

Foreign exchange interventions and monetary policy: evidence from emerging economies

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Abstract: The role of foreign exchange interventions in monetary policy conduct is an ongoing debatable issue, especially in inflation-targeting emerging economies, where monetary authority can follow other targets rather than price stability. This paper examines whether interventions in foreign exchange markets affect the setting of interest rates in countries where price stability is the main target of monetary policy. We used the ARDL model to investigate the matter of the intervention policy as well as its asymmetric impacts on monetary policy. The results provide evidence of the significant effect of foreign exchange interventions on monetary policy in inflation-targeting emerging economies, implying the existence of fear of floating. Particularly, interest rate changes can mitigate or accommodate the intervention policy, depending on countries. Furthermore, the interventions have asymmetric effects on monetary policy, showing the bias toward sales interventions. While sales interventions play a more pronounced effect in most emerging economies, excepting for Mexico where purchase intervention effect is of more importance.

Keywords: foreign exchange intervention, monetary policy, interest rate, emerging economies, asymmetric effect.

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Introduction

In 1990s, many countries coped with economic and financial crises. These problems motivated them to reform financial systems and monetary policy institutions, which were expected to positively contribute to hyperinflation prevention and economy recovery. From theoretical perspective, monetary authorities in inflation-targeting countries commit to an explicit inflation target and a floating exchange rate regime, which is referred to as strict inflation targeting. Such an explicit commitment helps lower the expectation of inflation (Mishkin & Schmidt-Hebbel, 2007), thereby contributing to the credibility gain of the central bank and making this framework become more durable than others. However, the practice of monetary policy conduct is a different story in emerging economies, whereby monetary authorities can manage exchange rates to some degree by changing interest rates or conducting interventions in foreign exchange markets, which is referred to as flexible inflation targeting.

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Emerging economies can depart from the strict inflation targeting framework by not fully floating their exchange rate (Mishkin & Savastano, 2001) because they can experience output loss when exchange rates move strongly (Mundaca, 2018). Reinhart & Rogoff (2004) argued that de facto and de jure regime of exchange rates are likely to be different in emerging economies. Particularly, they often move to intermediate regimes, whereby they can intervene to adjust the movement of exchange rate in certain circumstances. Although interventions are common in emerging economies, their effects are still debatable (Menkhoff, 2013). Furthermore, less is known about the nexus between monetary policy and foreign exchange interventions, especially for inflation-targeting emerging economies.

This paper aims to fill the existing gaps by investigating the response of monetary policy to foreign exchange interventions in inflation-targeting emerging economies. On one hand, it examines whether foreign exchange interventions are informative about monetary policy in the long run. On the other hand, it extends the existing literature by investigating whether monetary policy asymmetrically respond to sales and purchase interventions.

We used the ARDL model to investigate the matter of the intervention policy as well as its asymmetric impacts on monetary policy. We found that foreign exchange interventions have significant effects on monetary policy in inflation-targeting emerging economies, implying the existence of fear of floating. In fact, the direction of monetary policy changes can mitigate or accommodate the intervention effects. Furthermore, the intervention effect is asymmetric, characterised by the bias toward sales interventions.

The paper contributes to the existing literatures in several aspects. Firstly, it provides a comparative analysis about how foreign exchange interventions affect monetary policy in inflation-targeting emerging economies. Particularly, it reveals whether interventions play different roles in signalling the future course of monetary policy in these emerging countries. Secondly, the paper provides evidence for the fear of floating, which sheds light on the existence of flexible inflation targeting in emerging economies. Finally, the paper extended the limited literature on the potential asymmetry in the linkage between intervention and monetary policy by investigating the effect of purchase and sales interventions separately.

The paper is organized as follows. The next section discusses the relevance of foreign exchange interventions and the mechanisms through which they interact with monetary policy in emerging economies that follow inflation targeting. The third section discusses methodology and data. The fourth section discusses empirical results. The final section summarises key findings and provides some policy recommendations.

Literature review

The relevance of foreign exchange interventions in emerging economies

From a theoretical perspective, strict and flexible inflation targeting is an ongoing debatable area of monetary policy analysis. While strict inflation targeting involves a commitment to a target rate of inflation in the conduct of monetary policy, flexible inflation targeting allows the existence of additional objectives of monetary policy. As noted by Wang et al. (2015), flexible inflation targeting suggests the attempts to stabilise

inflation on a long-term basis and the relevance of real exchange rates and other variables in the fulfilment of price stability targets. Yilmazkuday (2007) provide evidence of flexible inflation targeting by showing that the welfare loss is minimum when exchange rate is managed to a certain degree. On the other hand, Svensson (2000) argued that strict inflation targeting is not preferable because it leads to activism in monetary policy. To put it differently, monetary policy is subjected to frequent adjustments, causing considerable variability and uncertainty in economic variables (i.e. output). In other words, flexible inflation targeting requires less activism and less variability in other economic variables.

From an empirical perspective, monetary authorities can use foreign exchange interventions as a common policy to maintain the stability or finetune the movement of exchange rate. In practice, the use of intervention is at high frequency in inflation-targeting emerging economies such as Turkey, Mexico (Domaç & Mendoza, 2004), Latin American countries (Chang, 2008; Hansen & Morales, 2019; Humala & Rodríguez, 2010; Villamizar-Villegas, 2016), or Central and Eastern European countries (Křížek & Brčák, 2021; Sideris, 2008). As noted by Calvo & Reinhart (2002), the adoption of floating exchange rate regimes does not prevent the continuous adjustments of foreign reserves. Adler et al. (2021) argued that interventions are a popular policy in both inflation-targeting and non-inflation-targeting countries. For instance, Peruvian monetary authorities officially stated that interventions can be conducted if necessary (Humala & Rodríguez, 2010). Chang (2008) also documented the activism of Latin America countries in reserve accumulation to protect domestic currency from speculative attacks. Moreover, Chen & Lin (2019) suggested that reserve accumulation can be a policy to limit currency appreciation. Similarly, Levy-Yeyati & Sturzenegger (2007) argued that emerging-economy monetary authorities prefer to defend export and show the fear of appreciation, especially in economic booms.

There are many factors leading to the significance and popular use of foreign exchange interventions in emerging economies. A key factor is the presence of fear of floating, a phenomenon where monetary authorities try to maintain the stability of exchange rates. In fact, stable exchange rates can improve economic stability when a country has a high level of dollarization (Mundaca, 2018; Rossini et al., 2013), public foreign currency borrowing (Dudzich, 2020), or financial and real vulnerabilities (Cavoli, 2009). Removing sudden changes in exchange rates can protect domestic economy from the risk of the shortage of international liquidity, especially in times of crises, or the inflation pressure of exchange rate changes. Maintaining exchange rate stability is also a mean to deal with the problem of low credibility (Akinci et al., 2006; Caballero & Krishnamurthy, 2001; Calvo & Reinhart, 2000, 2002; Chang, 2008; Domaç & Mendoza, 2004).

Akinci et al. (2006) emphasized a situation where interventions are of importance in inflation targeting economies. Particularly, monetary authorities actively intervene when volatile exchange rates increase inflation volatility in these economies. Moreover, an overvalued currency can increase political pressures that motivate monetary authorities to raise the stock of foreign reserves, which can literally lead to depreciations and improve the competitiveness of domestic goods. Additionally, reserve accumulation gives an assurance that a country can meet its international short-term obligations, which reduces the risk of financial crisis caused by low accessibility to international funds or sudden stops in capital inflows. As pointed out by Blanchard & Adler (2015), interventions can

mitigate appreciation pressures caused by capital inflows in a group of 35 emerging economies.

As noted by Chang (2008), interventions are tools that monetary authorities can use to achieve other objectives beyond price stability. Faltermeier et al. (2022) favoured the use of reserve accumulation in a small and open economy when dealing with commodity booms. The main reason is the presence of learning-by-doing externalities, whereby a commodity boom shock can lead to excessive consumption growth, an amplified contraction in tradable goods, and resulted appreciated exchange rates. Using autoregressive conditional heteroscedasticity models, Domaç & Mendoza (2004) stated that interventions of different size and frequency can maintain the stability of exchange rates in inflation targeting economies such as Turkey and Mexico. However, they emphasized that interventions have asymmetric effects, whereby sales of foreign exchange lead to an appreciation while purchases of foreign exchange have an insignificant effect on the value of domestic currency. Similarly, Berganza & Broto (2012) investigated a panel of 37 emerging economies and argued that the adoption of inflation targeting can increase exchange rate volatility but interventions, especially sales of reserves, can keep exchange rate more stable. Using Markov Switching - Vector Autoregression Models, Humala & Rodríguez (2010) found that the effectiveness of interventions is high in the regime of highly volatile exchange rates. Sideris (2008) applied Johansen analysis and proved interventions are a useful instrument to achieve exchange rate stability in Central and East European countries (Bulgaria, Poland, Romania, Russia, Slovenia, and Ukraine).

Some studies argued that interventions can improve the welfare of a country. For instance, Yilmazkuday (2007) used a calibration analysis to investigate the role of managed floating regime in Turkey after this country followed inflation targeting. The study provided evidence for the effectiveness of flexible inflation targeting since it had less welfare loss than other frameworks. Similarly, Roger et al. (2009) documented that intervention policies can reduce welfare loss by mitigating the adverse effect of volatile exchange rates on the economy.

Nevertheless, other studies found that the effectiveness of interventions is mixed in some cases. To begin with, Guimarães & Karacadag (2004) found different, even opposite, effects of interventions on the level and volatility of exchange rates in Mexico and Turkey. While interventions help maintain the exchange rate stability in Turkey, they cause exchange rates more volatile in Mexico. Mundaca (2018) also emphasized the limited effectiveness of interventions. Particularly, they cannot reduce strong fluctuations of exchange rates in Peru. Krizek & Brčák (2021) stated that foreign exchange interventions can foster exports in Czech Republic. However, they emphasized such a positive effect is more pronounced in some parts of exports. On the other hand, Villamizar-Villegas (2016) argued that interventions have significant effects on the volatility rather than the level of exchange rates.

Furthermore, sales and purchases of foreign exchange can have different effects on exchange rates. Using a GARCH(1,1) model, Égert & Komárek (2006) showed that interventions have asymmetric effects in Czech Republic from 1997 to 2002, whereby foreign reserve purchases lead to depreciations of the koruna but foreign reserve sales cause depreciations rather than expected appreciations. Akinci et al. (2006) analysed

Turkey by using both event and time-series methods. They provided evidence for the more effectiveness of purchase interventions in the post-crisis period. By contrast, Domaç & Mendoza (2004) and Guimarães & Karacadag (2004) supported the effectiveness of sales interventions in Turkey and Mexico. In these emerging economies, sales interventions lead to expected appreciations while purchase intervention effects are not effective. Banerjee et al. (2018) provided a similar consensus about the role of sales interventions in Slovakia. Rishad & Gupta (2019) applied a GARCH(1,1) model for the case of India and found that sale interventions are useful to prevent the appreciation of the rupee whereas purchase interventions are not effective to finetune the exchange rate movement. Such a finding indicates the attempt of Indian monetary authorities to fulfil the inflation targets. Rakhmad & Handoyo (2020) used GARCH models and found that purchase rather than sale of foreign exchange is effective to stabilize exchange rates in Indonesia.

The use of interventions can confuse the public about the priority of monetary policy, thereby causing distortions in the expectation of the market. Such distortion can be high in certain circumstances, like when monetary policy and exchange rate policy have a low level of consistence. Therefore, it is cautious when intervening in the foreign exchange market (Guimarães & Karacadag, 2004). Minella et al. (2003) suggested that transparency can prevent misunderstanding in the conduct of intervention policies.

Foreign exchange interventions and monetary policy

Generally, exchange rates are an important input for the setting of monetary policy in emerging economies. Particularly, many emerging economies officially stated that they can conduct interventions in certain circumstances, especially when there are high misalignments between exchange rates and their fundamental levels.

Theoretically, foreign exchange interventions can affect monetary policy through several channels. Firstly, the interventions can mitigate or exemplify the effect of monetary policy through changes in commercial bank reserves or credit expansion (Ponomarenko, 2019). Accordingly, reserve accumulation leads to a rise in the stock of money supply although monetary authorities conduct sterilization actions. A key reason is that the sterilization has lagged effects, meaning that it takes time to realize the sterilization effect on money supply and interest rates. Once monetary authorities decide to increase foreign reserve stocks by purchasing foreign exchange, commercial banks cope with an equal reduction in their foreign assets. Because these commercial banks cannot offset this reduction immediately, their reserves increase, suggesting a rise in liquidity and money supply. Subsequently, increased liquidity spreads over non-banking sectors. Secondly, imperfect sterilization can cause a decrease in interbank interest rates, thereby indirectly affecting credit expansion.

Other studies recommend the signalling channel through which foreign exchange interventions establish a relationship with monetary policy (Akinci et al., 2006; Fatum & Hutchison, 1999; Kaminsky & Lewis, 1996). This channel operates based on the conventional wisdom that sterilised interventions can predict the future stance of monetary policy. It assumes that monetary authorities have more information than market participants. Once the interventions are conducted, asymmetric information causes market participants to have a perception that exchange rates are misaligned and the

interventions are of necessity to move exchange rates back to their equilibrium level. As a result, they adjust their expectation about the status of market and the stance of monetary policy in the future. To put it differently, although selling (buying) foreign exchange has no effect on current monetary policy, it leads to an expectation of tight (loose) monetary policy in the future (Kim, 2003).

However, the signalling channel is difficult to detect and its effect can be weak in some cases. The first situation is when monetary authorities decide to conduct interventions implicitly or secretly, thereby the market cannot reach new information about the intention of policymakers. The second situation happens when oral communication about future interventions is as expected by the market. In this case, there might be no reaction from the public following an announcement of the intervention policy. According to Kaminsky & Lewis (1996), monetary policy can change in an opposite direction, whereby its stance is contractionary (rather than expansionary) after a foreign exchange purchase.

Although there are concrete theoretical justifications about the relationship between foreign exchange intervention policy and monetary policy, the empirical literature about the nexus is limited, especially for emerging economies. As noted by Yeh (2010), monetary authorities can change the stance of monetary policy by changing the stock of foreign reserves while remaining the existing level of interest rates. Furthermore, Kim (2005) found that foreign exchange interventions can mitigate the effect of monetary policy on exchange rates, implying the existence of delayed overshooting problem. Accordingly, the appreciation period becomes longer after monetary contractions in Canada. Aizenman et al. (2011) showed that the Taylor rule augmented by foreign reserve changes are more relevant for not-inflation-targeting emerging economies.

Methodology and data

Theoretical model

According to Neely (2005), there are three methods that can be used to investigate the influence of foreign exchange interventions on other economic variables. Firstly, time-series analysis examines the role of the interventions by using a single equation in which the dependent variable is the affected variable. It is the most popular method in the study of intervention effects. Secondly, event study is considered as the most appropriate method to analyse intervention effects because interventions are undertaken occasionally, especially when a country needs to defend its domestic currency. This method uses data with high frequency like daily or intraday series. Consequently, it is common for the analysis of advanced economies whose general statistics are well organised. Nonetheless, data availability restrains the application of this method for emerging economies. Thirdly, structural analysis investigates the role of the interventions while considering the simultaneous interaction between variables in a system of equations.

In this paper, we applied the first method suggested by Neely (2005). Particularly, we apply the following specification to investigate how the interventions affect monetary policy in inflation-targeting emerging economies.

$$i_t = \beta_0 + \rho i_{t-1} + \beta_1 \pi_{t-k} + \beta_2 y_{t-m} + \beta_3 e_{t-n} + \beta_4 I_{t-p} + v_t \quad (1)$$

$$i_t = \beta_0 + \rho i_{t-1} + \beta_1 \pi_{t-k} + \beta_2 y_{t-m} + \beta_3 e_{t-n} + \beta_4 pur_{t-p} + \beta_5 sal_{t-q} + v_t \quad (2)$$

where i_t , π_t , y_t , e_t are short-term interest rates, inflation gap, output gap, and bilateral exchange rates, respectively. They are basic variables of monetary or business cycle analysis. Short-term interest rates are one of the most popular indicators of monetary policy. Output gap is the spread between its actual value and the potential estimated by the Hodrick-Prescott filter. Intervention, I_t , is foreign reserve changes, which is considered as a narrative proxy for foreign exchange interventions.

The existing literature (Berganza & Broto, 2012; Blanchard & Adler, 2015; Kim, 2003; 2005; Sideris, 2008) suggested that foreign reserves can be an indicator of foreign exchange interventions. A positive shock of this variable implies that foreign reserve purchase is greater than foreign reserve sales. In other words, it implies the net purchase of foreign reserve is positive. However, Blanchard & Adler (2015) argued that foreign reserves are a narrative measure of foreign exchange interventions. One reason is that foreign reserves can capture information beyond interventions (Berganza & Broto, 2012). Other reason is that foreign reserve changes have errors in their measurement (Sideris, 2008). Finally, Neely (2000) argued that the correlation between foreign reserves and actual interventions can be weak.

In equation (1) and (2), the effect of inflation and output gap should follow the Taylor principle to ensure that monetary policy has a stabilization effect on economic variables. Therefore, inflation coefficient β_1/ρ should be larger than unity whereas output coefficient β_2 should be positive. As observed, equation (1) and (2) examine the symmetric and asymmetric effect of interventions on interest rates, respectively. Observing the effect (direction and magnitude) of sales and purchase interventions can shed light about how interventions asymmetrically affect monetary policy in inflation-targeting emerging economies.

Since the Global financial crisis and the outbreak of Covid pandemic have substantial effects on economic activities and thus the conduct of monetary policy, it is of importance to account for these structural breaks. Therefore, we add time dummies that represent the period of the crisis and covid, named T1 and T2 respectively. Furthermore, we include trade (trade) as a control variable since its movements can affect the intervention policy. Consequently, equation (1) and (2) can be rewritten as follows:

$$i_t = \beta_0 + \rho i_{t-1} + \beta_1 \pi_{t-k} + \beta_2 y_{t-m} + \beta_3 e_{t-n} + \beta_4 I_{t-p} + \beta_5 trade_{t-q} + \beta_6 T_{1,t-l} + \beta_7 T_{2,t-j} + v_t \quad (3)$$

$$i_t = \beta_0 + \rho i_{t-1} + \beta_1 \pi_{t-k} + \beta_2 y_{t-m} + \beta_3 e_{t-n} + \beta_4 pur_{t-p} + \beta_5 sal_{t-q} + \beta_6 trade_{t-s} + \beta_7 T_{1,t-l} + \beta_8 T_{2,t-j} + v_t \quad (4)$$

Estimation methods

In this paper, we choose ARDL models to estimate the effect of foreign exchange interventions on monetary policy because this model allows variables to be stationary at different levels. Therefore, it helps avoid any loss in information and degree of freedom. For this reason, ARDL models have some advantages over other estimators such as GMM or VAR models. In ARDL models, we can use variables that are purely $I(1)$ or purely $I(0)$ or a mixture of both. When using a mixture of $I(1)$ and $I(0)$ variables, they should be cointegrated. To put it differently, these variables are bound together due to the impact of equilibrium forces. Pesaran et al. (2001) proposed a bound test to investigate the existence of cointegration. Accordingly, if the F statistic is high enough, being greater than the critical value at 5 percent, variables are cointegrated.

Other reasons are that ARDL models can account for the problem of the lagged effect of foreign exchange interventions and economic variables on monetary policy. As an illustration, changes in monetary policy takes time to realise its effect on or respond to variables such as output, inflation, or foreign exchange interventions. An ARDL model with proper lags can capture this type of interaction between economic and policy variables. According to Gujarati (2014), the Akaike information criterion (AIC) and other information criteria can be used to determine the optimal lags for an ARDL model.

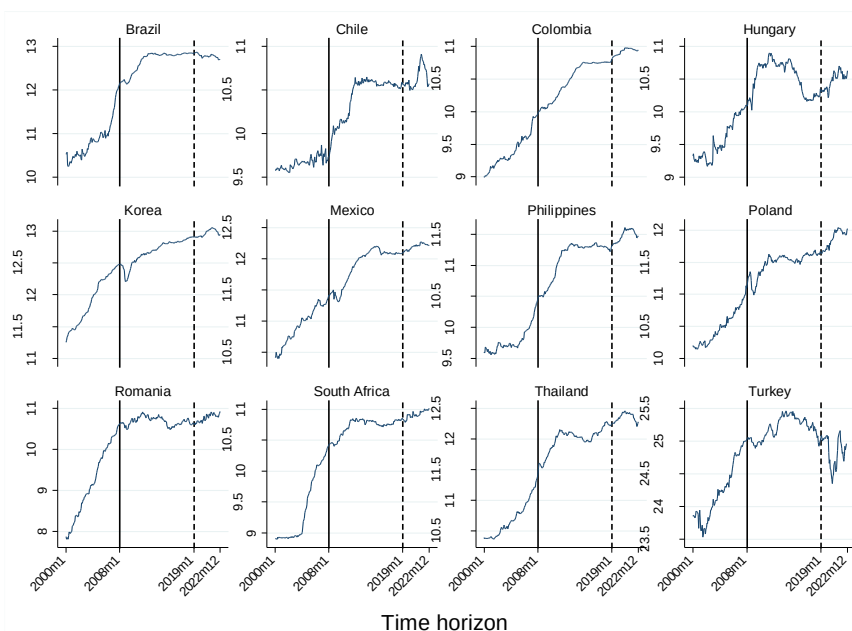
Since the research period includes the Global financial crisis and the worldwide spread of Covid-19 disease, it is of importance to account for structural breaks when analysing the effect of foreign exchange interventions on monetary policy. There are two methods that can be used to incorporate structural break effects. The first method is to divide the sample into some sub-samples such as pre- and post-crisis period. It can investigate the relationship of interest under different circumstances. However, this method copes with a great information loss when it reduces the time length of data series and uses a shorter sample in the estimation. Therefore, it is not preferable in this paper. The second method involves the use of time dummies, indicating different stages or phases of the economy. This method maintains the length of the sample when considering the potential effect of structural breaks. Since the research sample has a moderate length in this paper, the use of sub-sample method can lead to a great loss of information and degree of freedom and thus the time-dummy method is more preferred in this paper. Shambaugh (2004) applied this method when investigating the interaction between exchange rates and monetary policy in the presence of common shocks. Moreover, Juurikkala et al. (2011) used various time dummies when analysing how banks can affect the transmission of monetary policy in Russia.

Data

This paper focuses on a group of twelve emerging economies that target price stability: Brazil, Chile, Colombia, Mexico, Hungary, Poland, Romania, Turkey, Korea, Philippines, Thailand, and South Africa. The data is monthly, spanning January 2000 - December 2022. Most series, excepting for exchange rate, are collected from the IMF. Exchange rate is derived from several sources: IMF for most countries whereas Bank for International Settlements for Turkey, Korea, and Thailand. Following previous studies (Cermeno et al., 2012; De Mello & Moccero, 2011; Furlani et al., 2010; Jawadi et al., 2014; Sánchez-Fung, 2011), money market interest rates are used as a proxy for monetary

policy. Following the existing literature, consumer price index (industrial production index) is used as a measure of inflation (output).

Figure 1: The evolution of foreign reserves in emerging economies



Source: Authors' construction

Figure 1 illustrates the dynamics of foreign reserves, which is considered as a measure of foreign exchange intervention (Domaç & Mendoza, 2004). As observed, the interventions can be categorized into some distinctive periods. The first period is characterized by a rapid increase in the stock of foreign reserves in most inflation-targeting emerging economies. This period ended before the onset of the Global financial crisis in 2008. Remarkably, reserves accumulation remained at a stable space in the early 2000s in many countries: Brazil, Chile, Hungary, Philippines, Thailand, and South Africa. A possible explanation is that emerging economies whose growth depends on export prefer to reserve accumulation (Johannes & Sondergaard, 2007). Fear of appreciation can emerge in case of export-oriented countries (Blanchard & Adler, 2015). However, Ding & Wang (2022) argued that high pace of reserve accumulation can leads to a rise in money supply, which can cause inflation. Another justification is the presence of precautionary motive since monetary authorities were likely to protect domestic economy against possible appreciations caused by continuous capital inflows and the risk of their sudden stop (Blanchard & Adler, 2015; Johannes & Sondergaard, 2007; Ponomarenko, 2019). Cheung & Qian (2009) were supportive of this motive, especially in case of Asian economies since these economies did not want to become a target of speculative attack.

The second period occurred in the aftermath of the Global financial crisis. In this period, foreign reserves showed a short-lasting fall, then increased at high speed in the early years

of economic recovery and eventually remained stable at high level, which can be considered as a buffer against international shocks.

In recent years, the outbreak of Covid-19 pandemic and subsequent economic recessions lead to changes in the pattern of foreign reserves in most countries. Reserve accumulation experienced a slowdown and then a slight decrease in many countries (Brazil, Chile, Korea, Romania, South Africa, and Thailand). In Turkey, reserves stock showed a sharp fall in the post-Covid era. In Hungary, reserve stock sharply dropped before the onset of the Covid-19 pandemic.

In summary, changes in foreign reserves may indicate the relevance of exchange rates, foreign shocks, foreign exchange interventions, or additional objectives in the conduct of monetary policy in inflation-targeting emerging economies. According to Wang et al. (2015) and Yilmazkuday (2007), such a phenomenon may indicate the presence of a regime of flexible inflation targeting in emerging economies.

Empirical analysis

Monetary policy response to foreign exchange interventions

As shown in Table 1, the interventions demonstrate pronounced effects on interest rates in most economies. This means that inflation-targeting monetary authorities take account of foreign reserves in the conduct of monetary policy. To put it differently, foreign exchange interventions are useful to predict the future stance of monetary policy, which is in line with Ding & Wang (2022) and Kaminsky & Lewis (1996) but contrast with Fatum & Hutchison (1999). Furthermore, the finding implies that monetary authorities are reluctant to allow the free movement of exchange rates in emerging economy even though the inflation targeting is adopted

However, the intervention effect has different sign between emerging economies. On one hand, interest rates tend to reduce after a positive shock of foreign reserves in Brazil, Chile, Colombia, Mexico, Turkey, Korea, and Philippines. Although the negative response emerges for other countries such as Romania, Thailand, and South Africa, it is not statistically significant. These findings are in line with the finding of Kim (2003). However, the findings are contrast with Aizenman et al. (2011) since we found that the intervention effect is significant even in inflation-targeting emerging economies. Particularly, interest rate setting accommodates the intervention policy, exemplifying the liquidity effect and inflation pressure of the latter. However, it should be noted that the pattern of interest rate changes does not mean that the interventions are not sterilised. Conventionally, monetary authorities can mitigate the intervention effect on prices by manipulating tools such as required reserves or security trading. Therefore, an interest rate cut after a rise in foreign reserves may suggest that the intervention is either unsterilized or partially sterilized.

Table 1: Long-run effects of interventions on monetary policy

	ADJ	y_{t-1}	π_{t-1}	I_{t-1}	e_{t-1}	$trade_{t-1}$
Brazil	-0.061* (0.012)	0.077 (0.052)	0.531* (0.141)	-3.329* (0.383)	1.149 (1.556)	1.298 (2.287)
Chile	-0.163* (0.029)	0.029 (0.206)	0.992* (0.147)	-1.583** (0.791)	-6.981* (2.404)	-2.820 (1.985)
Colombia	-0.045* (0.011)	0.344* (0.114)	2.070* (0.433)	-3.115* (0.866)	-5.941*** (3.434)	2.278 (4.592)
Mexico	-0.057* (0.015)	0.750* (0.248)	-0.291 (0.592)	-7.001* (1.914)	13.493* (5.076)	11.109 (17.053)
Hungary	-0.120* (0.029)	0.027 (0.066)	0.548* (0.186)	3.460** (1.445)	2.477 (6.700)	-54.025* (12.366)
Poland	-0.069* (0.014)	0.203** (0.083)	0.517** (0.220)	5.717* (2.162)	14.608*** (8.788)	-50.088* (9.915)
Romania	-0.195* (0.023)	-0.034 (0.054)	0.493* (0.077)	-0.070 (1.383)	-15.925* (5.010)	-2.562 (2.642)
Turkey	-0.068* (0.014)	0.709** (0.308)	-0.077 (0.428)	-9.243*** (5.186)	-4.489 (6.136)	18.366 (18.577)
Korea	-0.042* (0.013)	0.063*** (0.035)	0.446** (0.191)	-1.501* (0.428)	-6.280* (1.993)	-7.189** (2.860)
Philippines	-0.059* (0.019)	0.022 (0.017)	0.718* (0.275)	-2.713* (0.859)	4.214 (5.478)	-2.922 (2.652)
Thailand	-0.046* (0.012)	0.059 (0.044)	0.458* (0.147)	-0.420 (0.982)	3.758 (5.082)	1.711 (2.679)
South Africa	-0.021*** (0.012)	0.223 (0.142)	1.684** (0.838)	-1.112 (1.197)	0.974 (2.790)	-10.320 (6.996)

Source: Authors' estimation

Notes: *, **, *** denote the significance at 1%, 5%, and 10% respectively. Standard errors in the parentheses. Time dummies include the Global financial crisis 2008 and Covid-19 pandemic 2019.

On the other hand, foreign exchange interventions have a positive effect on interest rates in some countries like Hungary and Poland. Such a positive effect indicates that monetary authorities would like to counter the inflation pressure of reserve accumulation. Generally, a positive shock of foreign reserves can lead to a rise in the stock of money supply, a depreciation of domestic currency and an increase in inflation. Monetary authorities, who focus on price stability, can decide to increase interest rates to mitigate the inflation pressures. In a nutshell, monetary authorities are cautious about the price stability in Hungary and Poland.

There are some justifications for the significance of foreign exchange interventions in inflation-targeting emerging economies. Firstly, the significance of the intervention implies the relevance of the “impossible trinity”, suggesting that there is a trade-off between monetary independence, free capital flows, and fixed exchange rate. When allowing free capital flows, monetary policy independence is low if monetary authorities want to manage the movement of the exchange rate. Secondly, exchange rate stability can be subordinated to price stability in inflation-targeting emerging economies, indicating

the relevance of the flexible inflation targeting. However, it should be noted that the use of intervention should be limited so that exchange rate does not become a normal anchor. Lastly, incorporating foreign exchange intervention in the reaction function of monetary policy can lead to an increase in uncertainty over the future course of monetary policy.

Foreign exchange intervention and the potential effect of a structural break

Table 2 illustrates how foreign exchange interventions alter their effects on interest rates when structural breaks are included or excluded. As observed, structural breaks lead to changes in the intervention effect in most inflation-targeting emerging economies. On one hand, the interventions have more pronounced effect in Colombia, Mexico, Poland, Turkey, and Philippines when accounting for the Global financial crisis and Covid-19 pandemic. On the other hand, their effect shows a slight decrease in other countries but Thailand.

Table 2: Forex interventions and structural breaks

	With time dummies			Without time dummies		
	γ_{t-1}	π_{t-1}	I_{t-1}	γ_{t-1}	π_{t-1}	I_{t-1}
Brazil	0.077 (0.052)	0.531* (0.141)	-3.329* (0.383)	0.162*** (0.098)	0.601** (0.245)	-3.680* (0.689)
Chile	0.029 (0.206)	0.992* (0.147)	-1.583** (0.791)	0.207 (0.161)	0.860* (0.140)	-1.624** (0.762)
Colombia	0.344* (0.114)	2.070* (0.433)	-3.115* (0.866)	0.213* (0.078)	0.953* (0.226)	-1.995* (0.637)
Mexico	0.750* (0.248)	-0.291 (0.592)	-7.001* (1.914)	0.932* (0.305)	-0.013 (0.592)	-6.960* (1.932)
Hungary	0.027 (0.066)	0.548* (0.186)	3.460** (1.445)	0.018 (0.076)	0.421** (0.198)	3.701** (1.718)
Poland	0.203** (0.083)	0.517** (0.220)	5.717* (2.162)	0.247** (0.096)	0.366*** (0.219)	5.627** (2.395)
Romania	-0.034 (0.054)	0.493* (0.077)	-0.070 (1.383)	0.053 (0.097)	0.549* (0.117)	4.243*** (2.164)
Turkey	0.709** (0.308)	-0.077 (0.428)	-9.243*** (5.186)	0.737** (0.304)	-0.154 (0.368)	-8.496*** (4.561)
Korea	0.063*** (0.035)	0.446** (0.191)	-1.501* (0.428)	0.077*** (0.041)	0.498** (0.204)	-1.743* (0.415)
Philippines	0.022 (0.017)	0.718* (0.275)	-2.713* (0.859)	0.026** (0.012)	0.543** (0.215)	-2.069* (0.707)
Thailand	0.059 (0.044)	0.458* (0.147)	-0.420 (0.982)	0.112*** (0.066)	0.496* (0.185)	0.638 (1.364)
South Africa	0.223 (0.142)	1.684** (0.838)	-1.112 (1.197)	0.154** (0.064)	0.389* (0.134)	-2.166* (0.496)

Source: Authors' estimation

Notes: *, **, *** denote the significance at 1%, 5%, and 10% respectively. Standard errors in the parentheses. Time dummies include the Global financial crisis 2008 and Covid-19 pandemic 2019.

Asymmetric effect of foreign exchange interventions

This section examines the possible asymmetries in the response of monetary policy to foreign exchange interventions. As shown in Table 3, sales and purchase interventions show distinctive and inconsistent effects on interest rates between inflation-targeting emerging economies. To begin with, either sales or purchase interventions are statistically significant in all countries but Thailand where both are statistically significant. Such findings provide evidence of the asymmetric effect of intervention policy on monetary policy in inflation-targeting emerging economies, which is in line with Kaminsky & Lewis (1996).

Particularly, the asymmetry indicates a bias toward sales interventions, whereby their effect on interest rate is more pronounced in most inflation-targeting emerging economies. On one hand, a positive shock of sales interventions, which indicates a reduction in the stock of foreign reserves and money supply, can lead to an interest rate rise in many countries (Chile, Colombia, Hungary, Romania, Turkey, and Thailand). According to the conventional wisdom, sterilised interventions should follow by an interest rate cut. Therefore, the positive response of interest rate implies that monetary authorities tempt to accommodate rather than counter the liquidity effect of sales interventions. Since both policies ends with appreciations, fear of depreciation is considerably significant in inflation-targeting emerging economies. There are several justifications for this phenomenon. Firstly, emerging economies can cope with international liquidity constraint, especially during the crisis. In that context, depreciations may have contractionary rather than expansionary effect. When domestic firms have foreign debts but their markets are limited to the domestic economy, depreciations may worsen the condition and net worth of debtor firms, which impairs their accessibility to both domestic and international funds. This eventually leads to a reduction in investments. Secondly, expansionary monetary policy has limited effects on output and it can lead to a sharp overshooting depreciations in financial constrained countries. Therefore, a tightened monetary policy becomes a plausible and conservative policy to stabilise the exchange rate and price level (Caballero & Krishnamurthy, 2001). In a nutshell, inflation-targeting emerging economies prefer using sales of foreign exchange to support interest rate increases when their monetary authorities tempt to fight depreciations and inflation, especially during times of financial constraints. Such a typical policy response is consistent with the argument of Chang (2008) and the finding of Chen & Lin (2019).

On the other hand, interest rate shows a decrease after a sales intervention in some countries such as Poland, Korea, Philippines, and South Africa. Such a response suggests that monetary authorities would like to use monetary policy to counter the intervention effect in these countries. According to Adler et al. (2021), a possible explanation for such a response pattern is that exchange rate can become another objective of monetary authorities, especially when inflation or its expectation is high. In these context, sales of foreign exchange are likely to happen to stabilise the exchange rate.

Purchase interventions are significant in only a few countries. They have a negative and statistically significant effect on interest rates in Mexico. It is of difficulty to conclude that purchase interventions are sterilised or not sterilised by Mexican monetary authorities. In Thailand, both purchase and sales interventions can lead to a rise in interest

rates. The positive effect of purchase intervention implies that monetary authorities in Thailand are cautious about the inflation pressure caused by depreciations following a rise in foreign reserves. Nonetheless, a rise of interest rate follows a sales intervention implies the great caution about previous depreciations in Thailand. In most emerging economies, monetary policy is unresponsive to purchase interventions. This phenomenon is conditional on the fact that purchase interventions are caused by many factors such as self-protection against financial crises, political pressures, export-led growth policies, and fear of floating. To reduce uncertainty, monetary policy is only active under certain conditions: there is a sign of an acceleration in the rate of inflation.

Table 3: Sales and purchase intervention effect on interest rate setting

	ADJ	y_{t-1}	π_{t-1}	e_{t-1}	$trade_{t-1}$	pur_{t-1}	$sales_{t-1}$
Brazil	-0.008 (0.010)	0.751 (1.161)	5.422 (6.041)	20.781 (37.493)	-74.011 (114.386)	-0.838 (2.012)	-0.042 (1.472)
Chile	-0.110* (0.026)	0.356*** (0.207)	0.756* (0.223)	-2.769 (3.256)	1.233 (3.110)	-0.095 (0.162)	0.428*** (0.254)
Colombia	-0.049* (0.009)	0.243* (0.086)	0.991* (0.348)	3.342 (2.665)	7.345** (3.131)	0.341 (0.263)	1.692*** (0.958)
Mexico	-0.034* (0.011)	0.816** (0.388)	-0.560 (0.940)	-5.072 (5.087)	21.272 (27.818)	-3.654*** (1.884)	0.040 (0.698)
Hungary	-0.103* (0.027)	0.114 (0.087)	0.762* (0.217)	3.316 (7.589)	-31.547* (8.690)	-0.157 (0.155)	0.939** (0.431)
Poland	-0.069* (0.014)	0.203** (0.081)	0.834* (0.225)	3.693 (7.652)	-24.529* (4.072)	-0.023 (0.171)	-1.161* (0.370)
Romania	-0.237* (0.024)	0.018 (0.048)	0.464* (0.058)	-14.411* (4.198)	-3.115 (2.019)	0.020 (0.065)	0.514* (0.123)
Turkey	-0.035* (0.010)	2.683* (0.988)	0.756 (0.588)	-31.271** (13.598)	103.964** (43.070)	-1.355 (2.168)	6.361* (2.388)
Korea	-0.032* (0.007)	0.035 (0.037)	0.776* (0.218)	-1.693 (2.362)	-19.469* (3.960)	-0.267 (0.197)	-2.893* (0.654)
Philippines	-0.044* (0.012)	-0.040 (0.032)	1.205* (0.362)	18.479* (4.415)	-0.182 (2.581)	0.433 (0.422)	-2.736* (1.022)
Thailand	-0.083* (0.014)	-0.037 (0.027)	0.363* (0.088)	5.511* (1.673)	-5.384 (3.302)	0.868* (0.259)	0.517** (0.222)
South Africa	-0.017* (0.006)	0.267*** (0.136)	0.678** (0.342)	2.297 (3.165)	6.503 (5.879)	0.422 (0.350)	-4.858** (2.153)

Source: Authors' estimation

Notes: (a): p -value of Hansen J test. *, **, *** denote the significance at 1%, 5%, and 10% respectively. Standard deviation in the parentheses.

Furthermore, the asymmetric response of monetary policy to purchase and sales intervention can be conditional on the dynamic of foreign reserves in inflation-targeting emerging economies. As discussed in Data section, reserve accumulation is more common than reserve loss in these countries. From the public's perspective, sales intervention does not follow the normal pattern, which may suggest the misalignment of

exchange rates. The situation may become worse when the economy is subjected to a high degree of asymmetric information. Furthermore, the asymmetry is in line with Adler et al. (2021) who emphasised that sales intervention is more relevant when dealing with inflationary pressures and purchase intervention can be more relevant when dealing with deflationary pressures.

There are other justifications for the bias of monetary policy toward sales interventions. Monetary authorities may have an asymmetric loss function of exchange rate. In the context of this paper, sharp depreciations can generate greater loss than appreciations, requiring the sales of foreign reserves to reverse such a trend. Therefore, sales interventions can be more significant. Furthermore, purchase and sales interventions have different mechanism of transmission. It is likely that sharp depreciations are strongly related to inflation, thereby implying the urgency of sales interventions and thus monetary policy if monetary authorities are cautious about price stability.

Conclusions

Despite of the vast literature about foreign exchange interventions, less is known about their linkage with monetary policy in emerging economies that follow inflation targeting. This paper used ARDL models to investigate the dynamic of the linkage in twelve inflation-targeting emerging economies. The empirical results provide evidence for the significant role of foreign exchange interventions in the conduct of monetary policy in these countries. Particularly, changes in foreign reserves lead to changes in interest rates in most economies. The negative effect is pronounced in most countries (Brazil, Chile, Colombia, Mexico, Turkey, Korea, and Philippines). By contrast, the positive effect emerges in a few economies (Hungary and Poland). Furthermore, it should be noted that intervention effects are subjected to structural breaks. Lastly, the intervention effect on interest rates is asymmetric, with a bias toward sales interventions. Particularly, sales interventions have significant effects in most emerging economies whereas purchase interventions are significant in only Mexico and Thailand.

These findings provide some implications for both market participants and policy makers. Firstly, market participants should consider information embed in the intervention policy when analysing the stance of monetary policy as well as the behaviour of monetary authorities in inflation-targeting emerging economies. One reason is that the intervention has a significant effect on interest rate setting in most emerging economies. Other reason is that the effect can be asymmetric with respect to types of interventions and it is not consistent between countries. Heterogeneity in the intervention effects between emerging economies implies that market participants should carefully consider their role in signalling the future course of monetary policy. Secondly, the popular use of foreign exchange interventions and their significant effects can provide misleading information about the priority of monetary policy in emerging economies that focus on price stability. This may lead to the confusion of the public as well as a deterioration in the central bank creditability. However, monetary authorities can mitigate these problems by improving the transparency of monetary policy and intervention policy or increasing the development of domestic financial system.

Although foreign exchange intervention is visible in the context of inflation-targeting emerging economies, its relevance is open to question. Further studies should investigate

whether foreign exchange intervention is related to the development of inflation or exchange rate. The former case suggests that the intervention is a tool to deal with inflation pressure, implying the existence of multiple-instrument framework in the conduct of monetary policy in inflation-targeting emerging economies. On the other hand, latter case indicates the active use of the intervention policy in dealing with the evolution of exchange rate. This implies the existence of dual targets or multiple targets even though inflation targeting is adopted in emerging economies.

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References

- ADLER, G., CHANG, K. S., and WANG, Z. (2021). Patterns of foreign exchange intervention under inflation targeting. *Latin American Journal of Central Banking*, 2(4), 100045.
- AIZENMAN, J., HUTCHISON, M., and NOY, I. (2011). Inflation targeting and real exchange rates in emerging markets. *World development*, 39(5), 712-724.
- AKINCI, Ö., CULHA, O. Y., ÖZLALE, Ü., and ŞAHINBEYOĞLU, G. (2006). The effectiveness of foreign exchange interventions under a floating exchange rate regime for the Turkish economy: a post-crisis period analysis. *Applied Economics*, 38(12), 1371-1388.
- BANERJEE, B., ZEMAN, J., ÓDOR, L., and RIISKA, W. O. (2018). On the effectiveness of central bank intervention in the foreign exchange market: the case of Slovakia, 1999–2007. *Comparative Economic Studies*, 60(3), 442-474.
- BERGANZA, J. C., and BROTO, C. (2012). Flexible inflation targets, forex interventions and exchange rate volatility in emerging countries. *Journal of International Money and Finance*, 31(2), 428-444.
- BLANCHARD, O., and ADLER, G. (2015). Can foreign exchange intervention stem exchange rate pressures from global capital flow shocks? Cambridge: National Bureau of Economic Research. DOI: <https://doi.org/10.3386/w21427>
- CABALLERO, R., and KRISHNAMURTHY, A. (2001). A "vertical" analysis of crises and intervention: fear of floating and ex-ante problems. Cambridge: National Bureau of Economic Research. DOI: <https://doi.org/10.3386/w8428>
- CALVO, G. A., and REINHART, C. M. (2000). Fixing for your life. Cambridge: National Bureau of Economic Research. DOI: <https://doi.org/10.3386/w8006>
- CALVO, G. A., and REINHART, C. M. (2002). Fear of floating. *The Quarterly Journal of Economics*, 117(2), 379-408.
- CAVOLI, T. (2009). Is fear of floating justified?: The East Asia experience. *Journal of Policy Modeling*, 31(1), 1-16.

- CERMEÑO, R., VILLAGÓMEZ, F. A., and POLO, J. O. (2012). Monetary Policy Rules In A Small Open Economy: An Application to Mexico. *Journal of Applied Economics*, 15(2), 259-286.
- CHANG, R. (2008). Inflation targeting, reserves accumulation, and exchange rate management in Latin America. *Borradores de Economía*, 487, 1-78.
- CHEN, S. S., and LIN, T. Y. (2019). Do exchange rate shocks have asymmetric effects on reserve accumulation? evidence from emerging markets. *The Scandinavian Journal of Economics*, 121(4), 1561-1586.
- CHEUNG, Y. W., and QIAN, X. (2009). Hoarding of international reserves: Mrs Machlup's wardrobe and the Joneses. *Review of international economics*, 17(4), 824-843.
- DE MELLO, L., and MOCCERO, D. (2011). Monetary policy and macroeconomic stability in Latin America: The cases of Brazil, Chile, Colombia and Mexico. *Journal of International Money and Finance*, 30(1), 229-245.
- DING, X., and WANG, M. (2022). The Effectiveness of Foreign Exchange Intervention: Empirical Evidence from Vietnam. *The Journal of Asian Finance, Economics and Business*, 9(2), 37-47.
- DOMAÇ, I., and MENDOZA, A. (2004). *Is there room for foreign exchange interventions under an inflation targeting framework? Evidence from Mexico and Turkey* (T. W. Bank Ed.). Washington: The World Bank.
- DUDZICH, V. (2020). Relationships between exchange rate regime, real exchange rate volatility and currency structure of government bonds in emerging markets. *Review of Economic Perspectives*, 20(1), 3-22.
- ÉGERT, B., and KOMÁREK, L. (2006). Foreign exchange interventions and interest rate policy in the Czech Republic: Hand in glove? *Economic Systems*, 30(2), 121-140.
- FALTERMEIER, J., LAMA, R., and MEDINA, J. P. (2022). Foreign exchange intervention for commodity booms and busts. *European Economic Review*, 143, 1-22.
- FATUM, R., and HUTCHISON, M. (1999). Is intervention a signal of future monetary policy? Evidence from the federal funds futures market. *Journal of Money, Credit and Banking*, 31(1), 54-69.
- FURLANI, L. G. C., PORTUGAL, M. S., and LAURINI, M. P. (2010). Exchange rate movements and monetary policy in Brazil: Econometric and simulation evidence. *Economic Modelling*, 27(1), 284-295.
- GUIMARÃES, R. F., and KARACADAG, C. (2004). The Empirics of Foreign Exchange Intervention in Emerging Market Countries: The Cases of Mexico and Turkey. *IMF Working Papers*, 4(123), 1-33.
- GUJARATI, D. N. (2014). *Econometrics by example*: Palgrave Macmillan.
- HANSEN, E., and MORALES, M. (2019). When does the Central Bank intervene the foreign exchange market? Estimating a time-varying threshold intervention function. *International Review of Finance*, 1-11.

- HUMALA, A., and RODRÍGUEZ, G. (2010). Foreign exchange intervention and exchange rate volatility in Peru. *Applied Economics Letters*, 17(15), 1485-1491.
- JAWADI, F., MALLICK, S. K., and SOUSA, R. M. (2014). Nonlinear monetary policy reaction functions in large emerging economies: the case of Brazil and China. *Applied Economics*, 46(9), 973-984.
- JOHANNES, B. W., and SONDERGAARD, L. Q. (2007). Reserve accumulation: objective or by-product? Frankfurt: ECB.
- JUURIKALA, T., KARAS, A., and SOLANKO, L. (2011). The role of banks in monetary policy transmission: Empirical evidence from Russia. *Review of international economics*, 19(1), 109-121.
- KAMINSKY, G. L., and LEWIS, K. K. (1996). Does foreign exchange intervention signal future monetary policy? *Journal of Monetary Economics*, 37(2), 285-312.
- KIM, S. (2003). Monetary policy, foreign exchange intervention, and the exchange rate in a unifying framework. *Journal of international economics*, 60(2), 355-386.
- KIM, S. (2005). Monetary policy, foreign exchange policy, and delayed overshooting. *Journal of Money, Credit, and Banking*, 37(4), 775-782.
- KRIZEK, D., and BRCAK, J. (2021). Support for export as a non-standard Central Bank policy: foreign exchange interventions in the case of the Czech Republic. *Eastern Journal of European Studies*, 12(1), 191.
- LEVY-YEYATI, E., and STURZENEGGER, F. (2007). Fear of appreciation. Washington: World Bank.
- MENKHOFF, L. (2013). Foreign exchange intervention in emerging markets: a survey of empirical studies. *The World Economy*, 36(9), 1187-1208.
- MINELLA, A., DE FREITAS, P. S., GOLDFAJN, I., and MUINHOS, M. K. (2003). Inflation targeting in Brazil: constructing credibility under exchange rate volatility. *Journal of International Money and Finance*, 22(7), 1015-1040.
- MISHKIN, F. S., and SAVASTANO, M. A. (2001). Monetary policy strategies for Latin America. *Journal of Development Economics*, 66(2), 415-444.
- MISHKIN, F. S., and SCHMIDT-HEBBEL, K. (2007). Does inflation targeting make a difference?: National Bureau of Economic Research.
- MUNDACA, G. (2018). Central bank interventions in a dollarized economy: managed floating versus inflation targeting. *Empirical Economics*, 55(4), 1507-1535.
- NEELY, C. J. (2000). Are changes in foreign exchange reserves well correlated with official intervention? *Review*, 82(5), 17-32.
- NEELY, C. J. (2005). An analysis of recent studies of the effect of foreign exchange intervention. *Review*, 87(6), 685-718.
- PESARAN, M. H., SHIN, Y., and SMITH, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326.

- PONOMARENKO, A. (2019). Do sterilized foreign exchange interventions create money? *Journal of Asian Economics*, 62, 1-16.
- RAKHMAD, W., and HANDOYO, R. D. (2020). Foreign Exchange Intervention: Has It Been Effective in Indonesia. *International Journal of Advance Science and Technology*, 29(4), 1937-1946.
- REINHART, C. M., and ROGOFF, K. S. (2004). The modern history of exchange rate arrangements: a reinterpretation. *The Quarterly Journal of Economics*, 119(1), 1-48.
- RISHAD, A., and GUPTA, S. (2019). The effectiveness of foreign exchange intervention in India: Evidence from time-series approach. *Journal of Statistics and Management Systems*, 22(4), 707-718.
- ROGER, S., RESTREPO, J., and GARCIA, C. (2009). Hybrid Inflation Targeting Regimes. *MF Working Papers*, 9(234), 1-57.
- ROSSINI, R., QUISPE, Z., and SERRANO, E. (2013). Foreign exchange intervention in Peru. Basel: BIS.
- SÁNCHEZ-FUNG, J. R. (2011). Estimating monetary policy reaction functions for emerging market economies: The case of Brazil. *Economic Modelling*, 28(4), 1730-1738.
- SHAMBAUGH, J. C. (2004). The effect of fixed exchange rates on monetary policy. *The Quarterly Journal of Economics*, 119(1), 301-352.
- SIDERIS, D. A. (2008). Foreign exchange intervention and equilibrium real exchange rates. *Journal of International Financial Markets, Institutions and Money*, 18(4), 344-357.
- SVENSSON, L. E. (2000). Open-economy inflation targeting. *Journal of international economics*, 50(1), 155-183.
- VILLAMIZAR-VILLEGAS, M. (2016). Identifying the effects of simultaneous monetary policy shocks. *Contemporary Economic Policy*, 34(2), 268-296.
- WANG, Y., JIANG, C., CHANG, H.-L., and SU, C.-W. (2015). Are Taylor Rules Valid in Central Eastern European Countries? *Ekonomicky Casopis*, 63(7), 665.
- YILMAZKUDAY, H. (2007). Inflation targeting supported by managed exchange rate. *Applied Economics*, 39(16), 2011-2026.