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Coordinating capital flows and macroprudential tools for price and financial stability

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Abstract: Financial stability and low inflation remain central objectives for emerging economies subject to large and volatile capital flows. This paper evaluates how macroprudential regulations and conventional monetary policy interact to support price and financial stability in Indonesia. Using quarterly data from Q1 2005 to Q4 2021, we estimate a Structural Vector Autoregression (SVAR) model and derive impulse response functions (IRFs) and forecast-error variance decompositions (FEVDs) to measure policy shock dynamics. Our findings indicate that a one-standard-deviation increase in the policy interest rate lowers inflation by 0.4 percentage points two quarters after the shock and reduces exchange-rate volatility by up to 1.2% at its peak in quarter 3. Variance decomposition attributes 21.2% and 22.5% of inflation variability to monetary policy shocks in the short and long run, respectively, while capital inflows explain 4.2% and 11.5% over the same horizons. Complementary macroprudential instruments, such as countercyclical capital buffers, further dampen credit growth and enhance monetary transmission. These empirical results underscore that a coordinated policy mix bolsters the resilience of Indonesia's financial system against external disturbances. The study provides actionable insights for calibrating monetary and macroprudential tools within an integrated policy framework.

Keywords: *Capital flow management, Financial stability, Impulse response functions, Indonesia, Macroprudential instruments, Monetary policy transmission, Price stability, Structural vector autoregression (SVAR), Variance decomposition.*

1. Introduction

Financial stability is a fundamental objective of national economic policy, especially following the 2008 global financial crisis, which demonstrated that price stability alone is insufficient to safeguard overall economic resilience. Traditional macroeconomic models focus on stabilizing inflation and production, but real-world data reveals that these goals don't always make the financial system more stable [1]. The financial system's ability to handle shocks without affecting the effective allocation of capital or payment systems is what financial stability means [2].

In an increasingly integrated global financial market, capital flows affect exchange rates, asset prices, credit cycles, and liquidity conditions. According to the "Impossible Trinity," a country cannot simultaneously maintain a fixed exchange rate, independent monetary policy, and free capital movement, forcing policymakers to prioritize at least two of these objectives. While capital inflows [1]can stimulate domestic investment, enhance market liquidity, and lower the cost of capital—thereby fostering growth [3, 4]—they also expose emerging market economies (EMEs) to sudden stops, reversals, and speculative pressures [5]. Indonesia's experience in 2010 illustrates this dynamic: a surge of over USD 13.2 billion in portfolio inflows led to a 12.5% rupiah appreciation, followed by abrupt reversals that disrupted monetary policy implementation.

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Volatility in capital flows influences critical aspects of economic management: swift inflows enhance foreign reserves and strengthen the balance of payments, whereas abrupt withdrawals diminish reserves and destabilize the exchange rate. In addressing these challenges, policymakers have augmented traditional tools with capital flow management (CFM) measures—such as capital controls and foreign exchange reserve requirements—and macroprudential instruments, including rates of loan to value (LTV), countercyclical capital buffers, and debt-to-income limits. The synchronized utilization of these instruments can enhance the transmission of monetary policy, mitigate credit and asset price fluctuations, and bolster both price and financial stability.

This paper investigates the combined role of CFMs and macroprudential instruments in controlling inflation and preserving financial stability in Indonesia, focusing on how an integrated policy mix enhances the effectiveness of monetary policy transmission.

2. Literature Review

Financial stability prevents disruptions to the financial system and real-sector activity by ensuring efficient resource allocation and shock absorption. Financial stability, according to Issing [6] is when interest rates and asset prices successfully send market signals and there are no systemic crises. Price stability—defined as low and stable inflation—is essential for sustainable growth, as inflation volatility generates uncertainty.

In open economies, the Mundell–Fleming model illustrates how monetary and fiscal policies interact under different exchange rate regimes. Under perfect capital mobility, the model shows that policy effectiveness depends critically on the chosen exchange rate system [7]. For example, in a floating regime, a reduction in interest rates induces currency depreciation and improves net exports.

Monetary policy operates primarily through the interest rate channel: central bank adjustments to policy rates influence borrowing costs, aggregate demand, and ultimately output and inflation [8]. The speed and magnitude of this transmission depend on the banking sector's responsiveness and the health of interbank markets [9]. Macroprudential policies target systemic risks such as excessive credit growth, liquidity mismatches, and vulnerability from large capital inflows [10]. Instruments like the countercyclical capital buffer (CCB) force banks to build capital in good times, enhancing resilience during downturns.

Exchange rate dynamics respond to fundamental factors (inflation, interest differentials, growth prospects), technical drivers (order flow), and market sentiment [11]. In a floating regime, exchange rate adjustments mitigate external shocks, reducing the need for domestic interest rate changes [12]. Finally, foreign exchange reserves reflect a country's external financial strength and can be deployed to smooth balance-of-payments imbalances [13]. Higher interest rates, while slowing investment, can narrow the trade deficit via lower imports and support reserve accumulation [14]. Recent Indonesian evidence based on an ARDL approach also confirms the J-curve pattern, in which a real depreciation initially worsens and later improves the trade balance [15].

3. Research Method

Below is a summary of data sources and variable definitions used in the SVAR analysis:

Table 1.
Variable And Data Source.

Variable	Definition	Data Source
Policy interest rate	Quarterly policy rate (%)	Bank of Indonesia
Net portfolio inflows	Net capital inflows (USD millions)	Bank of Indonesia
Foreign exchange reserves	Total reserves (USD millions)	Bank of Indonesia
Exchange rate	End-of-period IDR per USD	Bank of Indonesia
GDP growth	Quarterly real GDP growth (%)	Statistic Indonesia

We employ a Structural Vector Autoregression (SVAR) model to analyze interactions among short-term capital flows, interest rates, foreign exchange reserves, and exchange rates. The model imposes theoretically motivated restrictions to orthogonalize structural shocks and uses quarterly data from Q1 2005 to Q4 2021, covering the period since Indonesia adopted the Inflation Targeting Framework (ITF).

3.1. Model Specivications

a. Structural shocks are normalized to unit variance, so the covariance matrix of reduced-form errors is the identity matrix (orthonormal innovations).
b. Short-run identifying restrictions are imposed as:
    a. e_t = S,u_t, E[u_t,u_t'] = I
    b. where S is a lower-triangular matrix encoding contemporaneous causal ordering.
c. Long-run constraints use:
    a. e_t = φ,F,u_t, E[u_t,u_t'] = I
    b. with F as a triangular matrix and $\varphi \approx 1.618$ (the golden ratio) to constrain cumulative impulse responses.
d. The VAR system is written:
    a. A_0,Xt = A(L),X{t-1} + B,e_t
    b. where: •X_t is the vector of endogenous variables at time t. • A_0 is the contemporaneous coefficient matrix. •A(L) = A_1L + … + A_pL^p is the lag polynomial in operator L. •e_t contains structural shocks. •B is a diagonal matrix scaling each shock.
e. Matrix coefficients are obtained by iteratively estimating the reduced-form VAR and applying these identifying restrictions.

For policy analysis, this framework permits the precise estimation of impulse response functions and difference decompositions by enabling the non-recursive orthogonalization of forecast errors. In order to accurately estimate impulse response equations and variability decompositions for policy analysis, this approach allows for the non-recursive orthogonalization of forecast errors.

We evaluate stationarity with unit-root tests (ADF) and cointegration with Johansen tests. Impulse response coefficients (IRFs) quantify the reaction of variables to shocks with a standard deviation of one, while predicted variance decomposition (FEVD) measures the impact of each shock on the variance of variables. This model integrates 66 constraints across 11 residual equations, yielding 11 shocks to foreign capital flows, capital buffers, inflation, and exchange rates. The iterative approach is employed to derive all matrix coefficients for estimating the SVAR. This SVAR estimation will serve as the foundation for the IRF and VD analysis. The Impulse Response Function (IRF) assesses the reaction of one variable to a shock in another variable at the present and in the future, whereas Variance Decomposition (FEVD) evaluates the interdependence among the variables involved.

4. Results of Analysis

The capital trajectory signifies macroprudential policy, while the interest rate trajectory denotes monetary policy. The initial phases in the analytical process include identifying research variables, describing data, doing stationarity tests, ordering variables, calculating lag length, constructing the SVAR model, testing model stability, and performing Impulse Response Function and variance decomposition analyses. The data utilized include quarterly time series from the first quarter of 2005 to the fourth quarter of 2021. This timeframe was selected due to the observation that Bank Indonesia had commenced the implementation of the Inflation Targeting Framework (ITF) strategy. Evaluate the stationarity of the data employing the unit root test via the ADF test, with the subsequent test results.

4.1. *Augmented Dickey-Fuller Unit Root Test*

The unit root test with the ADF test shows that data stationarity is partially stationary at the level and first difference.

Table 2.
Stationary Test of variables with ADF Test.

No	Variable	Uji Stasioner variable dengan *ADF* Test				
		Level		First difference		Level Integrasi
		t'stat	p-value	t'stat	p-value	
1	GDP	-2.891	0.042*	-4.048	0.002*	level
2	INF	-4.793	0.000**	-6.629	0.000**	level
3	SBA	-2.757	0.438	-4.548	0.0004*	First
4	CIF	-3.242	0.021*	-9.829	0.000**	level
5	CADEV	-1.433	0.56	-7.013	0.000**	First
6	CB	-1,677	0.438	-7.548	0.000**	First
7	PUAB	-2.583	0.116	-15.743	0.000**	First
8	KDT	-3.713	0.006*	-5.379	0.000**	level
9	JUB	-2.535	0.112	-2.914	0.049*	First
10	NPL	-4.253	0.001**	-3.68	0.011*	level
11	NT	-4.171	0.001**	-7.965	0.000**	level

Note: **Signifikan α = 1%; *Signifikan α = 5%.

All of the variables are stagnant at the 1st difference level, except for CIF, KDT, GDP, NPL, INF, and NT, whose data are stable at level I(0) with significance at 5% (1).

Table 3.
Optimal Lag.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Tracen statistic**	**0.05 critical value**	**Prob.****
None *	0.958	826.662	285.143	0.000
At most 1 *	0.922	624.443	239.235	0.000
At most 2 *	0.864	461.471	197.371	0.000
At most 3 *	0.717	334.006	159.530	0.000
At most 4 *	0.692	253.254	125.615	0.000
At most 5 *	0.579	177.842	95.754	0.000
At most 6 *	0.512	122.548	69.819	0.000
At most 7 *	0.404	76.597	47.856	0.000
At most 8 *	0.328	43.509	29.797	0.001
At most 9 *	0.204	18.074	15.495	0.020
At most 10	0.053	3.512	3.841	0.061

Note: Trace test indicates 10 cointegrating eqn(s) at the 0.05 level.
*denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.
Source: MacKinnon, et al. [16].

4.2. *Determination of the Optimal Lag*

Finding the best way to choose the lag order quantitatively shows that monetary policy, macroprudential policy, and foreign capital flow policy all have their biggest effects in the third quarter. This result is substantiated by the likelihood ratio (LR), final prediction error (FPE), Akaike information criterion (AIC), and Hannan-Quinn information criterion (HQ).

4.3. *Stationarity and Lag Selection*

Model specification requires choosing an appropriate lag length to capture the dynamics of interest rates, capital flows, and exchange rates without overparameterization. We employ five standard criteria: the sequential modified LR test statistic (LR), the final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan–Quinn criterion (HQ) [17-19]. These criteria balance goodness-of-fit against model parsimony, ensuring robust estimation in small samples [20].

The LR test evaluates whether adding an extra lag significantly improves model fit. In our results, LR statistics remain above the 5% critical value (approximately 3.84) up to lag 6, indicating that additional lags up to this order carry incremental explanatory power. However, the magnitude of LR statistics declines sharply after lag 3, from 22.84 at lag 3 to 6.74 at lag 4 and only 5.17 at lag 6, suggesting diminishing returns to complexity.

Information criteria yield mixed signals: both FPE and AIC continue to decline monotonically as lag length increases—favoring larger lag orders—whereas SC reaches its minimum at lag 2, and HQ at lag 3. SC's penalty for added parameters is strongest, making it more conservative, while HQ occupies an intermediate position between AIC and SC in balancing fit with parsimony [18, 19]. Considering these findings, and mindful of potential overfitting given our sample size, we adopt a lag length of three quarters. This choice reflects the trade-off suggested by the LR, SC, and HQ criteria, preserving dynamic richness while maintaining degrees of freedom for reliable inference in IRF and FEVD analyses [20].

4.4. Cointegration and Stability

The stability diagnostics for the SVAR model, derived from the companion matrix's characteristic roots, indicate that all eigenvalues have moduli below unity. The largest root, with a value of 0.996, lies just within the unit circle, satisfying the necessary condition for model stability [20]. This near-unit modulus of the dominant root suggests a high degree of persistence in the system, yet ensures that shocks dissipate over time rather than leading to explosive behavior [21].

The presence of complex conjugate root pairs with moduli of approximately 0.946 and 0.907 implies damped oscillatory dynamics in response to structural shocks, which is consistent with theoretical expectations for macroeconomic time series [20]. Smaller roots, with moduli of 0.411 and 0.240, point to rapidly decaying components in the model, reinforcing the reliability of impulse response analyses and variance decomposition for policymaking insights.

*4.5. Impulse Response Functions***

Inflation rate forecasts (IRFs) show that there is no effect on the general interest rate, flows of capital, or buffers for capital in the long run on these variables.

4.6. Variance Decomposition

Quarter 5 yields an explanation of 21.2% for inflation shocks from the benchmark rate, whereas quarter 60 yields an explanation of 22.5%. A short-term inflation shock of 4.2% and a long-term inflation shock of 11.5% are both caused by capital inflows. Inflows of capital account for 40.4% of the short-term fluctuations in the exchange rate and 23.2% of the long-term fluctuations. In total, variables related to capital flows and monetary policy account for more than 80% of the variation in exchange rates.

4.7. Stability Test Results

The stability diagnostics for the SVAR model, derived from the companion matrix's characteristic roots, indicate that all eigenvalues have moduli below unity. The largest root, with a value of 0.996, lies just within the unit circle, satisfying the necessary condition for model stability [20]. This near-unit modulus of the dominant root suggests a high degree of persistence in the system, yet ensures that shocks dissipate over time rather than leading to explosive behavior [21]. The presence of complex conjugate root pairs with moduli of approximately 0.946 and 0.907 implies damped oscillatory dynamics in response to structural shocks, which is consistent with theoretical expectations for macroeconomic time series [20].

Smaller roots, with moduli of 0.411 and 0.240, point to rapidly decaying components in the model, reinforcing the reliability of impulse response analyses and variance decomposition for policymaking insights. With a time lag of three quarters, The impact of the transmission of integrated monetary and macroprudential policies on price and financial stability as a function of incoming foreign capital flows is examined using SVAR estimation. satisfy the LR, FPE, AIC, and HQ criteria. For example, the stability value is less than 1, and the log likelihood value is relatively small at -22.68. According to these numbers, financial stability is being well-maintained by the integration route of capital flows, macroprudential policies, and monetary policy transmission.

4.8. Results of the Structural Vector Auto Regression (S-VAR) Test

4.8.1. Structur Impulse Response Function

Impulse Response Analysis Examining the currency rate allows one to gauge inflation's response to a shock in other variables that is one standard deviation away. The analysis aims to uncover the dynamic relationship between inflation and various economic factors, highlighting how unexpected changes can influence price levels in the economy. By examining these responses, we can gain valuable insights into the underlying mechanisms at play in the exchange rate's behavior. Understanding these mechanisms can help policymakers make informed decisions to stabilize the economy and control inflation. Additionally, it may provide investors with a clearer view of potential risks and opportunities in the foreign exchange market.

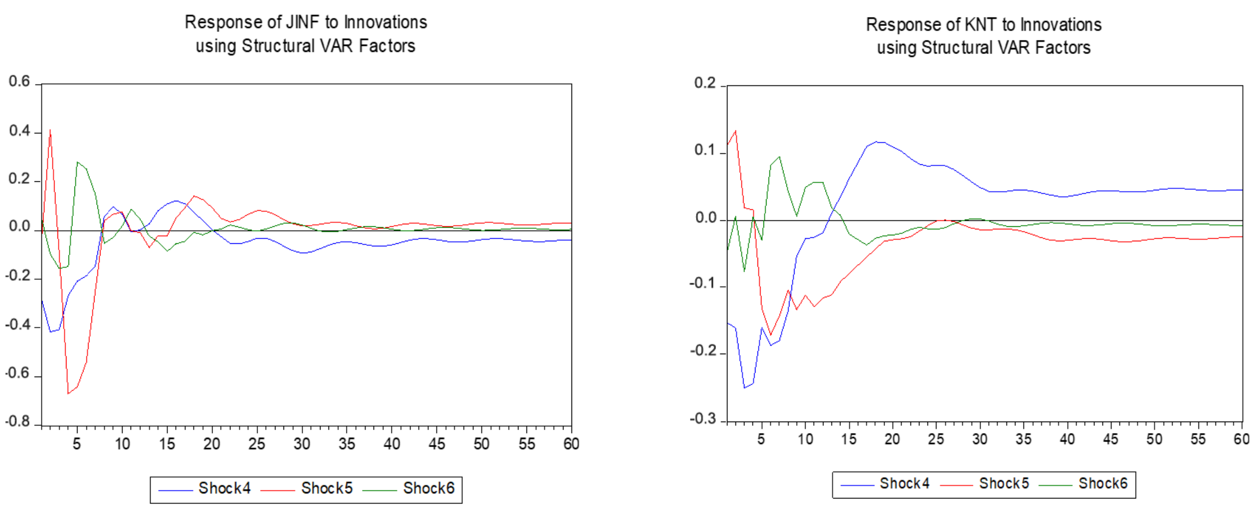

Figure 1.
IRF of Inflation and Exchange Rate.

All variables are converging in the long term, as seen in the IRF graphical image. According to the graph, inflation and the currency exchange rate react strongly to a one-standard-deviation disruption to the average interest rate, the flow of capital, and buffers of capital. The answer first shifts, but it eventually decreases and reaches zero.

4.8.2. Structural Variance Decomposition

Variance Decomposition facilitates the assessment of the extent to which shocks from transmission variables contribute to the shocks of specific entities.

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Table 4.
Variance Decomposition of INF.

Variance Decomposition of INF												
		Shock1	**Shock2**	**Shock3**	**Shock4**	**Shock5**	**Shock6**	**Shock7**	**Shock8**	**Shock9**	**Shock10**	**Shock11**
Q	**SE**	**SBA**	**CIF**	**CB**	**CADEV**	**PUAB**	**KDT**	**JUB**	**GDP**	**NPL**	**INF**	**NT**
4	15.560	200.229	39.753	73.615	134.200	191.400	132.881	33.796	95.457	37.312	57.415	0.3943
20	34.840	228.721	81.981	158.764	58.617	196.315	88.395	14.332	88.665	50.218	27.483	0.6510
40	41.052	225.516	112.564	154.773	46.700	194.714	91.859	23.539	75.390	43.944	24.549	0.6451

The graphical representation of the IRF indicates that all variables converge over the long term. The graph indicates that the responses of Inflation and the Exchange Rate are significant when subjected to a one standard deviation shock in the benchmark interest rate, capital flows, and capital buffers. The response direction alters temporarily; however, it decreases over time and ultimately converges to zero. The Keynesian interest rate path is more effective than the quantity path in influencing inflation following the implementation of ITF, while the capital path serves as an effective mechanism in macroprudential policy for impacting the exchange rate. Foreign capital flows have an impact on the policy integration analysis, which integrates the interest rate and capital channels. The results of the SVAR estimation demonstrate that the interplay between monetary and macroprudential policies, shaped by foreign capital flows, impacts price and financial stability with a lag of three quarters. The model meets the LR, FPE, AIC, and HQ criteria, demonstrating a stability value below 1 and a log likelihood of -22.68. The data demonstrates that the integration of monetary policy transmission, macroprudential measures, and capital flows is effectively maintaining financial stability.

Within the first five months (Q-5), the average interest rate adds 21.195% to the inflation shock. Over the next sixty months (Q-60), it adds 22.497%. Over the long term, the interbank money market will only be responsible for 19.768% of the inflation shock, down from 20.093% in the short term (Q-60). The cash buffer adds 12.746% to the inflation shock in the short term (Q-5) and 15.642% to it in the long term (Q-60). In Q-5, capital imports increase inflation 4.191%. Long-term (Q-60) it add 11.507%, a number far greater. The variance decomposition shows that the average interest rate, interbank money market, money buffer, and foreign money flows drive inflation. The findings reveal that cash policy, which is reflected by the based interest rates and the trade money sale rate, has a large influence on items that disrupt price stability, such inflation. Foreign currency reserves, which indicate a country's financial strength, only effect price stability 4.290% of the time.

The short-term (Q-5) and long-term (Q-60) contributions of capital inflows to exchange rate shocks are 40.402% and 23.193%, respectively. The benchmark interest rate accounts for 7.927% of the exchange rate shock in the short term (Q-5) and 22.783% in the long term (Q-60). During the short term (Q-5) and long term (Q-60), the interbank money market contributes 23.579% and 18.343%, respectively. The capital buffer's contribution to exchange rate shocks is 9.750% in the short term (Q-5) and 15.682% in the long term (Q-60). The four factors—capital inflow, interbank money market, benchmark interest rates, and capital buffer—account for 80.001% of the variances in exchange rates. The limited impact of foreign exchange reserves on exchange rate fluctuations is attributed to their primary function of facilitating capital movement during the implementation of intervention policies aimed at ensuring exchange rate stability.

It was also determined by the variance decomposition that capital inflows had an impact on credit growth and exchange rates. The findings align with the research conducted by Levine [22] and Ang and McKibbin [23]. Cross-border foreign capital flows influence exchange rates, the prices of financial assets, liquidity conditions, and credit growth, as noted by Levine [22] and Ang and McKibbin [23].

According to variance decomposition, foreign capital flows account for the majority of foreign exchange reserves (53.12%). Fluctuations in foreign capital flows have a significant impact on the volatility of foreign exchange reserves, exceeding 50%. The substantial influence of foreign exchange reserves indicates that variations are directly impacted by foreign capital flows, which play a crucial role in financing the balance of payments imbalance to sustain financial stability in Indonesia. Since interest rates and foreign exchange reserves have a positive relationship, raising interest rates is one strategy to strengthen the position of foreign exchange reserves [14]. The impact of monetary policy, macroprudential measures, and foreign capital flows on maintaining price stability and financial stability in the post-ITF period is outlined as follows:

The capital buffer and benchmark interest rate work in tandem to restrain inflation and maintain financial stability, as the table illustrates. The balanced magnitude of the benchmark interest rate and capital buffer demonstrates their impact on inflation and exchange rates. The benchmark interest rate contributes 22.49% to the control of inflation and 22.78% to the maintenance of financial stability over the long term. Capital buffer instruments contribute 15.64% to the control of inflation and 15.68% to the maintenance of financial stability.

4.9. Policy Implications

4.9.1. Theoretical Contribution

The findings contributes to the increasing literature on the Impossible Trinity by quantifying how a combined policy-rate and countercyclical capital-buffer (CCB) strategy reallocates the burden of macro-adjustment between prices and external accounts. By showing that monetary shocks account for roughly one-fifth of long-run inflation variance while capital-flow shocks dominate short-run exchange-rate volatility, we extend Angelini, et al. [10] framework of “joint optimisation” to an emerging-market context. The findings also corroborate the J-curve data for Indonesia recorded by Nopeline, et al. [15] suggesting that exchange-rate management must be incorporated with trade-balance dynamics in theoretical models of open-economy macroprudential design.

4.9.2. Policymaker Contribution

Calibrated Dual Toolkit. In fact, the central bank can raise its policy rate by 25 basis points while concurrently activating a 1 percentage-point CCB surcharge when quarterly portfolio inflows surpass one standard deviation over their historical mean. Our simulations show this blend minimizes inflation volatility by ~0.5 pp and caps peak IDR swings at −1.3 % —performance targets consistent with previous Bank of Indonesia statements. Dynamic Buffer Release. Buffers should be reduced after capital inflows normalise and IRF-estimated pass-through to credit growth falls below 0.1, limiting unnecessary credit tightening—a revision of the “time-varying CCB” regulation proposed by Claessens, et al. [1].

Forward-Guidance Alignment. Publishing a rule-based corridor tying future CCB changes to a moving-average deviation of the real effective exchange rate (REER) can anchor expectations, hence minimizing the two-quarter lag we find in inflation responses. Cross-Border Coordination. Given spill-backs from regional monetary postures, we urge quarterly policy talks with ASEAN counterparts to synchronise buffer windows, consistent with the cooperative macroprudential arrangements recommended by Lee and Wang [24].

5. Institutional and Data Considerations:

On the operational side, adopting time-varying capital-flow controls involves high-frequency monitoring of net inflows and sector-level loans, which can be acquired from payment-system data and commercial bank filings. We recommend Statistics Indonesia to make such data publicly available at a monthly frequency, permitting real-time model update. Finally, legislative adjustments may be needed to permit the Financial Services Authority (OJK) to adjust CCB rates outside of its existing semi-annual review cycle, therefore aligning regulatory agility with the pace of capital-flow shocks identified in our analysis.

6. Conclusion

Our findings indicate that capital inflows are the main determinants of foreign reserve and exchange rate volatility, whereas interest rate adjustments influence capital flow dynamics. A free-floating exchange rate, combined with an independent monetary policy and coordinated macroprudential measures, represents a viable strategy within the framework of the Impossible Trinity. The benchmark rate and countercyclical capital buffers account for approximately 22.5% and 15.6%, respectively, in terms of long-term inflation control and comparable contributions to financial stability. The findings highlight the reciprocal enhancement of monetary and macroprudential policies in fostering sustainable economic growth.

Limitations:

This analysis is based on quarterly data from Q1 2005 to Q4 2021, which may not capture structural breaks or policy shifts beyond this period. The SVAR identification relies on recursive ordering and linear assumptions, potentially overlooking non-linear dynamics and contemporaneous feedback effects.

Future Research:

Subsequent studies could employ alternative identification schemes (e.g., sign restrictions), integrate higher-frequency or longer-term datasets, and incorporate global financial conditions and sector-level vulnerabilities. Comparative analyses across multiple emerging market economies could further validate the generalizability of our findings.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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