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Dynamic Relationship Between External Economic Shocks and Banking Stability: Empirical Evidence from Indonesia Banking Sector

Relação Dinâmica Entre Choques Económicos Externos e Estabilidade Bancária: Evidência Empírica do Sector Bancário Indonésio

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ABSTRACT

Banking stability is critical for financial resilience in open emerging economies exposed to external shocks. This study examines how external factors, the US Dollar Index, foreign exchange reserves, and foreign bank asset penetration, affect banking stability in Indonesia, proxied by the Loan-to-Deposit Ratio (LDR). Using monthly data from January 2020 to December 2024, the analysis applies a Vector Error Correction Model (VECM) complemented by Impulse Response Functions, Variance Decomposition, and Granger causality tests. The results reveal a significant long-run relationship between external variables and banking stability. US dollar appreciation and higher foreign bank penetration tend to weaken banking intermediation, while foreign exchange reserves enhance stability. In the short run, the banking sector remains vulnerable to external shocks, particularly from global dollar movements and foreign bank dominance. IRF and variance decomposition results confirm the growing contribution of external shocks to LDR fluctuations over time. Granger causality indicates that foreign exchange reserves and foreign bank penetration are key determinants

of banking stability. These findings underscore the importance of dynamic reserve management, exchange rate flexibility, and prudent macro prudential regulation to strengthen Indonesia's financial resilience amid global volatility.

Keywords: Banking Stability, Loan to Deposit Ratio (LDR), US Dollar Index, Foreign Exchange Reserves, Foreign Banks.

JEL classification: F41; F65; G21

1. INTRODUCTION

Global economic developments over the past decades have been characterized by heightened volatility in international financial markets, shifts in monetary policy stances in advanced economies, and increasing financial integration across countries. One key indicator reflecting these global dynamics is the US Dollar Index, which measures the relative strength of the United States dollar against a basket of major international currencies. Movements in the US Dollar Index play a central role in shaping global liquidity conditions, capital flows, and financial stability in emerging economies (Obstfeld, et al. 2019 ; Huang and Liao, 2023). A strengthening US dollar typically increases external financing costs, intensifies capital outflows, and tightens domestic liquidity conditions, thereby affecting banking sector stability in developing countries.

Indonesia represents a particularly relevant case for examining these global transmission mechanisms. As one of the largest emerging economies with a bank-dominated financial system, Indonesia combines moderate financial openness, substantial exposure to global capital flows, and a non-negligible presence of foreign banks in its domestic banking sector. Unlike advanced economies with deep and diversified capital markets, Indonesia relies heavily on banks as the primary channel of financial intermediation. Consequently, shocks originating from global financial conditions are more likely to propagate through the banking system and directly affect credit provision and liquidity management. This structural characteristic makes the Indonesian case especially informative for the broader literature on banking stability in emerging market economies.

For Indonesia, foreign exchange reserves serve as a key buffer against external volatility. Changes in foreign exchange reserves reflect not only macroeconomic fundamentals but also the dynamics of capital inflows and outflows. Adequate reserve buffers are widely regarded as an important policy instrument to mitigate external shocks and stabilize domestic financial systems during periods of global stress (Mishra and Sharma, 2021).

Furthermore, the role of foreign banks in the Indonesian banking system is also an important variable to consider. The ratio of foreign bank assets to total domestic banking assets indicates the degree of foreign financial institution involvement in domestic financial intermediation. While foreign banks may enhance efficiency and access to finance, they may also transmit external shocks into the domestic financial system (Claessens and Horen, 2015; Hasan, et al. 2022).

Banking stability in Indonesia is closely related to the performance of the intermediation function, commonly measured by the Loan-to-Deposit Ratio (LDR). During the 2020–2024 period, the Indonesian banking sector experienced substantial fluctuations in LDR. At the onset of the COVID-19 pandemic, the LDR declined sharply from 93.36% in January 2020 to 77.13% in December 2021, reflecting weakened credit demand, heightened uncertainty, and increased liquidity preference. As global and domestic conditions improved, the LDR gradually recovered, reaching 90.34% by December 2024. These developments indicate that banking intermediation in Indonesia is highly sensitive to external economic pressures and global financial cycles, rather than being driven solely by domestic banking fundamentals.

Although a growing body of literature has examined the influence of external factors on financial stability in emerging economies (Kim and Lee, 2020; Sharma and Shukla, 2022),

empirical studies specifically linking the US Dollar Index, foreign exchange reserves, and foreign bank asset penetration to banking stability in Indonesia remain limited. Most existing studies on Indonesian banking stability focus primarily on domestic bank-specific indicators such as capital adequacy, asset quality, efficiency, and liquidity, while overlooking the role of global external variables. Moreover, much of the global literature relies on cross-country panel data, which may obscure country-specific transmission mechanisms and institutional features. As a result, there is limited empirical evidence documenting how global external shocks affect banking stability through the intermediation channel in Indonesia.

In addition, there is limited evidence regarding how the long-term relationship (cointegration) and short-term dynamics between external variables and banking stability in Indonesia operate. In fact, the 2020–2024 period showed LDR fluctuations that were in line with the dynamics of the three external variables, emphasizing the need for a more comprehensive analysis.

This study addresses these gaps by employing a Vector Error Correction Model (VECM) using monthly data from 2020 to 2024. The empirical results confirm the existence of a long-run equilibrium relationship between external economic factors and banking stability. In the long run, a strengthening US dollar and an increase in foreign bank asset penetration are associated with weaker banking intermediation, while foreign exchange reserves exert a stabilizing effect. In the short run, shocks to external variables generate persistent effects on the Loan to Deposit Ratio, underscoring the vulnerability of banking stability to global financial disturbances.

Beyond its relevance for Indonesia, this study contributes to the global literature by offering insights applicable to other emerging economies with bank-centered financial systems, exposure to global dollar cycles, and growing foreign bank participation. While institutional settings and degrees of financial openness differ across countries, the transmission mechanisms identified in this study are likely to be relevant for a broad set of emerging markets.

In addition, there is limited evidence regarding how the long-term relationship and short-term dynamics between external variables and banking stability in Indonesia operate. In fact, the 2020–2024 period showed LDR fluctuations that were in line with the dynamics of the three external variables, emphasizing the need for a more comprehensive analysis.

Thus, this study can provide important contributions by: (1) presenting the latest empirical evidence regarding the influence of external factors on the stability of banking intermediation in Indonesia, (2) applying the Vector Error Correction Model (VECM) to separate long-term and short-term effects and examine shock responses, and (3) offering policy implications for monetary authorities and banking regulators in anticipating external risks to banking stability.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 provides an overview of the Indonesian banking sector. Section 4 describes the data and methodology. Section 5 presents the empirical results, robustness checks and discussion. Section 6 concludes and shows the policy implications.

2. LITERATURE REVIEW

Banking stability in developing countries is increasingly shaped by global financial dynamics, particularly fluctuations in the global dollar cycle. The US Dollar Index serves as a widely recognized proxy for global liquidity conditions and reflects shifts in international capital flows and monetary policy spillovers from advanced economies. A strengthening US dollar is commonly associated with tighter global financial conditions, rising foreign currency funding costs, increased exchange rate volatility, and deteriorating investor sentiment (Obstfeld et al. 2019; Huang and Liao, 2023). These developments may directly affect domestic banking systems in emerging markets, especially those characterized by partial financial openness and exposure to external debt.

From an intermediation perspective, movements in the US Dollar Index may influence the Loan-to-Deposit Ratio (LDR) through multiple channels. On the one hand, tighter global conditions may induce banks to strengthen liquidity management and improve risk pricing. On the other hand, dollar appreciation often leads to domestic currency depreciation and capital outflows, which may constrain credit growth relative to deposit expansion. Emerging market banking systems, therefore, may experience credit contraction during episodes of global dollar tightening (Kim and Lee, 2020; IMF, 2024).

Foreign exchange reserves are widely viewed as a key macroeconomic buffer against external volatility. Theoretical and empirical studies suggest that adequate reserves enhance policy credibility, stabilize exchange rates, and provide foreign currency liquidity during periods of stress (Mishra and Sharma, 2021). Through these channels, foreign exchange reserves may support banking intermediation stability by reducing uncertainty and mitigating liquidity risks. However, maintaining large reserves entails sterilization and opportunity costs (ECB, 2019), and excessive reliance on reserves without complementary macroprudential instruments may create moral hazard. The effectiveness of reserves in stabilizing banking systems therefore depends on institutional quality and policy coordination (BIS, 2024; IMF, 2024).

In addition to global liquidity conditions and reserve buffers, the presence of foreign banks plays an important role in shaping domestic banking stability. The literature highlights both stabilizing and destabilizing effects. On the positive side, foreign banks may enhance efficiency, introduce advanced risk management practices, and diversify funding sources (Claessens and van Horen, 2015). Increased competition and technological spillovers can strengthen financial intermediation capacity. On the negative side, foreign banks may transmit external shocks through cross-border liquidity reallocation, particularly during episodes of global stress (Hasan et al. 2022). Parent banks may repatriate funds to headquarters, leading to credit contraction in host countries. Furthermore, selective lending behavior may reduce credit access for smaller or riskier borrowers (Sanya and Wolfe, 2018).

Recent cross-country evidence suggests that the impact of foreign bank penetration is heterogeneous and depends on regulatory quality, market structure, and supervisory coordination. Consequently, the interaction between global dollar dynamics, reserve adequacy, and foreign bank presence forms a complex framework through which external shocks may influence banking intermediation stability in emerging economies.

3. OVERVIEW OF THE INDONESIA BANKING SECTOR

To properly interpret the empirical findings, it is essential to understand the structural and statistical characteristics of the Indonesian banking system during the period of analysis (2020-2024). Indonesia operates a bank-dominated financial system in which commercial banks constitute the primary channel of financial intermediation. Credit provision to households and firms relies predominantly on banking institutions rather than capital markets, making banking stability central to macroeconomic stability.

During the 2020–2024 period, the Indonesian banking sector demonstrated resilience despite significant external shocks, including the COVID-19 pandemic and global financial volatility. Table 1 presents key banking indicators over the study period.

Table 1. Key Banking Sector Indicators in Indonesia (2020-2024)

Indicator	2020	2021	2022	2023	2024
Loan to Deposit Ratio (LDR)	82.54%	77.49%	78.98%	84.11%	88.57%
Capital Adequacy Ratio (CAR)	23.89%	25.66%	25.62%	27.75%	26.69%
Gross Non-Performing Loans (NPL)	3.06%	3.00%	2.44%	2.19%	2.08%
Deposit Growth (YoY)	11.11%	12.21%	9.01%	3.73%	4.48%
Loan Growth (YoY)	2.41%	5.24%	11.35%	10.38%	10.39%

Source: Otoritas Jasa Keuangan (OJK), Indonesian Banking Statistics (various issues).

As shown in Table 1, the Loan-to-Deposit Ratio (LDR) declined significantly during the pandemic, falling from 82.54% in 2020 to 77.49% in 2021, reflecting weakened credit demand and heightened liquidity preference. However, LDR gradually recovered in the post-pandemic period, reaching 88.57% in 2024, indicating a strengthening intermediation function.

In terms of capitalization, the Capital Adequacy Ratio (CAR) remained consistently well above the regulatory minimum threshold of 8%, increasing from 23.89% in 2020 to 26.69% in 2024. This indicates that Indonesian banks maintained substantial capital buffers during both crisis and recovery phases. Meanwhile, credit quality improved steadily, with gross NPL ratios declining from 3.06% in 2020 to 2.08% in 2024, suggesting effective risk management and loan restructuring policies during the pandemic recovery period.

From a liquidity and growth perspective, deposit growth was strong during the pandemic (above 11% in 2020-2021) due to precautionary savings and accommodative monetary policy. However, deposit growth moderated in 2023-2024 as economic activity normalized. Conversely, credit growth accelerated significantly in the recovery phase, exceeding 10% in both 2023 and 2024, contributing to the rising LDR.

Structurally, the Indonesian banking system consists of state-owned banks, private domestic banks, regional development banks and foreign banks. Market concentration remains relatively high, with large commercial banks dominating asset ownership. Regulatory oversight is conducted under an integrated financial supervisory framework with macroprudential

instruments including capital requirements, liquidity coverage ratios and foreign exchange liquidity regulations designed to mitigate systemic risk.

Overall the statistical evidence suggests that the Indonesian banking system entered the post-pandemic period with strong capital buffers, improving asset quality, and recovering intermediation activity. However, the fluctuations in LDR and credit dynamics during 2020–2024 indicate sensitivity to both domestic and external macro-financial conditions. These structural and cyclical characteristics justify examining how external variables, such as the US Dollar Index, foreign exchange reserves and foreign bank penetration interact with banking intermediation stability in Indonesia.

4. METHODOLOGY AND DATA

This study uses a quantitative approach with econometric analysis based on the Vector Error Correction Model (VECM). VECM was chosen because it is able to analyze the dynamic relationship between cointegrated non-stationary variables, so that it can differentiate between long-run equilibrium and short-run dynamics (Johansen, 1988).

4.1. DATA AND DATA SOURCES

This study used monthly time series data for the period January 2020 - December 2024. The variables used are in Table 2.

Table 2. Variable Definitions and Data Sources

Variable	Definition	Source
LDR	Loan-to-Deposit Ratio (%)	Financial Services Authority (OJK) Publication
LUSI	US Dollar Index	Federal Reserve Economic Data (FRED)
LCD	Foreign Exchange Reserves	<i>Indonesian Economic and Financial Statistics</i> Bank Indonesia Report
RASIO	Foreign Bank Assets / Total Bank Assets (%)	OJK Publication

4.2. MODEL SPECIFICATIONS

To investigate the dynamic relationship between external economic variables and banking stability in Indonesia, this study employs the Vector Error Correction Model (VECM) framework. The VECM approach allows for the examination of both long-run equilibrium relationships and short-run dynamic adjustments among non-stationary but cointegrated variables (Johansen, 1988; Enders, 2015).

Following the empirical frameworks of Nguyen and Bui (2021), the model in this study is specified as follows:

$$\Delta LDR_t = \alpha_0 + \lambda(LDR_{t-1} - \beta_1 LUSI_{t-1} - \beta_2 LCD_{t-1} - \beta_3 RASIO_{t-1}) + \sum_{i=1}^k \gamma_{1i} \Delta LUSI_{t-i} + \sum_{i=1}^k \gamma_{2i} \Delta LCD_{t-i} + \sum_{i=1}^k \gamma_{3i} \Delta RASIO_{t-i} + \epsilon_t \quad (1)$$

Where LDR_t is Loan to Deposit Ratio, $LUSI_t$ is US Dollar Index, LCD_t is Foreign Exchange Reserves, $RASIO_t$ is Ratio of Foreign Banks' Assets to Total Banking Assets, λ is error correction coefficient, which indicates the speed of adjustment toward long-run equilibrium, γ_i is short-run dynamic parameters capturing immediate responses among variables and ϵ_t is white noise disturbance term.

The term λ represents the cointegrating vector that captures the long-run equilibrium relationship among the variables. The sign and magnitude of the coefficient λ indicate how quickly the system corrects any disequilibrium from its long-run path.

4.3. ANALYSIS STAGES

The analysis is carried out in several stages:

1. Stationarity Test: using the ADF and PP tests to ensure the stationarity properties of the data (Dickey & Fuller, 1979; Phillips & Perron, 1988).
2. Determination of Optimum Lag: determined using the AIC, SC, and HQ criteria according to the VAR/VECM procedure (Lütkepohl, 2005).
3. Johansen Cointegration Test: used to identify the number of long-term relationships between variables (Johansen, 1988).
4. VECM Model Estimation: produces cointegration vector coefficients (long run) and error correction term (ECT) as short run adjustment.
5. Impulse Response Function (IRF): used to observe the LDR response to shocks on the US Dollar Index, foreign exchange reserves, and the foreign bank asset ratio (Winarno et al., 2021).
6. Variance Decomposition (VD): used to measure the relative contribution of external variables to LDR fluctuations (Lütkepohl, 2005).
7. Granger Causality Test: used to identify the direction of the causal relationship between variables (Enders, 2015).

5. ANALYSIS RESULTS

5.1. DESCRIPTIVE STATISTICS

Table 3 presents the descriptive statistics of the variables used in the analysis. The Loan to Deposit Ratio (LDR) averages 83.25% over the sample period, with a standard deviation of 4.14, indicating relatively moderate fluctuations in banking intermediation during 2020-2024. The US Dollar Index exhibits greater dispersion, reflecting substantial movements in global dollar conditions throughout the observation period.

Table 3. Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Minimum	Maximum
Loan-to-Deposit Ratio (LDR, %)	83.25	82.48	4.14	77.13	93.36
US Dollar Index	99,936.90	101,513.50	5,763.75	89,894.00	112,084.00
Foreign Bank Asset Ratio (%)	8.40	8.22	0.55	7.65	9.83
Foreign Exchange Reserves (Million US\$)	138,698.11	137,607.03	6,427.15	120,968.88	155,719.38

Source: Author's calculation based on monthly data (2020-2024).

Foreign exchange reserves average USD 138.7 billion, with a relatively wide range, suggesting active reserve management in response to global financial volatility. In contrast, the foreign bank asset ratio shows comparatively low variability, indicating gradual structural adjustments in foreign bank penetration rather than abrupt shifts. Overall, the descriptive statistics suggest that while domestic banking stability remains relatively contained, external variables display greater volatility, justifying the use of dynamic time series techniques to capture both short term adjustments and long term equilibrium relationships.

5.2. STATIONARITY TEST RESULTS

Stationarity test is conducted to ensure the integration properties of the research variables, namely Loan to Deposit Ratio (LDR) , US Dollar Index (LUSI) , Foreign Exchange Reserves (LCD) , and the Ratio of Foreign Bank Assets to Total Commercial Bank Assets (RATIO) . Considering that economic and financial time series data are generally non-stationary at the level, testing is conducted up to the first difference stage using several methods, namely Levin, Lin & Chu (LLC) , Im, Pesaran and Shin (IPS) , as well as the Fisher panel test based on Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) .

The results of the stationarity test on the first difference are presented in Table 4.

Table 4. Stationarity Test Results (*First Difference*)

Method	Statistics	Probability	Conclusion
Levin, Lin & Chu t*	-13.2456	0.0000	Stationary
Im, Pesaran and Shin W-stat	-13.0019	0.0000	Stationary
ADF - Fisher Chi-square	129,544	0.0000	Stationary
PP - Fisher Chi-square	145,648	0.0000	Stationary

Source: Processed data, 2025.

Table 4 shows that all methods give consistent results. In the LLC test, a statistical value of -13.2456 with a probability of 0.0000 rejects the null hypothesis (H_0) of the existence of a unit root, so that the research variables are stationary at first difference. The same result is shown by the IPS test with a statistical value of -13.0019 and a probability of 0.0000. Furthermore, the ADF-Fisher test produces a statistical value of 129.544 with a probability of 0.0000, while the PP-Fisher test produces a value of 145.648 with a probability of 0.0000, all of which confirm that the four variables are stationary at first difference. Thus, it can be concluded that all research variables, namely LDR, LUSI, LCD, and RATIO, are not stationary at the level, but become stationary after being differentiated once ($I(1)$).

5.3. RESULTS OF DETERMINING OPTIMAL LAG

Determining the optimal lag length is a critical step in estimating VAR and VECM models. The appropriate number of lags is necessary to adequately capture the dynamics between variables while avoiding model specification issues such as autocorrelation.

Table 5 presents the results of selecting the optimum lag based on several criteria, namely LR (Likelihood Ratio test), FPE (Final Prediction Error), AIC (Akaike Information Criterion), SC (Schwarz Information Criterion), and HQ (Hannan-Quinn Information Criterion).

Table 5. Results of Determining Optimal Lag

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-140.7563	NA	0.001730	4.991595	5.133694	5.046946
1	63.87361	373.9787*	2.59e-06*	-1.512883*	-0.802386*	-1.236130*
2	77.87310	23.65430	2.80e-06	-1.443900	-0.165004	-0.945744

Source: Processed data, 2025.

Based on Table 5, it can be seen that lag 1 was selected as the optimum lag by almost all criteria (LR, FPE, AIC, SC, and HQ). This indicates that lag 1 is most appropriate to describe the dynamics of the relationship between the Loan to Deposit Ratio (LDR), the US Dollar Index (LUSI), Foreign Exchange Reserves (LCD), and the Foreign Bank Asset

Ratio (RASIO). Although at lag 2 the AIC value is relatively close to lag 1, most other criteria do not support it, so the selection of lag 1 is more consistent and more appropriate for use in the model.

5.4. MODEL STABILITY TEST

Before further VECM estimation, it is important to ensure that the model meets the stability requirements. Stability testing is performed using the roots of a characteristic polynomial, where the model is considered stable if all root values have a modulus less than one and lie within the unit circle. The stability test results are presented in Table 6.

Table 6. VECM Model Stability Test Results

Root	Modulus
$0.959961 - 0.049797i$	0.961252
$0.959961 + 0.049797i$	0.961252
0.837321	0.837321
0.339785	0.339785

Source: Processed data, 2025.

Based on Table 6, all roots have modulus values smaller than 1. The largest modulus value is 0.961252, while other modulus values are in the range of 0.83 and 0.33. This indicates that there are no roots outside the unit circle (modulus value greater than 1), so the model meets the stability conditions.

Meeting this stability condition is crucial because it is a prerequisite for the validity of VECM estimates. If any roots lie outside the unit circle, the model can become unstable and produce biased or inconsistent estimates (Lütkepohl, 2005; Enders, 2015).

These results provide confidence that the VECM model used in the study is suitable for use in subsequent analysis stages, including the estimation of long-term and short-term relationships, Granger causality tests, and Impulse Response Function (IRF) and Variance Decomposition (VD) analyses. Thus, the stability of the model ensures that the dynamics captured by the VECM can be trusted in representing the relationship between external variables (the US Dollar Index, foreign exchange reserves, and the foreign bank asset ratio) with the stability of banking intermediation (LDR) in Indonesia.

5.5. JOHANSEN COINTEGRATION TEST

After ensuring first-order stationary data and determining the optimum lag, the next step is to conduct the Johansen cointegration test. This test is used to determine whether there is a long-term relationship between the variables in the model, namely the Loan to

Deposit Ratio (LDR), the US Dollar Index (LUSI), Foreign Exchange Reserves (LCD), and the Ratio of Foreign Bank Assets to Total Commercial Bank Assets (RATIO).

Testing is carried out using two main statistics, namely Trace Statistics and Maximum Eigenvalue Statistics. The test results are shown in Table 7 and Table 8.

Table 7. Results of the Johansen Cointegration Test (Trace Statistics)

Hypothesis No. of CE(s)	Eigenvalue	Trace Statistics	Critical Value (5%)	Prob.
None *	0.386967	52.68999	47.85613	0.0164
At most 1	0.240164	24.80433	29.79707	0.1877
At most 2	0.132597	8.375887	15.49471	0.4258
At most 3	0.002205	0.128020	3.841465	0.7205

Source: Processed data, 2025.

Table 8. Results of the Johansen Cointegration Test (Maximum Eigenvalue Statistic)

Hypothesis No. of CE(s)	Eigenvalue	Max-Eigen Statistics	Critical Value (5%)	Prob.
None *	0.386967	28.38156	27.58434	0.0395
At most 1	0.240164	15.92984	21.13162	0.2290
At most 2	0.132597	8.250567	14.26460	0.3538
At most 3	0.002205	0.128020	3.841465	0.7205

Source: Processed data, 2025.

Based on the results of the Johansen cointegration test on Trace Statistic (Table 7), it can be seen that the null hypothesis of no cointegration (None) is rejected at the 5% significance level because the Trace Statistic value (52.68999) is greater than the 5% critical value (47.85613) with a probability of 0.0164. However, in the at most hypothesis and so on, the Trace Statistic value is smaller than the 5% critical value, so the null hypothesis cannot be rejected. This result shows that there is one cointegration equation in the model.

Consistency is also shown by the Maximum Eigenvalue Statistic (Table 8), where the null hypothesis of no cointegration is rejected at the 5% significance level (Max-Eigen Statistic value = 28.38156 > 27.58434 with p-value = 0.0395). However, the hypothesis of at most 1 and so on is not rejected, which reaffirms that there is one cointegration equation.

These findings indicate that the LDR, US Dollar Index, Foreign Exchange Reserves, and Foreign Bank Asset Ratio variables have a stable long-term relationship. In other words, despite short-term fluctuations, there is a long-term equilibrium mechanism between external factors and the stability of banking intermediation in Indonesia.

The existence of this cointegration relationship indicates that the Vector Error Correction Model (VECM) is suitable for use in this study. Through the VECM, not only can short-term relationships between variables be analyzed, but also the adjustment process towards long-term equilibrium can be studied (Johansen, 1991; Enders, 2015).

5.6. VECM ESTIMATION RESULTS

After all tests before that demonstrate the feasibility of using the model, the next step is to estimate the Vector Error Correction Model (VECM). This estimation aims to identify the long-term and short-term relationships between external variables (US Dollar Index/LUSI, Foreign Exchange Reserves/LCD, and Foreign Bank Asset Ratio/RASIO) with the stability of banking intermediation in Indonesia as measured by the Loan to Deposit Ratio (LDR).

Long-term estimation results show that (Table 9):

1. The US Dollar Index (LUSI) has a negative and significant effect on the LDR, with a coefficient of -27,325.36. This means that USD appreciation tends to reduce banking intermediation capacity in Indonesia.
2. Foreign Exchange Reserves (LCD) also had a negative and significant effect on the LDR (-34,272.14). This suggests that increasing foreign exchange reserves is associated with reduced pressure on the financial system, leading banks to adjust their intermediation function.
3. The Foreign Bank Asset Ratio (RASIO) has a significant negative effect on the LDR (-2,314.175). The presence of foreign banks with a larger asset proportion has the potential to intensify competition and influence domestic banks' intermediation strategies.

Table 9. VECM Estimation Results

Variables	Coefficient	Std. Error	t-Statistic	Information
Cointegration Equation (Long Run)				
LDR(-1)	1,000,000	—	—	-
LUSI(-1)	-27325.36	4634.44	-5.89615	Significant (5%)
LCD(-1)	-34272.14	6413.44	-5.34380	Significant (5%)
RATIO(-1)	-2314.175	307.291	-7.53088	Significant (5%)
Constant	323928.8	—	—	—
Error Correction Term (ECT) and Short-Term Dynamics				
COINTEQ1 → D(LDR)	0.063124	0.03060	2.06284	Significant
COINTEQ1 → D(LUSI)	4.73E-06	3.9E-06	1.20508	Not significant
COINTEQ1 → D(LCD)	5.13E-06	4.5E-06	1.13596	Not significant
COINTEQ1 → D(RATIO)	0.000223	6.3E-05	3.53556	Significant

Source: Processed data, 2025.

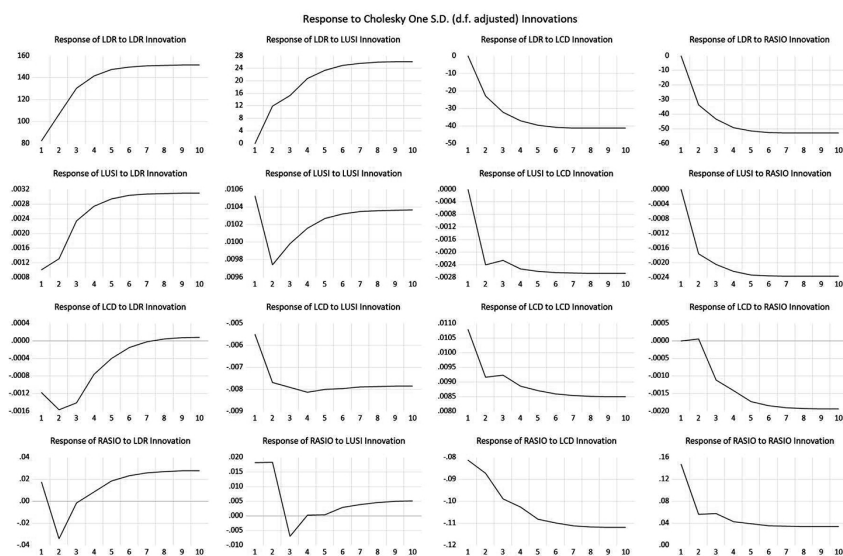
Overall, these results indicate that the three external variables have a long-term relationship with the stability of banking intermediation in Indonesia.

In the short run, the Error Correction Term (ECT) is significant for the ΔLDR and $\Delta RATIO$ equations:

1. The ECT coefficient for ΔLDR is 0.063124 with a t-statistic of 2.06284, which is significant at the 5% level. The positive and significant adjustment coefficient in the ΔLDR equation suggests that deviations from the long-run equilibrium are not corrected monotonically. Instead, the banking intermediation ratio exhibits short-run amplification dynamics, implying that external shocks may initially intensify liquidity imbalances before gradual stabilization through broader system dynamics.
2. The ECT coefficient for $\Delta RATIO$ is 0.000223 ($t = 3.53556$), which is also significant, indicating that the role of foreign banks contributes to the dynamics of adjustment towards equilibrium.
3. The ECT on $\Delta LUSI$ and ΔLCD is insignificant, which means that shocks to the USD Index and foreign exchange reserves do not directly affect short-term dynamics, but their impact is more dominant in the long term.

The Impulse Response Function (IRF) is used to trace the response of variables to shocks of one standard deviation from other variables in the VECM system. This analysis is important to understand the direction, intensity, and duration of the influence of external variables (US Dollar Index/LUSI, Foreign Exchange Reserves/LCD, and Foreign Bank Asset Ratio/RATIO) on banking stability as measured by the Loan to Deposit Ratio (LDR) (Figure 1).

Figure 1. Results of Impulse Response Function (IRF) Between Variables in VECM



Source: Processed data, 2025.

5.7. LDR RESPONSE TO EXTERNAL VARIABLE SHOCK

LDR Response to LUSI (US Dollar Index)

The LDR responded positively to the LUSI shock. The response increased sharply in the initial period (1–5) and then stabilized at a higher level. This indicates that USD appreciation leads to an increase in the LDR, which can be interpreted as an incentive for banks to expand intermediation when exchange rate pressures increase.

LDR Response to LCD (Foreign Exchange Reserves)

The LDR response to the foreign exchange reserve shock was significantly negative. The LDR declined drastically until the third period before stabilizing at a lower level. This means that the increase in foreign exchange reserves is associated with a decline in the bank intermediation function, which may be related to increased external liquidity, reducing the need for domestic credit distribution.

LDR Response to RATIO (Foreign Bank Assets)

The LDR also responded negatively to shocks to the RATIO, particularly in the initial period, before stabilizing at a lower level after period 5. This suggests that the expansion of foreign bank assets may put pressure on domestic banking intermediation.

External Variable Response to LDR Shock

LUSI on LDR

Positive response with a steady increase from the initial period to the 6th period, then reaching a balance point. This shows the link between the domestic intermediation function and global exchange rate pressures.

LCD on LDR

The initial response was negative before gradually turning positive, albeit by a small amount. This indicates that domestic intermediation has only a limited effect on the dynamics of foreign exchange reserves.

RATIO to LDR

Negative responses in the initial period and only increased slightly after the 5th period, although they remained at a low level. This confirms that the intermediary role of domestic banks is relatively weak in influencing the competitive position of foreign banks.

Internal Response between External Variables

LUSI on LCD and RATIO showed a significant negative pattern, indicating that USD appreciation tends to suppress foreign exchange reserves and the portion of foreign bank assets. LCD on LUSI and RATIO showed a negative response at the beginning of the period, which then stabilized near zero, indicating that the relationship between foreign exchange reserves and other external variables is more dominant in the short term. RATIO on LUSI and LCD shows a negative response that continues into the medium term, indicating that external fluctuations have implications for the dynamics of foreign banks in the Indonesian financial system.

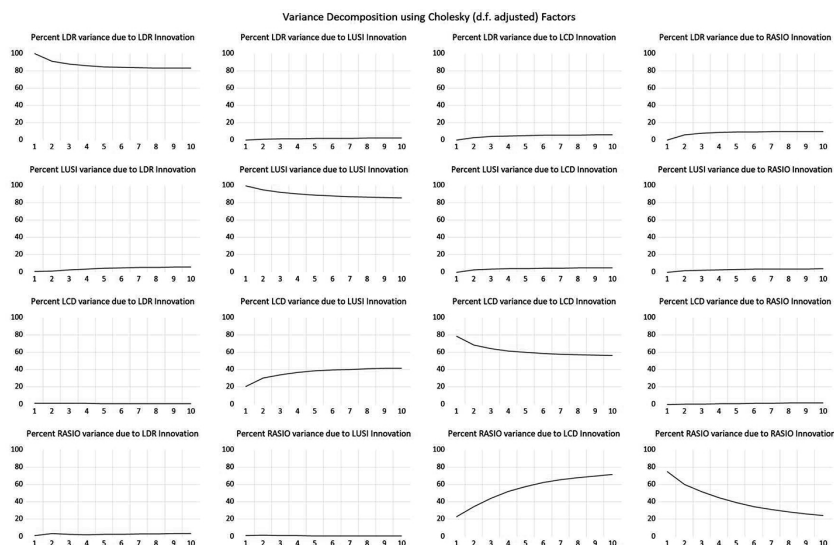
The results of the IRF confirm that external variables have a significant influence on the stability of banking intermediation in Indonesia. The shock to the US Dollar Index drove an increase in the LDR, while the shock to Foreign Exchange Reserves and the Foreign Bank Asset Ratio actually suppressed the intermediation function. The LDR response to external variables is relatively fast (1–3 periods) before reaching stability, which indicates the short-term vulnerability of the banking sector to external shocks.

This finding is in line with previous literature showing that financial openness makes domestic banking more vulnerable to external dynamics (Alper and Yilmaz, 2021; Park & Shin, 2020). Thus, the IRF results strengthen the evidence that the resilience of banking intermediation in Indonesia is greatly influenced by global conditions, particularly exchange rate fluctuations and international liquidity dynamics.

5.8. VARIANCE DECOMPOSITION (VD)

Variance Decomposition (VD) provides information on the proportion of a variable's variation explained by shocks to itself and shocks to other variables in the model. In other words, VD complements IRF analysis by showing the relative contribution of each variable in explaining short-term to long-term fluctuations (Figure 2).

Figure 2. Results of Variance Decomposition Between Variables in VECM



Source: Processed data, 2025.

Variance Decomposition (VD) provides an overview of the proportion of a variable's variation explained by its own shocks and shocks from other variables. The analysis results in Figure 2 show that the variation in the Loan to Deposit Ratio (LDR) in the initial period was almost entirely explained by its own shocks, approaching 100 percent. However, as the period progressed, this proportion decreased slightly to around 85 to 90 percent, while the influence of external variables such as the US Dollar Index (LUSI), Foreign Exchange Reserves (LCD), and the Foreign Bank Asset Ratio (RASIO) began to contribute, although on a relatively small scale, namely below 15 percent cumulatively. This finding indicates that the stability of banking intermediation in Indonesia, as measured by the LDR, is largely determined by internal domestic factors, although external factors still play an additional role.

Meanwhile, LUSI variation is dominated by its own shocks, which account for more than 90 percent of the observation period, while the contribution of other variables, including LDR, LCD, and RATIO, remains very limited, accounting for less than 10 percent. This confirms that the dynamics of the global exchange rate, as represented by the US Dollar Index, are more influenced by global external factors than by domestic banking conditions in Indonesia.

In contrast to LUSI, variations in the LCD exhibit a more dynamic pattern. In the initial period, approximately 70 to 80 percent of the variation in foreign exchange reserves was explained by internal shocks. However, in the medium to long term, the contribution from LUSI increased to approximately 30 percent. This fact confirms that Indonesia's foreign exchange reserves are highly sensitive to global exchange rate fluctuations. On the other hand, the contribution of the LDR and RATIO to the variation in foreign exchange reserves was relatively small and insignificant throughout the period.

As for the **RATIO**, in the initial period, its variation was largely explained by internal shocks, accounting for around 80 percent. However, in the medium term, the contribution from **LCD** gradually increased to around 30 percent, indicating that foreign exchange reserves play a significant role in explaining the movement of foreign bank assets in Indonesia. Furthermore, the **LUSI** (Low Debt to Deposit Ratio) also had a relatively small effect on **RATIO** variation, while the **LDR** (Low Debt to Deposit Ratio) did not have a significant effect.

Overall, the results of this Variance Decomposition confirm that the stability of banking intermediation in Indonesia remains highly dependent on internal factors. However, external factors, particularly global exchange rate fluctuations as reflected in the US Dollar Index and foreign exchange reserves, play a significant role in the medium to long term. The close relationship observed between foreign exchange reserves and the foreign bank asset ratio also demonstrates that foreign banking stability in Indonesia is closely linked to the national foreign exchange reserve position, which serves as a liquidity cushion against potential external shocks. These findings emphasize that strengthening domestic fundamentals remains a top priority in maintaining banking stability, alongside vigilance against external dynamics that could potentially impact the national financial system.

5.9. GRANGER CAUSALITY TEST

The Granger causality test was conducted to identify the direction of the causal relationship between external variables (**LUSI**, **LCD**, **RATIO**) and domestic banking stability (**LDR**). The test results are shown in Table 10.

Table 10. Granger Causality Test Results

Null Hypothesis	F-Statistic	Prob.	Results
LUSI does not Granger Cause LDR	2.31024	0.1092	Not significant
LDR does not Granger Cause LUSI	1.09316	0.3426	Not significant
LCD does not Granger Cause LDR	4.86512	0.0115	Significant (LCD → LDR)
LDR does not Granger Cause LCD	0.34992	0.7064	Not significant
RATIO does not Granger Cause LDR	7.24241	0.0017	Significant (RATIO → LDR)
LDR does not Granger Cause RATIO	1.34622	0.2690	Not significant
LCD does not Granger Cause LUSI	4.46910	0.0161	Significant (LCD → LUSI)
LUSI does not Granger Cause LCD	0.82612	0.4433	Not significant
RATIO does not Granger Cause LUSI	4.10623	0.0220	Significant (RATIO → LUSI)
LUSI does not Granger Cause RATIO	0.17284	0.8417	Not significant
RATIO does not Granger Cause LCD	0.57971	0.5636	Not significant
LCD does not Granger Cause RATIO	0.56192	0.5735	Not significant

Source: Processed data, 2025.

The test results show several significant causal relationships. First, there is a one-way causality from foreign exchange reserves (LCD) to the Loan to Deposit Ratio (LDR), with a probability value of 0.0115 which is significant at the 5 percent level. This indicates that changes in foreign exchange reserves can affect the banking intermediation function in Indonesia, but not vice versa. Second, the foreign bank asset ratio (RATIO) is also proven to significantly affect the LDR (p-value = 0.0017), which indicates that the presence of foreign banks affects the stability of domestic banking, especially in credit distribution and fund raising.

In addition, a one-way causality was found from LCD to LUSI (p-value = 0.0161), which means that the dynamics of foreign exchange reserves can affect the movement of the US Dollar Index. This is in line with the view that international capital and liquidity flows can affect global exchange rates through the role of foreign exchange reserves. Another important finding is the causal relationship of RATIO to LUSI (p-value = 0.0220), which indicates the role of foreign bank assets in influencing the dynamics of global exchange rates in Indonesia.

On the other hand, no evidence of causality was found from LDR to external variables, either to LUSI, LCD, or RATIO. These results strengthen the conclusion that domestic banking stability is more influenced by external factors than vice versa.

Overall, the Granger causality test results confirm that external factors, particularly foreign exchange reserves and the foreign bank asset ratio, play a dominant role in influencing the stability of banking intermediation in Indonesia. Meanwhile, the LDR's influence on external dynamics is relatively insignificant. This finding is in line with previous literature that emphasizes the importance of global factors and the country's external position in maintaining the stability of the domestic banking sector (Claessens and van Horen, 2015; Eichengreen, 2019).

5.10. ROBUSTNESS CHECKS

To ensure that the baseline VECM findings are not driven by temporary structural shocks, proxy selection or sample segmentation bias, several alternative specifications are estimated. These include the introduction of a COVID 19 dummy variable and the replacement of LDR with NPL as an alternative banking stability indicator. The results provide a deeper understanding of the structural stability of the macro banking nexus (Table 11).

Table 11. Robustness Results with Covid-19 Dummy Variable

Variable	Coefficient	t-Statistic
LUSI(-1)	455.9586	2.0991
LCD(-1)	-857.3675	-3.4028
RASIO(-1)	-60.0783	-3.9876
DUMMY(-1)	79.1505	5.2170
Error Correction Term (Δ LDR): -0.020340 (t = -2.4421)		

Source: Processed data, 2025.

The inclusion of a pandemic dummy variable (equal to 1 for 2020M03–2021M12 and 0 otherwise) allows the model to explicitly control for an extraordinary structural shock affecting both macroeconomic activity and banking behavior. The long-run cointegration equation remains statistically significant after controlling for the dummy. LUSI (455.9586; $t = 2.0991$), LCD (-857.3675; $t = -3.4028$), and RASIO (-60.0783; $t = -3.9876$) preserve their statistical relevance, indicating that the structural relationship between macroeconomic conditions and banking liquidity is not eliminated once the pandemic shock is isolated. Importantly, the dummy variable itself is highly significant (79.1505; $t = 5.2170$), confirming that the pandemic generated a discrete upward shift in the long-run equilibrium level of LDR.

Despite this shift, the error correction term in the Δ LDR equation remains negative and statistically significant (ECT = -0.020340; $t = -2.4421$), indicating continued convergence toward long-run equilibrium at a monthly adjustment speed of approximately 2%. This result is crucial because it shows that while COVID 19 altered the equilibrium level, it did not dismantle the equilibrium mechanism itself. In other words, the pandemic acted as a level shock rather than a structural break in the long-run relationship. This specification therefore strengthens the baseline findings by demonstrating that the long-run macro–banking linkage survives the inclusion of an explicit crisis control.

To examine whether the results are dependent on the choice of banking indicator, LDR is replaced with Non-Performing Loans (NPL), which captures credit risk rather than liquidity conditions (Table 14). The cointegration equation under this specification shows that LUSI (13.5297; $t = 7.0862$) and LCD (11.0031; $t = 4.3657$) remain highly significant, while RASIO becomes statistically insignificant (0.001573; $t = 0.0136$). This indicates that macroeconomic conditions exert a strong long-run influence on banking credit risk, even if capital adequacy plays a weaker direct role in this alternative formulation.

Table 14 Alternative Dependent Variable: NPL

Variable	Coefficient	t-Statistic
LUSI(-1)	13.5297	7.0862
LCD(-1)	11.0031	4.3657
RASIO(-1)	0.001573	0.0136
Error Correction Term (Δ NPL): -0.890769 ($t = -33.9955$)		

Source: Processed data, 2025.

Most strikingly, the error correction term in the Δ NPL equation is extremely large and highly significant (ECT = -0.890769; $t = -33.9955$). This implies a rapid speed of adjustment, with nearly 89% of disequilibrium corrected within one month. Economically, this suggests that credit risk adjusts far more aggressively to macroeconomic imbalances than liquidity ratios do. While LDR reflects balance sheet positioning behavior, NPL captures realized credit deterioration, which may respond more sharply to macro shocks. The substitution exercise therefore confirms that the macroeconomic determinants affect both liquidity and credit risk channels. The persistence of cointegration under an alternative proxy reduces concerns of indicator-specific bias and enhances the structural validity of the empirical framework.

These robustness exercises collectively indicate that the estimated long-run relationships are not driven by temporary crisis effects, proxy-specific bias, or sample segmentation, but instead reflect a structurally persistent macro banking equilibrium mechanism.

5.11. DISCUSSION

Long-Term Relationship between the US Dollar Index, Foreign Exchange Reserves, Foreign Bank Asset Ratio, and Banking Stability (LDR)

The VECM estimation results show that in the long run, the US Dollar Index (LUSI), foreign exchange reserves (LCD), and the foreign bank asset ratio (RASIO) have a significant relationship with banking stability in Indonesia, proxied by the Loan to Deposit Ratio (LDR). The long-term coefficients indicate that an increase in the US Dollar Index, a decline in foreign exchange reserves, and an increase in the proportion of foreign bank assets are associated with a deterioration in domestic banking intermediation. This finding is consistent with the theoretical framework suggesting that external shocks and foreign bank penetration may increase financial vulnerability in developing countries (Claessens and van Horen, 2015).

Importantly, the robustness analysis confirms that this long-run relationship is not driven solely by the COVID-19 crisis period. When a pandemic dummy variable is introduced to explicitly control for the structural shock during 2020–2021, the cointegrating relationship remains statistically significant. Although the dummy variable captures a discrete upward shift in the equilibrium level of LDR, the macroeconomic variables retain their long-run relevance. This indicates that the pandemic acted as a level shock rather than a structural break in the macro–banking nexus.

Findings regarding the US Dollar Index indicate that US dollar appreciation is associated with a contraction in banking intermediation. This is consistent with Avdjiev, et al. (2019), who found that a strengthening US dollar tightens global financial conditions and reduces lending in emerging markets. In Indonesia, dependence on international capital flows amplifies this transmission mechanism, reinforcing the vulnerability of domestic liquidity conditions to global dollar cycles.

Meanwhile, foreign exchange reserves play a stabilizing role. The negative long-term relationship between LCD and LDR suggests that declining reserves weaken banking intermediation. This aligns with Aizenman and Sun (2012), who emphasize the buffer-stock function of reserves in mitigating sudden stops and capital flow volatility. Adequate reserve accumulation therefore strengthens market confidence and enhances systemic resilience.

Furthermore, the foreign bank asset ratio exhibits a significant long-run effect on LDR, indicating that deeper foreign bank penetration may alter the structure of domestic intermediation. While this supports Cull and Martínez Pería (2013), who document crowding-out effects in developing markets, it also highlights the importance of regulatory quality, as emphasized by Claessens and van Horen (2012).

The substitution of LDR with Non-Performing Loans (NPL) as an alternative stability proxy further strengthens the structural interpretation. The persistence of cointegration under the NPL specification indicates that macroeconomic fundamentals influence not only liquidity positioning but also credit risk dynamics. Notably, the substantially larger error

correction coefficient in the NPL model suggests that credit risk adjusts more rapidly to macroeconomic disequilibria than liquidity ratios. This distinction implies the presence of multiple transmission channels—liquidity and credit-risk—through which external shocks propagate within the banking system.

Thus, the findings confirm a structurally persistent long-run relationship between external variables and domestic banking stability, which remains intact even after controlling for crisis effects and alternative stability proxies.

Short-Term Dynamics between the US Dollar Index, Foreign Exchange Reserves, Foreign Bank Asset Ratio and Banking Stability

The short-term dynamics indicate heterogeneous adjustment behavior. In the full-sample estimation, the error correction term (ECT) in the LDR equation is statistically significant, indicating convergence toward long-run equilibrium following short-term disequilibria.

In the short term, the LUSI's influence on the LDR tends to be unstable and fluctuating. The IRF results support the estimate, indicating that shocks to the US Dollar Index will increase pressure on banking liquidity, which in turn weakens the intermediation function. This is in line with research by Kalemli-Ozcan et al. (2013), which found that US dollar exchange rate volatility is a key determinant of global risk transmission to the domestic financial sector, including banking.

Foreign exchange reserves (LCD) have a relatively limited but still significant impact on the LDR over a specific time horizon. This reflects the role of foreign exchange reserves as a buffer, the effects of which only become apparent after a certain period. Aizenman et al. (2015) also found that foreign exchange reserves have a more dominant influence in dampening long-term volatility, while in the short-term, their function is more focused on maintaining market confidence.

Meanwhile, the foreign bank asset ratio (RATIO) shows a significant influence in the short term on LDR. The VECM and IRF results confirm that increased foreign bank penetration immediately depresses domestic bank intermediation performance. This finding is consistent with Ghosh et al. (2014), who stated that the role of foreign banks in emerging markets often increases the vulnerability of the banking system to external shocks, particularly in the short term. However, this crowding-out effect has the potential to diminish in the long term if the domestic financial system successfully undergoes structural adaptation.

Thus, the short-term dynamics of the three independent variables indicate that Indonesian banking stability remains vulnerable to external shocks, particularly from fluctuations in the US Dollar Index and the dominance of foreign banks. Foreign exchange reserves serve more as a long-term buffer, although their initial effect is limited. Therefore, monetary and macro prudential policies responsive to global volatility are crucial to maintaining the stability of the banking intermediation function in the short term.

The Impact of External Shocks on Banking Stability

The Impulse Response Function (IRF) analysis shows that the Loan-to-Deposit Ratio (LDR) responds significantly to shocks from external variables, although in varying directions and intensities. Shocks to the US Dollar Index (LUSI) tend to suppress the banking intermediation function, as evidenced by the decline in the LDR in the initial periods before eventually

stabilizing. This confirms that a strengthening US dollar tightens domestic liquidity, reduces credit capacity, and weakens banking intermediation. This finding is consistent with Avdjiev et al. (2019), who found that global US dollar appreciation worsens the financial conditions of emerging market countries through a contraction in cross-border lending.

Meanwhile, shocks to foreign exchange reserves (LCD) elicit a positive response from the LDR, indicating that increased foreign exchange reserves strengthen the intermediation function. With sufficient foreign exchange reserves, domestic banks are more resilient to external pressures, allowing them to continue disbursing credit stably. This finding aligns with Aizenman and Hutchison (2012), who demonstrated that foreign exchange reserves serve as a buffer against external financial shocks, thereby strengthening the stability of the domestic financial sector.

In contrast to the two previous variables, shocks to the foreign bank asset ratio (RATIO) have a negative impact on the LDR, meaning that the penetration of foreign bank assets has the potential to reduce the ability of domestic banks to carry out their intermediation function. This can be caused by the crowding out effect, where the presence of foreign banks dominates the market and suppresses the room for domestic banks to operate. These findings align with research by Cull and Martínez Pería (2013), who found that foreign bank expansion in developing countries often reduces the role of domestic banks in credit distribution, particularly during periods of global uncertainty. However, these findings also echo the alternative argument of Claessens and van Horen (2014), who argued that the presence of foreign banks can enhance stability if domestic regulations are strong and policy coordination is effective.

The Variance Decomposition (VD) results show that although the LDR variation is still dominated by its own contribution, the proportion of contributions from LUSI, LCD, and RATIO increases gradually in the medium to long term. This reinforces the finding that external shocks, although initially temporary, have a significant cumulative role in domestic banking stability. Thus, the stability of banking intermediation in Indonesia is highly vulnerable to external shocks, particularly from the global exchange rate (LUSI) and foreign bank dominance (RATIO), while foreign exchange reserves serve as an important mitigation instrument.

Overall, this study confirms that the impact of external shocks cannot be ignored in maintaining banking stability. Therefore, policies that emphasize strengthening foreign exchange reserves, stabilizing the exchange rate, and appropriate regulation of the role of foreign banks are key to strengthening the banking intermediation function in Indonesia.

Direction of Causality between External Variables and Banking Stability

The results of the Granger causality test indicate that the relationship between external variables and banking stability (LDR) in Indonesia is not symmetrical, but rather dominated by a one-way causal relationship. First, a causal relationship was found from foreign exchange reserves (LCD) to LDR, but not vice versa. This means that changes in foreign exchange reserves have been shown to influence the dynamics of domestic banking intermediation, but LDR fluctuations have no significant impact on changes in foreign exchange reserves. This is in line with the findings of Aizenman, Jinjark and Park (2011), who stated that foreign exchange reserves function as a stabilization instrument against external shocks, making them more exogenous to the domestic financial system.

Second, there is a one-way causal relationship from the foreign bank asset ratio (RATIO) to LDR, which indicates that increasing foreign bank penetration affects domestic banking stability, but the stability of banking intermediation does not directly affect the proportion of foreign bank assets. These findings support research by Cull and Martínez Pería (2013), who found that foreign bank expansion in developing countries can influence domestic bank lending patterns. However, these results also differ from the study by Claessens and van Horen (2014), who found that the presence of foreign banks in some countries actually strengthens stability if the regulatory infrastructure is strong and external risks are minimized.

Third, in terms of interactions between external variables, the causality test found an effect of LCD on the US Dollar Index (LUSI) and of RATIO on LUSI. This indicates that foreign exchange reserves and foreign bank penetration contribute to the dynamics of US dollar exchange rate movements in Indonesia, although the reverse direction was not proven significant. This finding is relevant to the research of Kalemli-Ozcan et al. (2013), which emphasized that international capital flows and global banking activity play a role in strengthening the transmission of exchange rate shocks to the domestic market.

Overall, these results confirm that banking stability in Indonesia is more influenced by external variables (LCD and RATIO), while the US Dollar Index does not directly affect the LDR in the short term through a causal mechanism. This pattern highlights the importance of foreign exchange reserves and supervision of foreign bank activities as key factors in maintaining the resilience of the banking intermediation system. Thus, the identified direction of causality supports the view that external factors are more determinant than endogenous in explaining domestic banking stability.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1. CONCLUSION

This study analyzes the relationship between external variables (the US Dollar Index, foreign exchange reserves, and the foreign bank asset ratio) and banking stability in Indonesia, proxied by the Loan-to-Deposit Ratio (LDR), using the Vector Error Correction Model (VECM) approach. Four main findings can be concluded.

First, in the long term, the US Dollar Index, foreign exchange reserves, and the foreign bank asset ratio have been shown to significantly influence the stability of banking intermediation. A strengthening US dollar and the increasing dominance of foreign bank assets suppress the intermediation function, while foreign exchange reserves play a positive role in maintaining banking resilience.

Second, in the short term, LDR dynamics exhibit high sensitivity to external shocks, particularly the US dollar exchange rate and the role of foreign banks. Meanwhile, foreign exchange reserves exhibit a stronger stabilizing effect in the long term, although its short-term impact is relatively limited.

Third, the IRF and Variance Decomposition results confirm that shocks from the US Dollar Index and the foreign bank asset ratio tend to lower the LDR, while shocks from foreign exchange reserves strengthen the intermediation function. Although variations in the

LDR are largely explained by its own contribution, the role of external variables increases significantly over the medium to long horizon.

Fourth, the Granger causality test results indicate a one-way causality from foreign exchange reserves and the foreign bank asset ratio to the LDR. This indicates that external factors are more determinant than endogenous in explaining domestic banking stability, while the LDR's influence on external factors is relatively insignificant.

Overall, the results of this study confirm that the stability of banking intermediation in Indonesia is strongly influenced by external factors, both through global exchange rate channels and foreign bank penetration, with foreign exchange reserves as a key instrument for risk mitigation.

6.2. POLICY RECOMMENDATIONS

The findings of this study have several important policy implications. First, strengthening foreign exchange reserves should be a monetary policy priority, as adequate reserves have been shown to reduce banking vulnerability to external shocks and maintain the intermediation function. Second, monetary and macro prudential authorities need to respond proactively to US Dollar Index volatility through more flexible exchange rate policies and domestic liquidity stabilization instruments.

Third, supervision and regulation of foreign banks need to be strengthened. Although the presence of foreign banks has the potential to increase efficiency, the results of this study indicate that excessive penetration can reduce the space for domestic banking intermediation. Therefore, policies that balance the role of foreign banks with protecting systemic stability are very important.

Fourth, coordination between Bank Indonesia, the Financial Services Authority, and the government in macro prudential and fiscal policies needs to be strengthened, considering that domestic banking stability is heavily influenced by external factors. This policy integration can strengthen the resilience of Indonesia's financial system to global shocks.

While the empirical findings suggest strengthening foreign exchange reserves and calibrating the role of foreign banks, the feasibility of these recommendations must be assessed within Indonesia's macroeconomic and regulatory constraints. Reserve accumulation is not costless, as it involves sterilization costs, fiscal coordination challenges, and exposure to global monetary cycles, particularly those driven by the Federal Reserve. However, Indonesia's institutional framework provides sufficient policy space for dynamic reserve management. Bank Indonesia has implemented a multi-instrument exchange rate stabilization strategy, including spot market intervention, domestic non-deliverable forwards, and government bond market operations, which allows reserve management without excessive distortion.

Similarly, regulating foreign bank penetration does not imply restricting financial openness. Indonesia remains committed to international financial integration and WTO obligations. Nevertheless, macro prudential supervision under the Financial Services Authority (OJK) provides tools to manage systemic exposure, including capital adequacy requirements, liquidity coverage ratios, and countercyclical buffers. The recommendation therefore concerns prudential calibration rather than protectionist intervention. In this context, the

policy implications derived from this study are feasible when they are implemented within a coordinated macro–financial policy framework rather than as isolated measures.

Thus, this study provides an empirical contribution to the literature on banking stability in developing countries and offers relevant policy recommendations to maintain the intermediation function of Indonesian banking amidst increasingly complex global dynamics.

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