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The Asymmetric Effect of Interbank Rate and Financial Performance Ratios on Commercial Bank Profitability: Empirical Evidence of Macro-Level Data from Indonesia

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ABSTRACT

This study investigates the asymmetric effects of interbank rates and financial performance ratios on Indonesian commercial bank profitability. The contribution of this study is to provide analyzes that separate the effects of increases and decreases in interbank rates and bank soundness indicators proxied by financial performance ratios on profitability through the Nonlinear Autoregressive Distributed Lag model approach. The data analyzed were monthly data for the period of 2012M01 – 2020M12. Rising interest rates have a greater effect on increasing profits than decreasing interest rates in the long run. Changes in net interest margin have the effect of decreasing profitability when it goes up or down. The increase in efficiency as measured by a decrease in the operating expenses to operating income ratios significantly increases profitability, compared to when they increase. Likewise, a decrease in the loan-to-deposit ratio reduced bank profits. In the short run, increasing interest rates and decreasing loan-to-deposit ratio increase profitability. Commercial banks in their operations should focus more on increasing operational and income efficiency to increase profitability. Also, banks consistently and continuously should meet bank soundness indicators, especially capital adequacy and solvency.

INTRODUCTION

The issue of the link between financial soundness and bank profitability has become increasingly prominent recently, especially since the 2007 global financial crisis. Bank operations specifically face the problem of maturity mismatch which causes the bank to face risks in the financial environment (Yang et al., 2021). In their daily operations, banks can take advantage of the interbank money market to meet their short-term liquidity needs. In addition, because banks are engaged in a highly regulated financial industry due to the risks they face, monetary authorities, financial services authorities, and bank management pay more attention to the health performance of banks to promote financial stability. Changes in money market interest rates and financial performance can affect bank profitability. Bank profitability which can maintain the existence of bank operations plays a key role in supporting financial stability. The interest rates and bank performance effects on profitability are very important in supporting bank soundness and financial stability. According to M. Papavangjeli et al. (2018), the relationship between interest rates and profitability is very important in assessing the effect of monetary policy through the transmission to market interest rates and indicators of financial soundness on the profitability of banks which will support financial stability.

Indonesia is one of the emerging countries whose financial sector is still dominated by banks. The bank's role in Indonesia stands out in terms of asset value compared to other financial institutions. The asset value of commercial banks still dominates in the financial sector with a proportion of 79 percent, compared to other financial institutions (Andriansyah, 2016). The dominant role of banks in the financial sector is supported by the continuous increase in bank assets. Figure 1 shows a consistent increase in bank assets. The increase in assets was also followed by an increase in third-party funds and loans extended by the banking industry. The comparison between credit and third-party funds shows the performance of the implementation of the intermediation function of banks through the ratio of loan to deposit. The ratios of loan to deposit of commercial banks during 2012-2021 are around an average of 89 percent which is still following the applicable range provisions.

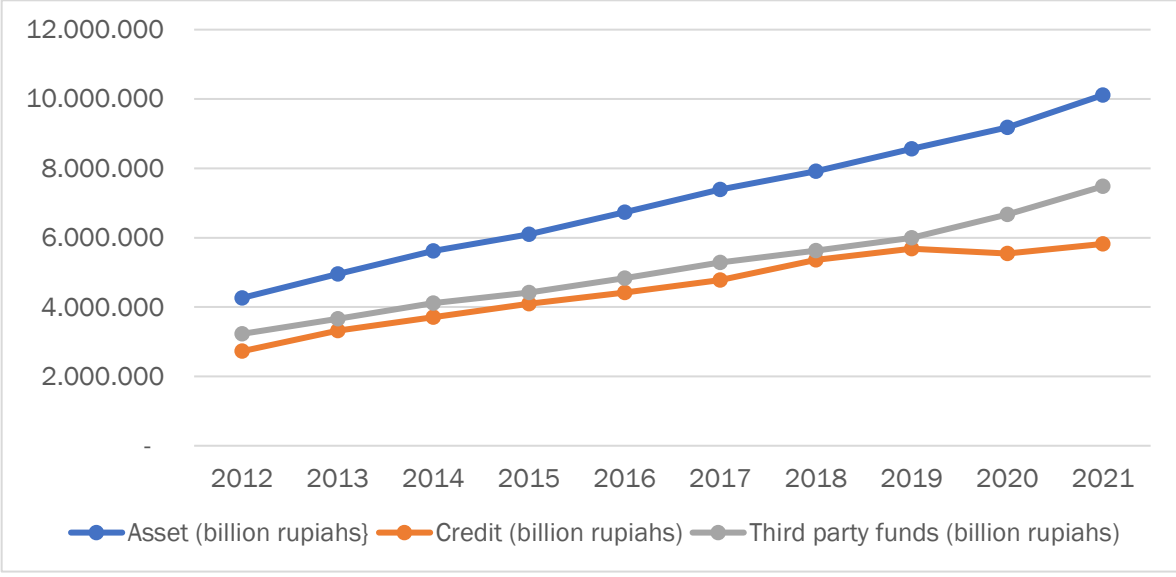

Figure 1. Asset, third-party funds, and credit of Indonesian commercial banks, 2012 – 2021

Source: Financial Services Authority (Otoritas Jasa Keuangan, OJK)

The study of commercial banks in Indonesia is interesting in terms of how their profit responds to changes in interest rates and financial soundness indicators. The relevance is that commercial bank operations still rely on interest income rather than non-interest income. The risks faced by banks due to changes in interest rates and bank soundness indicators are key factors that will affect bank profitability.

Figure 2 shows that the dominant source of bank income comes from interest income. Until 2021, even though the contribution of non-interest income has increased, the contribution of interest income appears to be greater than that of non-interest income. The possible consequence is that the bank's profitability is responsive to interest rate changes and financial performance ratios. Short-term interest rate changes in the monetary policy environment refer to policy interest rates whose changes follow the monetary policy stance.

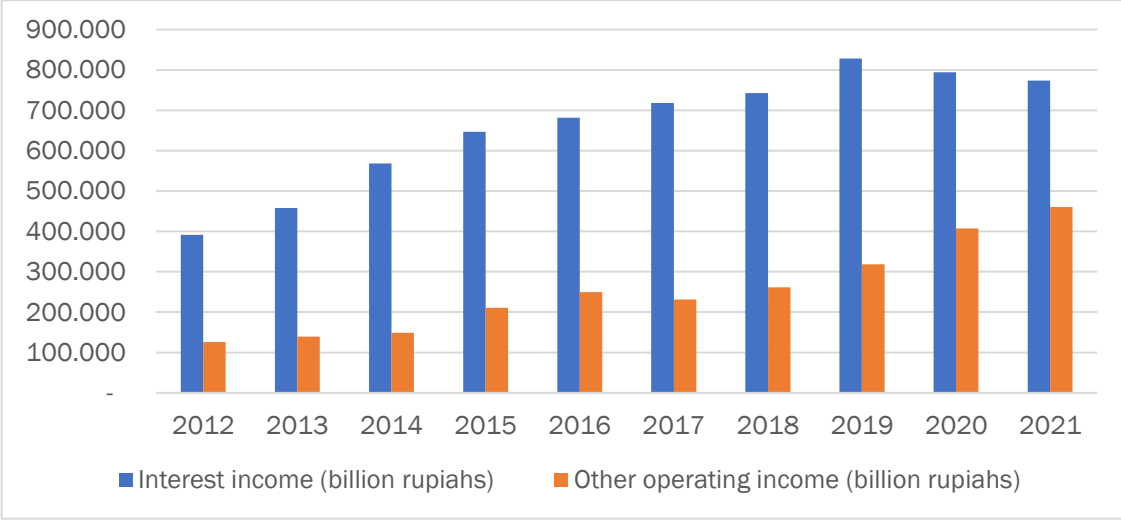

Figure 2. Interest income and other operating income of commercial banks in Indonesia, 2012 – 2021

Source: Financial Services Authority (OJK)

Bank profitability is one of the main elements in measuring bank performance. Bank performance will determine profit in bank operations. On a macro level, the profitability of banks will certainly support stability in the banking and financial sectors. Profitability for financial institutions that provide credit will be able to generate capital and loans that support bank operations (Altavilla et al. 2018). Several studies on bank performance related to interest rates and financial soundness indicators have been conducted, including studies conducted by C. Borio et al. (2017), S. Claessens et al. (2018), A. Rachman et al. (2019), V. Kumar et al. (2020), P. Agnese and P. Capuano (2021), L. Do et al. (2021), and H. Haddad et al. (2022), These studies provide empirical findings that interest rate and bank financial performance ratios as soundness indicators have significant effects on bank profitability. Healthy bank operations supported by high profitability support effective transmission of monetary policy. According to C. Borio et al. (2017), short-term interest rates directly affect the profitability of banks as measured by return on assets. On the other hand, good bank performance can support the effectiveness of the transmission of monetary policy. A study by M. Jonas and S. King (2008) shows evidence that the more efficient a bank's operations are, the more responsive it is to monetary policy. However, in an economy where there are higher risks faced by the banking industry, the response to decreases in the interest rates and financial health indicators may be different than to increases in interest rates and soundness indicators. This condition encourages the emergence of asymmetric effects, especially on the profitability of banks.

The existence of asymmetric effects becomes far more important for monetary and financial authorities in implementing policies and banking as a consideration in carrying out bank operations in responding to changes in interest rates and indicators of bank soundness. Banks will face different consequences when interest rates and their financial health decrease and when they increase, requiring different strategies to deal with these differences. The research model developed is aimed at analyzing bank performance from a macro perspective based on macro-level data. The research model proposes an alternative model that links market interest rates and the main indicators of bank soundness with profitability as an endogenous variable. The model was developed to separate the effects of increases and decreases in interest rates and financial soundness as represented by financial performance ratios by applying the Nonlinear

Autoregressive Distributed Lag (NARDL) model which was adapted from the model developed by Y. Shin et al. (2014). So, this study is aimed at investigating asymmetric effects in the long and short run.

1. LITERATURE REVIEW

In their operational activities, banks do not only focus on the orientation of earning income, but also on aspects of liquidity and risks. Therefore, increasing the ability to earn bank profits will sacrifice aspects of liquidity and risk. Banks will experience a decrease in their ability to generate profits when their liquidity is higher. Conversely, the lower the liquidity, as a sacrifice of liquidity, the bank has increased ability to earn profits. The interbank money market can play a role in reallocating liquidity from banks that have a liquidity surplus to banks that suffer from a liquidity deficit (Alaeddini et al., 2022). In conditions of declining bank liquidity to comply with provisions regarding reserve requirements and liquidity management, banks can make a demand for a loan from the interbank money market. Loans from the interbank money market are a source of funding for financing from second-party funds. Banks experiencing excess liquidity will act as lenders rather than borrowers, whereas banks experiencing a lack of liquidity, will demand loans.

Analysis of core bank transaction paths in the interbank call money market in Indonesia conducted by I. Yusgiantoro and A. Raymond (2016), showed that the core banks, which are the top tier banks, are the dominant banks in the interbank money market, and as the main source of lenders in the structure of the interbank money market network. Therefore, the increased interbank interest rate will benefit the dominant lenders in the interbank money market by increasing their interest income and increasing their ROA. On the other hand, for borrowing banks, rising interest rates increase the cost of funding. If the cost of funding increases faster than interest income, the ROA will decrease. Thus, the net aggregate effect of increases and decreases in interest rates on the interbank market will depend on the dominance of the lending or borrowing banks.

In monetary operations, an increase in interest rates on the interbank money market indicates a lack of liquidity, and open market operations require injection. Conversely, a decrease in interbank interest rates indicates excess liquidity, and open market operations require absorption. So, the monetary transmission that affects changes in interest rates on the interbank money market will have an impact on bank profitability.

Commercial banks are actually given the right to determine their interest rates independently according to the demand for funds and supply of funds, although interest rates are controlled indirectly by the central bank through policy rates, discount rates, statutory reserves, and open market operations. The marketized interest rates can affect the capabilities of risk management and the pricing of interest rates on deposits and loans for commercial banks under normal conditions (Zeng et al., 2022). Therefore, changes in interest rates on the interbank money market, along with the monetary operations, will affect the profitability of commercial banks.

In addition to interbank money market interest rates, financial performance as reflected by bank soundness indicators, as stipulated in applicable regulations, are also the main factors determining banks' profitability. The main financial performance indicators include aspects of capital adequacy, the market risk which is reflected in net interest income, the efficiency of bank operations related to expenditure and income, and lending related to aspects of bank liquidity. Each of these aspects is reflected in CAR, NIM, OEOI, and LDR.

The capital adequacy ratio for banks is used to measure financial strength based on capital and assets used in their operations. This capital strength can protect depositors and support overall financial stability. Strength in capital adequacy will increase the ability of banks to earn profits. With a high CAR, the bank has solvency so it can handle some losses and can avoid failure. An increased CAR will provide more opportunities to create higher profits. S. Khalifaturofi'ah (2021) obtained an empirical finding that CAR has a positive effect on commercial bank profitability, as measured by ROA. H. Haddad et al. (2022) also provide the same empirical findings that CAR increases bank profitability through increasing ROA. The positive effect of CAR on the ROA of banks was also proven empirically by H. Shabani et al. (2019). A. Capponi et

al. (2017) stated that the risk of default and the resulting losses can be reduced with adequate capital buffers owned by the bank.

As a financial institution that relies on interest income, the NIM ratio is appropriate to use in measuring bank performance which affects bank profitability as measured by ROA. The NIM reflects the pricing policy of the bank and has a mutual relationship with the asset structure (Marinkovic and Radovic, 2014). Increasing NIM due to a more aggressive asset structure will increase interest income to increase bank profitability. H. Haddad et al. (2022) provide empirical evidence that NIM significantly increases bank profitability. Likewise, the positive effect of NIM on bank ROA is also proven by the findings of studies by U. Widyastuti et al. (2017) and A. Rachman et al. (2019). The higher the NIM, the higher the bank's profitability through increasing interest income on managed productive assets.

The study by V. Kumar et al. (2020) also reports that the cost-to-income ratio harms bank profitability. Dsouza et al. (2022) provided findings that the ratio of cost to income has a negative effect on the bank's ROA. Increased efficiency drives increased profitability. B. Rakshit and S. Bardhan (2022) prove empirically that cost efficiency can increase the bank's ROA. Likewise, E. Puspitasari et al. (2021) prove that a decrease in OEOI, which means an increase in efficiency, increases bank profitability through an increase in ROA. Also, E. Jaouad and O. Lahsen (2018) and Do et al. (2021) provide evidence that an increase in bank efficiency, as measured by a decrease in the cost-to-income ratio, increases bank performance as measured by ROA. In a study related to the performance of insurance companies which are also financial institutions, Arintoko et al. (2021) put forward their findings that the ratio of expenses to income harms firm profitability. For financial institutions in general and banks in particular, an increase in efficiency, as indicated by a decrease in the ratio of expenses to income, will increase profitability.

With regard to sources of funding from third parties, the LDR measures the level of bank liquidity. Otherwise, the increased LDR indicates the level of a bank's ability to extend credit on third-party funds obtained by the bank, which consists of current accounts, savings, and time deposits. The higher the LDR, the greater the credit given relative to the funds received. In this condition, the bank has the opportunity to obtain a higher profit through increasing income from the provision of more credit. R. Supriyono and H. Herdhayinta (2019) found empirical evidence that LDR significantly increases bank profitability as measured by ROA. Likewise, L. Do et al. (2021) provide empirical evidence that LDR is positively correlated with profitability. Işık (2022) also provides a finding that LDR has a positive influence on bank ROA in China.

The existence of an asymmetric effect becomes much more important for the monetary and financial services authority as a consideration in implementing policymaking, and for banks in responding to changes in interest rates and soundness indicators. Banks will face different consequences when interest rates go down and when they go up, so they need different strategies in dealing with these differences (Bui et al., 2021). For each of the same changes in absolute terms, the bank can get an increase in profits when interest rates and financial performance rise, and on the other hand, the bank will not necessarily get the same amount of decrease in profits when interest rates and financial performance decrease. Statistically, the difference in effect can be seen from the significant difference in estimated parameters between when interest rates and financial performance rise and when interest rates and financial performance fall. Also, the effect of interest rates and financial performance is likely only significant when interest rates and financial performance rise or when fall. In this study, interest rates and financial ratios which include CAR, NIM, ROA, and LDR are key factors affecting bank profitability.

2. RESEARCH METHODOLOGY

2.1 Variable and Data

The data analyzed are monthly time series data with the period 2012M01 - 2020M12. This period was chosen because of the stability of the model for that period in the pre-modeling analysis simulation. The variable that serves as a proxy for bank profitability in this model is ROA. ROA is a measure of how well a bank is performing, which is more appropriate to use than ROE because it is related to asset funding. Therefore, the addition of interest expense to net income will determine the bank's ROA. As a riskier fi-

nancial institution, ROA was chosen as a measure of how effectively a bank has mobilized its total assets, which are funded by equity or deposits from the public. The variables selected as independent variables are the variables which are interbank interest rate (IBR) whose changes reflect changes in monetary policy, and the variable group of financial performance ratios which reflect bank soundness indicators, which include CAR, NIM, OEOI, and LDR. CAR is an indicator of bank health from the aspect of capital adequacy. NIM reflects market risk in bank operations. OEOI measures the efficiency of a bank's operations. Finally, LDR indicates a bank's performance from the number of loans provided relative to deposits, as well as measuring liquidity based on third-party funding sources. The definitions of all variables are given in Table 1.

Table 1. The Variables in the Model

Variable	*Term*	*Measurement*	*Data Source*
Return on assets	ROA	Profit before tax divided by average total assets and in percentage term	Financial Services Authority (OJK)
Interbank rate	IBR	The average interest rate of IDR interbank call money morning session and afternoon session for all maturities in percent. The interest rate of interbank call money is the weighted average interest rate of interbank call money transactions in rupiah that are conducted between domestic banks.	Bank Indonesia
Capital adequacy ratio	CAR	Bank capital divided by risk-weighted assets	Financial Services Authority (OJK)
Net interest margin	NIM	Net interest income divided by average total productive assets and in percentage term	Financial Services Authority (OJK)
Operating expenses to operating income	OEOI	Operating costs divided by operating income and in percentage term	Financial Services Authority (OJK)
Loan to deposits ratio	LDR	Total loans divided by total deposits and in percentage term	Financial Services Authority (OJK)

2.2 Pre-Modeling Tests

Unit root tests are carried out to identify the integration order of the stationary processes for the given time series. Unit root tests used the commonly used Augmented Dickey-Fuller (ADF) method, including implementing the ARDL and NARDL models in dynamic analysis. The ADF test is used to test whether the time series of policy interest rates and bank performance variables are stationary or not. The method of applying the ARDL model also applies to the NARDL model, the regressor can be purely I(0), purely I(1), or mixed.

2.3 Research Model

This research model is applied to determine the effect of interbank money market interest rates and financial performance ratios on the profitability of commercial banks. The analytical approach used is the ARDL model which was developed to identify asymmetric effects. The asymmetric effect of changing one variable on another variable is very likely to occur in the real world. The existence of an asymmetric effect makes more sense occurs when changes in the rise and fall of a variable have different effects on other variables. Specifically, in this study, the NARDL model is applied to analyze the effect of asymmetric inter-bank money market interest rates and financial performance ratios on the profitability of commercial banks as measured by ROA, which is expressed in equation (1). This study consolidates theoretical and

econometric studies by examining bank profitability models whereby bank profitability responds asymmetrically to changes in interbank interest rates and financial performance ratios.

The ARDL model which was developed into the NARDL model by Shin et al. (2014) then developed into a special form according to the model and variables in this study into equation (1). The model developed is a cointegrating NARDL model with short-run and long-run nonlinearity through positive and negative partial sum decompositions of the regressors.

$$\Delta ROA_t = \alpha + \beta ROA_{t-1} + \gamma_1^+ IBR_{t-1}^+ + \gamma_1^- IBR_{t-1}^- + \gamma_2^+ CAR_{t-1}^+ + \gamma_2^- CAR_{t-1}^- + \gamma_3^+ NIM_{t-1}^+ + \gamma_3^- NIM_{t-1}^- + \gamma_4^+ OEOI_{t-1}^+ + \gamma_4^- OEOI_{t-1}^- + \gamma_5^+ LDR_{t-1}^+ + \gamma_5^- LDR_{t-1}^- + \sum_{i=1}^{k} \delta_i \Delta ROA_{t-i} + \sum_{i=0}^{l} \left(\theta_i^+ \Delta IBR_{t-i}^+ + \theta_i^- \Delta IBR_{t-i}^-\right) + \sum_{i=0}^{m} \left(\lambda_i^+ \Delta CAR_{t-i}^+ + \lambda_i^- \Delta CAR_{t-i}^-\right) + \sum_{i=0}^{n} \left(\rho_i^+ \Delta NIM_{t-i}^+ + \rho_i^- \Delta NIM_{t-i}^-\right) + \sum_{i=0}^{p} (\sigma_i^+ \Delta OEOI_{t-i}^+ + \sigma_i^- \Delta OEOI_{t-i}^-) + \sum_{i=0}^{q} \left(\phi_i^+ \Delta LDR_{t-i}^+ + \phi_i^- \Delta LDR_{t-i}^-\right) + \varepsilon_t \quad (1)$$

Where:

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} max\left(\Delta x_j\ , 0\right) \quad (2a)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} min\left(\Delta x_j\ , 0\right) \quad (2b)$$

The x variables include IBR, CAR, NIM, OEOI, and LDR.

Expected long-run coefficients and asymmetric effects:

$$-\frac{\gamma_1^+}{\beta} > 0, -\frac{\gamma_1^-}{\beta} > 0, -\frac{\gamma_1^+}{\beta} \neq -\frac{\gamma_1^-}{\beta}$$
$$-\frac{\gamma_2^+}{\beta} > 0, -\frac{\gamma_2^-}{\beta} > 0, -\frac{\gamma_2^+}{\beta} \neq -\frac{\gamma_2^-}{\beta}$$
$$-\frac{\gamma_3^+}{\beta} > 0, -\frac{\gamma_3^-}{\beta} > 0, -\frac{\gamma_3^+}{\beta} \neq -\frac{\gamma_3^-}{\beta}$$
$$-\frac{\gamma_4^+}{\beta} < 0, -\frac{\gamma_4^-}{\beta} < 0, -\frac{\gamma_4^+}{\beta} \neq -\frac{\gamma_4^-}{\beta}$$
$$-\frac{\gamma_5^+}{\beta} > 0, -\frac{\gamma_5^-}{\beta} > 0, -\frac{\gamma_5^+}{\beta} \neq -\frac{\gamma_5^-}{\beta}$$

To estimate short-run effects and error correction term (ECT) values, the NARDL model can be expressed in equation (3).

$$\Delta ROA_t = \alpha + \sum_{i=1}^{k} \delta_i \Delta ROA_{t-i} + \sum_{i=0}^{l} \left(\theta_i^+ \Delta IBR_{t-i}^+ + \theta_i^- \Delta IBR_{t-i}^-\right) + \sum_{i=0}^{m} \left(\lambda_i^+ \Delta CAR_{t-i}^+ + \lambda_i^- \Delta CAR_{t-i}^-\right) + \sum_{i=0}^{n} \left(\rho_i^+ \Delta NIM_{t-i}^+ + \rho_i^- \Delta NIM_{t-i}^-\right) + \sum_{i=0}^{p} (\sigma_i^+ \Delta OEOI_{t-i}^+ + \sigma_i^- \Delta OEOI_{t-i}^-) + \sum_{i=0}^{q} \left(\phi_i^+ \Delta LDR_{t-i}^+ + \phi_i^- \Delta LDR_{t-i}^-\right) + ECT_{t-1} + \varepsilon_t \quad (3)$$

Where:

$$ECT_{t-1} = ROA_{t-1} - (\beta_1^+ IBR_{t-1}^+ + \beta_1^- IBR_{t-1}^- + \beta_2^+ CAR_{t-1}^+ + \beta_2^- CAR_{t-1}^- + \beta_3^+ NIM_{t-1}^+ + \beta_3^- NIM_{t-1}^- + \beta_4^+ OEOI_{t-1}^+ + \beta_4^- OEOI_{t-1}^- + \beta_5^+ LDR_{t-1}^+ + \beta_5^- LDR_{t-1}^-) \quad (4)$$

In this study, the analysis of the model is carried out in a long-run form and through bounds tests. The estimated value of the error-correction term (ECT) is obtained when the model is expressed in the form of error correction. The ECT values that are in line with expectations are ECT values ranging from -1 to 0. Significant ECT values and values between -1 and 0 have a meaning, that the deviation of the last period from the long-run equilibrium, affects its short-run dynamics.

3. RESULTS AND DISCUSSION

This section begins with a description of the main characteristics of the data. Table 2 provides a summary of the main characteristics of ROA, IBR, CAR, NIM, OEOI, and LDR. Data characteristics include minimum, maximum, mean, and standard deviation. Central tendency is measured from the mean, meanwhile, the difference between the maximum and the minimum determines the range, and the standard deviation measures the dispersion.

Table 2. Descriptive Statistics

Variable	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
ROA	1.5900	3.7000	2.5993	0.3812
IBR	3.1400	7.8100	5.1044	0.9688
CAR	17.2800	24.2500	21.2798	2.0928
NIM	4.0600	6.0600	5.0666	0.4688
OEOI	73.7400	91.7800	79.9430	3.7886
LDR	78.5800	96.1900	89.1641	3.8112

Note: all variables are measured in percent

NIM has the smallest range, but ROA has the smallest mean and standard deviation. Even though ROA has the smallest average, the range is relatively large from NIM. Meanwhile, IBR has a larger range, average, and standard deviation than ROA and NIM. The average CAR for commercial banks is 21.28 percent, which is far more than the minimum CAR based on Basel III of 10.5 percent. OEOI and LDR have size and range values that are not much different. However, LDR has a higher standard deviation than OEOI. The maximum LDR exceeds the LDR provisions imposed by Bank Indonesia in the range of 78 - 92 percent. However, the average LDR of commercial banks is still in that range.

3.1 Unit Root Tests

Table 3 presents the ADF test with intercept for all variables. Tests are carried out based on Akaike Information Criterion (AIC) for optimal lag selection.

Table 3 reports that ROA as the independent variable in level is not significantly stationary at I (0). It takes one differencing for ROA to be stationary so that ROA is I (1). Likewise the series of independent variables which include IBR^{+}, IBR^{-}, CAR^{+}, CAR^{-}, NIM^{+}, NIM^{-}, $OEOI^{+}$, $OEOI^{-}$, LDR^{+}, and LDR^{-} are also not stationary at I (0) and each requires one differencing to be stationary at I(1). This stationary condition supports the requirements for the application of the NARDL model to investigate asymmetric effects with stationary dependent and independent variables in I (1).

Table 3. Results of Unit Root Test

Series	*ADF test*	
	Level	*First Difference*
ROA	-1.9208	-10.7030***
IBR^+	-1.3508	-5.1383***
IBR^-	-0.3982	-5.0017***
CAR^+	-0.0324	-6.3928***
CAR^-	0.3359	-9.7584***
NIM^+	-1.1104	-11.5885***
NIM^-	-1.4011	-6.0268***
$OEOI^+$	-1.2433	-6.0273***
$OEOI^-$	-2.2032	-9.4175***
LDR^+	-2.6025*	-11.1109***
LDR^-	1.1938	-7.6739***

*** p-value <0.01, * p-value <0.1

3.2 Statistical Values and Diagnostic Tests

Table 4 below reports the statistical values and results of the diagnostic tests on the model. The ARDL model is valid based on statistical values which include F-statistics and tests on models that include normality, serial correlation and heteroscedasticity, stability, and bound tests. Meanwhile, the values of the Akaike Information Criterion and Schwarz Information Criterion are the minimum values of the selected model among the alternative NARDL models.

Table 4. Summary of Statistics and Model Tests

Statistical Elements	*Value*	*Annotation*
R^2	0.9892	
$\bar{R}^2$	0.9828	
F-Stat	154.2543***	Significant at the 1% level
Akaike Information Criterion	-3.0314	
Schwarz Information Criterion	-2.0338	
Jarque-Bera Stat (Normality test)	4.3780	
Serial Correlation LM test, F-stat (4.60)	0.7101	
Heteroskedasticity test, F-stat (38.64)	1.5037	
CUSUM Test		Stable (see Figure 3)
F-stat of bound test of cointegration	8.0968***	significant at the 1% level with boud values of I(0) = 2.54 and I(1) = 3.86

The test results in Table 4 conclude that the NARDL model passed the tests on problems of non-normality, serial correlation, heteroscedasticity, and model instability. With the CUSUM test, Figure 3 shows an indication that the model is stable with the support of data during the study period. Through the bound test, in the model, there is cointegration or a long-run relationship of bank profitability to the explanatory variables.

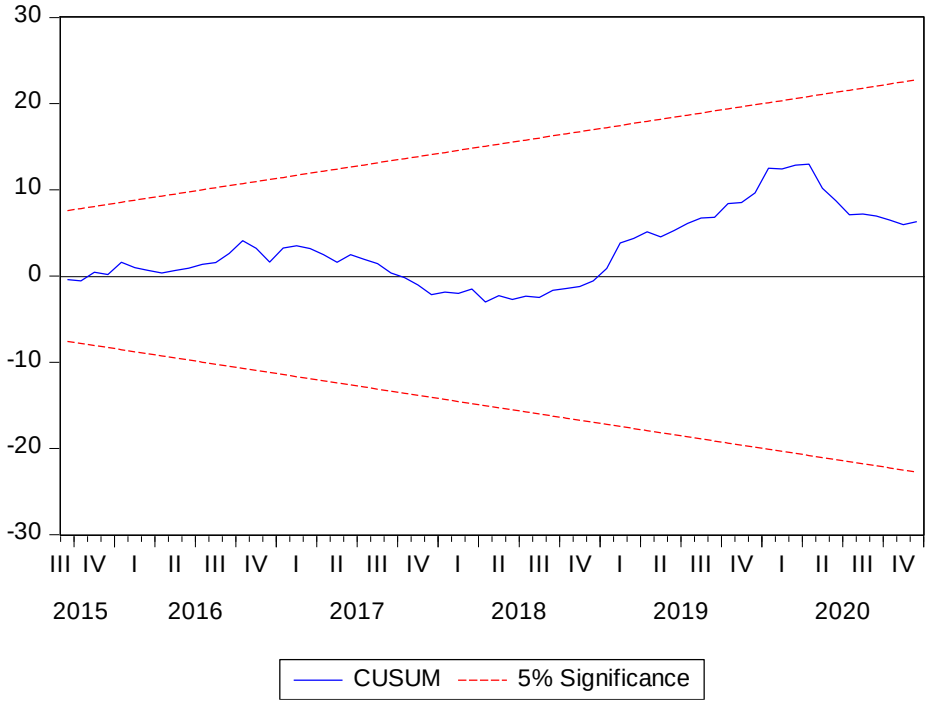

Figure 3. CUSUM Test for Model Stability

3.3 Long Run Effects

Long-run effects were tested with the Wald-t test whether there was an asymmetry effect or not on each independent variable. In Table 5, the interbank money market interest rate (IBR) has an asymmetric effect on bank profitability as measured by ROA in the long run. An increased IBR (IBR^+) has a significant positive effect, while a decreased IBR (IBR^-), profitability still rises with less effect. The dominance of the positive effect of IBR is clear and strengthens the evidence that there is a positive effect of interest rates on profitability.

Table 5. Long-Run (LR) Estimated Parameters

Variable	*Coefficient*	*Wald t-stat for LR Asymmetric Effect*	*Conclusion LR Asymmetric Effect*
IBR^+	0.0985***	6.4256***	Significant at the 1% level
IBR^-	-0.0329*		
CAR^+	-0.0276	-0.0075	Not significant
CAR^-	-0.0273		
NIM^+	-0.3291***	-6.9959***	Significant at the 1% level
NIM^-	0.2660***		
$OEOI^+$	-0.0059	3.3101***	Significant at the 1% level
$OEOI^-$	-0.0356***		
LDR^+	-0.0191	-4.7621***	Significant at the 1% level
LDR-	0.0657***		

Source: own

CAR does not affect profitability, either in the increase (CAR^+) or decrease in CAR (CAR^-) in the long run. Meanwhile, the results show that the effect of NIM on profitability is distinguished between increases and decreases in NIM. The increased NIM (NIM^+) has a negative effect, whereas the decreased NIM (NIM^-) has a positive effect on profitability. This means that a decrease in NIM will reduce profitability. The result

means that the bank must avoid decreasing NIM so that its profitability does not decrease. In other words, the meaning of the results is that profitability will be maintained in a stable NIM. For efficiency as measured by OEOI, in the long run, an increase in efficiency shown by a decrease in OEOI (OEOI$^-$) significantly increases profitability. Meanwhile, a decrease in LDR (LDR$^-$) significantly reduces profitability. The decrease in LDR reduces the opportunity for banks to earn more profit from the loans provided.

3.4 Short Run Effects

In the short run, Table 6 shows that interbank interest rates have a positive effect in decreasing ΔIBR (ΔIBR$^-$). When ΔIBR goes down, ΔROA goes down. Meanwhile, the increase in ΔIBR (ΔIBR$^+$) did not significantly affect the change in profitability. The changes in IBR have an asymmetric effect in the short run. Changes in CAR do not have an asymmetry effect because an increase in ΔCAR (ΔCAR$^+$) and a decrease in ΔCAR (ΔCAR$^-$) have a negative effect with the same estimated parameters. The meaning of these results is that to obtain profits continuously at a stable level, banks should maintain a stable CAR so that it does not rise and fall randomly. Meanwhile, this model does not capture the effect of decreasing NIM (ΔNIM$^-$), while the effect of increasing NIM (ΔNIM$^+$) is not significant.

The short-run effect of efficiency as measured by OEOI on profitability is not proven to be following theoretical expectations in the long run. Meanwhile, in the short run, increases and decreases in ΔLDR have a negative effect on changes in ROA. For the profitability to be stable, the LDR should be kept stable.

Table 6. Results of NARDL Error Correction and Short-Run (SR) Estimated Parameters

Variable	*Lag(s)*	*Sort-Run Coefficient*	*Wald t-stat for SR Asymmetric Effect*	*Conclusion of SR Asymmetric Effect*
$\sum_{i=0}^{l} \theta_i^+ \Delta IBR_{t-i}^+$	3	-0.1126	-3.6396***	Significant at the 1% level
$\sum_{i=0}^{l} \theta_i^- \Delta IBR_{t-i}^-$	2	0.1170*		
$\sum_{i=0}^{m} \lambda_i^+ \Delta CAR_{t-i}^+$	1	-0.0992***	-0.1149	Not significant
$\sum_{i=0}^{m} \lambda_i^- \Delta CAR_{t-i}^-$	0	-0.0932***		
$\sum_{i=0}^{n} \rho_i^+ \Delta \mathrm{NIM}_{t-i}^+$	3	0.1686	-	-
$\sum_{i=0}^{n} \rho_i^- \Delta \mathrm{NIM}_{t-i}^-$	-	-		
$\sum_{i=0}^{p} \sigma_i^+ \Delta \mathrm{OEOI}_{t-i}^+$	2	0.0291**	0.4630	Not significant
$\sum_{i=0}^{p} \sigma_i^- \Delta \mathrm{OEOI}_{t-i}^-$	2	0.0184		
$\sum_{i=0}^{q} \phi_i^+ \Delta \mathrm{LDR}_{t-i}^+$	0	-0.0487***	0.4371	Not significant
$\sum_{i=0}^{q} \phi_i^- \Delta \mathrm{LDR}_{t-i}^-$	3	-0.0631**		
ECT_{t-1}		-0.8603***		Meet the expected value between -1 and 0

Note: Short-run effects are total effects and are tested by the Wald-t test

Estimation of the ECT value in the error correction regression is following expectations and is significant. The ECT value estimates the speed at which profitability, with the ROA indicator, returns to equilibrium

after changes in IBR^{+}, IBR^{-}, CAR^{+}, CAR^{-}, NIM^{+}, NIM^{-}, $OEOI^{+}$, $OEOI^{-}$, LDR^{+}, and LDR^{-}. The bank's ROA adjusts to explanatory variables with a lag and about 86.03 percent of ROA deviation between the long and short run is corrected within one month.

4. DISCUSSION

In the long run, the dominance of the positive effect of rising interbank rates (IBR+) on profitability indicates that the interbank money market is dominated by banks as lenders relative to banks as borrowers according to findings by I. Yusgiantoro and A. Raymond (2016). Therefore, increased interbank rates increased profitability. In addition, an increase in interbank rates indicates decreased liquidity as banks use their assets to finance loans to maximize loans to increase profits. On the other hand, the effect of lowering interbank rates on increasing profitability is possible due to lower funding costs for banks originating from second-party funds. The positive effect of interbank market rates on funding costs is empirically proven by J. Gerlach et al. (2018). Meanwhile, in the short run, the greater the decrease in IBR, the greater the decrease in ROA. This condition means that banks face relatively high risks in the short run dealing with changes in interbank interest rates.

In the long run, profitability is not significantly affected by CAR. This empirical evidence supports the results of research by U. Widyastuti et al. (2017) that CAR has no significant effect on profitability. This is because banks rely on loans to generate interest income. In the short run, profitability significantly decreases as CAR increases. and conversely, profitability rises when CAR decreases. The negative effect of CAR on profitability is also found in a study conducted by Alnajjar and Othman (2021) on Islamic banks. However, in this study, the negative effect of CAR in the asymmetric effect on ROA, implies that a stable CAR is needed to support bank profitability. It is important to note that a higher increase in CAR in the short run can reduce a bank's ability and opportunity to increase profits.

In the long run, a decrease in NIM will significantly reduce bank profitability. This positive effect is also corroborated by most of the results of previous studies, including those by U. Widyastuti et al. (2017), P. Silaban (2017), D. Sunaryo (2020), and H. Haddad et al. (2022). However, because of the asymmetric effect, the results of this study imply the need for a stable NIM to support bank profitability through achieving consistent ROA, considering that bank profitability is still largely supported by interest income. Meanwhile, in the short run, NIM does not significantly increase ROA.

The important meaning of the finding is that the efficiency of bank operations is the spearhead of bank profitability, especially in the long run. Increasing efficiency is the main driver of profitability. This finding reinforces previous empirical findings, in general, the positive effect of bank efficiency on profitability, including findings by V. Kumar et al. (2020), I. Puspitasari et al. (2021), L. Do et al. (2021), and S. Dsouza et al. (2022). However, the increase in efficiency does not significantly increase profitability in the short run. The decline in efficiency in the short run was still able to maintain profitability due to the support of a high CAR and the bank's capabilities to extend credit effectively.

In the long run, decreased LDR significantly reduces profitability. Bank opportunities to increase profits through optimizing lending will decrease, so profitability decreases. The positive effect of LDR on profitability is consistent with the findings by, among others, R. Supriyono and H. Herdhayinta (2019) and Do et al. (2021). The short-run estimation results show that the negative effect is symmetrical with increasing and decreasing changes in LDR, which implies that banks need to maintain LDR stability at a level where banks are still able to extend credit effectively without creating liquidity risk. The negative effect of LDR on the bank's ROA is following the empirical findings of I. Puspitasari et al. (2021) and S. Liniarti (2021).

CONCLUSION

Interbank rates, NIM, OEOI, and LDR have asymmetric effects on the profitability or ROA of the bank in the long run. An increase in interbank rates is more profitable for banks than a decrease in interbank rates. Meanwhile, CAR has no significant effect on ROA. NIM has an asymmetric effect which means that the bank should maintain a stable NIM. Increases and decreases in NIM can be detrimental to banks. The

efficiency of a bank, as measured by OEOI, significantly increases bank profitability through ROA. Efficiency is the spearhead for increasing bank profitability. The findings also show that a decrease in LDR significantly reduces ROA. The implication is that banks can also maintain profits by maintaining a stable LDR, taking into account sufficient liquidity.

In the short run, the model estimation can only provide evidence of the asymmetric effect of interbank rates on ROA. A decrease in changes in interbank rates reduces changes in ROA. CAR and LDR have a symmetric negative effect on profitability. Banks should pay attention to these two ratios that the higher the increase of the two can reduce bank profitability. Meanwhile, NIM does not significantly affect ROA. However, the decline in efficiency is still able to increase ROA.

The results of this study imply that banks should achieve financial performance that can comply with applicable regulations of bank soundness indicators for CAR, NIM, and LDR. There should be a balance between managing CAR, NIM, and LDR with achieving profitability, because both sacrifice each other. Furthermore, increasing operational efficiency and bank income is the main way to increase profitability in responding to changes in interest rates.

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