Quantitative Finance and Economics

QFE, 10(1): 41–62.
DOI: 10.3934/QFE.2026003
Received: 02 July 2025
Revised: 28 November 2025
Accepted: 02 December 2025
Published: 09 January 2026

https://www.aimspress.com/journal/QFE

Research article

Market intervention in the inflation targeting regime: the case of Indonesia

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Abstract: This paper aims to analyze the monetary authority's decision to intervene in the foreign exchange market in the inflation targeting regime. Different from previous studies, the present study expands the intervention not only in the currency but also in the security markets. Taking the case of Indonesia over the period from 2005 (7) to 2023 (12), the two-stage least squares and generalized method of moment estimations found that exchange rate fluctuations dominantly affect the monetary authority intervention in both markets. Exchange rate movements are associated with a 1.35% increase in currency market intervention, consistent with precautionary motives. Meanwhile, the impact of financial stability depends on the methods used and episodes of economic uncertainty, particularly in relation to capital outflows. However, inflation pressure from the target has little to no effect on the intervention. Those findings suggest that the trilemma impossibility among credible monetary policy, exchange rate, and capital mobility holds. Accordingly, a discretionary intervention strategy could save foreign reserves as well as avoid confusion between exchange rate and inflation stability goals.

Key words: market intervention; foreign reserves; inflation-targeting; exchange rate; TSLS; GMM

JEL Codes: E52, E58, F31, G15

1. Introduction

Intervention of monetary authorities in the foreign exchange market has drawn much attention, especially in the inflation targeting (IT) policy. On one hand, the standard IT regime argues that inflation at a low and stable rate should be the main objective so it cannot be concurrently achieved by the exchange rate stabilization goal (Obstfeld et al., 2005). The fluctuations of the exchange rate increase with IT as a result of replacing the managed float exchange rate with flexible exchange rate regimes (Edwards, 2006; Sek, 2009), resulting in lower exchange rate volatility (Berganza & Broto, 2012). Accordingly, market intervention in the IT countries is theoretically less necessary.

On the other hand, the high degree of nominal exchange rate pass-through leads to consumer prices being responsive to fluctuations in import prices (Kuncoro, 2015). The policy rate, as the key instrument in the IT regime, fails to curb the exchange rate volatility (Kuncoro, 2020). Emerging economies have less flexible exchange rate arrangements (Kurihara, 2013), resulting in a higher volatility of the exchange rate than in developed countries (Chițu & Quint, 2018). The lack of deep foreign exchange markets may also contribute to the decline of the foreign exchange market (Kruskovic, 2022). Therefore, market intervention in developing countries with an IT regime is carried out more often than in developed countries (Sikarwar, 2020).

It seems that the IT regime requires foreign exchange market interventions. Market intervention is also needed as an additional instrument for macroeconomic stabilization (Hofman et al., 2020). Often, market intervention requires sufficient foreign reserves. Hence, most emerging markets with IT have been recently accumulating their stock of foreign reserves. The foreign reserves stock, for example, has skyrocketed to 25% of GDP (gross domestic product) by 2010 (Ghosh et al., 2017). Stockpiling a relatively high level of foreign reserves avoids speculative activities and boosts economic growth (Cheung & Qian, 2009). The increase and magnitude of international reserves can also act as a good signal concerning the credibility of monetary measures (Andriyani et al., 2020). The adequacy of foreign reserves held in emerging markets could dampen the exchange rate depreciations (Arslan & Chantu, 2019).

Despite the foreign exchange market intervention remaining a widely used policy instrument among IT emerging market economies, the effect of monetary authority intervention provides diverging results. By disposing of foreign reserves, monetary authority interventions not only smooth out the exchange rate fluctuation but also affect its level (Kearns & Rigobon, 2005). In contrast, the interventions might raise the fluctuation of the exchange rate (Frenkel et al., 2005) or have a little impact on the longer-term fluctuation (Dominguez, 2006). Even intensive sterilized market interventions induce higher systemic financial risks (Agenor et al., 2020). It appears that there has been no consensus in the case of emerging markets on the link between market intervention and exchange rate stability, which needs to be further investigated.

Reinvestigating the true relationship between market intervention and the exchange rate in the IT framework is important. From the scholar's perspective, the exact link is a crucial test for the justifiability of two competing theories: precautionary motives and mercantile motives. The precautionary motives argue that foreign reserves can absorb the undesired and transitory shocks in international payments (Aizenman & Lee, 2007). Hence, the market intervention uses discretionary strategies (Wang et al., 2015). The mercantile motives suggest that foreign reserves can accelerate export growth by preventing exchange rate appreciation to assist global competitiveness and foreign

direct investment inflows (Shijaku, 2012). Therefore, the market intervention uses rule-based approaches (Santos, 2018).

From a policymaker's point of view, imperfect information on the relationship structure between the two major macroeconomic variables means that central bank intervention will occur under any exchange rate regime (Oskoee & Brown, 2002). Market intervention is widely believed to be expensive when the domestic currency appreciates. The aggregate income or welfare foregone is the price that should be paid for the loss of foreign reserves (Chan, 2007). Market intervention is also costly when those financial resources are allocated to a number of physical investments (Green & Torgeson, 2007). Ultimately, continuous market intervention could also disturb the financial market stability (Mohanty & Turner, 2006; Agenor et al., 2020).

Indonesia provides a good case study in this context. The Asian monetary crisis in 1997/98 directed the monetary authority to focus on economic recovery. The 2008 global financial crisis pushed the central bank to revive economic activity through various financial stimulus measures. After that, Indonesia, in the 2010s, gradually became one of the largest emerging markets to implement various economic liberalization reforms that produced strong economic growth (Abdurahman & Resosudarmo, 2017). Policy coordination between monetary and fiscal authorities during the COVID-19 pandemic enabled the economy to survive the recession. This allowed Indonesia, during that period, to be one of the last countries among its peers to raise policy rates.

Furthermore, foreign exchange reserves accumulated by the Indonesian central bank have continued to increase since 2000 (Figure 1). In 2005, for example, when Indonesia began adopting IT policies, the foreign exchange reserves reached 38 billion US dollars. In 2021, when the COVID-19 pandemic peaked, foreign exchange reserves increased by more than three times, amounting to 140 billion US dollars. However, the increase in the foreign reserves is not proportional to the increase in the months of imports. Although the foreign reserves are above the international standard of 3 months of imports, they cover only 4–8 months of import financing needs.

This raises a concern about how the central bank intervenes in the foreign exchange market. In line with the fact that Indonesia is an open economy and a small country in the international context, the scope for actively influencing global trade as well as affecting the international financial market to attract foreign exchange inflows remains limited. As a floating exchange rate system adopter, countries' currencies are considered vulnerable to major external factors such as interest rate, inflation rate, money stock, and growth rate differentials. Moreover, Indonesia, like many emerging markets, deals with great uncertainty and obstacles in the medium term, so it would be risky to deploy the foreign reserves to stimulate speculative activities. This brings back the central bank's behavior in the foreign currency market intervention, whether permanent or transitory in nature.

This study enriches the empirical literature on the determinants of intervention in the foreign currency market. Most existing studies on market intervention focus on the exchange rate stabilization. As mandated by the new law, Act No. 4/2023 of Developing and Empowering Financial Sectors, the main contribution of this paper specifies the monetary authority's intervention in foreign currency and security markets. Framed by motives for foreign reserves holding, the market intervention relates not only to the exchange rate movement but also to inflation pressure and financial market stability. The elaboration of the three impacts allows the intervention to be more effective.

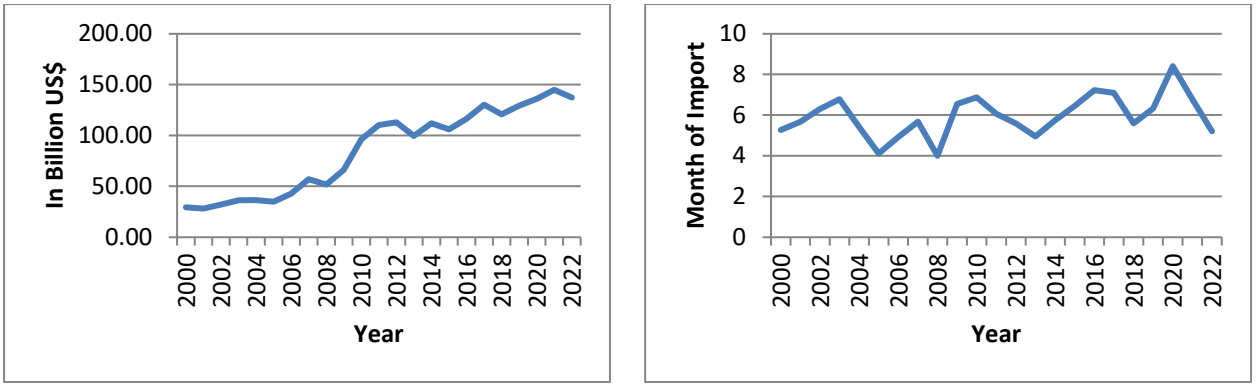

Figure 1. Indonesia's Foreign Reserves. Source: IMF.

This study is structured as follows: Section 1 delivers a brief review of empirical literature on the relationship between international reserves and the exchange rate. The estimation procedures and data used in the research methodology are presented in Section 2. Section 3 provides the estimation results and discussion. Some concluding remarks are described in the last section.

2. Literature review

A fundamental principle in monetary economics postulates the impossible trinity framework. Mundell (1963) and Fleming (1962) stated that a country cannot simultaneously achieve three monetary policy objectives: independent monetary policy, free capital mobility, and exchange rate stability (Obstfeld & Taylor, 2004). Countries prioritizing exchange rate stability and free capital mobility must sacrifice independent monetary policy, while those choosing independent monetary policy and free capital mobility must accept exchange rate instability. This concept is particularly relevant for developing countries, which frequently struggle to balance exchange rate stability, capital flows, and monetary policy flexibility, especially amid external shocks.

Regarding exchange rate instability, central bank intervention in the exchange rate market is still required in emerging countries with IT (Disyatat & Gaiati, 2007). While the IT framework relies on the policy rate to anchor the future inflation expectation, currency depreciation contributes to relatively high inflation, which further shapes the inflation expectation. Hence, central bank intervention operates through psychological effects in directing the exchange rate in the short term. The central bank intervention is also quite effective, especially when it is compared to a response pursued by using the policy rate. At this juncture, market intervention to reduce exchange rate fluctuation requires maintaining a credible monetary framework.

A high persistent exchange rate fluctuation could imply a convergence process to a lower exchange rate, which might be slow and costly in terms of growth. To reduce this cost and accelerate the convergence process, the central bank plays an important role in building its consistency and thus affecting the formation of exchange rate expectations. In contrast, the high persistent exchange rate fluctuation could imply that a convergence process may not be achieved in the long run. To overcome the convergence process, the central bank can be actively involved in the foreign exchange market. In this respect, holding sufficient foreign reserves is useful.

Maintaining sufficient foreign reserves is advocated by precautionary motives and mercantile motives. The precautionary motive for holding foreign reserves refers to the idea that countries

accumulate these reserves as a buffer against unforeseen economic events or shocks. This helps them to manage situations like sudden changes in capital flows, balance of payments difficulties, or currency instability (Aizenman & Lee, 2007). Reserve holdings can also help a central bank manage its currency's discretionary strategies in terms of not being openly declared (Wang et al., 2015). In this case, market intervention is more responsive to any exchange rate fluctuation. The mercantile motives suggest that the market intervention prefers to use rule-based approaches, especially under the identified circumstances (Santos, 2018). In such a case, market intervention is less sensitive to the exchange rate movement, particularly depreciation.

The existing empirical studies can be classified into three groups. The first strand conducts causality analysis between foreign reserves and the exchange rate. Bayat et al. (2014) concluded that there is a causal relationship running from international reserves to both nominal and real exchange rates. In contrast, Gokhale & Raju (2013) proposed that there are no long- and short-term associations between the exchange rate and foreign reserves in the case of India. Lee & Yoon (2020) discovered that a bi-causal direction between the changes in foreign reserves and exchange rate fluctuations was more definitively held in China, Hong Kong, Japan, Korea, and Taiwan. Some of the studies above have not yet firmly explained the direction of causality.

Given unclear causality direction, some scholars posit exchange rate movements as one of the determinants of foreign reserves accumulation. Therefore, the second group then takes into account the risks and benefits of market intervention by assuming that the determinants of foreign reserves accumulation could be considered as determinants of market intervention. Calvo & Reinhart (2002) claimed that "fear of floating" is the main determinant of market intervention. Challenging that "fear of floating", Steiner (2013) mainly attributed the market intervention to the "fear of capital mobility" to offset the capital market's liberalization. Yeyati et al. (2013) raised the asymmetric issues in the discourses of the "fear of floating" as the sole determinant of market intervention. More recently, in a panel study for Southern African countries, Sanusi et al. (2019) found that the market intervention is positively determined by exchange rate and inflation rate fluctuations. Rashid & Basit (2021) concluded that exchange rate volatility significantly induced aggressive intervention in Bangladesh, Indonesia, and Malaysia.

It seems that there has been no unique agreement on the sources of exchange rate fluctuations that universally makes market intervention effective. As the economic circumstances are not the same across the country, the market intervention implemented by the central banks in many economies differs from each other, conditioned by the set of policy preferences and other objective aspects. However, in developing countries, unstable financial markets and a lack of liquid currencies encourage the monetary authority to intervene in the foreign exchange market to mitigate the adverse impacts of current account crises and capital account shocks (Bhakri & Verma, 2021).

The third one expands the determinant of the monetary authority's market intervention within the framework of the impossible trinity. Malliaropulos & Migiakis (2023), for example, found that market intervention enables the exchange rate to be stable. Unfortunately, it often limits monetary policy flexibility. These challenges are exacerbated in times of global economic instability, where external pressures can significantly affect domestic economic stability. On the contrary, Beutel et al. (2025) showed that countries with flexible exchange rate systems (implicitly less intervention) are more resilient to external shocks and rarely have to adjust monetary policy to accommodate capital flows. Both studies suggest that monetary policy is faced with potentially conflicting goals of domestic and foreign economic stabilization.

Focusing on the context of Indonesia, similar works are scarce. Diwantari (2010) found that the decision of the monetary authority to intervene in the foreign currency market in the long term is insignificantly influenced by interest rate differential. Andriyani et al. (2020) showed that the exchange rate movements significantly affect market intervention in the opposite direction, whereas the inflation rate has an insignificant effect. Juhro & Azwar (2021) found that intervention is more powerful in the spot market than in the derivative market. They also concluded that the integrated intervention policy plays a key role in improving exchange rate stability. Kuncoro & Pardede (2024) noted that foreign currency and bond reserves held by Bank Indonesia are mutually substituted. Hence, intervention in the security market could support exchange rate stabilization.

Dealing with the credibility of monetary policy, Ikhsan et al. (2012) noted that the monetary policy framework implemented by Bank Indonesia has led the trilemma configuration into a more flexible exchange rate regime, greater monetary policy independence, and growing financial integration. However, Basri & Sumartono (2023) showed that Indonesia's experience with the impossible trinity framework often involves policy conflicts. Efforts to maintain exchange rate stability amid global uncertainty limit monetary policy independence. It seems that financial stability has become a crucial factor in protecting domestic economies from systemic risks caused by capital flow volatility. As suggested by Liu & Molise (2020), monetary policy should consider financial stability in responding to external pressures without having to sacrifice one of the main objectives of the impossible trinity.

Table 1 highlights the selected previous empirical studies. A brief survey above offers some challenging hypotheses about the potential link between market intervention and exchange rate movements. First, studies in developed economies tend to bolster the exchange rate fluctuation as the main determinant of market intervention. Second, on the contrary, studies in emerging markets produce non-uniform conclusions, which need to be further reconciled. Third, numerous external factors contribute to the dynamics of market intervention. However, none of them simultaneously explores exchange rate movement, inflation pressure, and financial stability as the explanatory variables. This study fills in the empirical gap.

Table 1. Selected previous empirical studies.

No.	Researcher	Coverage	Method	Finding
1	Bayat et al. (2014)	Turkey	Granger causality	Causality running from foreign reserves to exchange rates
2	Lee & Yoon (2020)	East Asia	Quantile Granger causality	Bi-causal direction between foreign reserves and exchange rates
3	Sanusi et al. (2019)	Southern African countries	Autoregressive distributed lag	Exchange rate and inflation affect market intervention
4	Juhro & Azwar (2021)	Indonesia	TSLS	Intervention in spot and forward market effectively stabilizes the exchange rate
5	Bhakri & Verma (2021)	India	OLS	Intervention mitigates the adverse impact of capital and current accounts shocks
6	Malliaropulos & Migiakis (2023)	9 major central banks of developed economies	Error correction model	Intervention limits monetary policy flexibility
7	Beutel et al. (2025)	44 advanced and emerging economies	Quantile vector autoregressions	Exchange rate policy can mitigate downside risks to growth
8	Liu & Molise (2020)	South Africa	Dynamic stochastic general equilibrium	Monetary policy focuses on price stability, and macroprudential policy facilitates financial stability
9	Present study	Indonesia	TSLS and GMM	Exchange rate, financial stability, and inflation pressure determine intervention in foreign currency and security markets

Source: own compilation.

3. Research method

In many cases, how much and when monetary authorities intervene in the foreign currency market is confidential. They only periodically announce the current stock of foreign reserves. Signaling about market intervention in the next period to maintain the exchange rate does not clearly state the size of market intervention. In the context of Indonesia, the central bank communicates publicly about monetary policy in general, rather than about its intervention strategies, through speeches, reports, or press releases. Moreover, Kuncoro et al. (2021) indicated that the public suffers linguistic constraints in understanding press releases on monetary policy issued by Bank Indonesia. Thus, conducting research on market intervention with qualitative data is difficult.

According to Daude et al. (2016), the change in foreign reserves (FR) could be considered as the degree of market intervention (MI). We assume that the market intervention strategy is mainly determined by exchange rate (ER) movements in the current period, financial stability (FS), inflation pressure (IP), and the stock of foreign reserves in the previous period. Inflation pressure is included in relation to the additional money supply impact when market intervention is unsterilized.

$$\mathrm{MI}_t \cong \Delta \mathrm{FR}_t = \mathrm{f}\left(\Delta \mathrm{ER}_t, \mathrm{FS}_t, \mathrm{IP}_t, \mathrm{FR}_{t-1}\right). \quad (1)$$

Inflation pressure is specified by the inflation differential between the actual inflation rate and the targeted inflation (TI) rate. The inflation rate is derived from the domestic price level (PD):

$$IP_t = \Delta PD_t - TI_t. \quad (2)$$

A rise (reduction) in FR describes a purchasing (selling) foreign exchange transaction by the central bank. Converting Equation (1) into the log-linear form results in:

$$\Delta fr_t = a + b_1\, \Delta er_t + b_2\, fs_t + b_3\, ip_t + b_4\, fr_{t-1} + \epsilon_t, \quad (3)$$

where the lower-case letter indicates the logarithmic form, and ϵ is the disturbance term, which is independently and identically distributed ~ $N(0, \sigma^2)$.

The international reserve basket consists of various foreign currencies, securities, monetary gold, reserves position in the IMF, and special drawing rights, which are under the control of the monetary authority. They are readily available for any balance of payments financing, suggesting that the change in foreign reserves does not wholly represent the central bank intervention. Accordingly, the vector Δ fr is specified only on the change in the foreign currencies (Δ cr) and securities (Δ sr), respectively. They are presented in a ratio to the total foreign reserves.

$$\Delta fr_t \in \{\Delta\, cr\, ;\, \Delta\, sr\}. \quad (4)$$

A rise (reduction) in cr indicates a purchasing (selling) foreign exchange transaction by the central bank. An increase (decrease) in sr represents a buying (selling) foreign securities transaction by the central bank. We predict that the coefficient of exchange rate movement would be positive ($b_1 > 0$) in the currency market and negative ($b_1 < 0$) in the security market. According to Wang et al. (2015), the central bank's intervention behavior in the foreign exchange market is asymmetric between the risks carried and the benefits obtained. Hence, intervention in both markets (to avoid risks in terms of income loss) supports mercantile motives if $|b_1| < 1$. Market intervention (to maintain benefits in terms of foreign capital inflows) confirms precautionary motives if $|b_1| > 1$.

The coefficients of b_2 and b_3 are supposed to be negative in the currency market and positive in the security market. Higher stability of the financial system and inflation pressure reduce the monetary authority's ability to intervene. The coefficient b_4 is expected to be negative, $0 < |b_4| < 1$, indicating the speed of adjustment, which market intervention returns to its desired value after a shock. When $b_4 = 0$, shocks will tend to have instantaneous effects on the behavior of the series. If $b_4 = 1$, the behavior of the series is unpredictable and therefore highly persistent in going back to its desired path, or may even deviate from its long-run equilibrium. Table 2 outlines the expected sign of the effect of each variable on market intervention.

Table 2. Expected sign of market intervention determinants.

	Currency market	Security market
Exchange rate movement	+	-
	Precautionary motives > 1	Precautionary motives < -1
	Mercantile motives < 1	Mercantile motives > -1
Inflation pressure	+	-
Financial stability	-	+
Lagged	-	-

However, the main problem in measuring the impact of the exchange rate movements on the market intervention policy is the endogeneity of the exchange rate (Adler et al., 2019). In such a case, while the central bank's market intervention in the foreign currency market is intended to control exchange rate fluctuations, the decision to intervene is also determined by exchange rate movements. The two-way causality will lead to insignificant estimation between foreign exchange intervention policies and exchange rate movements or even produce the opposite direction of the coefficients (Daude et al., 2016).

$$\Delta er_t = a + \beta_1 \Delta fr_t + \beta_2 er_{t-1} + \varepsilon_t. \quad (5)$$

To avoid the endogeneity problem, we incorporate some control variables into Equation (5). As proposed by the monetary approach, the change in the exchange rate is derived from Keynes's demand for money in each country. Comparing them leads to the change in exchange rate being stipulated by interest rate differential (rd-rf), price differential (pd-pf), money demand differential (md-mf), and output differential (qd-qf). The presence of interest rate differential is as suggested by Fanelli & Straub (2020) and Juhro & Azwar (2021), and monetary authority intervention in the security market can be affected by the exchange rate and yield differential between foreign and domestic securities.

$$\Delta er_t = \alpha + \beta_1 \Delta fr_t + \beta_2 er_{t-1} + \beta_3 \Delta(rd - rf)_t + \beta_4 \Delta(pd - pf)_t + \beta_5 \Delta(md - mf)_t + \beta_6 \Delta(qd - qf)_t + \mu_t. \quad (6)$$

Transforming Equations (3) and (6) into reduced forms provides overidentification. The number of exogenous and predetermined variables is greater than the number of endogenous variables. Regarding the overidentification problem, we use the two-stage least squares (TSLS) method. Stage one estimates Equation (6) using the ordinary least squares (OLS) method. Stage two substitutes the fitted value of (6) into (3):

$$\Delta fr_t = a + b_1 \widehat{\Delta er_t} + b_2 fs_t + b_3 ip_t + b_4 fr_{t-1} + \epsilon_t. \quad (7)$$

The estimation result of the TSLS method will be consistent and normally distributed in the large sample (Gujarati et al., 2012). Figure 2 presents the empirical framework used in this study.

Since market intervention is our concern, we need a long-span and reliable time series data on international reserves, exchange rate, foreign and domestic interest rates, foreign and domestic prices, foreign and domestic money demand, and foreign and domestic outputs. The exchange rate is specified as the price of the US dollar against the domestic currency (Indonesian rupiah). The domestic price level is represented by the CPI (consumer price index, 2012 = 100). The foreign price level refers to the US CPI (2012 = 100). Since the targeted inflation rate is available only on a yearly basis, it is then transformed into a monthly basis by dividing it by 12. The money demand refers to narrow money (M1), consisting of currency and demand deposits. Dealing with the interest rate differential, we use the interest rate of a 5-year government bond of Indonesia and the US.

Financial stability is measured by the uncertainty index taken from Ahir et al. (2022). It implies that higher economic uncertainty leads the central bank to intervene. Unfortunately, monthly GDP series data is unavailable. We prefer to employ the industrial production index as a proxy, rather than interpolating quarterly GDP into monthly series data. The month-to-month industrial production index growth rate allows identifying economic contraction, which is frequently observed in the quarterly but rarely found in the annual series data. The industrial production index for

Indonesia and the US is measured in 2012 as a base year (2012 = 100). The sample observation covers from 2005 (M7) to 2023 (M12), which extends the implementation of the IT framework. Most of the monthly data are taken from the central bank of Indonesia and BPS. Other data are obtained from the IMF and the Fed. Table 3 summarizes the details of the data.

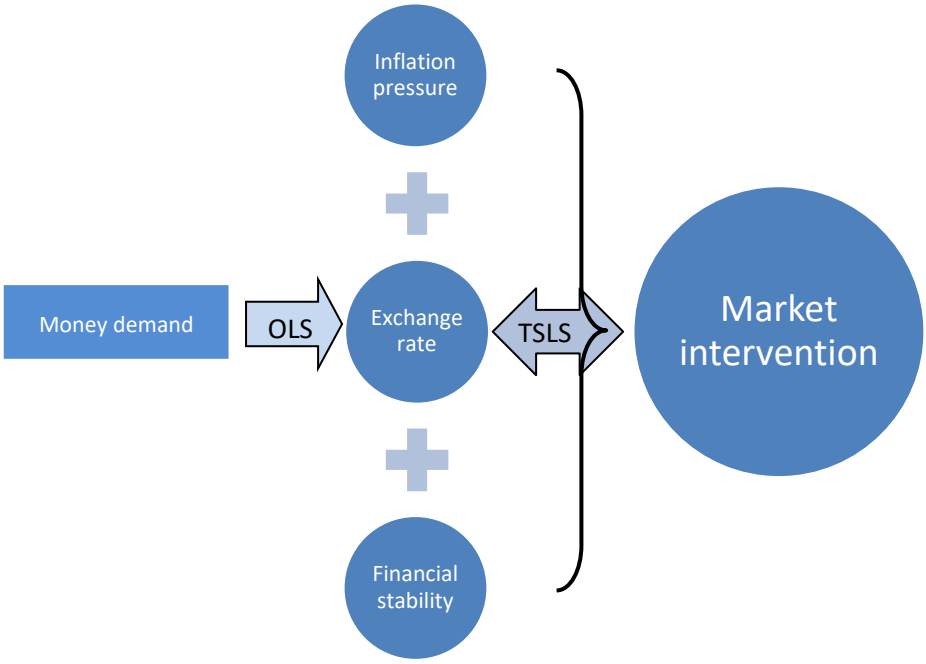

Figure 2. Empirical framework.

Table 3. Data and variable specification.

Variable	Definition	Source
CR	Currency reserves denominated in US dollars	Bank Indonesia
SR	Security reserves denominated in US dollars	Bank Indonesia
FR	Total foreign reserves in US dollars	Bank Indonesia
FS	Financial stability index	Ahir et al. (2022)
IP	Inflation pressure, the difference between actual rate and targeted inflation rate	BPS and Bank Indonesia
PD	Domestic price level, Indonesian CPI, 2012 = 100	BPS
PF	Foreign price level, US CPI, 2012 = 100	Federal Reserve
ER	Exchange rate, domestic currency to US dollars	Bank Indonesia
RD	Domestic interest rate, 5-year Indonesian government bond	IMF
RF	Foreign interest rate, 5-year US government bond	IMF
MD	Indonesia's money demand	Bank Indonesia
MF	US money demand	Federal Reserve
QD	Domestic output level, Indonesian industrial production index, 2012 = 100	BPS
QF	Foreign output level, US industrial production index, 2012 = 100	Federal Reserve

Source: own compilation.

4. Results and discussion

To begin our discussion, it is worth analyzing the stock of international reserves held by the monetary authority. As presented in Figure 3, the foreign reserves in the form of securities dominate for about 80% on average during the observation period. The foreign currency stock is, on average, about 13% of the total reserves. It seems that the monetary authority relies on the open market operation using foreign securities to manage exchange rate fluctuation rather than directly purchasing/selling foreign currency in the foreign exchange market.

Table 4 reports descriptive statistics of market intervention. The mean value of foreign currency and security interventions is almost the same, suggesting that the central bank uses the two instruments in the market complementarily. Given the magnitudes of the mean value, we expect the inflation pressure and financial stability to be more influential, compared to the exchange rate movement, for the monetary authority to intervene in the foreign currency market.

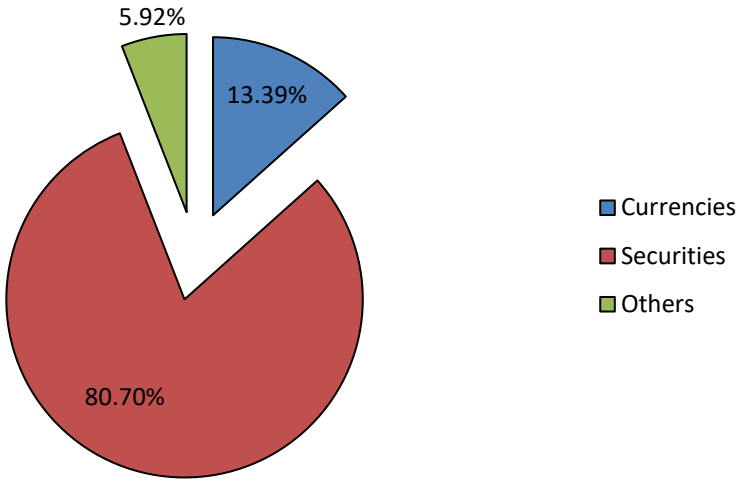

Figure 3. Average composition of Indonesia's foreign reserves, 2005–2023. Source: Bank Indonesia.

In the exchange rate movement determinants, as presented in Table 5, the mean values of all variables of interest are not far from the corresponding median value, suggesting that they have a bell-shape distribution. However, the non-normal distribution of the exchange rate fluctuation data is noticeable from the positive values of its skewness. The shape of the exchange rate movement distribution is somewhat right-skewed, implying that most of the data series is depreciating. This finding confirms the observation by Adler et al. (2021) that developing countries suffer prolonged currency depreciation.

In contrast, the interest rate and money demand growth differentials series data do not vary, indicated by the low standard deviation relative to the mean value. The gap between the highest and lowest values of each series data also supports that they are relatively homogeneous. Meanwhile, the output growth differential has the lowest skewness and kurtosis, implying the corresponding series data is almost platykurtic, bell-shaped distributed. Based on those data characteristics, the interest rate and money demand growth differentials are more dominant in affecting the exchange rate movement.

Table 4. Descriptive statistics of market intervention.

	Δ cr	Δ sr	fs	ip
Mean	0.0004	−0.0006	0.1126	0.0688
Median	0.0002	−0.0001	0.0810	−0.0501
Maximum	0.2074	0.2089	0.4400	7.8375
Minimum	−0.2104	−0.1999	0.0000	−0.7853
Std. Dev.	0.0284	0.0291	0.1044	0.7032
Skewness	0.1332	−0.0574	1.0802	6.6412
Kurtosis	29.4287	25.1426	4.0016	69.9673
Observations	221	221	221	221

Source: own calculation.

Table 5. Descriptive statistics of exchange rate determination.

	Δ er	rd-rf	pd-pf	md-mf	qd-qf
Mean	0.0020	1.0550	0.0619	5.5365	0.1012
Median	0.0013	1.0530	0.1123	5.7380	0.1022
Maximum	0.1591	1.1410	0.2434	5.9867	0.3618
Minimum	−0.1041	1.0170	−0.3381	4.5709	−0.2969
Std. Dev.	0.0277	0.0184	0.1560	0.4381	0.1729
Skewness	0.9741	1.0608	−0.6852	−1.1608	−0.4427
Kurtosis	10.8956	6.2666	2.2355	2.8656	2.1913
Observations	221	221	221	221	221

Source: own calculation.

Do they correlate with each other? Table 6 links the movement of the exchange rate and the foreign currency market intervention. Surprisingly, the correlation between the exchange rate movement and inflation pressure is very low (−0.02). Since inflation pressure in the IT framework is the main factor in establishing a policy rate, it preliminarily indicates that market intervention is not aligned with the policy rate. As postulated by the uncovered interest rate parity theorem, the policy rate should restrain the exchange rate fluctuation. Exchange rate movements deviate from inflation pressure as a result of distortions in domestic prices generated by speculative activities.

The exchange rate is negatively correlated with the change in securities reserve. This suggests that they are substitutes for each other, as found by Kuncoro & Pardede (2024). Both types of market intervention are inversely correlated with the exchange rate movement. A similar result is found in the case of financial stability. Those correlations are consistent with the foreign exchange flows to/from the central bank. The negative correlation between currency and security reserves suggests substitutability. This could be linked to liquidity management strategies to achieve optimal composition of reserves. Expecting higher returns and diversifying risk are the main considerations for the central bank to arrange a reserve portfolio (Arslan, 2019).

Furthermore, to ascertain the causal relationship between the actual exchange rate fluctuation and market intervention, we conduct the pairwise-Granger causality test. As presented in Table 7, the test confirms a bi-directional causality. Using 4 lags, verified by the LR (log-likelihood ratio), FPE (final prediction error), and AIC (Akaike information criterion) optimum criteria, it is evident that a

causal relationship flows from market intervention to exchange rate movement and vice versa, which denies most empirical studies outlined in the Literature Review section.

In this case, while market intervention is designed to control exchange rate fluctuations, the decision to intervene is also determined by exchange rate movements. Such bi-directional causality means that the estimated effect of the variable on the outcome might not accurately reflect the true causal relationship. Causality is closely related to endogeneity. Both are important concepts in statistical analysis, particularly in econometrics. Endogeneity arises when the explanatory variables in a regression model are correlated with the error term, which can lead to biased and inconsistent estimates of causal effects. Considering the presence of endogeneity problems, we need a set of instrumental variables, instead of the original one.

Table 6. Correlation matrix.

	Δ er	Δ cr	Δ sr	fs	ip
Δ er	1	0.1384	−0.1721	0.1513	−0.0190
Δ cr	0.1384	1	−0.8849	0.0140	−0.0034
Δ sr	−0.1721	−0.8849	1	−0.0702	−0.0039
fs	0.1513	0.0140	−0.0702	1	−0.0707
ip	−0.0190	−0.0034	−0.0039	−0.0707	1

Source: own calculation

Table 7. Granger causality test.

Null hypothesis:	Obs	F-Stat	Prob.
Δ er does not Granger cause Δ Cr	217	3.5435	0.0080
Δ cr does not Granger cause Δ er		2.4605	0.0465
Δ er does not Granger cause Δ sr	217	2.4949	0.0440
Δ sr does not Granger cause Δ er		2.1335	0.0779

Source: own calculation

Before estimating the variables of interest, the existence of unit roots needs to be examined. By conducting an augmented Dickey–Fuller (ADF) test, the results are provided in Table 8. The test shows that interest rate differential, inflation pressure, inflation differential, and financial stability series data have unit roots in level or integrated in degree zero [I(0)]. It implies that the three variables after a shock will return to the steady state, suggesting that they are temporary in nature.

The other series data do not have unit roots in level but are stationary in first differences at 5% significance level. It implies that the remaining five series data are stable in accordance with a disequilibrium process. Both tests suggest that the effect of any shock will eventually vanish, and all series data will move together to its long-run mean. In other words, they remain to evolve toward the long-run equilibrium relationship as predicted by the standard economic theory. Hence, the exchange rate movement, inflation rate differential, and financial stability can expectably explain the decision of the central bank to intervene in the foreign exchange market.

Table 8. Unit root tests.

	Level		First difference	
	Coeff.	Prob.	Coeff.	Prob.
cr	−2.2664	0.1839	−17.9439	0.0000
sr	−2.4250	0.1360	−15.2352	0.0000
fs	−3.5938	0.0066	–	–
ip	−10.5264	0.0000	–	–
er	−1.6846	0.4377	−13.6828	0.0000
pd-pf	−4.5491	0.0002	–	–
rd-rf	−2.6316	0.0882	−10.9233	0.0000
md-mf	−1.3258	0.6177	−13.2032	0.0000
qd-qf	−0.9829	0.7595	−16.7753	0.0000

Source: own calculation.

Table 9 presents the estimation results of Equation (3) using the TSLS method. The exchange rate determination model [Equation (6)] is run first. As expected by the monetary approach, the interest rate and money demand growth differentials significantly affect the exchange rate movement. The null hypothesis that those coefficients are statistically equal to zero can be rejected at 5% or at least a 10% confidence level. The acceptance of the null hypothesis holds for the output growth differential. The industrial production growth differential cannot describe the exchange rate fluctuation. The insignificance of lagged exchange rate depicts that the exchange rate movement is unstable.

Unfortunately, the coefficient of market intervention yields a conflicting result. In the case of currency intervention, the associated coefficient is significantly positive, but negative for security intervention. The intervention in the foreign currency market induces the exchange rate to appreciate. Similarly, the intervention in the security market leads the home currency to depreciate. However, our major concern is not the determinations of exchange rate movement but the decision of the central bank to intervene in the foreign exchange market, taking into account the exchange rate movement.

In the second stage, the predicted value of the monetary approach model is used as an explanatory variable replacing the initial one. The results have strong instrumental variables. The J-tests deny the null hypothesis that the instrumental variable is weak. Orthogonality tests ensure that independent variables do not have significant relationships with each other. Endogeneity tests ensure that independent variables in a regression model are not correlated with the error term. Weak instrument tests show that the instrumental variable in a TSLS regression is strong. They are also robust tests for heteroskedasticity, autocorrelation, and cluster-robust weak instrument tests.

The coefficient of exchange rate movements in the foreign currency market is observed to be significantly positive and in line with the theory. When the domestic currency depreciates (appreciates) 1% against the US dollar, the central bank increases (decreases) the sale of foreign currency by about 1.35% of the total reserves on average. In the security market, a 1% home currency depreciation (appreciation) leads the central bank to purchase (sell) foreign securities for about 1.25% of the total reserves. Purchasing (selling) foreign securities will inject (absorb) foreign currency liquidity into (from) the domestic market. Based on those figures, the monetary authority's decision to intervene in the foreign exchange market refers to precautionary motives.

Table 9. TSLS estimation of market intervention.

	Δ cr		Δ sr	
	Coeff.	Prob.	Coeff.	Prob.
C	0.3591	0.0234	1.4521	0.0328
Δ er	1.3486	0.0493	−1.2478	0.0721
fs	−1.2199	0.0411	1.1531	0.0767
ip	0.0295	0.1906	−0.0183	0.3684
Lagged	−0.6954	0.0208	−0.9547	0.0337
Instrument variable for Δ er	Coeff.	Prob.	Coeff.	Prob.
C	−0.3372	0.0578	−0.3431	0.0518
Δ fr	0.1461	0.0270	−0.1760	0.0061
Δ (pd-pf)	−0.0559	0.8240	−0.0715	0.7746
Δ (rd-rf)	0.2783	0.0154	0.2851	0.0125
Δ (md-mf)	0.0383	0.0763	0.0381	0.0757
Δ (qd-qf)	0.0151	0.6891	0.0148	0.6938
Lagged	0.0049	0.6246	0.0048	0.6313
J-test	0.5513	0.9075	0.6553	0.8837
Orthogonality test	0.0752	0.8493	0.0825	0.7739
Endogeneity test	1.9537	0.5929	1.6454	0.6819
Weak instrument test	0.8419	0.9999	0.6836	0.9999

Source: own calculation.

This study also observes that there are differences in the responsiveness of exchange rate movement in the foreign currency market and the security market. In the currency market, the exchange rate movement coefficient is found to be larger than that in the security market. As is known, transactions in the open market operation take the form of direct exchange between domestic and foreign currency. In contrast to the currency market, transactions in the securities market take the form of exchanging securities for foreign currency. The difference in the level of liquidity between foreign currency and securities makes intervention in the securities market less responsive to exchange rate fluctuations.

The effect of exchange rate movement on the decision to intervene is consistent with financial market stability. Better financial market stability reduces market intervention in the currency market. In the security market, higher (lower) financial market stability induces the central bank to sell (purchase) security in order to strengthen the stabilization of the exchange rate. Selling (purchasing) security increases (decreases) the attractiveness of security yields for entry of portfolio investment from abroad through an increase (decrease) in the yield on short-term security and an increase (decrease) in the yield structure for long-term security. Both strategies are done primarily when capital outflows substantially increase, which supports Bhakri & Verma (2021).

Selling (purchasing) foreign currency and securities should be consistent with the development of the policy rate as the primary instrument in the IT policy. The policy rate is set to anchor the future inflation rate. The insignificance of the inflation pressure coefficient indicates that the central bank's decision to intervene does not take into account the ongoing inflation pressures. Kuncoro

(2024) points out that the change in the foreign exchange reserves has an inflationary impact, which can further disturb the inflation target achievement in the short-, medium-, or long-term.

To confirm the above results, a robustness test is conducted through the approach's performance evaluation using a competing model. A GMM (generalized method of moments) is employed to capture dynamic effects, particularly when equations in the system contain lagged dependent variables. Applying the GMM estimation for the same equation and instruments yields better results regarding the strength of instrumental variables. The J-test, orthogonality test, endogeneity test, and weak instrument test convince the strength of instrument variable validity. The exchange rate movement, both in the currency and security markets, is a major determinant for monetary authority decisions to intervene in the foreign exchange market. Its magnitude is greater in the foreign currency market (1.1) than in the security market (1.0). Both are not much different from the TSLS result.

Overall, the GMM result does not change the main conclusion. Table 10 presents that inflation pressures do not significantly affect market intervention, as found by Andriyani et al. (2020), but challenges Sanusi et al. (2019). While both use the actual inflation rate, the present study measures inflation pressures from the target. The smaller the difference between actual inflation and the target rates, the lower the inflation pressures. As noted by Broto (2011), an inflation target helps to reduce variability about current inflation, even if IT lowers inflation and inflation uncertainty. Hence, the impact of IT institutionally is effective in declining inflation variability. At the same time, open market operation to sterilize an increase in the domestic monetary base plays an important role. Even though open market operation serves with temporal lags, it can dampen inflation pressure, resulting in the central bank not immediately needing to intervene in the foreign exchange market.

Table 10. GMM estimation of market intervention.

	Δ cr		Δ sr	
	Coeff.	Prob.	Coeff.	Prob.
C	0.2771	0.0695	1.2127	0.0282
Δ er	1.1552	0.0483	−1.0298	0.0641
fs	−0.8341	0.1962	0.7244	0.2429
ip	0.0273	0.4196	−0.0143	0.5765
Lagged	−0.4398	0.0452	−0.5865	0.0296
J-test	1.0884	0.7799	2.3309	0.5066
Orthogonality test	0.0313	0.8596	0.4582	0.4985
Endogeneity test	2.0946	0.5530	3.5047	0.3202
Weak instrument test	0.8419	0.9997	0.6836	0.9999
COVID-19 breakpoint test	5.1551	0.5241	7.0276	0.3183

Source: own calculation.

The different result, compared to the TSLS results, is found to be insignificant in terms of financial stability. The impact of the associated variable tends to be sensitive depending on the circumstances. It seems that financial stability is not established enough to be considered for the central bank to intervene in the foreign exchange market. In addition, the Chow breakpoint test shows equality between the period before and during the COVID-19 pandemic. This result is reasonable. First, the sample size during the COVID-19 pandemic is relatively small compared to the total observations. Second, Bank Indonesia's mandate to stabilize the financial system explicitly

began in 2023. Third, Bank Indonesia has recently intervened more in the forward market (Juhro & Azwar, 2021). As part of the triple intervention, Bank Indonesia actively participates in the domestic non-delivery forward (DNDF) market. The settlement of DNDF is in rupiah, resulting in the exchange rate fluctuations being reduced and foreign currency reserves being saved.

Fourth, the foreign exchange intervention strategy is not to achieve a certain level of the exchange rate but rather to minimize the volatility of the exchange rate (Goeltom, 2007). Hence, it is not surprising that the adjustment speed in the currency market is also lower (−0.44) than that in the security market (−0.59). They suggest that a change in the market intervention between the previous month and the current month induces the market intervention process in the current month, with only 44% to 59% partial adjustments to manage to the desired levels. Those figures also indicate that the market intervention carried out by the monetary authority is relatively persistent, as found by Hofman et al. (2020).

Nevertheless, the importance of market interventions as explained above may hold in certain cases and does not apply universally. According to the IMF (2023), several central banks that are classified as IT regimes operate under a free-floating exchange rate system with no foreign exchange interventions (Australia, Canada, Japan, Mexico, Norway, Poland, Russia, Sweden, United Kingdom). It is also important to emphasize that central bank transparency is widely recognized as a defining characteristic of IT (Svensson, 2010). The literature highlights a relationship between central bank transparency and exchange rate volatility. The availability of information about monetary policy objectives may induce exchange rate fluctuations (Weber, 2019). The transparency of monetary policy may also decrease exchange rate volatility (Eichler & Littke, 2018). Accordingly, market intervention in an IT regime, which is guided by precautionary motives, can cope with exchange rate volatility.

5. Conclusions

The objective of this paper is to analyze the monetary authority's decision to intervene in the foreign exchange market. The motivation behind this research is that there is no wide agreement on the role of foreign exchange market intervention in the IT regime. On the one hand, exchange rate stabilization should be the secondary goal. On the other hand, foreign exchange market intervention has remained a widely used policy instrument among IT emerging market economy central banks. Different from prior studies, the monetary authority intervention decision in the currency and security markets refers not only to the exchange rate movement but also to inflation pressure and economic uncertainty.

The main contribution of this research is to synthesize market intervention strategies with the motive of accumulating foreign exchange reserves in the framework of the impossible trinity. Taking the case of Indonesia for the monthly data over the period 2005 (7) to 2023 (12), we found that exchange rate fluctuation affects the monetary authority intervention both in the currency and security markets. The impact of financial instability depends on the methods used and episodes of economic uncertainty, particularly in relation to capital outflows. In contrast, the inflation pressure fails to explain the central bank intervention in both markets, which contradicts the IT logic. An inflation target announced by the monetary authority in advance helps to reduce actual inflation from its target. In other words, the central bank's commitment to the inflation target reduces the pressure to intervene.

Those findings suggest the trilemma impossibility among credible monetary policy, exchange rate, and capital mobility holds. Assuming financial stability remains unchanged, the exchange rate fluctuation leads the monetary authority to conduct market intervention. Concurrently, the managed exchange rate movement attracts capital inflows in the security market. As a consequence, both strategies neglect inflation pressure and thereby undermine the credibility of IT monetary policy. Under the above circumstances, market intervention should use discretionary strategies (in accordance with precautionary motives) to mitigate shocks in the foreign exchange market. Despite facing time inconsistency problems, the discretionary strategy is favorable for saving foreign reserves in the short run. The saved foreign reserves are useful to intervene in the foreign exchange market, especially during capital outflow episodes. It can also avoid confusion between the exchange rate and inflation stability goals.

Market intervention strategy in the IT regime is still open to being reinvestigated. The exchange rate in this paper is limited to its movement. The market intervention does not differentiate between the purchasing and selling states. Further research is advisable to incorporate the depreciation and appreciation states. The inflation pressure could also be split into over- and under-projected states. Similarly, market intervention might also consider the sterilized and unsterilized states. It is also recommended to explore the alternative measures of monetary policy transparency, financial stability, output level proxy, money supply, and asymmetric issues, which have not been explored in this study. Pairing them to analyze the impact of exchange rate fluctuation on the foreign exchange market intervention leads to a home currency stabilization strategy being more targeted.

Author contributions

Both authors contributed equally to the conceptualization, methodology, formal analysis, investigation, writing of the original draft, and writing, review, and editing. All authors have read and approved the final manuscript.

Use of AI tools declaration

The author declares they have not used Artificial Intelligence (AI) tools in the creation of this article.

Acknowledgment

This work is financially supported by the Faculty of Economics and Business, State University of Jakarta, Indonesia in collaboration with the Faculty of Economics, Business, and Accountancy, Universiti Malaysia Sabah.

Conflict of interest

The author declares no conflicts of interest in this paper.

References

Abdurohman A, Resosudarmo BP (2017) The behavior of fiscal policy in Indonesia in response to economic cycles. *Singap Econ Rev* 62: 377–401. https://doi.org/10.1142/S0217590816500041

Adler G, Chang KS, Mano RC (2021) Foreign exchange intervention: A dataset of public data and proxies. IMF Working Paper WP/21/47. https://doi.org/10.5089/9781513566672.001

Adler G, Lisack N, Mano RC (2019) Unveiling the effects of foreign exchange intervention: A panel approach. *Emerg Mark Rev* 40: 1–29. https://doi.org/10.1016/j.ememar.2019.100620

Agenor PR, Jackson TP, Silva LP (2020) Foreign exchange intervention and financial stability. BIS Working Papers No 889. Available from: https://www.bis.org/publ/work889.pdf (accessed 22 January 2025).

Ahir H, Bloom N, Furceri D (2022) The world uncertainty index. NBER Working Paper No. w29763. https://doi.org/10.3386/w29763

Aizenman J, Lee J (2007) International reserves: precautionary versus mercantilist views theory and evidence. *Open Econ Rev* 18: 191–214. https://doi.org/10.1007/ s11079-007-9030-z

Andriyani K, Marwa T, Adnan N, et al. (2020) The determinants of foreign exchange reserves: evidence from Indonesia. *J Asian Fin Econ Bus* 7: 629–636. https://doi.org/10.13106/jafeb.2020.vol7.no11.629

Arslan Y (2019) Reserve management and FX intervention. BIS Papers No 104. Available from: https://www.bis.org/publ/bppdf/bispap104.htm (accessed 22 January 2025).

Arslan Y, Chantu C (2019) The size of foreign exchange reserves. BIS Papers No 104. Available from: https://www.bis.org/publ/bppdf/bispap104a_rh.pdf (accessed 22 January 2025).

Basri MC, Sumartono L (2023) The impossibility of the impossible trinity? The case of Indonesia. *Oxford Rev Econ Pol* 39: 341–355. https://doi.org/10.1093/oxrep/grad010

Bayat T, Senturk M, Kayhan S (2014) Exchange rates and foreign exchange reserves in Turkey: nonlinear and frequency domain causality approach. *Theo Appl Econ* 21: 27–42.

Berganza JC, Broto C (2012) Flexible inflation targets, foreign exchange interventions and exchange rate volatility in emerging countries. *J Int Money Fin* 31: 428–444. https://doi.org/10.1016/j.jimonfin.2011.12.002

Beutel J, Emter L, Metiu N, et al. (2025) The global financial cycle & macroeconomic tail risks. *J Int Money Fin* 156: 1–24. https://doi.org/10.1016/j.jimonfin.2025.103342

Bhakri S, Verma A (2021) Determinants of foreign exchange reserves in India. *Int J Res - Granthaalayah* 9: 229–240. https://doi.org/10.29121/granthaalayah.v9.i2.2021.3493

Broto C (2011) Inflation targeting in Latin America: Empirical analysis using GARCH models. *Econ Mod* 28: 1424–1434. https://doi.org/10.1016/j.econmod.2011.02.009

Calvo G, Reinhart C (2002) Fear of floating. *Quar J Econ* 117: 379–408. https://doi.org/10.1162/003355302753650274

Chan SS (2007) The basic framework for international reserves and its application to Macau. *Mon Res Bul* 2 Monetary Authority of Macao. Available from: https://cdn.amcm.gov.mo/uploads/files/research_and_stats/research_and_publication/quarterly_report/issue_no_02/internationalreserves_en.pdf (accessed on 7 February 2025).

Cheung Y, Qian X (2009) Hoarding of international reserves: Mrs. Machlup's wardrobe and the Joneses. *Rev Int Econ* 17: 824–843. https://doi.org/10.1111/j.1467-9396.2009.00850.x

Chițu L, Quint D (2018) Emerging market vulnerabilities– a comparison with previous crises. *ECB Econ Bul* Issue 8/2018. Available from: https://www.ecb.europa.eu/press/economic-bulletin/focus/2018/html/ecb.ebbox201808_01.en.html (accessed on 7 February 2025).

Daude C, Yeyati EL, Nagengast A (2016) On the effectiveness of exchange rate intervention in emerging markets. *J Int Money Fin* 64: 239–261. https://doi.org/10.1016/j.jimonfin.2016.01.004

Disyatat P, Gaiati G (2007) The effectiveness of foreign exchange intervention in emerging market countries. *J Int Money and Fin* 26: 383–402. https://doi.org/10.1016/j.jimonfin.2007.01.001

Diwantari H (2010) The motives for international reserves holding in Indonesia. Master Thesis Graduate School of Development Studies Haque Netherland. Available from: https://thesis.eur.nl/pub/13591 (accessed on 7 February 2025).

Dominguez KME (2006) When do central bank interventions influence intra-daily and longer exchange rate movements? *J Int Money Fin* 25: 1051–1071. https://doi.org/10.1016/j.jimonfin.2006.08.009

Edwards S (2006) The relationship between exchange rate and inflation targeting revisited. NBER Working Paper No. 12163, Cambridge MA. https://doi.org/10.3386/w12163

Eichler S, Littke HC (2018) Central bank transparency and the volatility of exchange rates. *J Int Money Fin* 89: 23–49. https://doi.org/10.1016/j.jimonfin.2018.07.006

Fanelli S, Straub L (2020) A theory of foreign exchange interventions. In NBER Working Paper Series. https://doi.org/10.2139/ssrn.2846984

Fleming JM (1962) Domestic financial policies under fixed and floating exchange rates. *IMF Staff Pap* 9: 369–379. https://doi.org/10.2307/3866091

Frenkel M, Pierdzioch C, Stadtmann G (2005) The effects of Japanese foreign exchange market interventions on the Yen/US dollar exchange rate volatility. *Int Rev Econ Fin* 14: 27–39. https://doi.org/10.1016/j.iref.2003.09.003

Gokhale MS, Raju JVR (2013) Causality between exchange rate and foreign exchange reserves in the Indian context. *Global J Man Bus Res Fin* 13: 1–12. Available from: https://globaljournals.org/GJMBR_Volume13/2-Causality-between-Exchange-Rate.pdf (accessed on 22 March 2025).

Ghosh A, Jonathan R, Ostry D, et al. (2017) Shifting motives: Explaining the buildup in official reserves in emerging markets since the 1980s. *IMF Econ Rev* 65: 308–364. https://doi.org/10.1057/s41308-016-0003-3

Green R, Torgeson T (2007) Are high foreign exchange reserves in emerging markets a blessing or a burden? Occasional Paper No. 6, United States Department of the Treasury. Available from: https://home.treasury.gov/system/files/206/ForeignExchangeReport_ANNEX.pdf (accessed on 21 April 2025).

Gujarati DN, Porter DC, Gunasekar S (2012) *Basic Econometrics.* New Delhi: McGraw Hill Education.

Goeltom MS (2007) Essays in macroeconomic policy: The Indonesian experience. Jakarta: Gramedia Pustaka Utama.

Hofman D, Chamon M, Deb P, et al. (2020) Intervention under inflation targeting—when could it make sense? IMF Working Paper No. WP/20/9. https://doi.org/10.5089/9781513526027.001

Ikhsan M, Affandi Y, Mochtar F (2012) The trilemma inflation and central bank balance sheet: The case of Indonesia. *Econ Fin* 60: 127–144. Available from: https://www.lpem.org/repec/lpe/efijnl/201201.pdf (accessed on 17 October 2025).

IMF (2023) Annual Report on Exchange Arrangements and Exchange Restrictions 2023. IMF Washington DC. Available from: https://www.elibrary.imf.org/fileasset/downloads/AEIEA2023001-S001.pdf (accessed on 17 October 2025).

Juhro SM, Azwar P (2021) FX intervention strategy and exchange rate stability in Indonesia. Bank Indonesia Working Paper WP/03/2021. Available from: https://publication-bi.org/repec/idn/wpaper/WP032021.pdf (accessed on 12 May 2025).

Kearns J, Rigobon R (2005) Identifying the efficacy of central bank interventions: evidence from Australia and Japan. *J Int Econ* 66: 31–48. https://doi.org/10.1016/j.jinteco.2004.05.001

Kuncoro H (2015) Inflation targeting exchange rate pass-through and monetary policy rule in Indonesia. *Int J Bus Econ Law* 7: 14–25. Available from: https://ijbel.com/wp-content/uploads/2015/09/INFLATION-TARGETING-EXCHANGE-RATE-PASS-THROUGH-AND.pdf (accessed on 19 May 2025).

Kuncoro H (2020) Interest rate policy and exchange rates volatility lessons from Indonesia. *J C B Theo Prac* 9: 19–42. https://doi.org/10.2478/jcbtp-2020-0012

Kuncoro H (2024) The role of foreign reserves in inflation dynamics. *Econ J Emer Mark* 16: 1–12. http://doi.org/10.20885/ejem.vol16.iss1.art1

Kuncoro H, Nazir GA, Sebayang D (2021) A textual analysis of central bank communication the case of Indonesia. *Econ Bul* 41: 2158–2172. Available from: https://www.accessecon.com/Pubs/EB/2021/Volume41/EB-21-V41-I3-P186.pdf (accessed on 10 October 2025)

Kuncoro H, Pardede J (2024) Modelling the Indonesia's demand for foreign reserves. *Econ Inno and Econ Res J* 12: 131–151. https://doi.org/10.2478/eoik-2024-0005

Kruskovic BD (2022) Central bank intervention in the inflation targeting. *J C B Theo Prac* 11: 67–85. https://doi.org/10.2478/jcbtp-2022-0003

Kurihara Y (2013) Does adoption of inflation targeting reduce exchange rate volatility and enhance economic growth? *J World Econ Res* 2: 104–109. https://doi.org/10.11648/j.jwer.20130206.11

Lee Y, Yoon SM (2020) Relationship between international reserves and FX rate movements. *Sustainability* 12: 6961. https://doi.org/10.3390/su12176961

Liu G, Molise T (2020) The optimal monetary and macroprudential policies for the South African economy. *South African J Econ* 88: 368–404. https://doi.org/10.1111/saje.12260

Malliaropulos D, Migiakis PM (2023) Quantitative easing and sovereign bond yields: A global perspective. *J Empi Fin* 70: 445–465. https://doi.org/10.1016/j.jempfin.2022.12.011

Mohanty MS, Turner P (2006) Foreign exchange reserve accumulation in emerging markets: What are the domestic implications? *BIS Q Rev,* 39–52. Available from: https://www.bis.org/publ/qtrpdf/r_qt0609f.htm (accessed on 10 June 2025).

Mundell RA (1963) Capital mobility and stabilization policy under fixed and flexible exchange rates. *Can J Econ Pol Sci* 29: 475–485. https://doi.org/10.2307/139336

Obstfeld M, Taylor AM (2004) Global Capital Markets: Integration Crisis and Growth. Cambridge University Press. https://doi.org/10.1017/CBO9780511616525

Obstfeld M, Shambaugh JC, Taylor AM (2005) The tri-lemma in history: tradeoffs among exchange rates monetary policies and capital mobility. *Rev Econ Stat* 87: 423–438. https://doi.org/10.1162/0034653054638300

Oskoee MB, Brown F (2002) Demand for international reserves: a review article. *App Econ* 34: 1209–1226. https://doi.org/10.1080/00036840110096129

Rashid A, Basit M (2021) Empirical determinants of exchange-rate volatility: evidence from selected Asian economies. *J Chinese Econ F Trade Stud.* https://doi.org/10.1108/JCEFTS-04-2021-0017

Santos HC (2018) Foreign exchange interventions capital outflows and financial vulnerabilities in selected Asian emerging economies. BSP Working Paper Series Series No. 2018-02 November. Available from: https://www.bsp.gov.ph/Media_And_Research/WPS/WPS201802.pdf (accessed on 10 June 2025).

Sanusi KA, Meyer DF, Hassan AS (2019) An investigation of the determinants of foreign exchange reserves in southern African countries. *J Int Stud* 12: 201–212. https://doi.org/10.14254/2071-8330.2019/12-2/12

Sek SK (2009) Interactions between monetary policy and exchange rate in inflation targeting emerging countries: the case of three east Asian countries. *Int J Econ Fin* 1: 27–44. https://doi.org/10.5539/ijef.v1n2p27

Shijaku G (2012) Optimal level of reserve holding: an empirical investigation in the case of Albania. MPRA Paper 79091 University Library of Munich Germany. Available from: https://mpra.ub.uni-muenchen.de/79091/2/MPRA_paper_79091.pdf (accessed on 20 September 2025).

Sikarwar E (2020) Forex interventions and exchange rate exposure: Evidence from emerging market firms. *Econ Mod* 93: 69–81. https://doi.org/10.1016/j.econmod.2020.07.010

Steiner A (2013) The accumulation of foreign exchange by central banks: Fear of capital mobility? *J Macroecon* 38: 409–427. https://doi.org/10.1016/j.jmacro.2013.08.002

Svensson L (2010) Inflation targeting, In: Friedman B.M and Woodford M. editors, *Handbook of Monetary Economics,* 1 edition volume 3 chapter 22: 1237–1302. Elsevier. https://doi.org/10.1016/B978-0-444-53454-5.00010-4

Wang Y, Li X, Li Y, et al. (2015) A Study on Asymmetric Preference in Foreign Exchange Market Intervention in Emerging Asia. Proceedings of the 2015 International Conference on Humanities and Social Science Research. https://doi.org/10.2991/ichssr-15.2015.19

Weber CS (2019) The effect of central bank transparency on exchange rate volatility. *J Int Money Fin* 95: 165–181. https://doi.org/10.1016/j.jimonfin.2019.04.002

Yeyati EL, Sturzenegger F, Gluzmann PA (2013) Fear of appreciation. *J Dev Econ* 101: 233–247. https://doi.org/10.1016/j.jdeveco.2012.11.008

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