long run, the positive effect of RMIA on ROA remains, although it largely depends on the consistency of asset management strategies implemented by each bank. Banks that maintain high-quality earning assets, diversify investments, and optimize fund allocation tend to achieve more stable and higher ROA. Conversely, poor asset management may weaken this positive impact over time.

This relationship indicates that RMIA not only improves short-term performance but also serves as a strategic factor in sustaining long-term profitability. Therefore, all KBMI groups need to strengthen asset and investment management to maintain an optimal balance between risk and return.

Finally, the performance of commercial banks across KBMI groups reflects a strong linkage between short-term dynamics and long-run equilibrium, as indicated by the Error Correction Term (ECT) in the ECM model. The negative ECT value ( $-0.1041$ ) indicates that when deviations from long-run equilibrium occur, the banking system adjusts back toward equilibrium.

In the short run, variables such as BOPO, NIM, LDR, RPKM, and RMIA influence ROA in a fluctuating manner. However, the presence of the ECT suggests that such disequilibria are not permanent. The ECT coefficient of  $-0.1041$  indicates that approximately 10.41% of the disequilibrium is corrected within one period, implying a gradual adjustment process.

In the long run, this confirms the existence of cointegration among variables, meaning that bank performance is not only influenced by temporary factors but also by stable structural equilibrium relationships. Thus, despite short-term pressures or changes, banks within KBMI groups tend to return to an optimal performance path. This highlights the importance of maintaining strong fundamentals to ensure effective adjustment toward long-run equilibrium.

## VI. CONCLUSION

Based on the results of this study using a dynamic panel Error Correction Model (ECM), it can be concluded that the performance of commercial banks in Indonesia, categorized into KBMI1, KBMI2, KBMI3, and KBMI4, exhibits both short-term and long-term interrelated relationships. The estimation results indicate the existence of a long-run equilibrium between the variables examined and bank performance. This is evidenced by the Error Correction Term (ECT), which is significant and negatively signed, implying that when short-term disequilibrium occurs, the system will automatically adjust to return to long-run equilibrium.

In the short run, the effects of variables on bank performance vary across KBMI groups. This suggests that each group of banks has distinct characteristics and responds differently to changes in economic conditions as well as internal variables. Banks in higher KBMI categories tend to be more stable and better able to adjust compared to those in lower KBMI groups. Meanwhile, smaller KBMI groups tend to be more sensitive to short-term fluctuations.

Based on these findings, it can be concluded that the ECM approach is highly appropriate for analyzing banking performance, as it is capable of capturing both short-term and long-term adjustment dynamics simultaneously. Furthermore, the differences in behavior across KBMI groups indicate that banking analysis should not be generalized, but rather differentiated according to bank categories.

The study offers several recommendations. First, bank management should consider long-term equilibrium in decision-making, rather than focusing solely on short-term outcomes. Second, banks in lower KBMI categories need to enhance performance stability to reduce vulnerability to economic fluctuations. Third, regulators such as Otoritas Jasa Keuangan (OJK) can utilize the KBMI classification as a basis for formulating more targeted policies in accordance with the characteristics of each bank group.

In addition, future research is recommended to extend the observation period and expand the set of variables, for instance by including macroeconomic variables such as interest rates, inflation, and exchange rates, in order to provide a more comprehensive understanding of banking performance in Indonesia.

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