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The Impact of Exchange Rate, Inflation, BI7DRR, and Money Supply on the Efficiency of Indonesian Commercial Banks 2018-2024 Period: An Error Correction Model

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Abstract

This study is motivated by the urgency to maintain the operational efficiency of Indonesia's banking sector amid ongoing global economic uncertainty in the post-COVID-19 era, exchange rate volatility, inflationary pressures, and the dynamics of both domestic and international monetary policies. Banking efficiency is a crucial factor in sustaining competitiveness and ensuring the stability of the financial system, especially when facing persistent external pressures. The main objective of this study is to analyze the impact of key macroeconomic variables exchange rate, inflation, the Bank Indonesia 7-Day Reverse Repo Rate (BI7DRR), and money supply on the efficiency of Indonesian commercial banks during the 2018–2024 period. Bank efficiency is measured using the Operating Expenses to Operating Income (OpEx) ratio, which reflects the bank's ability to manage its operational costs effectively. The study employs the Error Correction Model (ECM) to capture both the short-term and long-term relationships between macroeconomic variables and banking efficiency. The results reveal that exchange rate fluctuations have a significant impact on bank efficiency in the short term, while inflation and money supply exert significant influence in the long term. Conversely, BI7DRR does not show a significant effect in either the short or long term. These findings suggest that banks' responses to macroeconomic pressures are dynamic and gradual, requiring continuous strategic adjustments. This research contributes to the literature on banking economics in developing countries and provides practical recommendations for policymakers and banking industry stakeholders in formulating monetary policies and operational strategies that are adaptive to volatile economic conditions.

Keywords: *Exchange Rate, Inflation, BI7DRR, Money Supply, OpEx, ECM*

Introduction

Operational efficiency is a fundamental aspect in maintaining the competitiveness and sustainability of the banking industry, especially amid global economic turbulence that remains uncertain in the post-COVID-19 era (Fadillah et al., 2024). This uncertainty is exacerbated by geopolitical crises such as the Russia–Ukraine war, global supply chain disruptions, and the dynamics of global monetary policies, particularly interest rate policies by the United States central bank (The Fed), which have placed significant pressure on the macroeconomic stability of many countries, including Indonesia (Agustin et al., 2022). In such conditions, banks are

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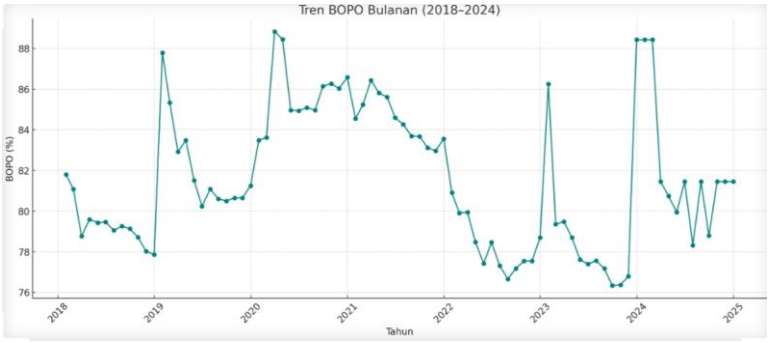
required to maintain operational efficiency to sustain the overall efficiency and resilience of the national financial system.

The commonly used indicator to measure efficiency is the OPEX ratio (Operating Expenses to Operating Income). The lower the OPEX ratio, the more efficient a bank is in managing its available resources (Lutfiana & Yulianto, 2015). A high level of efficiency reflects a bank's ability to minimize costs without sacrificing productivity and service quality, while simultaneously enhancing competitiveness in the face of rapidly changing economic conditions. However, banking efficiency is not solely determined by internal factors; it is also strongly influenced by macroeconomic conditions (Hanania, 2015).

The post-pandemic global economic turmoil, coupled with inflationary pressures, supply chain disruptions, and monetary policy responses from various countries, has posed major challenges to the stability of the financial sector, including Indonesia's banking industry (Rizky & Utomo, 2024). Banks have had to deal with operational efficiency pressures due to slowing economic activity, liquidity fluctuations, and market uncertainty. In this context, the 2018–2024 period is particularly significant to examine, as it captures the accumulation of various dynamics, from the pre-pandemic era to the post-COVID-19 recovery phase (Hidayat et al., 2024).

The pandemic caused major shocks that forced the banking sector to undertake structural adjustments to survive. In the aftermath, surging commodity prices and global distribution disruptions drove inflation, which was then responded to by central banks, including Bank Indonesia, through interest rate adjustments as part of contractionary monetary policies (Hutagaol et al., 2022). Meanwhile, the government also implemented expansionary monetary policies to maintain economic recovery momentum. All these dynamics have affected banking operational efficiency, both in terms of cost structure, operating income, and the adaptation of business strategies in response to external and domestic pressures.



Picture 1. *Monthly Trend of OPEX Ratio of Commercial Banks for the 2018–2024 Period*

Throughout the 2018–2024 period, Indonesia's economy has undergone complex dynamics. Sharp fluctuations in the rupiah exchange rate, inflationary pressures due to rising energy and food prices, as well as Bank Indonesia's alternating contractionary and expansionary monetary policies in response to global and domestic economic conditions, have significantly influenced the cost structure and operational strategies of banks (Sonambela et al., 2023). OPEX trend data indicate significant fluctuations, with spikes in early 2019 and 2020 suggesting an increase in operational costs or a decline in bank revenues, likely resulting from the rupiah's depreciation and reduced economic activity during the pandemic. The decline in OPEX throughout 2022 reflects improved efficiency in line with economic recovery, while the

resurgence in early 2024 indicates that external pressures remain relevant to banking efficiency.

The macroeconomic and monetary literature, variables such as exchange rate, inflation, policy interest rate (BI7DRR), and money supply (M2) are recognized as key determinants of financial system stability (Achmadi, 2023). The exchange rate, for instance, plays a role in determining the cost of acquiring capital goods and technology for banks and affects the valuation of foreign currency assets and liabilities (Ayu et al., 2024). Inflation impacts consumer purchasing power, credit portfolio quality, and operational burdens, as suggested by monetarist perspectives and money demand theory (Arya et al., 2020). The BI7DRR, which serves as a benchmark for the interbank rate, directly influences banks' cost of funds and earnings from intermediation activities (Kim & Choi, 2017). Meanwhile, the money supply affects systemic liquidity and banks' capacity for credit expansion (Hidayat et al., 2019). However, the relationship between these four macroeconomic variables and the efficiency of commercial banks in Indonesia has rarely been examined simultaneously using an econometric approach that distinguishes between short-term and long-term effects. According to the theory of dynamic adjustment and the monetary transmission mechanism, banks' efficiency responses to macroeconomic changes are not instantaneous but occur through a gradual adjustment process. Therefore, applying the Error Correction Model (ECM) becomes crucial to capture the dynamic relationship between these variables and banking efficiency.

Several previous studies have attempted to identify the impact of macroeconomic variables on bank efficiency. The research found that exchange rate depreciation increases operational costs and reduces efficiency (Palupi & Azmi, 2019). Inflation negatively affects short-term efficiency but can be mitigated through long-term strategic adjustments. The research confirmed that BI7DRR affects efficiency through lending and deposit interest rate mechanisms (Ardana, 2016). Meanwhile, the studies an increase in the money supply supports efficiency by expanding credit capacity (Hakim, 2024).

Theoretically, bank efficiency is determined by both internal and external factors. Internal factors include management, technology, and organizational structure, while external factors relate to macroeconomic conditions. This study focuses on the influence of four key external variables exchange rate, inflation, BI7DRR, and money supply on the efficiency of Indonesian commercial banks, as reflected by the OPEX ratio. Using the ECM approach, this study aims to identify both short-term and long-term effects and to understand the adjustment dynamics of bank efficiency in response to macroeconomic changes. Against this background, this research is expected not only to contribute to the development of the monetary economics and banking literature but also to serve as a policy reference for monetary authorities and financial industry players in formulating efficiency strategies that are adaptive to ever-changing economic conditions.

The novelty of this study lies in the application of the Error Correction Model (ECM) to analyze the simultaneous effects of exchange rate, inflation, BI7DRR, and money supply on the efficiency of Indonesian commercial banks, distinguishing between short-term and long-term impacts. Furthermore, the analysis period of 2018–2024, which encompasses the pre-pandemic, pandemic, and post-pandemic phases, offers a comprehensive perspective on the dynamics of banking efficiency in response to sustained global and domestic macroeconomic shocks.

Method

This study employs a quantitative causal research design using a time series econometric approach to investigate both the short-term and long-term effects of macroeconomic variables namely exchange rate, inflation, BI7DRR (Bank Indonesia's 7-Day Reverse Repo Rate), and money supply (M2) on the operational efficiency of commercial banks in Indonesia, as measured by the OPEX (Operating Expenses to Operating Income) ratio. The econometric framework applied is the Error Correction Model (ECM), which is suitable for capturing dynamic adjustments in response to macroeconomic shocks over time..

The population of this study includes all commercial banks operating in Indonesia from 2018 to 2024. A total of 84 monthly observations were selected based on data availability and completeness, with secondary data obtained from the Financial Services Authority (OJK) and Statistics Indonesia (BPS). The data span from January 2018 to December 2024, and are treated as monthly time series to ensure that macroeconomic trends are adequately captured.

Data collection was conducted through documentation techniques, utilizing publicly available macroeconomic and banking efficiency indicators. Stationarity of each time series variable was tested using the Phillips-Perron (PP) unit root test, while the Johansen Cointegration Test was applied to examine the existence of long-run relationships among variables (Castro & Rodrigues, 2015). These diagnostic steps justified the use of the ECM methodology (Kim & Choi, 2017). Once cointegration was confirmed, the long-run relationship was estimated using the Ordinary Least Squares (OLS) method (Castro & Rodrigues, 2015).

The Error Correction Model (ECM) is an econometric model used to capture both short-term relationships and the correction mechanisms towards long-term equilibrium in time series data (Ardana, Y. 2016). ECM can only be applied if there is a cointegrating relationship between the variables. Using the ECM method, the following linear regression model equation can be derived: $Y_t = c + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + ECT(1)$. Where: Y = Efficiency of Commercial Banks, X1 = Exchange Rate, X2 = Inflation, X3 = BI7DRR, X4 = Money Supply, and ECT = Error Correction Term

The Error Correction Model (ECM) is used to assess the impact of the independent variables on the dependent variable in the short term, and to determine whether there is any long-term impact of the independent variables on the dependent variable. The OLS estimator is applied under the assumption that it satisfies the Gauss-Markov conditions, ensuring that the estimated coefficients are BLUE (Best Linear Unbiased Estimator). This implies that, among all linear and unbiased estimators, OLS has the minimum variance. An ECM was then developed to assess short-run dynamics and the speed of adjustment toward long-run equilibrium.

Several statistical tests were conducted, including the t-test for individual parameter significance, the F-test for overall model significance, and the R-squared (R^2) to measure the explanatory power of the regression to evaluate the validity and reliability of the model. Classical assumption tests such as tests for autocorrelation, heteroscedasticity, and normality of residuals were also performed to ensure that the OLS assumptions were met. All data analysis and model estimation were conducted using EViews software.

Results

The data analysis in this study is the result of data processing that has been tested using statistical and econometric analysis approaches. The processing was carried out with the assistance of EViews 12 software to evaluate the research outputs. The following presents the data analysis results obtained through the application of the Error Correction Model (ECM) method.

Unit Root Test

The initial stage of this analysis is the unit root test to evaluate the stationarity of the time series data and prevent spurious regression. This study uses the Phillips-Perron method, incorporating a constant and trend to ensure the data meets the stationarity assumption before proceeding with further modeling.

Table 2. *Unit Root Test Result*

Variable	T-Statistics	Prob	Crit Value 1%	Crit Value 5%	Crit Value 10%
X1	-9.802655	0.0000	-3.513344	-2.897678	-2.588103
X2	-7.567097	0.0000	-3.512229	-2.897223	-2.585881
X3	-4.838937	0.0006	-3.512229	-2.897223	-2.585881
X4	-13.48011	0.0001	-3.512229	-2.897223	-2.585881

Based on the results of the unit root test shown in the table, all variables X1, X2, X3, and X4 became stationary after first differencing. This is indicated by t-Statistic values smaller than the critical values at the 1%, 5%, and 10% significance levels, leading to the rejection of the null hypothesis (H0: the variable has a unit root/is non-stationary). Additionally, the probability (Prob) values less than 0.05 indicate statistical significance at the 5% confidence level. Therefore, all variables are integrated of order one, I(1), allowing for further cointegration testing. If the cointegration test shows a long-term relationship between the variables, the appropriate approach is the Error Correction Model (ECM).

Cointegration Test

Cointegration indicates a long-term relationship between variables that are individually non-stationary, but their linear combination can become stationary. The cointegration test aims to identify the long-term equilibrium between economic or financial variables and is a continuation of the unit root test and integration degree analysis. If the variables are cointegrated, it means there is a stable long-term relationship, whereas if not, there is no long-term linkage between the variables.

Table 2. *Cointegration Test Result*

Variable		Trace	5%	
No. Of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None*	0.302227	73.86758	69.81889	0.0229
At most 1	0.272273	44.71878	47.85613	0.0957
At most 2	0.141784	18.97457	29.79707	0.4947
At most 3	0.075180	6.589722	15.49471	0.6258
At most 4	0.003193	0.259044	3.841465	0.6108

Based on the results of the Johansen cointegration test, it is found that there is at least one cointegrating relationship among the variables. This is indicated by a Trace Statistic value of 73.86788, which is greater than the critical value at the 5% level of 69.81889, with a probability of 0.0229 < 0.05, leading to the rejection of the null hypothesis (no cointegration).

However, for the hypothesis of at most 1 and beyond, the Trace Statistic value is smaller than the critical value, so the null hypothesis cannot be rejected, indicating that only one cointegrating relationship exists in this model.

Given the cointegrating relationship, it can be concluded that the variables in this study have a long-term equilibrium relationship, even though they are individually non-stationary at the level. Therefore, the appropriate model to use for further analysis is the Error Correction Model (ECM), which captures both short-term relationships and the adjustment process towards long-term equilibrium

Error Correction Model

The Error Correction Model (ECM) is a method used to test the long-term equilibrium in an economic relationship. The validity of the ECM is determined by the significance of the Error Correction Term (ECT) coefficient. If the ECT is statistically significant, the model can be used to explain the long-term relationship and the adjustment process toward equilibrium. However, if the ECT is not significant, the model is considered less appropriate and may require further adjustments or modifications. The following is the ECM model used in this study:

$$DY_t = c + b_1DX_1 + b_2DX_2 + b_3DX_3 + b_4DX_4 \ ECT(1)$$

Where:
DY_t = Y_t-Y_{t-1}
DX_1 = X_1-X_{1t-1}
DX_2 = X_2-X_{2t-1}
DX_3 = X_3-X_{3t-1}
DX_4 = X_4-X_{4t-1}
ECT = Resid (-1)
b = Koefisien Regresi ECM Jangka Pendek

Table 3. *Output Estimation*

Variable	Coefficient	Std.Error	Centered VIF	Prob.
C	0.001973	0.003138	0.627819	0.5320
D(X1)	0.185284	0.051157	3.621877	0.0005
D(X2)	-0.034958	0.025302	-1.381628	0.1711
D(X3)	-0.063235	0.080435	-0.786164	0.4342

Based on the results of the Error Correction Model (ECM) estimation, the coefficient of the Error Correction Term (ECT) shows a t-statistic value greater than ±1.99 and a p-value less than 0.05. This indicates that the ECT is statistically significant at the 95% confidence level. It suggests the presence of an adjustment mechanism toward long-term equilibrium within the tested model. In other words, if a short-term disequilibrium occurs, the system will undergo a correction process to return to its long-term equilibrium. This demonstrates that the relationships among the variables in the model are economically grounded, and the ECM used is valid and reliable for further analysis.

Multicolinearity Test

Multicollinearity testing on the independent variables can be analyzed using the Variance Inflation Factor (VIF) and tolerance values. If the VIF is greater than 1 or the tolerance value is less than 10, and conversely, the tolerance is greater than 0.10, it can be concluded that multicollinearity is not present.

Table 4. *Multicolinearity Test*

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	9.84E-06	1.253361	NA
D(X1)	0.002617	1.198957	1.197249
D(X2)	0.000640	1.024424	1.018161
D(X3)	0.006470	1.093616	1.079397
D(X4)	0.046184	1.437093	1.185445
ECT	0.008508	1.087017	1.086942

Based on the results of the test, no correlation was found among the independent variables, as indicated by VIF values below 10. Therefore, it can be concluded that the regression model is free from multicollinearity issues.

Heteroskedasticity Test

The Breusch-Pagan-Godfrey test is used to detect whether there is non-constant variance (heteroskedasticity) in the residuals of the regression model. If the p-value (Prob. Chi-Square) is less than the significance level (5%), it indicates the presence of heteroskedasticity in the model. If the p-value is greater than the significance level, the model does not exhibit heteroskedasticity (homoskedasticity), meaning the residual variance is constant.

Table 5. *Heteroskedasticity Test*

F-Statistic	Prob. F(5,77)	Obs*R-Squared	Prob.Chi-Square(5)	Scaled Explained SS	Prob. Chi-Square (5)
1.762546	0.1306	8.523872	0.1296	21.30766	0.0007

Based on the results of the heteroskedasticity test using the Breusch-Pagan-Godfrey method, the Prob. Chi-Square (Obs*R-Squared) value is 0.1296, which is greater than the significance level of 0.05 (0.1296 > 0.05). Therefore, it can be concluded that the residual variance is constant (homoskedasticity), indicating that the regression model meets the classical assumptions and can be interpreted more accurately, producing efficient estimates.

Auto-Correlation Test

The Durbin-Watson (DW) test is used to detect the presence of first-order autocorrelation in the residuals of a linear regression model, particularly for time series data.

Table 6. *Auto-Corelation Test*

Durbin Watson Value	Conclusion
0-1	Strong positive autocorrelation
1-dL	Indication of positive autocorrelation
dL-dU	Inconclusive
dU-(4-dU)	No Autocorrelation
(4-dU)-(4-dL)	No Autocorrelation
(4-dL)-4	Indication of negative autocorrelation

Based on the Durbin-Watson test results, the DW value obtained is 1.828994, while the upper critical value (dU) is 1.7685 and the threshold for no autocorrelation is 4–dU = 2.2315. Since the DW value falls within the range of dU < DW < (4–dU), it can be concluded that there is no autocorrelation in the regression model. This result indicates that the residuals in the model are independent and do not exhibit a systematic pattern that could affect the accuracy of parameter estimation. Therefore, the classical regression assumption of residual independence is fulfilled, making the model more valid and capable of producing efficient estimates.

Short-Term t-Test Statistics (Partial Analysis)

The individual significance test aims to evaluate whether each independent variable has a significant impact on the dependent variable. This test is conducted by comparing the t-statistic with the critical t-value (t-table), or by examining the probability value (p-value). If the t-statistic is greater than the t-table value, or if the p-value is less than 0.05, then the independent variable has a statistically significant effect on the dependent variable.

Table 7. *Short-Term t-Test Results*

Variable	Coefficient	t-Statistic	Critical Value	Prob.	Decision
D(X1)	0.185284	3.621877	1.99085	0.0005	Significant
D(X2)	-0.034958	-1.381628	1.99085	0.1711	Not Significant
D(X3)	-0.063235	-0.786164	1.99085	0.4342	Not Significant
D(X4)	-0.362525	-1.686905	1.99085	0.0957	Not Significant

Based on the two-tailed short-term t-test results, only the Exchange Rate variable (D(X1)) is found to have a significant influence on the operational efficiency of commercial banks. Meanwhile, Inflation (D(X2)), BI7DRR (D(X3)), and Money Supply (D(X4)) are not statistically significant in the short run. The exchange rate (D(X1)) has a t-statistic of 3.621877, which is greater than the t-table value of 1.99085, with a probability of 0.0005 < 0.05. This indicates that the exchange rate has a statistically significant effect on bank efficiency in the short term. This suggests that exchange rate fluctuations directly impact banking efficiency, likely through their influence on foreign exchange transactions and the value of foreign-denominated assets and liabilities.

On the other hand, inflation (D(X2)) has a t-statistic of -1.381628, which is lower than the t-table value, and a probability of 0.1711 > 0.05, indicating no significant effect. This implies that short-term inflation changes do not directly affect bank efficiency. Similarly, the BI7DRR (D(X3)) does not have a significant short-term impact, with a t-statistic of -0.786164 and a p-value of 0.4342. This shows that policy interest rate changes have yet to show a tangible effect on bank efficiency in the short term. Finally, the money supply (D(X4)) has a t-statistic of -1.686905, which is still below the t-table value of 1.99085, with a probability of 0.0957. Although this is below 10%, it is not statistically significant at the 5% level. This indicates that short-term changes in the money supply do not yet have a direct impact on banking efficiency, though they may exert a more apparent influence in the long term.

F-Statictic Test (Simultanous Analysis)

Simultaneous Test or F-Test is a statistical procedure used to determine whether the independent variables jointly have a significant effect on the dependent variable. The following are the results of the F-test using EViews 12:

Table 8. *Short-Term F-Test Results*

Test Statistic	Value
F-Statistic	8.075127
Prob (F-Statistic)	0.000004

Based on the F-test results, the calculated F-value is 8.075127, while the F-table value at the 5% significance level is 2.333308. Since the calculated F-value is greater than the F-table value (8.075127 > 2.333308), we reject the null hypothesis (H0). This indicates that, simultaneously, the independent variables, Exchange Rate, Inflation, BI7DRR, and Money Supply (M2) have a significant influence on the Efficiency of Commercial Banks. Therefore, the

regression model is valid and can be used to explain how these macroeconomic factors collectively affect bank efficiency with a 95% confidence level.

Coefficient of Determination (R^2)

The R-squared (R^2) value is used to measure how much of the variation in the dependent variable is explained by the independent variables in a regression model, with a range between 0 and 1 (Arya et al., 2020). A value closer to 0 indicates a weaker influence, while a value closer to 1 suggests a stronger influence. In the Error Correction Model (ECM) estimation, the R^2 value is 0.343987 and the Adjusted R^2 is 0.301388. This means that approximately 30.1% of the variation in Commercial Bank Efficiency can be explained by the Exchange Rate, Inflation, BI7DRR, and Money Supply (M2) in the short run. The remaining 69.9% is influenced by other factors not included in the model

Long-Term t-Test Statistics (Partial Analysis)

The individual test aims to evaluate whether each independent variable has a significant effect on the dependent variable. This test is carried out by comparing the t-statistic with the t-table value or by examining the probability level (p-value). If the t-statistic is greater than the t-table value, or if the p-value is less than 0.05, the independent variable is considered to have a significant impact on the dependent variable individually.

Table 9. *Long-Term t-Test Results*

Variable	Coefficient	t-Statistic	Critical Value	Prob.	Decision
X1	0.261973	3.279576	1.99085	0.0015	Significant
X2	-0.057455	-5.887402	1.99085	0.0000	Significant
X3	-0.027563	-1.439118	1.99085	0.1541	Not Significant
X4	-0.100584	-3.594612	1.99085	0.0006	Significant

Based on the results of the long-run t-test, the Exchange Rate (X1), Inflation (X2), and Money Supply (X4) have a significant impact on commercial bank efficiency (Y), while the BI7DRR (X3) does not have a significant effect in the long run. The Exchange Rate (X1) has a t-statistic of 3.279576, which is greater than the t-table value of 1.99085, with a probability of 0.0015 < 0.05, indicating that the exchange rate significantly affects commercial bank efficiency in the long run. Inflation (X2) has a t-statistic of -5.887402, which is larger than the t-table value in absolute terms, with a probability of 0.0000 < 0.05, indicating a significant effect on bank efficiency. The BI7DRR (X3) has a t-statistic of -1.439118, smaller than the t-table value of 1.99085, with a probability of 0.1541 > 0.05, meaning that in the long run, BI7DRR does not have a significant effect on commercial bank efficiency. The Money Supply (X4) has a t-statistic of -3.594612, which is greater than the t-table value in absolute terms, with a probability of 0.0006 < 0.05, indicating that money supply significantly affects commercial bank efficiency in the long run.

F-Statictic Test (Simultanous Analysis)

Simultaneous Test or F-Test is a statistical procedure used to determine whether the independent variables jointly have a significant effect on the dependent variable. The following are the results of the F-test using EViews 12:

Table 10. *Long-Term F-Test Results*

Test Statistic	Value
F-Statistic	10.04797
Prob (F-Statistic)	0.000001

Based on the F-test results, the F-statistic is 10.04797 and the F-table value is 2.333308 at the 5% significance level. Since the F-statistic is greater than the F-table value, we reject the null hypothesis (H0), meaning that, simultaneously, the independent variables, namely Exchange Rate, Inflation, BI7DRR, and Money Supply (JUB), have a significant impact on the Efficiency of Commercial Banks in the long run. Therefore, this regression model can be used to explain how these macroeconomic factors influence commercial bank efficiency with a 95% confidence level.

Coefficient of Determination (R^2)

The R-squared (R^2) value is used to measure how much the independent variables influence the dependent variable in a regression model, with values ranging from 0 to 1 (Arya et al., 2020). The closer the value is to 0, the smaller the influence of the independent variables on the dependent variable, whereas the closer it is to 1, the greater the influence. In the long-term test, the Adjusted R^2 value is 0.337208, and in the short-term, the Adjusted R^2 is 0.303644, indicating that 33.7% of the variation in the Efficiency of Commercial Banks can be explained by the Exchange Rate, Inflation, BI7DRR, and Money Supply in the short term, while 66.3% is influenced by other factors not included in the model. In the long term, 30.3% of the variation in the Efficiency of Commercial Banks can be explained by these factors, with the remaining 69.7% being influenced by other factors not included in the model.

Discussion

Exchange Rate on the Efficiency of Commercial Banks

The exchange rate significantly influences the operational efficiency of commercial banks, which can be measured through the Operational Cost-to-Income Ratio (OPEX). The OPEX ratio reflects how efficiently a bank manages its operating costs compared to the income it generates. Exchange rate fluctuations can impact OPEX both in the short and long term through various mechanisms.

The exchange rate changes can directly affect a bank's operating costs. If the exchange rate depreciates (the rupiah weakens), the bank's operating costs tend to rise, especially for banks with exposure to foreign currency transactions (Achmadi, 2023). For instance, a bank with foreign currency debt or involved in import financing will face higher costs, which can increase the OPEX ratio. Additionally, exchange rate depreciation can increase credit risk for debtors with foreign currency liabilities but income in rupiah (Palupi & Azmi, 2019). If credit risk rises, the bank needs to set aside higher provisions, further increasing operating costs and reducing banking efficiency. Conversely, exchange rate appreciation (rupiah strengthening) can reduce operating costs and improve efficiency in the short term, especially for banks with foreign currency assets (Sonambela et al., 2023).

The continuously fluctuating exchange rates may force banks to adjust their operational strategies to maintain efficiency (Andriani, 2017). If the exchange rate depreciation lasts for an extended period, banks may be encouraged to increase efficiency by managing operating expenses more tightly, such as optimizing digital banking technology or reducing reliance on foreign currency funding sources (Sia et al., 2025). On the other hand, high exchange rate volatility can create uncertainty in operational income, requiring banks to strengthen risk management to maintain OPEX stability.

Inflation on the Efficiency of Commercial Banks

Estimation results show that inflation does not significantly impact OPEX in the short term but does have a significant effect in the long term. The lack of significance in the short term may be due to the rigidity of banking operating costs, which are mostly fixed in the short run, such as employee salaries, building rents, and service contracts (Hanania, 2015). Banks also have the flexibility to absorb short-term inflation pressures through internal efficiency or budget management (Sihombing & Marbun, 2022).

The accumulated price pressures due to inflation lead to structural increases in operational costs, particularly in labor, operational materials, logistics, and energy costs. Higher inflation reduces the real value of savings, as rising prices erode purchasing power. As a result, people tend to focus more on using their funds for consumption rather than saving. This condition may pressure bank efficiency. If inflation continues to rise in the long term, its effects will become more pronounced as prices continue to increase, even though it may not have a significant impact in the short term (Hanania, 2015). During the 2018–2024 period, the rising global inflation pressures since 2022, caused by the energy crisis and supply chain disruptions post-COVID-19 pandemic, gradually increased banking operating costs, as reflected in the rising OPEX. This highlights that inflation is a critical factor to consider in maintaining long-term banking efficiency.

BI7DRR on the Efficiency of Commercial Banks

BI7DRR does not show a significant effect on OPEX, both in the short and long term. This lack of significance suggests that changes in Bank Indonesia's policy interest rates are not strong enough to directly influence bank operational efficiency. In practice, banks have room to adjust deposit and loan interest rates, thus maintaining profit margins even with changes in the BI7DRR (Sihombing & Marbun, 2022). Furthermore, improvements in interest rate risk management and asset-liability management allow banks to mitigate the impact of interest rate fluctuations on operational performance. The 2018–2024 period includes both a phase of rate cuts during the pandemic and a phase of increases since 2022; however, bank operational efficiency remained relatively stable due to adaptations via digitalization, cost adjustments, and increased non-interest income (Susilo, 2025). Therefore, the effect of monetary policy on bank efficiency via the BI7DRR channel appears limited.

Money Supply on the Efficiency of Commercial Banks

Money Supply (M2) does not significantly affect OPEX in the short term but shows a significant impact in the long term. The lack of significance in the short term indicates that an increase in the money supply does not immediately lead to improved banking operational efficiency. This is due to limitations in the liquidity transmission to the real sector, particularly during the COVID-19 pandemic, when credit demand weakened and banks tended to be cautious (Winarto & Beik, 2024). Conversely, in the long term, an increase in M2 contributes to banking efficiency through increased intermediation activities (Fadillah et al., 2024). With more liquidity available, banks can disburse more credit, raising interest income and lowering the OPEX ratio due to economies of scale. The 2022–2024 period witnessed a recovery in credit disbursement alongside rising economic mobility and consumption, indicating that M2 growth can support bank efficiency if accompanied by optimal credit demand recovery and expansion.

Simultaneous Effects

The F-test results show that, simultaneously, the exchange rate, inflation, BI7DRR, and money supply significantly affect the efficiency of commercial banks in Indonesia, both in the short and long term. This finding economically reflects that banking efficiency is not solely influenced by one macroeconomic indicator in isolation but by the complex interaction of various factors influencing one another (Sihombing & Marbun, 2022). In the framework of monetary policy transmission, changes in the policy interest rate (BI7DRR) can influence funding costs and credit demand, while inflation increases aggregate operational cost pressures. The exchange rate plays a crucial role in determining the value of bank foreign currency assets and liabilities, as well as influencing credit risk volatility (Palupi & Azmi, 2019). Meanwhile, the money supply determines the amount of liquidity available for intermediation to the real sector through bank functions (Putri, 2024). When these four variables move together in unsynchronized directions, such as an increase in interest rates amidst high inflation and exchange rate depreciation, banks must adjust their efficiency strategies holistically. Efficiency becomes harder to achieve if macroeconomic pressures come from multiple sides simultaneously. Therefore, the testing results emphasize the importance of coordination between monetary policy, price stability, liquidity management, and exchange rate stability as prerequisites for sustained operational efficiency in the national banking system.

Conclusion

This study successfully reveals that macroeconomic variables, namely the exchange rate, inflation, BI7DRR (Bank Indonesia 7-Day Reverse Repo Rate), and money supply, have a significant impact on the operational efficiency of commercial banks in Indonesia, with differing effects in the short and long term. The exchange rate shows a significant influence in the short term, while inflation, BI7DRR, and money supply exert stronger effects over the long term. Using the Error Correction Model (ECM) approach, the study identifies a long-run relationship between these macroeconomic factors and bank efficiency, highlighting the importance of adjustment mechanisms to maintain equilibrium amid economic fluctuations.

This research is limited in scope as it focuses solely on external macroeconomic factors, without incorporating internal bank variables such as management structure, technology adoption, and internal operational efficiency. Future research is recommended to integrate both internal and external variables simultaneously and employ bank-level panel data for more detailed insights. The practical implications of these findings are crucial for policymakers and banking industry players, as they underscore the need for adaptive strategies in response to macroeconomic pressures, including interest rate adjustments, exchange rate risk management, and inflation control. On the theoretical front, the results contribute to the banking economics literature in developing countries by emphasizing the value of a dynamic approach in assessing banking efficiency, particularly in the context of ongoing global and domestic economic uncertainty in the post-pandemic era.

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