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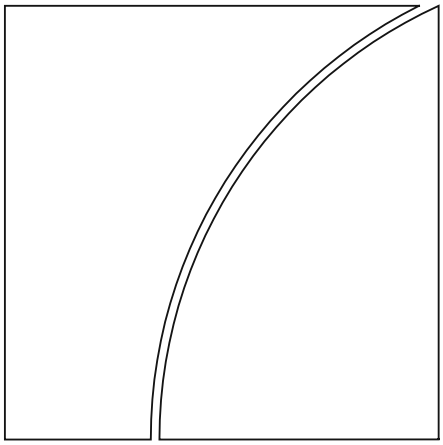

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Market volatility and foreign exchange intervention in EMEs: what has changed?

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Market volatility and foreign exchange intervention in EMEs: what has changed?

An overview

M S Mohanty[1]

Over the past five years, huge swings in capital flows to and from emerging market economies (EMEs) have led many countries to re-examine their foreign exchange market intervention strategies. Quite unlike their experiences in the early 2000s, several countries that had at different times resisted appreciation pressures suddenly found themselves having to intervene against strong depreciation pressures. The sharp rise in the US long-term interest rate from May to August 2013 led to heavy pressures in currency markets. Several EMEs sold large amounts of forex reserves, raised interest rates and – equally important – provided the private sector with insurance against exchange rate risks.

This volume, summarising the discussion and papers presented at the meeting of Deputy Governors of major EMEs in Basel on 21–22 February 2013, focuses on three main questions concerning foreign exchange intervention.[2] First, what is the role of a flexible exchange rate in stabilising the economy and promoting financial stability and development? Second, how have the motives and strategy behind the interventions changed since the 2008 global financial crisis? Finally, is intervention effective and, if so, how can its efficacy be measured?

The main conclusion emerging from the discussion is that a flexible exchange rate plays a crucial role in smoothing output volatility in EMEs. However, as highlighted by several papers in this volume, a highly volatile exchange rate can increase output volatility and itself become a source of vulnerability. Second, over the past five years, most official forex interventions in EMEs were intended to stem volatility rather than to achieve a particular exchange rate. Finally, the majority view was that exchange rate intervention needs to be consistent with the monetary policy stance. Persistent, one-sided intervention, associated with sharp expansion of central bank balance sheets, creates risks for the economy.

Yet there was no consensus about the effectiveness of forex intervention. Whereas intervention was viewed as an instrument that could potentially curb forex volatility and support market functioning, many participants were sceptical about its effectiveness in the face of a shift in the equilibrium exchange rate. A review of replies from central banks to a survey questionnaire suggested that, while intervention may work mainly through the signalling channel, some of its effectiveness may be due to the fact that it was combined with other measures to moderate capital flows or prevent the build-up of certain positions in the foreign exchange market. In several cases, intervention had no persistent effects on the

[1] I am grateful to Torsten Ehlers, Blaise Gadanecz, Aaron Mehrotra, Ken Miyajima, Carlos Montoro, Elod Takats and Philip Turner for comments and contributions.

[2] Many of these issues were first examined by Deputy Governors in 2004: see BIS (2005).

exchange rate and might have helped to exacerbate exchange rate volatility in the wrong direction.

This overview is organised around the three main themes of the meeting. Section I looks at the role of a flexible exchange rate. Section II discusses the motives and objectives behind intervention. Section III reviews lessons learned about the effectiveness of intervention.

I. The exchange rate, macroeconomy and monetary policy

Exchange rate movements raise issues for EMEs for at least three reasons: (a) their impact on the real economy; (b) implications for financial development and stability; and (c) consequences for monetary policy. The first session of the meeting was devoted to these three issues.

The exchange rate and real economy

During the 1980s and 1990s, a lack of sufficient flexibility in the exchange rate exposed EMEs to the risk of currency misalignment and financial instability. But this started to change in the 2000s, with many EMEs adopting a flexible exchange rate regime, often accompanied by inflation targeting. How has a flexible exchange rate worked in reducing EMEs' vulnerabilities? In particular, what has been the effect on the real economy?

It was generally agreed that increased exchange rate flexibility has helped to smooth output volatility in the past decade. In particular, the inflation targeting EMEs (eg Chile) looked to the exchange rate as a shock absorber and emphasised the importance of conveying to the public the central bank's commitment to a flexible exchange rate. Combined with a reduced tolerance for currency mismatches, more flexible exchange rates have also allowed for a more markedly countercyclical monetary policy, which is especially relevant during a crisis.

Yet many central banks have noted that excessive exchange rate volatility can be counterproductive for the real economy. The threshold above which exchange rate volatility starts to hurt the real economy may be lower in small economies than in large countries. The choice of the exchange rate regime is influenced by the structure of the economy, economic fundamentals and the prevailing institutions. While, in the past, the level of the exchange rate was important for some EMEs due to their export-led growth strategies, it is now increasingly the volatility of the exchange rate that matters for the tradable goods sector.

The BIS background paper by Gadanecz and Mehrotra sheds some empirical light on these issues. The authors report that, over a cross section of 52 advanced and emerging economies, exchange rate volatility does not have a statistically significant effect on long-term growth (as represented by growth in labour productivity). Neither does the result depend on an economy's degree of development (eg its particular income level). However, the short-term relationship between the exchange rate and output volatility in EMEs is U-shaped – that is, up to a point, a higher exchange rate volatility reduces output volatility, but extreme exchange rate volatility can itself become a source of real volatility (see Graph 2 in the Gadanecz and Mehrotra paper).

These findings resonate with several country papers in this volume. For instance, Adam, Kozinski and Zielinski note that in Poland a floating exchange rate has generally helped to reduce economic uncertainty in the face of adverse external shocks. But, sharp exchange rate volatility caused, at times, by the use of zloty by investors as a proxy hedge currency, has created negative consequences for the economy. The paper by Guinigundo points out that in the Philippines the exchange rate is a key determinant of the price of local currency sovereign paper, and therefore serves as a barometer for foreign investors' confidence in the economy. The negative feedback loop between exchange rate and financial inflows therefore requires careful attention, particularly in view of increased participation by foreign investors in EME financial markets. In Turkey, Alper, Kara and Yorukoglu, refer to similar feedback effects arising from exchange rate appreciation, balance sheet improvements and the lending appetite of banks during periods of strong capital flows. These effects can mask the vulnerability of EMEs to a reversal in capital inflows. In India, the main objective of intervention has been to maintain orderly conditions and curb speculation in the foreign exchange market (see the paper from the Reserve Bank of India).

The exchange rate, financial stability and market development

The role of the exchange rate in financial crises has been well emphasised in the literature.[3] Past EM crises were typically preceded by large currency mismatches and overvalued exchange rates, underlining the critical importance of the exchange rate in the private sector's decision to borrow in foreign currency. Another aspect of the exchange rate regime is its interaction with financial development: while a flexible exchange rate helps the development of hedging and local currency debt markets, the degree of market development also influences the choice of exchange rate flexibility.

The Deputy Governors broadly agreed that increased exchange rate flexibility can help to reduce currency mismatches, particularly the extent of foreign currency borrowing. It was suggested that wrong incentives can be created by too stable an exchange rate and, in some cases, by FX intervention. Claro and Soto in this volume provide two main reasons for this observation: first, intervention to restrict exchange rate flexibility can give a false sense of security for the private sector regarding financial risks. Second, lower exchange rate volatility leads to higher speculation about the future value of the currency, encouraging investors to exploit the interest rate differential more aggressively (the so called "carry trade"). Both factors create risks for the financial system.

As regards financial development, the role of the exchange rate is less clear-cut. As financial markets in EMEs continue to develop, international investors are more likely to become significant players. Cross-border asset positions continue to build up rapidly and small shifts in investor portfolios can result in large capital flows and hence exchange rate volatility. In several countries, higher exchange rate volatility has been associated with more developed financial markets and the greater use of hedging instruments. However, most participants agreed that increased exchange rate volatility cannot guarantee financial market development. Financial markets take time to develop. Fixed exchange rates can deliver microeconomic benefits, as

[3] See, for instance, Kaminsky and Reinhart (1999).

seen in the case of the international financial centres of Hong Kong SAR and Singapore. If a peg is credible, it can reduce exchange rate risks, at least in the short run.

In addition, some participants argued that the private sector's expectations about the exchange rate influence decisions to hedge. When the exchange rate is volatile in both directions there is an incentive for the private sector to hedge its exchange rate risk. For instance, in Thailand greater exchange rate flexibility has been associated with increased demand for hedging instruments by banks and non-financial corporations, leading to a steady rise in the ratio of hedged liabilities to total forex liabilities (see the paper from the Bank of Thailand). However, several participants felt that one-sided exchange rate movements can reduce the incentive to hedge forex risks, leading to speculative capital flows, with adverse consequences for market volatility and financial development in general.

There was a view that developing financial markets goes beyond the choice of exchange rate regimes, requiring deeper reforms in the financial systems. For instance, hedging markets are typically deeper in countries with more sophisticated long-term institutional investors (eg Chile) than in those with less developed financial institutions. And, the lack of a well developed domestic financial system could mean that some sophisticated financial activities, including hedging markets, may move offshore.

The exchange rate and monetary policy

Several country papers in this volume note that FX intervention should be consistent with the stance of monetary policy. There are, at least, two aspects of this issue. First, any inconsistency between the exchange rate and the monetary policy stance can impair the transmission mechanisms for monetary policy and militate against the success of the intervention. Second, persistent intervention can create risks for the economy through the high costs of intervention and the expansion of central banks' balance sheets. Several studies suggest that large-scale interventions to resist appreciation, financed by the issuance of short-term debt by the central bank, will inflate commercial bank balance sheets with expansionary implications for the economy.[4]

In principle, interventions in the foreign exchange market can be designed to complement the stance of monetary policy. In practice, however, the challenges for the monetary authorities vary depending on the state of the economy. For instance, Flug and Shpitzer note that in Israel sharp interest rate cuts, combined with an intervention to resist appreciation were reasonably successful in reducing the risk of recession during the 2008 global crisis. But, during the recovery, when the central bank raised interest rates in the face of rising inflation expectations, strong capital flows complicated the management of the exchange rate. Intervention to resist appreciation weakened the monetary policy transmission channel and shifted the burden of adjustment to the external sector.

In the context of Korea, Ryoo and Kwon note that strong capital inflows and high inflation can put the central bank in a "double bind". On the one hand, raising

[4] These issues have been examined in detail by Deputy Governors in 2004 and 2012 (*BIS Papers*, nos 24 and 67). See also Mohanty and Turner (2006), Filardo, Moreno and Mohanty (2012) and Vargas, Gonzalez and Rodriguez (in this volume).

interest rates to fight inflation will attract further inflows and accentuate currency appreciation pressures. On the other hand, reducing interest rates to limit capital inflows will stoke inflation. Under these circumstances, these authors argue that forex intervention helps to stem inflows attracted by self-fulfilling expectations of currency appreciation.

Several central banks insisted on the need for appropriate communication so as to avoid any market perception that foreign exchange intervention is inconsistent with monetary policy. Some central banks have been announcing a fixed amount of foreign exchange purchases with a view to sending a signal to this effect. The discussion also pointed to a moral hazard issue with respect to intervening in a period of outflows. In such episodes, the central bank should be careful to avoid giving foreigners the impression that it is financing their way out. This argues in favour of a rule-based, market-friendly approach.

As regards the risks posed by intervention, one perspective was that the financial costs of FX intervention (determined by domestic and foreign interest rates) arising from reserve accumulation can be relatively large as a percentage of GDP in EMEs, with adverse implications for fiscal and monetary policy. Some participants argued that the high costs of intervention could erode a central bank's credibility and independence, impairing its ability to deliver on the price stability objective. Another perspective was that the financial costs of FX reserves are less important when inflation is low and stable. In addition, the economic benefits of holding FX reserves (eg insurance against adverse external shocks) can be large even though these are not easy to quantify and communicate to the public.

Many participants felt that the balance sheet effects of intervention deserve careful attention. One reason is that the average maturity of central bank securities (respectively, the substitutability of long-term government bonds and deposits) is an important determinant of banking system liquidity and thus has implications for the transmission of sterilised intervention via the bank lending channel. Second, as discussed by Vargas, Gonzalez and Rodriguez, the macroeconomic effects of intervention depend on the composition of banks' portfolios. When banks hold more government bonds than is optimal from a long-term portfolio perspective they will try to reduce the lending rate to achieve the desired loan-to-investment ratio. This results in an expansion of bank credit.

The survey results reported by Mohanty and Berger illustrate the magnitude of balance sheet changes following large-scale interventions over the past decade. One effect is that, with central banks issuing large amounts of short-term securities to sterilise their FX reserve purchases, the average maturity of their securities has shrunk to less than one year since 2000, although the EM governments have increased the average maturity of their debt. The second effect is that as the size and the frequency of sterilised intervention increased, so did banks' holding of government and central bank securities, which peaked at 55.8% of the total outstanding securities in Asia in 2000 (40% in 2012) and 36.3% in Latin America in 2010 (35.8% in 2012).

II. Motives and tactic of intervention

Central banks intervene in the foreign exchange market for various reasons, and with a variety of techniques, depending on the objectives. One purpose of the

meeting was to explore whether the motives for intervention and the tactics of its implementation have changed post-crisis and in the light of increasingly large and volatile capital flows.

Motives and objectives of intervention

The summary of responses to the survey questionnaire points to two interesting findings. First, although the broad motives of intervention in EMEs (eg maintaining monetary and financial stability) have not changed much over the past decade, almost 80% of respondents said that curbing speculative pressures on the exchange rate was the most important priority. In addition, many central banks stepped up intervention to discourage sharp volatility in capital inflows and correct the dysfunctional foreign exchange market by supplying liquidity from their own reserves. Surprisingly, stabilising inflation continues to be a major objective of foreign exchange intervention, despite the recent decline in the exchange rate's pass-through into consumer prices. Second, to achieve these goals, most central banks seek to limit volatility and smooth the trend path of exchange rate rather than to influence the level of the exchange rate.

Many participants emphasised that the intervention motives should be seen in a wider macroeconomic context – that of their appropriateness for monetary and financial stability goals. In the fixed exchange rate regimes, preserving monetary stability depended critically on the monetary authorities' strong commitment to the exchange rate peg in the face of large shocks. In Hong Kong SAR, precisely this has been the objective behind the credible and transparent operation of the currency board (see the paper from the Hong Kong Monetary Authority). Al-Hamidy and Banafe convey a similar message for Saudi Arabia, where the Monetary Agency intervenes in the forward market to dampen speculation about the fixed exchange rate. In the UAE, Al-Shamsi notes that the central bank's readiness to provide unlimited dollars to the market ensured the successful operation of the fixed exchange rate regime.

For the flexible exchange rate regimes, a key challenge was determining the point beyond which exchange rate volatility posed risks to monetary and financial stability. In a number of EMEs, the impact of volatile capital flows on the exchange rate was often exacerbated by the speculative positioning of market participants. As cross-border asset positions are rapidly increasing, these effects could potentially become even more pronounced in the future.

The meeting highlighted three main issues regarding international investor behaviour and intervention strategy. First, many Deputy Governors agreed with the conclusion of the BIS background paper by Ehlers and Takats that FX intervention can help to break the momentum effect on the exchange rate. However, breaking the momentum is only possible if the flows are speculative or cyclical (as opposed to fundamental or structural).

A second related point was that the decision to intervene depends on the type of capital inflow. Most participants agreed that if capital inflows are primarily in the form of foreign direct investment, the exchange rate should be allowed to find its new equilibrium level. While portfolio inflows were seen as a potential source of volatility, the challenges vary depending on whether they were attracted by the improved fundamentals of the economy or by cyclical and speculative motives. In the latter case, allowing the exchange rate to move freely would encourage future volatility. That said, it is difficult for the central bank to know ex ante the precise

motives of international investors, or to identify the short-term component of capital flows.

Finally, some participants mentioned the need to consider the externalities of intervention. To the extent that FX interventions divert flows from one EME to another, such actions could result in a costly zero sum game. This raises questions about the wisdom of unilateral intervention and how to share the adjustment burden across EMEs.

Several central banks were of the view that reserve accumulation should be differentiated from intervention with the aim of achieving a certain exchange rate objective. The main purpose behind reserve accumulation is to protect the economy from adverse future shocks. If reserves are perceived as adequate, market participants may require a lower risk premium for holding local currency assets. This also means that reserve accumulation can affect the exchange rate level and volatility up to a certain point, until a level perceived as adequate is attained. Other participants, however, noted that the "adequate" level of reserves can vary considerably over time, particularly in crisis periods. Hence, the accumulation of reserves is desirable during periods of large inflows, despite the sizeable costs.

Discussion also focused on the alternative ways that a country can insure itself against external shocks. One view was that regional trade in local currencies should be strengthened to mitigate risks. It is also possible to address some of the vulnerabilities of EMEs through targeted macroprudential and capital flow management measures. In particular, macroprudential measures can be directed at specific sectors, such as housing or credit markets, to prevent the build-up of financial stability risks without adversely affecting long-term capital flows or the exchange rate.

Tactics of intervention

Regarding the tactics of intervention, as reported by the results of the survey questionnaire (see Mohanty and Berger), there has been little change over the past decade: most central banks intervened in the spot market and often favoured transparent over secret intervention and a reactive over a pre-emptive intervention strategy. But the typical scale of intervention by emerging market central banks has increased following the recent financial crisis. In line with the increased importance of international financial inflows, most central banks have increased their market monitoring activity, particularly as it relates to cross-border portfolio flows.

Many participants thought that the methods and tactic of intervention should evolve with the growing interconnectedness of financial markets. The ability of central banks to influence market liquidity and the exchange rate depends on the degree of development of the spot and derivative markets (forwards and swaps). To the extent that central banks can act as the lender of last resort in foreign currency, they can moderate the effects of cross-border financial shocks on the exchange rate.

In some countries, governments can also play a useful stabilising role, since they are large players in the FX markets, either directly or indirectly through intermediating banks. In the case of commodity exporters, governments often sell large amounts of foreign currency income in short periods of time, which can strongly affect FX markets. In countries with large external financing needs, the size,

maturity and timing of foreign currency borrowing by the government all have consequences for the exchange rate.

Turkey provides an interesting example of how intervention techniques have changed with capital flows. As discussed in the paper by Alper, Kara and Yorukoglu, the central bank has introduced two new instruments to respond to capital flows and mitigate financial stability concerns: (i) an asymmetric interest rate corridor and (ii) a reserve option mechanism for commercial banks. The main objective behind the interest rate corridor was to allow higher volatility in the short-term interest rate with an objective to influence the composition of capital flows (deter short-term flows). The reserve option mechanism gives the commercial banks the possibility of fulfilling reserve requirements (RRs) by depositing foreign currency with the central bank. Since the incentive for holding reserves in domestic and foreign currencies varies with the degree of capital flows and the associated opportunity costs, the mechanism can help dampen the impact of volatile capital flows on the exchange rate and bank credit.

III. Effectiveness of intervention

Views varied about the effectiveness of central bank foreign exchange intervention. One line of thought was that the effectiveness of an intervention can be judged by looking at market liquidity – that is, how far intervention ensured "orderly market conditions". Another view was that the success of an intervention depended on whether it helped to relieve depreciation pressure during episodes of panic. In these cases, the effectiveness of an intervention could be measured by the differential between the actual domestic interest rates and those implied by exchange rates. Unsurprisingly, as reported by Mohanty and Berger, over 80% of the respondent central banks surveyed by the BIS considered that their interventions were either partly or wholly successful.

Some central banks argued that their interventions have had long-lasting effects on exchange rate volatility. For instance, as discussed by Rossin, Quispe and Serrano, in Peru the central bank has been able to cap exchange rate volatility in the context of its highly dollarised economy. As a result, Peru's currency volatility has fallen below that of other regional currencies. Another successful case is Poland, where intervention was generally seen to be effective in moving the exchange rate in the desired direction and in reducing uncertainty about the future exchange rate (see Adam, Kozinski and Zielinski).

That said, the majority view was that intervention can influence the exchange rate only temporarily at best. This opinion is echoed by a number of papers in this volume. Based on intraday data for Chile, Colombia, Mexico and Peru, Gracia-Verdu and Ramos-Francia demonstrate that intervention had a small but short-lived effect on the exchange rate during 2009–13. In a separate study, Claro and Soto reach a similar conclusion for Chile. The BIS paper by Miyajima and Montoro approaches the same issue using the three-month-ahead expected exchange rate rather than the spot exchange rate for selected EMEs in Asia and Latin America. Their main conclusion is that intervention did not have the intended effect on the expected exchange rate and might have actually contributed to accentuating exchange rate movement in the wrong direction.

Several factors could account for the weakness of any effect that intervention has on the exchange rate. First, intervention may work essentially through the signalling channel: after controlling for monetary policy changes, intervention may exert no independent effect on the exchange rate. Second, the effectiveness of the portfolio balance channel may have weakened over the years. Although evidence is far from conclusive, some participants argued that the risk premium on EM assets has fallen, making such assets more attractive to investors as a substitute for assets from advanced economies. Finally, as pointed out by Vargas, Gonzalez and Rodriguez, to the extent that sterilised interventions affect bank credit, they tend to weaken the effectiveness of the portfolio balance channel.

In addition, the effectiveness of intervention is difficult to measure, which can lead to an incorrect assessment about its effects. Inferring the success of intervention from observed exchange rate changes is problematic because several other factors affect currency performance, such as fiscal policy, interest rates, capital account openness and prudential measures that are imperfectly controlled for in the empirical models. Some participants thought that the lack of counterfactual evidence – that is, the level of exchange rate that would have prevailed without intervention – makes it difficult to precisely measure the impact of intervention. In some countries, a long prior period without interventions has allowed the central bank to carry out an econometric exercise to evaluate the effectiveness of a recent intervention. As measured against the estimated counterfactual levels, the recent interventions did not seem to have any strong influence on the exchange rate.

Another point complicating the assessment of intervention effectiveness relates to the intended benefits of intervention. Intervention can be considered effective if it promotes external price competitiveness and allows countries to better insure themselves against external shocks, thereby reducing external funding costs and promoting long-term economic growth. But these benefits, and thus the associated effectiveness of intervention, are extremely difficult to measure.

Several participants argued that communication and institutional arrangements matter for the effectiveness of intervention. Interventions may be perceived very differently by market participants than intended by the central bank. For instance, market participants may believe that the central bank is targeting the exchange rate, even though it is actually addressing volatility. In one recent case communication about the current account balance helped narrow the gap between the pricing of onshore and offshore FX forwards.

In this respect, a few participants shared their successful experience in influencing exchange rates using complementary measures. In Turkey, the new monetary operating framework has played a key role in reducing currency volatility over the past two years. In Peru, the success of intervention is partly due to the restrictions on the transfer of sterilisation bonds by commercial banks to the non-financial sector. The high reserve requirements on local currency deposits held by non-residents have also helped. In Brazil, a mix of macroprudential and capital account management measures played a similar role. In Indonesia, foreign exchange intervention was often complemented by other measures (macroprudential polices and central bank bond purchases) to manage the volatility of capital flows and the exchange rate.

To sum up, many EMEs have had to confront exceptional global monetary and financial situations during the past five years. In several cases, interventions by EM central banks aimed at dampening exchange rate volatility has helped to ensure orderly market conditions in the face of disruptive changes in capital flows and, on

occasion, to counter strong speculative currency pressures. The evidence is generally supportive of the findings in the literature that sterilised interventions by EMEs have had small but short-lived effects on the exchange rate. Persistent interventions in the context of major shifts in the equilibrium exchange rate can lead to unintended effects on the exchange rate and on the balance sheets of the central bank and commercial banks, with adverse macroeconomic and monetary consequences.

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The exchange rate, real economy and financial markets

Blaise Gadanecz and Aaron Mehrotra[1]

Abstract

In this paper we analyse the relationship between increased exchange rate flexibility and economic growth and its volatility in emerging market economies. We also investigate the implications of exchange rate flexibility for financial market development. We do not find a robust correlation between exchange rate flexibility and long-run growth, although exchange rate flexibility has generally been beneficial in smoothing EMEs' output volatility in the previous decade. There are also indications that increased exchange rate flexibility is associated with a reduction in vulnerabilities such as currency mismatches, though its impact on financial market development is less clear.

Keywords: exchange rates, economic growth, volatility, financial market development

JEL classification: E23, F31, O16, O40

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Introduction

As exchange rates are key prices in the economy, their level and flexibility have implications for resource allocation and growth. Countries may attempt to influence the level of exchange rates and restrict their flexibility depending on, among other factors, the choice of monetary regime and the development of the financial system. Indeed, over the past decade, many emerging economies have done this. Such choices imply real trade-offs, with both short- and long-run implications.

The real economy is affected by the degree of exchange rate flexibility. Flexible exchange rates play a countercyclical role by smoothing output volatility. They are important in lessening incentives for foreign currency borrowing, thus reducing currency mismatches and deepening domestic financial markets. But financial development and exchange rate flexibility is a two-way street, since the degree of exchange rate flexibility is also likely to depend on the financial system's stage of development. This paper explores some of these issues in the context of emerging market economies.

The two main research questions we address are as follows. First, what is the relationship between increased exchange rate flexibility (implying less intervention), and economic growth and its volatility in our sample of EMEs? Second, what are the implications of exchange rate flexibility for financial market development, in particular that of local currency government bond markets and derivatives markets?

The following conclusions emerge.

- First, we do not find a robust correlation between exchange rate flexibility and long-run growth.
- Second, exchange rate flexibility has generally been beneficial in smoothing EMEs' output volatility in the previous decade.
- Third, there are also indications that increased exchange rate flexibility is associated with a reduction in vulnerabilities such as currency mismatches. However, its impact on financial market development is less clear.

This paper is structured as follows. Section 1 discusses the links between exchange rate flexibility and the real economy. Section 2 deals with the implications of exchange rate flexibility for vulnerabilities and financial market development. The final section concludes.

1. Exchange rate flexibility and the real economy

The extent of exchange rate flexibility, operating through a number of channels, has implications for both the real economy's long-run growth prospects and its volatility. This section outlines the trends in exchange rate flexibility in our sample of emerging economies in the past decade, discusses the relevant channels through which they influence real activity and documents their importance.

1.1 Developments in exchange rate flexibility

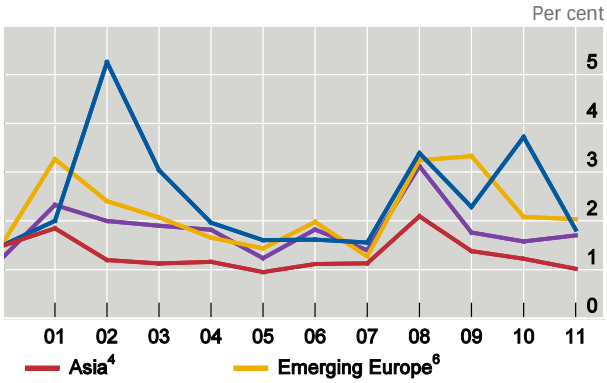
The degree of exchange rate flexibility has not changed substantially during the past decade in the EME regions (Graph 1). Based on the standard deviation of

changes in monthly[2] exchange rates, it appears that nominal[3] effective exchange rate (NEER) flexibility has been lower over time in Asia than in Latin America or central and eastern Europe, without any obvious trends in any of the regions (left-hand panel). Flexibility increased during the financial crisis in most regions, but has fallen since. Bilateral exchange rates against a base currency (either dollar or euro) have become somewhat more flexible over time in Asia, and in emerging Europe (right-hand panel).

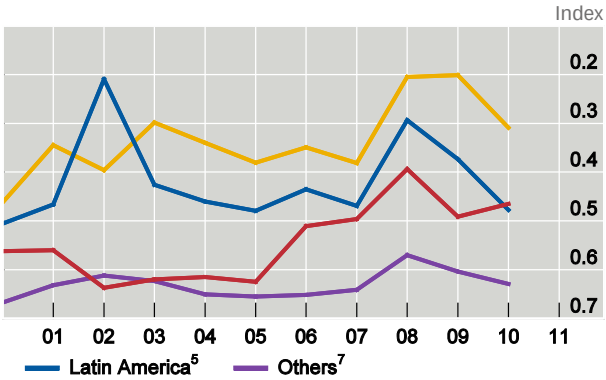
Exchange rate flexibility[1]

Graph 1

Flexibility of nominal effective exchange rate[2]



Bilateral exchange rate flexibility[3]



[1] Simple averages across the economies listed. [2] Standard deviation of the first difference in monthly log NEER. [3] Based on the normalised annual standard deviation of the monthly exchange rate between home and base country, as defined by Aizenman et al (2010). The index obtains values from 0 to 1, with higher values indicating a more stable movement against a base currency. [4] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [5] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [6] Czech Republic, Hungary, Poland, Russia and Turkey. [7] Israel, Saudi Arabia, South Africa and the United Arab Emirates.

Sources: BIS; Aizenman et al (2010); authors' calculations.

The increase in exchange rate flexibility in Asia and emerging Europe is also reflected in the *de facto* exchange rate regimes, based on the classification by the IMF (Table 1).[4] In both regions, there was a clear increase in the share of floating regimes during the previous decade, while pegged exchange rates and managed regimes became less prevalent. In Latin America, floating exchange rate regimes were already in place in most economies in 2002.

[2] These are low frequency indicators. Schnabl (2006) discusses the benefits of low versus high frequency exchange rate stabilisation.

[3] The analysis presented further below mostly uses real exchange rates, as these are arguably most relevant for real economic outcomes. Due to price stickiness, the measures of exchange rate flexibility presented in the left-hand panel in nominal terms are almost identical to those obtained with real effective exchange rates (REER).

[4] Another possibility is to examine *de jure* regimes. However, empirical analyses that link these regimes to economic outcomes can be problematic, as *de jure* regimes sometimes differ from actual behaviour (Rogoff et al (2003)).

Exchange rate regimes[1] Table 1

	2002				2011			
	Asia	Latin America	EM Europe	Other	Asia	Latin America	EM Europe	Other
Peg	33%	0%	20%	50%	11%	14%	0%	50%
Crawling peg	0%	0%	0%	25%	11%	14%	0%	0%
Managed	44%	14%	40%	0%	22%	0%	20%	0%
Floating	22%	86%	40%	25%	56%	71%	80%	50%

[1] De facto classification, exchange rate regimes at the end of the year. Shares of economies in each region. "Peg" includes currency board arrangements, other conventional fixed peg arrangements, pegged exchange rates within horizontal bands and conventional pegs. "Crawling peg" includes exchange rates within crawling bands, crawling pegs and crawl-like arrangements. "Managed" comprises managed floating with no pre-announced/predetermined path for the exchange rate and other managed arrangements. "Floating" includes both independently/free-floating and floating exchange rates.

Source: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions 2003, 2012.

1.2 Exchange rate flexibility and long-term growth

Exchange rate flexibility could affect long-run economic growth if it has an impact on productivity growth. Both the level and volatility of the exchange rate are at play here. With respect to the level, the early literature argues in favour of an undervalued exchange rate for the promotion of domestic industries. Many emerging economies continue to have growth models heavily reliant on exports (BIS (2012)). Rodrik (2008) shows in a theoretical model how exchange rate undervaluation can stimulate growth if the tradable goods sector is affected disproportionately by market failures or institutional weaknesses. In addition, trend appreciations and depreciations can have negative implications for foreign direct investment through the location of industries. These considerations suggest that limiting exchange rate flexibility could matter, especially for the tradable goods sector.

Large and frequent changes in the exchange rate can create a volatile economic structure, particularly if financial markets are underdeveloped and agents have few hedging possibilities. Such a volatile economy could adversely affect prospects for investment and growth. It could also reduce international trade, especially in economies dependent on intra-regional trade because large exchange rate changes have compounding effects on the costs of intermediate inputs (see eg Thorbecke (2008)).

But greater exchange rate flexibility could also lead to a more efficient allocation of resources and higher growth. It could encourage innovation and productivity growth, as domestic firms cannot rely on undervalued exchange rates and FX intervention to maintain external competitiveness. When exchange rates are flexible and financial markets are well developed, investment and production decisions can be disconnected from movements in the exchange rate.

Capturing the long-run impact of the exchange rate on growth is difficult because of the lack of information on total factor productivity in many EMEs. In general, econometric analysis gives inconclusive evidence about the relationship between exchange rate volatility and long-run growth. We regressed labour

productivity growth during 2000–11 on real exchange rate volatility during the same period, and on the level of initial income observed in 1999.[5] For a pooled sample comprising 52 advanced and emerging economies, the cross-sectional estimation yields a statistically insignificant and negative coefficient on exchange rate volatility, while the initial level of income appears as an important determinant of productivity growth, with a negative and statistically significant coefficient. This is in line with convergence effects in standard growth regressions. Chow breakpoint tests that we subsequently carried out were not able to establish a threshold level of initial income above or below which exchange rate volatility would become a statistically significant determinant of growth.[6]

These results suggest that other factors – such as financial development or exchange rate misalignments – may be at play in the relationship between exchange rate volatility and growth. This is in line with the extant literature. For instance, Aghion et al (2009) report that at low levels of financial development – measured by the ratio of credit to GDP – exchange rate volatility generally reduces growth. The authors show that this outcome is consistent with a model where real exchange rate uncertainty hinders investment when agents are credit constrained. It is plausible that firms in higher-income economies are more likely to internalise exchange rate movements and hedge against exchange rate risk – exchange rate movements then lead to smaller changes in real quantities than in lower-income economies. This is especially the case if income levels proxy for financial market development.[7] Finally, it is not clear to what extent possible exchange rate misalignments[8] account for the empirically observed relationships between productivity growth and exchange rate volatility. Rodrik (2008) provides empirical evidence that the growth impact of exchange rate undervaluation depends on the level of development, with stronger effects found in lower-income economies.

1.3 Exchange rate flexibility and output volatility

Moving from the *level* of growth to its *volatility*, a more flexible exchange rate could protect the economy against the adverse impacts of external shocks through its countercyclical role in reducing output volatility (eg Obstfeld and Rogoff (1995)).[9] Graph 2 suggests that there is a U-shaped relationship between real exchange rate volatility and output volatility in emerging economies (left-hand panel), when output volatility is measured by the standard deviation of quarterly real GDP growth. Up to a point, increased flexibility of the real exchange rate acts as a shock

[5] Real exchange rate volatility is defined as the standard deviation of the first difference in monthly log REER during 2000–11. Labour productivity is measured as real GDP per total employment. The level of initial income is specified as GDP *per capita* in USD.

[6] The Chow test endogenously conducts a search for a breakpoint that is unknown *a priori.*

[7] As part of our regression analysis we also carried out Chow breakpoint tests based on various threshold values of the ratio of domestic credit to GDP. The results are substantively similar to those using initial income as the threshold variable.

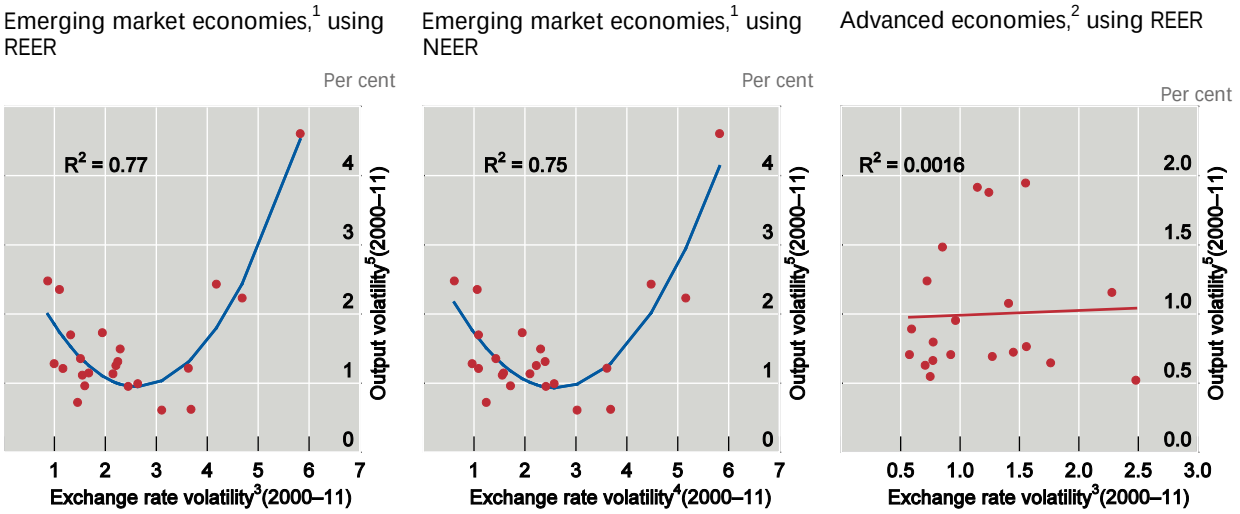
[8] Estimates of exchange rate misalignment are highly sensitive to the chosen method when computing equilibrium exchange rates, and there is no general agreement on a preferred measure.

[9] When an economy is hit by an external real shock in a regime of fixed exchange rates, the adjustment must come through changes in domestic prices and wages. As nominal rigidities typically hinder rapid adjustments in these variables, there are costs in terms of employment and output.

absorber and helps to insulate the economy against shocks. But extreme exchange rate flexibility can itself become a source of real volatility. This can arise if exchange rates display overshooting behaviour[10] and thereby become sources of shocks themselves; if a large exchange rate movement reflects a sudden stop of capital flows and a balance of payments crisis; or if large exchange rate movements exacerbate the impact of structural vulnerabilities in the economy, such as currency mismatches.[11] Due to price rigidities, it is not surprising that the U-shaped relationship is robust to using *nominal* effective exchange rates instead (centre panel) – these are arguably more relevant for policymakers from an operational viewpoint.

Exchange rate and output volatility

Graph 2



[1] Coverage of EMEs as in Graph 1, excluding Saudi Arabia and the United Arab Emirates. [2] The advanced economies are the 20 largest industrial countries based on the IMF WEO classification and nominal GDP data for 2011, omitting the economies classified as EMEs in this paper. [3] Standard deviation of first difference of monthly log REER during the specified period. [4] Standard deviation of first difference of monthly log NEER during the specified period. [5] Standard deviation of quarterly real GDP growth during the specified period.

Sources: IMF, *World Economic Outlook*; Datastream; national data; BIS calculations.

The database on financial crises by Laeven and Valencia (2012) classifies three EMEs in our sample as having experienced currency crises during the previous decade – Argentina, Turkey and Venezuela. These are the three economies located on the upward sloping part of the left-hand and centre graph, suggesting that the nature and size of shocks are indeed important. Omitting the economies that experienced currency crises, exchange rate flexibility appears beneficial in smoothing output volatility. For our sample of advanced economies (right-hand panel), we find no correlation between exchange rate and output volatility during the last decade.

An alternative perspective is provided by comparing output volatility with the exchange rate regimes in emerging economies. We use the IMF classification of *de*

[10] For a discussion of how foreign exchange intervention can break the destabilizing feedback loop of momentum effects, see Ehlers and Takáts (2013).

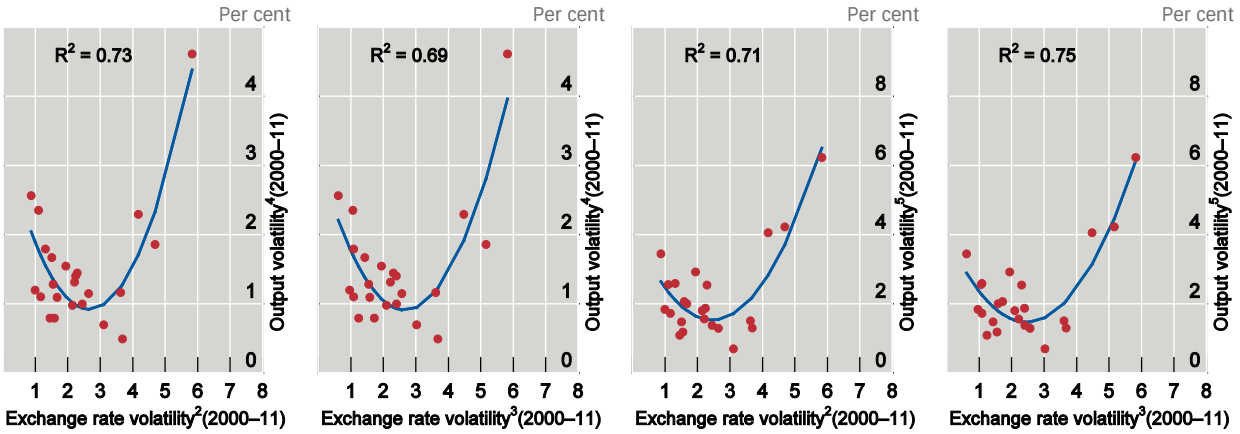
[11] The causality in Graph 2 could go either way. If an economy is hit by large external shocks such as those to the terms of trade, large movements in exchange rates are needed to bring about the required adjustment in the equilibrium exchange rate.

facto regimes, as in Table 1.[12] This analysis reinforces the result that exchange rate flexibility has a stabilising effect: output volatility during 2000-11 is lowest on average under floating exchange rates and highest in regimes of pegged exchange rates (2.5% vs 4.8%, respectively).[13] Managed regimes appear to feature slightly higher output volatility (2.9%) than floating ones.[14]

Theoretically, the stabilising role of flexible exchange rates could also come about through the impact of exchange rate regimes on fiscal discipline. Tornell and Velasco (2000) argue that flexible exchange rates would immediately reflect unsound fiscal policies; in contrast, fiscal indiscipline eventually leads to a collapse of the fixed exchange rate with costly real consequences.

Exchange rate and output volatility[1]

Alternative measures — Graph 3



[1] Coverage of EMEs as in Graph 1, excluding Saudi Arabia and the United Arab Emirates. [2] Standard deviation of first difference of monthly log REER during the specified period. [3] Standard deviation of first difference of monthly log NEER during the specified period. [4] Standard deviation of residuals from an AR(1) process of quarterly real GDP growth. [5] Standard deviation of quarterly output gap, as defined in Footnote 15.

Sources: IMF, *World Economic Outlook*; Datastream; national data; BIS calculations.

The finding of a U-shaped relationship between exchange rate and output volatility in emerging economies in the previous decade appears robust to two alternative measures of output volatility. In Graph 3, first and second panels, output volatility is defined as the standard deviation of the residuals of an AR(1) process of

[12] The *de facto* exchange rate regimes can of course change over time. We take the exchange rate regime reported for at least two out of the following three years: 2002, 2007 and 2011, as the relevant *de facto* exchange rate regime for this analysis. If an economy has a different regime during each of the three years, it is omitted.

[13] Output volatility is measured here as standard deviation of first difference of annual log real GDP. Results for the category "crawling peg" are not considered, since only one economy is included in this category.

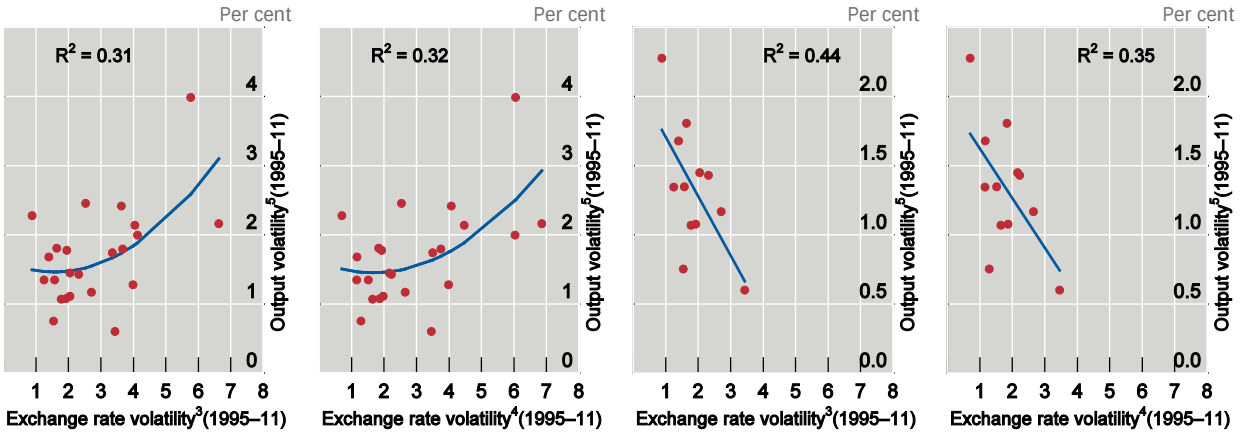
[14] Filardo and Grenville (2012) suggest that, while an intermediate approach between fixed and flexible rates has emerged as a feasible choice in Asian EMEs in the past decade, it has not been without costs. These costs arise, *inter alia*, from the expansion in central bank balance sheets through an increase in carrying costs and re-valuation risks when exchange and interest rates fluctuate.

quarterly real GDP growth; in the third and fourth panels, the standard deviation of an estimated output gap is used.[15] The similarities between these measures of output volatility are in line with evidence for the United States in Blanchard and Simon (2001).

Finally, the U-shaped relationship is dependent on the time period and the incidence of crises. If the years 1995–99 with multiple EME crises are included in the sample (Graph 4, first and second panels), the downward-sloping part of the curve disappears. This likely reflects the different nature of shocks, such as sudden stops in capital flows that lead to large exchange rate movements. Indeed, if the emerging economies that experienced currency crises are omitted from the sample, the graph becomes downward-sloping (third and fourth panels), again in line with the stabilising properties of flexible exchange rates. Finally, as shown in Graphs 2–4, the relationships are robust irrespective of whether nominal or real effective exchange rates are used.

Exchange rate and output volatility

Alternative samples — Graph 4



[1] Coverage of EMEs as in Graph 1, excluding Saudi Arabia and the United Arab Emirates. For the Czech Republic, Q2 1996–2011, for Hungary, Poland and Russia, Q2 1995–2011. [2] Chile, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Israel, Peru, Poland, Singapore and South Africa. For the Czech Republic, Q2 1996–2011, for Hungary and Poland, Q2 1995–2011. [3] Standard deviation of first difference of monthly log REER during the specified period. [4] Standard deviation of first difference of monthly log NEER during the specified period. [5] Standard deviation of quarterly real GDP growth during the specified period.

Sources: IMF, *World Economic Outlook*; Datastream; national data; BIS calculations.

2. Exchange rate flexibility and financial markets

The extent of exchange rate flexibility may affect the perception of economic agents regarding risks related to vulnerabilities such as currency mismatches. There may

[15] The output gap is defined as the difference between actual and potential output, where potential output is based on a Hodrick-Prescott filtered trend of quarterly real GDP (in logarithms) and a standard smoothing parameter of 1,600.

also be an impact on financial market development, in particular markets for local currency debt instruments and those for hedging against exchange rate risk. The hedging markets, in turn, arguably affect the desired extent of exchange rate flexibility for a given economy. These issues are examined in this section.

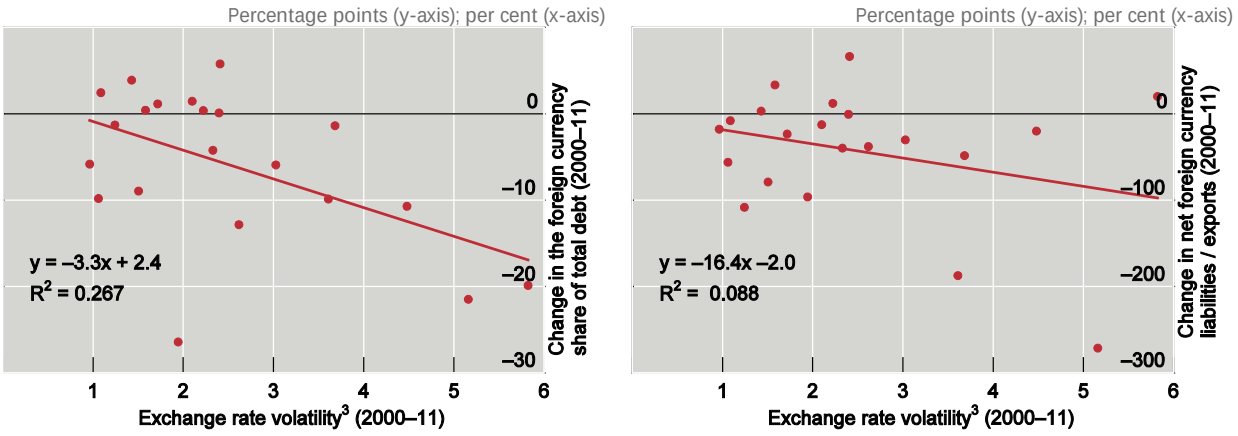
There is a two-way relationship between exchange rate flexibility and the structure of balance sheets, in particular the prevalence of currency mismatches. A more flexible exchange rate may encourage a reduction in currency mismatches and unhedged borrowing, by raising awareness about financial risks. The extent to which currency mismatches are reduced depends on whether firms and governments can hedge currency risks, affording an important role for the development of derivatives markets. On the other hand, the degree of exchange rate flexibility also depends on initial mismatches, as argued in the "fear of floating" literature (eg Calvo and Reinhart (2002)). In the presence of large currency mismatches, in particular under liability dollarisation, policymakers may be reluctant to allow much exchange rate flexibility. Lastly, large net foreign assets in the form of foreign exchange reserves could be used by the authorities to reduce exchange rate volatility.

Change in currency mismatches and exchange rate volatility[1]

Graph 5

Relationship with foreign currency share of total debt[2]

Relationship with net foreign liabilities (foreign currency liabilities less foreign currency assets) as share of exports[2]



[1] Coverage of EMEs as in Graph 1, excluding Hong Kong SAR, Saudi Arabia, Singapore and the United Arab Emirates. For Colombia, Mexico and the Philippines, 2001–11. [2] Based on the measure developed by Goldstein and Turner (2004); includes debt between residents. [3] Standard deviation of first difference of monthly log NEER.

Sources: IMF; CEIC; Datastream; national data; BIS.

Graph 5 shows that increased exchange rate flexibility has indeed been associated with a reduction in currency mismatches during the last decade. This holds if mismatches are expressed both as foreign currency shares of total debt (left-hand panel) and net foreign liabilities as share of exports (right-hand panel). This is consistent with the two-way relationship between currency mismatches and exchange rate flexibility.[16] The smaller currency mismatches, in turn, have allowed monetary authorities to conduct countercyclical interest rate policy, with fewer

[16] Such correlations cannot capture the importance of other, exogenous, factors. As an example, the Asian crisis led to greater focus on reducing currency mismatches, while at the same time international observers encouraged the adoption of more flexible exchange rate regimes.

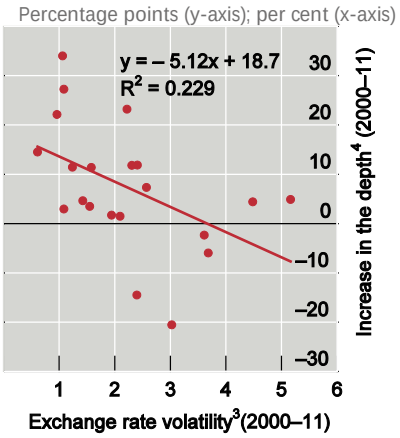
concerns about the adverse balance sheet effects of exchange rate depreciation (Mehrotra, Miyajima and Villar (2012)). This helps further smooth output volatility.

Greater exchange rate flexibility may affect the development of local currency bond markets. Central banks can benefit from the development of deep local currency securities markets for sterilisation operations. This is particularly relevant to those that actively intervene in the FX markets and sterilise the resulting increase in monetary liabilities. Another important consideration is how foreign investment in local currency bond markets is affected; foreign investors, who face exchange rate risk, are often seen to be the main contributors to liquidity in these markets (Turner (2012)). A fixed exchange rate regime reduces short-term currency risks, encouraging foreign investment in local currency debt. Indeed, Miyajima, Mohanty and Chan (2012) show that the high volatility of emerging market currencies can undo the potential diversification benefits for foreign investors, especially in the case where these investors are not hedged against exchange rate movements.

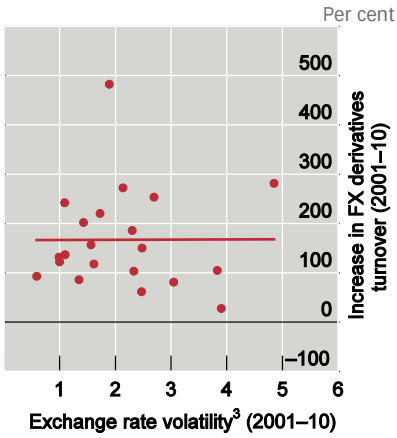
Financial market development and exchange rate volatility

Graph 6

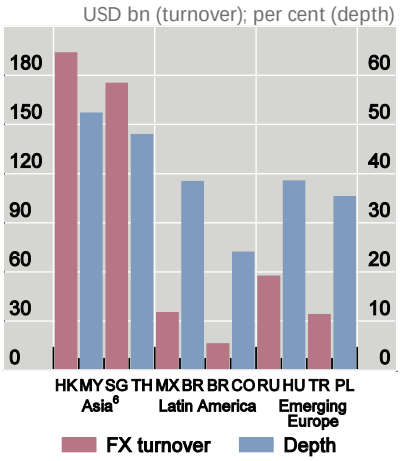
Exchange rates and increase in local currency government bond market depth[1]



Exchange rates and increase in FX derivatives turnover[2]



FX derivatives turnover and depth of local currency government bond markets[4, 5]



BR = Brazil; CO = Colombia; HK = Hong Kong SAR; HU = Hungary; MX = Mexico; MY = Malaysia; PL = Poland; RU = Russia; SG = Singapore; TH = Thailand; TR = Turkey.

[1] Coverage of EMEs as in Graph 1, excluding Israel, Saudi Arabia, the United Arab Emirates and Venezuela. [2] Coverage of EMEs as in Graph 1, excluding Argentina, China, the United Arab Emirates and Venezuela. [3] Standard deviation of first difference of monthly log NEER. [4] Depth defined as the share of local currency government bond securities outstanding to nominal GDP. [5] For each region, the graph shows the two economies with the highest turnover in 2010 and the highest depth of local currency government bond markets in 2011. [6] FX derivatives turnover for Hong Kong SAR and Singapore plotted on the left axis.

Source: BIS.

A prerequisite for fixed exchange rates to encourage foreign investment is credibility of the regime, effectively reducing unanticipated movements in exchange rates. In contrast, a flexible exchange rate regime may also encourage foreign investors to add more EME debt securities into their portfolio holdings, if they do not perceive the currency to be artificially moved by FX intervention away from the market equilibrium rate. Graph 6, left-hand panel, shows that greater exchange rate flexibility was negatively associated with the depth of local currency bond markets in our sample of emerging economies. This suggests that considerations of exchange rate risk may have been important.

When exchange rates are more volatile, firms may increase their hedging activities against expected fluctuations, contributing to higher turnover in FX derivatives markets. But exchange rate flexibility is only one of the many relevant factors influencing the development of derivatives markets. Capital account openness and market infrastructure arguably play important roles. Mihaljek and Packer (2010) show that growth in derivatives turnover in emerging markets is positively correlated with the volume of external trade, per capita income and financial activity. Geczy et al (1997) and Allayannis and Offek (2001) find that exposure factors (ie foreign sales and foreign trade) prompt firms to engage in hedging.[17]

Indeed, the centre panel of Graph 6 shows no obvious relationship between exchange rate volatility and the increase in FX derivatives turnover in the past decade. Some EMEs with less flexible exchange rates have large derivatives markets, in particular Hong Kong SAR (right-hand panel). Similar results are obtained when considering interest rate derivatives instead of FX derivatives. This lack of correlation may reflect either the multiple factors relevant for the development of derivatives markets, or reverse causality, whereby market completeness through derivatives contracts may help to stabilise exchange rates over time.[18]

As the development of local currency bond and derivatives markets is intertwined, the risks for foreign investors may eventually be highest in managed exchange rate regimes with underdeveloped hedging markets. Insufficient hedging may lead to crises in future. All things considered, a flexible exchange rate may not necessarily lead to a deeper derivatives market (as shown in Graph 6). Rather, it is the extent of development of hedging markets that influences the desired degree of exchange rate flexibility. That makes the development of these markets the crucial policy challenge.

Conclusions

In this paper, we have analysed the links between exchange rate volatility, the real economy and financial markets. The analysis is motivated by the observation that many emerging economies have intervened in the foreign exchange markets in the previous decade to contain volatility and possibly to curb appreciation pressures in their currencies. To the extent that intervention restricts the overall extent of exchange rate flexibility, there may be implications in terms of real economic outcomes and financial market development.

The paper reports the following findings. In line with the literature, we find no strong link between exchange rate flexibility and long-run productivity growth. Further, we find that the relationship between exchange rate volatility and output volatility in our sample of emerging economies is U-shaped. Some exchange rate flexibility is beneficial, but too much of it can create instability in the real economy. This also likely reflects the nature of shocks facing the economies. Focusing only on

[17] Allayannis and Ofek (2001) further find that other factors associated with theories of optimal hedging (eg size and R&D expenditures) are important determinants of the level of derivatives use.

[18] We have estimated panel regressions to further investigate the link between exchange rate volatility and derivatives markets turnover, controlling for the determinants that were found significant in Mihaljek and Packer (2010). The statistical insignificance of exchange rate volatility in determining derivatives turnover remains unchanged in such regressions.

economies with no currency crises, increased exchange rate flexibility appears to be largely beneficial for output stability.

Finally, the relationship between exchange rate flexibility and the development of financial markets is less clear. A multitude of different factors influence financial market development, and the credibility of the chosen foreign exchange rate regime also plays a non-trivial role. Besides, the relationship between exchange rate flexibility and financial market development may be subject to reverse causality.

Overall, the paper suggests that the choices regarding exchange rate flexibility have real economic consequences. Yet, the relationships between exchange rates and the real economy are complex, and there are many contributing factors, such as levels of income, market imperfections and financial development.

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Capital flow dynamics and FX intervention

Torsten Ehlers and Előd Takáts[1]

Abstract

Many emerging markets have intervened in FX markets during and after the global financial crisis to dampen movements in exchange rates and smooth volatile capital flows. Firstly, we show that the joint dynamics of capital flows, FX changes and asset returns in emerging markets are largely consistent with portfolio rebalancing of international investors. This suggests that large and volatile capital flows are here to stay and policy makers will have to devise effective frameworks to deal with them. Secondly, we analyse the differences between FX interveners and non-interveners. We show that intervening economies, on average, have exhibited dynamics that are less destabilising. In particular since 2009, non-intervening economies tend to experience additional capital inflows in response to an exchange rate appreciation – and these capital inflows then create additional appreciation pressures on the exchange rate (ie a momentum effect). In contrast, intervening economies have been able to break the destabilising feedback loop of this momentum effect.

Keywords: FX intervention, portfolio rebalancing, capital flow dynamics

JEL classification: F31, G11, G15

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Introduction

After the financial crisis, large and volatile capital flows to emerging markets (EMs) have put strong pressures on exchange rates. To dampen these pressures and the associated exchange rate volatility, many central banks have intervened in the FX market. This raises two main questions for policymakers: what triggers large and volatile capital flows? And can FX intervention influence the dynamics of capital flows and their impact on exchange rates?

We answer these questions by examining the joint dynamics of capital flows and exchange rates in EMs represented at the 2013 Meeting of Deputy Governors in Basel. We demonstrate that the portfolio rebalancing theory provides a robust empirical description of these joint dynamics. We also show that intervening economies, on average, have exhibited dynamics that are less destabilising than those of economies which do not intervene to counter capital flows or exchange rate pressures.

According to the portfolio rebalancing theory, shocks to EM equity prices or FX rates prompt international investors to rebalance their portfolios by changing their portfolio risk-return profiles. Following Hau and Rey (2004), we use a structural VAR model to show that the empirical dynamics are consistent with the predictions of the portfolio rebalancing model for various time periods and regions. In other words, the volatile market reactions seem to be consistent with the behaviour of international investors adjusting to economic shocks or news. Even though the resulting capital flows and pressures on exchange rates and asset prices could be large enough to raise financial stability concerns, these effects should be temporary as portfolio rebalancing will ultimately help to restore a sustainable equilibrium of flows and prices.

We analyse the differences between intervening and non-intervening economies by using central banks' responses to the BIS questionnaire to identify the two groups. This analysis reveals that, during the post-crisis period, the short-term dynamics for the group of non-intervening economies are no longer consistent with portfolio rebalancing, but have taken on a more destabilising character. Non-intervening economies tend to experience additional capital inflows in response to an exchange rate appreciation – and these capital inflows then create additional appreciation pressures on the exchange rate (ie a momentum effect). In contrast, intervening economies have been able to break the destabilising feedback loop of this momentum effect: an exchange rate appreciation did not lead to capital inflows, thus eliminating second-round effects.

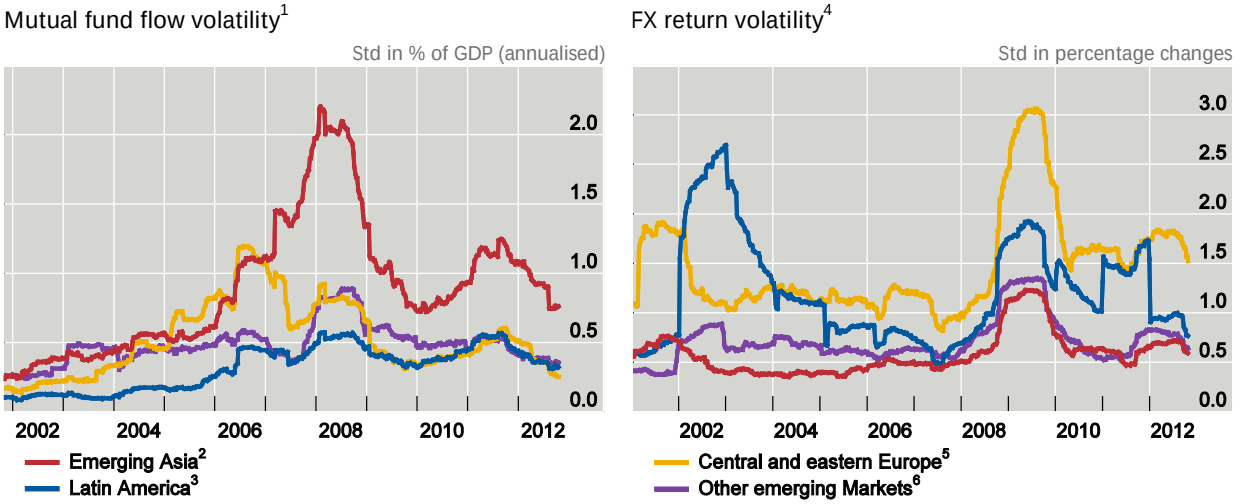
The results suggest that capital flow reversals are an integral part of international portfolio adjustment. Furthermore, they also hint at another possible channel for the impact of FX intervention: namely by influencing the interaction between exchange rates and capital flows. In particular, interventions might break the positive feedback loop between capital flows and exchange rates. Importantly, our analysis focusses on short-term dynamics driven by portfolio rebalancing. Beyond the very short term, FX intervention may be less successful in moving the exchange rate in the desired direction as described in the Miyajima and Montoro paper volume.

1. Capital flows, exchange rates and financial stability

The volatility of gross capital flows to emerging markets has increased substantially since the financial crisis. Although bond flows are increasingly important, equity flows constitute the dominant share of gross portfolio flows. Below we present flows into emerging markets from US- and Europe-based mutual funds. Equity fund flow volatility quadrupled in emerging Asia and doubled in other emerging market regions at the beginning of 2008 (left-hand panel of Graph 1). Equity flow volatility increased again in 2011 as the euro area crisis intensified and remained generally higher than before the financial crisis. Naturally, the relative shallowness of FX markets in EMs implies that higher capital flow volatility generally translates into higher exchange rate volatility (right-hand panel of Graph 1).

Volatility of mutual fund flows and exchange rates

52-week rolling window standard deviation — Graph 1



[1] Simple average across economies. Weekly flows in percent of GDP (annualised). Standard deviation of annualised weekly flows over a 52-week rolling window. [2] Emerging Asia = China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand. [3] Latin America = Argentina, Brazil, Chile, Colombia, Mexico, Peru. [4] Standard deviation of weekly percentage changes over a 52-week rolling window. [5] Central and eastern Europe = Czech Republic, Hungary, Poland, Russia, Turkey [6] Other emerging markets are Arab Emirates, Israel, Saudi Arabia, and South Africa.

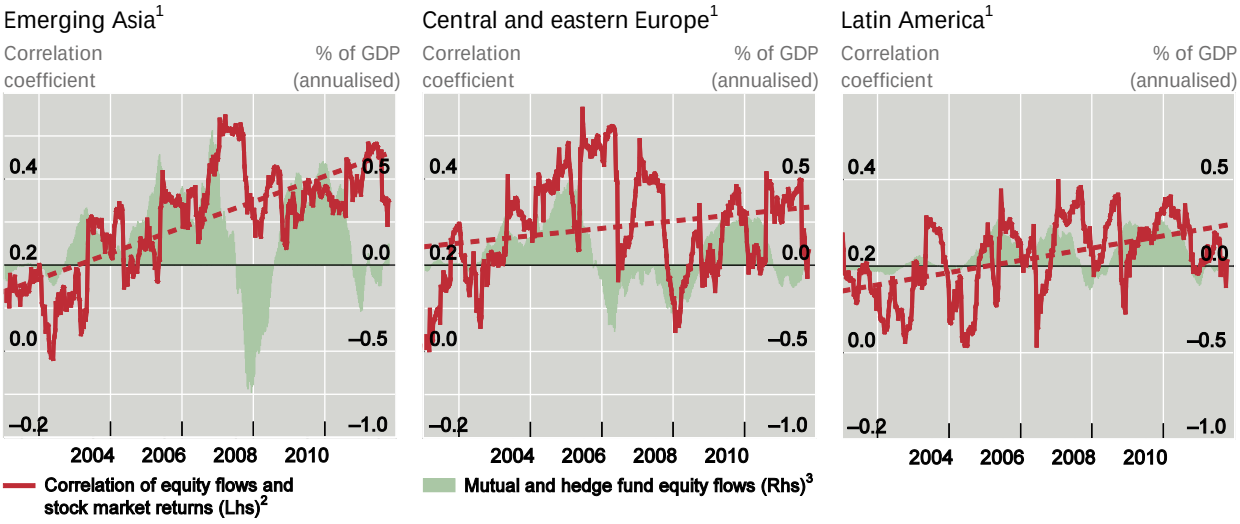
Sources: EPFR; Bloomberg.

As the participation of international investors in EM equity markets is rapidly increasing, their portfolio allocation decisions have become significant drivers of overall capital flows. The impact of international investors' order flows on prices is widely documented in the literature. Froot and Ramadorai (2005) found a strong and persistent link between FX order flows and FX returns. Dunne, Hau and Moore (2010), among many others, present evidence for the impact of international equity order flows on equity returns and exchange rates. In addition, trading volumes on EM FX and equity markets can be relatively limited. Thus, large order flows from US and European mutual funds and other institutional investors can have a strong and persistent effect on prices.

Furthermore, correlations (red lines in Graph 2) between mutual fund equity flows (green bars) and asset market returns in EMs are high and increasing. Although the 2008–09 financial crisis marks a natural peak, the upward trend is

visible. The relationship is particularly strong in regions that attract higher inflows relative to the size of their economies such as emerging Asia (left-hand panel).

Correlation of equity flows and local equity market returns — Graph 2



[1] Unweighted averages. For regional economies see footnotes below Graph 1. [2] Correlation coefficient between weekly equity flows and weekly local stock market returns in USD (52-week moving window); simple average across economies. [3] Mutual and hedge fund equity flows are the cumulative flows over the last 52 weeks; sum over all economies; in percent of annual GDP.

Sources: Morgan Stanley; EPFR; BIS calculations.

Large and volatile exchange rates and capital flows can greatly affect monetary and financial stability. Therefore, it is not surprising that central banks intervene on foreign exchange markets with the aim of curbing excessive exchange market speculation and FX volatility, as highlighted by the responses to the BIS questionnaire.[2] However, it remains unclear whether these interventions are capable of changing the basic dynamics of capital flows and exchange rates. In order to answer this question, we apply a structural VAR model in the next section to analyse the joint dynamics of capital flows, exchange rates and equity market returns.

2. The portfolio rebalancing model

According to the portfolio rebalancing model, international investors allocate their assets by trading off the expected return and variance of assets in different markets across the globe. This holds true even in the presence of substantial market imperfections (ie high trading costs, imperfect information) or capital controls. As long as it is possible to trade, investors can simply adjust the expected return and variance of assets accordingly. If investors are fully insured against FX risks, however, *random shocks* to equity prices or exchange rates do not alter the optimal portfolio allocation. In contrast, as is widely documented in the literature,[3] international

[2] See the background note for this meeting by Mohanty and Berger.

[3] The lack of hedging by institutional investors is well documented, for instance, in Bank of New York Mellon (2010) and Levich et al (1999). Furthermore, FX hedging instruments are bound to be

investors typically do not fully insure against FX risks on the grounds of cost and complexity. Thus, even though risk management practices have improved after the financial crisis, currency hedging is far from perfect. Therefore random shocks do affect the FX risk exposure of international investors; although by definition, they do not alter investors' expectations about the future returns or risks of their asset holdings. But, to retain a portfolio with an optimal trade-off between risk and return, investors need to rebalance their portfolio.

As an example, consider a positive random shock to equity prices in an emerging market economy. The representative international investor, who we assume is based in the United States, sees the emerging market share of his portfolio rising. This share is denominated in EM currency. Thus, with incomplete FX hedging, the FX risk exposure inherent in the investment portfolio increases. The risk of the investment portfolio is now too high, given that expected returns are unchanged by a random asset return shock. To restore an optimal portfolio allocation, the international investor sells equities from the respective emerging market until the risk-return ratio of the portfolio returns to its optimal level. The asset sales trigger capital outflows and, given the relative shallowness of EM FX markets, depreciates the emerging market's exchange rate vis-à-vis the US dollar.

Implied dynamics of the model

Based on the theoretical mechanism described above, the empirical implications of the portfolio rebalancing model for the joint dynamics of asset prices, capital flows and FX rates can be summarised as follows:

(i) A positive shock in EM equity prices triggers capital outflows and a currency depreciation, as investors reduce their FX risk exposure by repatriating a share of their assets.

(ii) By the same logic, an exchange rate appreciation shock in EMs leads to capital outflows and lower equity prices.

(iii) A capital inflow shock to EMs leads – via higher demand – to higher equity prices and exchange rate appreciation. If the respective EM equity and FX markets are relatively illiquid, then this effect is even stronger.

FX intervention, momentum effect and structural shifts

Three scenarios could alter the portfolio rebalancing dynamics:

(i) *FX intervention*: FX intervention can potentially influence the expectations of international investors about short-run exchange rate movements. Effective intervention can mitigate exchange rate volatility and counter the impact of capital flows. The central bank can also influence the demand and supply of foreign exchange relative to domestic currency on the FX market. All the above would affect the joint dynamics of exchange rates and capital flows.

(ii) *Momentum effect*: many international investors adopt a positive feedback strategy – also known as momentum strategy – in which they buy when prices

incomplete: in many EMs FX derivative contracts are still not widely available; and even when they are used, hedging against currency risks is highly complex and often not very effective as documented in Dale (1981) and Jong et al (1997) among many others.

rise and sell when prices fall (Kaminsky et al (2004)). Such a positive (ie destabilising) feedback loop is very different from the negative (ie stabilising) feedback implied by the portfolio rebalancing theory. Under the momentum effect, a positive exchange rate shock would lead to additional capital inflows and thereby second-round exchange rate appreciation.

(iii) *Structural shifts in portfolio allocation*: if international investors consistently shift their portfolios towards emerging market assets, then the resulting flows could potentially dominate the effects of portfolio rebalancing; even in the higher frequency data we use here. To account for this possibility, we will look separately at periods of prolonged inflows (2002–07, 2009–12) and a period of persistent outflows (2007–08).

The three scenarios are not independent of each other. A structural shift of the optimal portfolio allocation towards additional EM assets, as observed in recent years, can reinforce the momentum effect. If higher EM equity returns (relative to advanced economies) signal a structural shift towards additional EM asset holdings, then this would rationally imply greater capital inflows. The resulting exchange rate and asset price appreciations would ex post justify the reallocation of capital – and this justification might motivate even higher EM allocations. Furthermore, FX intervention might weaken or completely break the momentum effect, if the intervention is able to limit the second round of exchange rate appreciation.

Econometric model

Following Hau and Rey (2004), we formulate a structural vector auto-regression model in three variables:[4]

(i) EM equity price returns relative to the US equity market index;

(ii) Equity portfolio flows into EM dedicated mutual funds (relative to GDP);

(iii) EM exchange rate returns.

To capture the dynamics implied by portfolio rebalancing, we employ weekly data. The higher frequency of this data is well suited to capturing the movements caused by active international investors.

As the three variables in the system move contemporaneously, a simple identification based on a causal ordering is not permissible. Instead, we utilise the theoretical predictions of the portfolio rebalancing model to achieve identification. By imposing sign restrictions on the correlation between impulse responses of the three shocks (Uhlig (2001) and Canova and De Nicolo (2002)), we identify the variance-covariance matrix decomposition that is most consistent with the theoretical priors (see Appendix for details). Note that the sign restrictions do not pre-impose our results. A restriction on the correlation between impulse responses does not predetermine whether the individual responses are positive or negative.

[4] See the Appendix for a detailed technical description of the model and the shock identification strategy. We employ data for 16 of the 20 participating economies: Argentina, Brazil, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Russia, Saudi Arabia, Singapore, South Africa, Thailand, and Turkey. Due to incomplete data, Chile, India, Russia, and Saudi Arabia could not be included in the sample.

3. Results

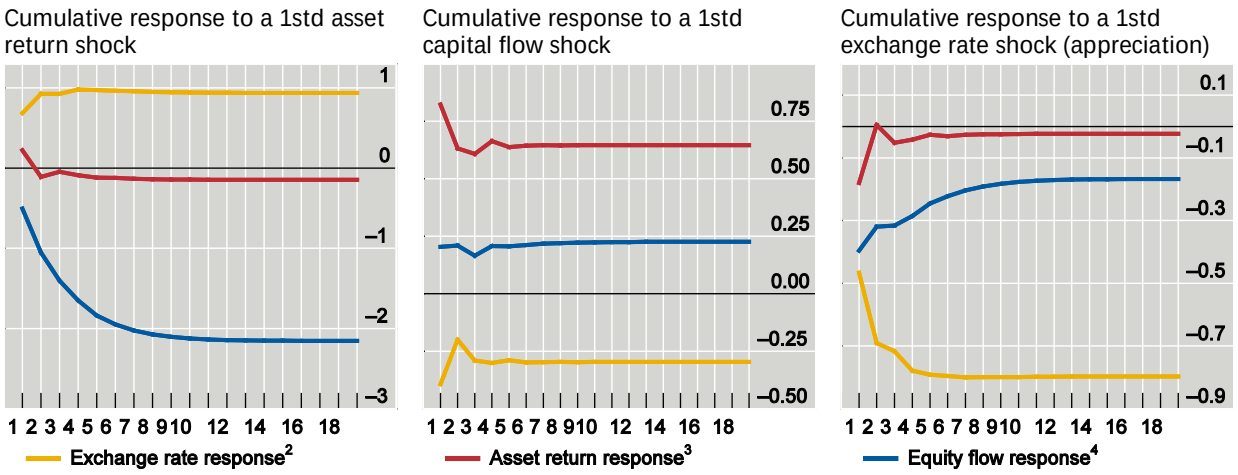
The relevance of portfolio rebalancing

The joint short-run dynamics of equity returns, equity flows and exchange rates in emerging markets are fully consistent with the portfolio rebalancing model (Graph 3). The signs of all impulse responses are as predicted by the model.

On average, a positive shock to EM equity prices (as shown in the left-hand panel) triggers capital outflows (blue line) and currency depreciation, ie a positive exchange rate response (yellow line). As expected, capital inflow shocks to EMs do lead to higher equity prices and exchange rate appreciation (centre panel). Finally, an unexpected exchange rate appreciation in EMs leads to capital outflows and lower equity prices, as investors reduce their FX risk exposure (right-hand panel).

Cumulative impulse responses from SVAR[1]

Weeks ahead, based on weekly data from 2009–12 Graph 3



[1] Impulse responses represent a GDP-weighted average over the 16 emerging economies for which data is available (see footnote 6 in the main text). Based on weekly data from the beginning of 2009 to November 2012. [2] FX returns response; weekly percentage changes in FX rates measured as local currency per USD. [3] Weekly percentage changes of broad based equity market index. [4] Weekly annualised flows in % of GDP; mutual and hedge fund flows from advanced economies into EM equities.

Sources: EPFR; Morgan Stanley; Bloomberg; Datastream; national data; BIS calculations.

The estimated short-term responses are also very significant in economic terms. A one-standard-deviation asset return shock (0.2% in a given week) triggers capital outflows of 2.1% of GDP (annualised) in the long run, as well as a currency depreciation of almost 1% (Graph 3, left-hand panel). Likewise, a one-standard-deviation capital flow shock (additional inflows of around 0.2% of GDP), leads to an FX appreciation of roughly 0.3%, and a rise in EM equity prices of about 0.6% in the long run (middle panel). In response to a one-standard-deviation currency appreciation (typically 0.45% in a given week), EMs, on average, exhibit annualised capital outflows of roughly 0.2% of GDP in the long run, although with only minor effects on asset prices after four weeks or more (right-hand panel).The robustness of this result is remarkable. While the presented impulse responses are based on weekly data from 2009 until November 2012 and are averaged across economies, the shock responses are qualitatively and quantitatively stable over time and across

regions. In particular, the results hold across both the full 2002–12 period and for the 2002–07 pre-crisis period. Consequently, they are not an artefact of recent crisis related capital movements. Furthermore, the results also hold for the three major EM regions separately.

FX intervention and portfolio rebalancing

In order to investigate the impact of intervention, we use the responses by central banks to the BIS questionnaire for this meeting to classify economies according to the motives for intervention. In particular, we identify two groups of economies that intervene actively in the FX market to influence portfolio rebalancing dynamics, namely (i) economies that intervene to dampen FX volatility and (ii) those that intervene to ease the pressure on FX rates caused by international speculators (see Table 1 for short summary). These two motives for intervention are not necessarily different from each other, but the economies which have responded to intervene on the grounds of the two different motives are not the same in the BIS questionnaire. Hence this can be seen as a robustness check for our identification.

Economies intervening in the FX market

Grouping according to the motives for intervention based on the responses to the BIS questionnaire Table 1

Reporting economies	Brazil, Hong Kong SAR, Korea, Malaysia, Peru, the Philippines, Singapore, Thailand, Turkey, South Africa	
Motives for intervention	Curb upward or downward pressure caused by international investors	Dampen exchange rate volatility
Number of economies intervening with this aim	7	7
Number of economies NOT intervening with this aim	3	3

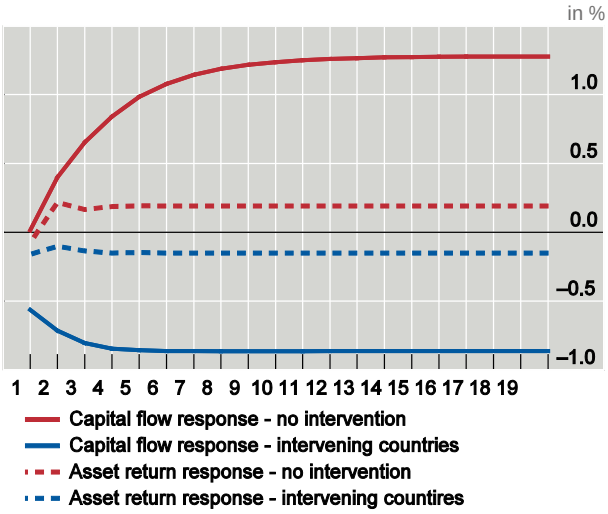
Classifying economies in this way reveals a systematic effect of FX intervention in the post-2008 period, when international investor interest in EMs was particularly high. The non-intervening economies exhibit a momentum effect: FX appreciation leads to capital inflows and higher asset prices, which in turn leads to even more FX appreciation (red lines in both panels of Graph 3). In contrast, the intervening economies seem to have been able to break this momentum effect (blue lines in both panels of Graph 4).

A closer look at the motives for intervention provides additional insights. Economies that intervened to limit FX volatility have seen significant long-run capital outflows and small negative asset returns after currency appreciations (blue lines in left-hand panel of Graph 4). In contrast, economies that intervened to limit upward or downward pressures caused by international investors did not experience any long-run impact on capital flows or asset returns after an exchange rate appreciation (blue lines in the right-hand panel).

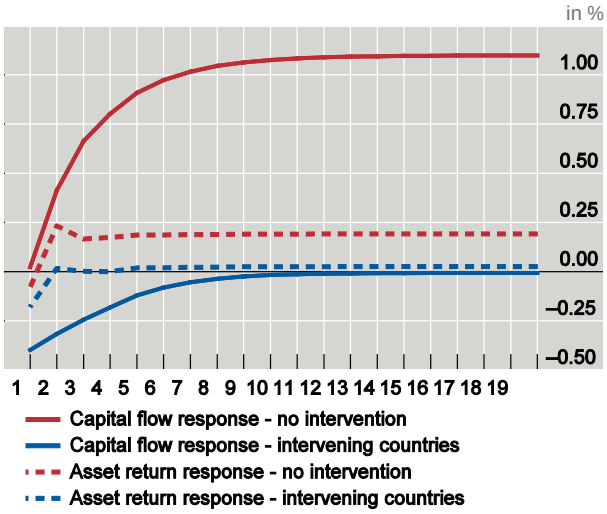
Cumulative impulse responses from the SVAR

Cumulative responses (weeks ahead) to a ***1std FX return shock*** (appreciation of currency)[1] Graph 4

Economies intervening to limit exchange rate volatility



Economies intervening to limit upward or downward pressure caused by international investors



[1] Impulse responses are weighted averages over economies which responded with yes or no. Based on responses from the BIS questionnaire on questions regarding immediate objectives of intervention. Equity flows are mutual and hedge fund flows from advanced economies into EM equities. FX returns are the weekly percentage changes in FX rates measured as local currency per USD. Based on weekly data from beginning of 2009 to November 2012.

Sources: EPFR; Morgan Stanley; Bloomberg; BIS calculations.

However, if shocks other than innovations in FX returns are considered, both intervening and non-intervening economy dynamics are again consistent with the portfolio rebalancing theory (Graph A1 in the Appendix). The impulse responses all have the right sign. The signs of all impulse responses to asset return (upper row) and capital flow shocks (lower row) are as predicted by the model. This suggests that portfolio rebalancing remains a key driver of exchange rate and capital flow dynamics also for intervening economies.

Overall, it seems that FX intervention may work through a channel which is often overlooked in the literature. It can mitigate the most destabilising effects on emerging markets by breaking the reinforcing feedback between FX appreciation and capital inflows. However, it cannot systematically insulate against the effects of portfolio rebalancing by international investors.

4. Caveats

Our results should be read with appropriate caveats. Most importantly, we identified systemic differences between intervening and non-intervening economies and did not analyse the effectiveness of exchange rate interventions. Hence, our results provide indirect, as opposed to direct, evidence of the effects of such interventions. For instance, it is theoretically possible that the momentum effect was broken by common factors other than FX interventions, such as capital control measures or large FX reserves. Hence, careful examination of policies that accompanied FX interventions might provide additional insights for policymakers. Nevertheless,

our results suggest a theoretically sound, but so far overlooked, channel through which intervention can be effective: to dampen potentially destabilising higher frequency *interactions* between exchange rate shocks and capital inflows.

A further caveat is that we base our identification of the motives for intervention on the questionnaire responses for the most recent time period (2011–12). While this ensures consistency across the empirical results for different time periods, it also implies that the identification of intervening and non-intervening economies becomes weaker as we consider older samples. For instance, if we repeat the analysis for the period preceding the financial crisis (2002–07), the difference between intervening and non-intervening economies disappears. This might be due to the fact that the set of interveners has changed during this time period.

While the applied methodology allows a structural identification of shocks, it has some important limitations. First, it treats capital inflows and outflows symmetrically. This may be appropriate most of the time, but capital outflows can differ in many important aspects from inflows, especially during times of market stress, as deputy governors highlighted during the discussions. As we have focussed our analysis on relatively high frequency data, a structural shift towards EME assets should not fundamentally influence our results. Nevertheless, it is unclear whether the news of improving or worsening economic fundamentals could drive asset prices and capital flows, rather than portfolio rebalancing motives. As deputy governors highlighted, exchange rate intervention policies might be able to curb speculative momentum, but it is unlikely to affect more fundamental reallocation.

Finally, our results concern groups, typically large groups of EMs. Consequently, the experiences of some individual economies, especially over shorter time periods, might differ significantly from the aggregated picture presented here.

5. Conclusion

The paper has demonstrated that portfolio rebalancing by international investors provides a robust model for describing the joint dynamics of exchange rates, capital flows and asset prices in EMs. Furthermore, FX intervention seems to have been effective in breaking the momentum effect of FX appreciation and capital inflows in the post-crisis period.

These results are relevant to policymakers for three main reasons. First, the portfolio rebalancing theory's success in describing capital flow dynamics so robustly throughout the past decade suggests that large and volatile capital flows are here to stay. In fact, as gross cross-border EM asset positions in advanced economies increase, economic shocks might well trigger a greater absolute amount of portfolio purchases and sales, and hence larger capital flows and reversals in the coming years. Consequently, policymakers in EMs might want to devise frameworks and strategies to cope with them.

Second, our results also propose a potential role for FX intervention in curbing some of the destabilising short-run effects of capital flow and exchange rate shocks. In particular, intervening economies seem to have succeeded in breaking the momentum effect of exchange rate appreciation and capital inflows in the post-crisis period. To some extent, this result may reflect that only central banks which are confident in the effectiveness of intervention do take action. However, the

relatively large number of interveners in our sample (7 out of 10) suggests that, on average, our results bear economic significance.

Finally, the overall picture emerging from our research suggests that portfolio rebalancing effects are strongly present in both intervening and non-intervening economies. Consequently, policymakers might also want to consider instruments other than FX interventions, such as macroprudential tools or capital account measures, when addressing potential financial stability issues that arise from portfolio rebalancing by international investors.

Appendix:
Model description

Specification and variables

Following Hau and Rey (2004), we set up a three-dimensional linear VAR

$$\begin{bmatrix} r_t^c \\ fl_t^c \\ fx_t^c \end{bmatrix} = \mu^c + \sum_{l=1}^{L} A_l \begin{bmatrix} r_{t-l}^c \\ fl_{t-l}^c \\ fx_{t-l}^c \end{bmatrix} + \varepsilon_t^c$$

where c denotes the economy (or region) and l the lag length. The model is estimated with weekly data and thus t denotes the time period in weeks. Based on the Akaike and Bayesian information criteria, the most appropriate common number of lags for all economies is $L = 2$.

The three endogenous variables are asset returns (r), equity flows (fl) and FX returns (fx). Asset returns are defined as weekly percentage changes in the broad-based MSCI equity market index for a given economy c. Capital flows are in percent relative to GDP (annualised). The measure is based on the weekly net inflows into emerging market dedicated mutual funds reported by EPFR. The funds reporting their net inflows are based primarily in the United States and Europe, as well as in some offshore centres. These inflows can be broken down into individual recipient economies. We divide the net inflows for individual economies by the respective annual nominal GDP in USD (as reported by the IMF) and then annualise (multiply by 52) to obtain the net inflows relative to GDP. Finally, FX returns are the weekly percentage changes of the daily end-of-business USD exchange rate in local currency as reported by Bloomberg.

To generate the impulse response functions for regional data, or the whole sample of economies, we construct GDP weighted averages of the endogenous variables.

Structural identification of shocks

The question of how structural economic shocks are identified is crucial in this setup. A standard causal ordering is not valid, since the variables in the VAR are moving at high frequencies. Hence a shock to one variable will most likely have an effect on other variables in the system within the same time period. To disentangle the effects of the three shocks in our system, we have to impose an additional structure on the VAR model. In effect, this means deriving implications from the underlying economic theory which help to pin down the set of plausible impulse response functions. From the implications of the portfolio rebalancing model (Section III), one can directly derive a set of time series correlation restrictions among impulse responses:

$$corr\left(IRF_{r^c}(r^c), IRF_{r^c}(fl^c)\right) < 0; \;\; corr\left(IRF_{r^c}(r^c), IRF_{r^c}(fx^c)\right) > 0;$$

$$corr\left(IRF_{fl^c}(r^c), IRF_{fl^c}(fl^c)\right) > 0; \;\; corr\left(IRF_{fl^c}(fl^c), IRF_{fl^c}(fx^c)\right) < 0;$$

$$corr\left(IRF_{fx^c}(r^c), IRF_{fx^c}(fx^c)\right) > 0; \;\; corr\left(IRF_{fx^c}(fl^c), IRF_{fx^c}(fx^c)\right) > 0;$$

where $IRF_{r^c}(fl^c)$, for instance, denotes the impulse response function of capital flows (fl) in response to an asset return shock (r). Note that these restrictions are

based on the sign of a time series correlation and do not pre-impose whether the impulse response is negative or positive at any given point in time.

The identification is then achieved by a grid-search over the possible three-dimensional rotations of the covariance matrix of shocks, such that the resulting impulse responses are most consistent with the restrictions above. Consistency is measured by a high value of the objective function

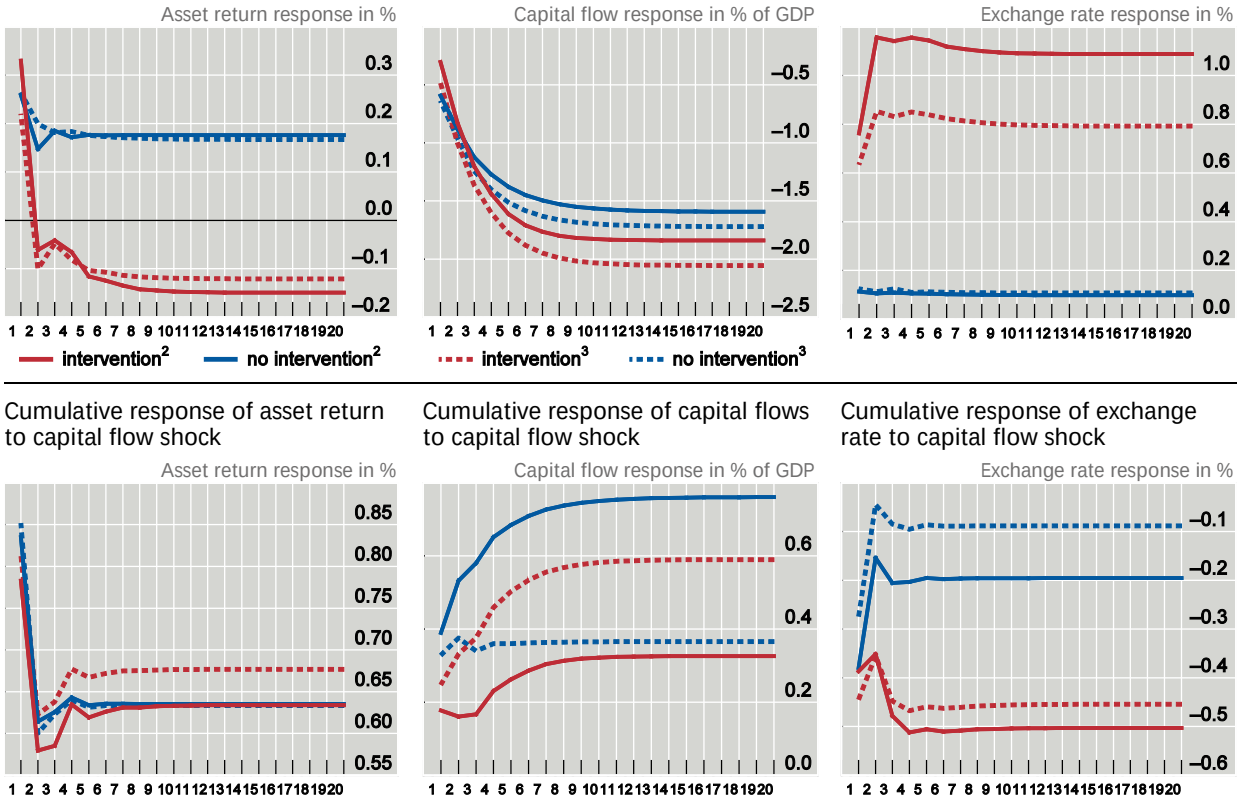
$$\sum_{s}(1-\exp(-(corr_s)^2)) \times I\big(sign(corr_s)\big)$$

where $I\big(sign(corr_s)\big)$ is an indicator function which takes a value of 1 if the measured correlation fulfils the corresponding sign-restriction above, and is set to -1 if the restriction s is not fulfilled. This deviates slightly from Hau and Rey (2004) to give more weight to the sign of the observed correlation rather than its absolute value.

Appendix graph

Cumulative impulse responses to 1 std shocks[1]

Weeks ahead, based on weekly data from 2009–12 — Graph A1



[1] Impulse responses are GDP-weighted averages over economies which responded with yes or no. Based on responses from the BIS questionnaire regarding the immediate objectives of intervention. Capital flows are mutual and hedge fund flows from advanced economies into EM equities. FX returns are the weekly percentage changes in FX rates measured as local currency per USD. Based on weekly data from beginning of 2009 to November 2012. [2] Economies that intervened to dampen exchange rate volatility. [3] Economies that intervened to limit upward and downward pressure caused by international investors.

Sources: EPFR; Morgan Stanley; Bloomberg; Datastream; national data; BIS calculations.

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Impact of foreign exchange interventions on exchange rate expectations

Ken Miyajima and Carlos Montoro[1]

Abstract

Using monthly data for four selected emerging economies, we find that sterilised central bank foreign exchange intervention has little systematic influence on near-term nominal exchange rate expectations in the direction intended by the central banks. In other words, central bank dollar purchases to stem exchange rate appreciation or related exchange rate volatility are not associated with an adjustment of near-term exchange rate forecasts in the direction of depreciation, and vice versa. This suggests that intervention may not change near-term exchange rate expectations. Moreover, intervention may have unintended effects in the sense that it can lead to undesired volatility in the exchange rate, which is consistent with previous studies.

Keywords: exchange rate expectation, foreign exchange intervention

JEL classification: D84, E58, F31

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Introduction

Has sterilised intervention in emerging market economies (EMEs) had an impact on exchange rate expectations? The question arises because "in the era of flexible exchange rates, relative currency prices are clearly expectations driven" (Dominguez (1986)). If expectations remain unchanged, any impact on the spot exchange rate could be short-lived. If interventions are believed to help guide the exchange rate towards values more consistent with fundamentals, such policy actions probably change exchange rate expectations to the direction desired by the central bank. This will be welfare-enhancing to the extent that a persistent deviation of the exchange rate from levels consistent with fundamentals creates welfare losses.

In what follows, this note will first motivate the question by reviewing findings in previous studies. Then it will present a simple model and econometrically estimate the impact of central bank interventions on exchange rate expectations using monthly data from Consensus Economics and for a panel of four EMEs (Brazil and Peru in Latin America, and Malaysia and Korea in Asia) over the period of 2004–12. Finally, we discuss the findings and policy implications.

1. Findings in previous studies

The bulk of the literature on the effectiveness of central bank interventions has focused on their impact on the spot exchange rate, and the evidence in EMEs is mixed. Reviews by Menkhoff (2012) and Ostry et al (2012) suggest that interventions in some cases have a systematic impact on the rate of change in exchange rates, while in other cases they have been able to reduce exchange rate volatility. Intervention appears to be more effective when it is consistent with monetary policy (Amato et al (2005), Kamil (2008)). Thus results vary depending on the intervention episode and instrument.

Of course, the effectiveness of central bank intervention needs to be evaluated against its policy goal. However, meeting discussion highlighted that the assessment of intervention effectiveness can be complicated. Intervention may be considered as effective if it promotes external price competitiveness and increases capacity to insure themselves against external shocks, thereby reducing external funding cost and promoting long-term economic growth. But these benefits, and thus the associated effectiveness of intervention, are extremely difficult to measure. Intervention may be considered effective if "orderly market conditions" have been maintained. But efforts to reduce currency volatility today may also reduce incentive for the private sector to develop mechanism to manage exchange rate risk, increasing currency volatility down the road.

Recent research papers by central banks in Latin America using intraday data found that intervention has a small but transitory effect on exchange rate movements (see Box). The impact of discretionary intervention tends to be larger than the impact of non-discretionary intervention. The majority of meeting participants believed that intervention can influence exchange rates temporarily at best.

Effects of foreign exchange intervention in Latin America

Takeaways from the BIS Consultative Council for the Americas Research Network

During 2012, the BIS Consultative Council for the Americas (CCA) sponsored a research network on the effects of foreign exchange market operations in Latin America. The central banks of Brazil, Chile, Colombia, Mexico and Peru participated. The goal of the project was to understand the impact that foreign exchange interventions conducted by these central banks has on the exchange rate.

Several key findings emerged from the contributions to the meeting. Moreno et al (2013) find that foreign exchange intervention can affect exchange rate returns and volatility, although the effects may be transitory. Echavarría et al (2013) find that, in Colombia, the exchange rate responds differently to discretionary intervention and intervention following preannounced rules. In the context of Peru, Lahura and Vega (2013) find that central bank sales of foreign exchange have a larger impact on the exchange rate than purchases. Kohlscheen (2013) argues that, in Brazil, foreign exchange intervention reduces the impact of order flows on exchange rate returns. According to Pincheira (2013), intervention in Chile used to have a substantial (but transitory) impact on inflation expectations but not any longer. In the case of Mexico, García-Verdú and Zerecero (2013) find that the impact of foreign exchange auctions on market liquidity and conditions depends on the procedure of these auctions.

The view taken in the literature is that central bank foreign exchange interventions may have a larger effect in EMEs than in advanced economies. The portfolio balance channel tends to be stronger in EMEs because the degree of substitutability between domestic and foreign assets is considered to be lower. In addition, central banks in EMEs may have an information advantage over market participants because of their informational and regulatory power (Canales-Kriljenko (2003)). Finally, non-sterilisation of intervention can strengthen the impact of intervention, as discussed by Sarno and Taylor (2001) and Menkhoff (2012). The signalling or expectations channel, through which sterilised intervention affects market expectations about future fundamentals, is likely to be weaker in EMEs because policy credibility may be lower.

The BIS survey summarized by Berger and Mohanty for this meeting reveals that central banks in EMEs believe the signalling channel is the most prominent channel of effectiveness. Meeting participants had mixed views about the effectiveness through the portfolio balance channel, as greater financial market integration has probably made EM assets more substitutable.[2]

Despite the literature's strong focus on the effectiveness of central bank intervention on spot exchange rates, the response of exchange rate expectations could be of greater importance for policymakers. This is particularly so to the extent that interventions in EMEs have become more persistent, with potential implications for market views about future exchange rates. To have a durable effect on the spot exchange rate, central bank intervention probably needs to alter market expectations about the currency's future path. Therefore a direct way to measure

[2] An increasing number of capital flow management measures in EMEs were cited as evidence that assets in EMEs have become more substitutable with those in advanced economies. As these measures should reduce substitutability of assets in EMEs, the effectiveness of the portfolio channels depends on country circumstances.

the effect on spot exchange rate may be to look at the changes in exchange rate forecasts.

A large body of literature has exploited data on exchange rate expectations for advanced markets. This literature examines the characteristics of survey-based exchange rate forecasts: formation process, predictive power and heterogeneity across individual forecasters (Dominguez (1986), Frankel and Froot (1987), Ito (1990), Elliott and Ito (1999), Bénassy-Quéré et al (2003), Frenkel et al (2009)).

One interesting question is whether central bank intervention can provide guidance to market participants about the central banks' desire about exchange rate movement. A study by Rülke and Yoshida (2009) for Japan provides tentative evidence about the potential role of learning, whereby interventions, under certain conditions, lead market participants to learn the central bank's reaction function and its desired exchange rate path. These authors find that, in some cases, dollar purchases by the Bank of Japan can lead to an adjustment of three-month dollar/yen monthly forecasts to the direction of a weaker yen. For this to happen, the intervention needs to be able to influence the spot exchange rate to the same direction. In addition, it needs to be followed by a period of no intervention, which is considered to allow forecasters to evaluate and learn the effect of the intervention.

However, Beine et al (2007) suggest that intervention can unanchor exchange rate expectations. The authors find that interventions can increase the heterogeneity of individual forecasts, measures by the coefficient of variation across the individual forecasts, for euro/dollar and yen/dollar crosses.[3] In other words, intervention seems to increase uncertainty around the trajectory of exchange rates. This is consistent with the finding in the many studies on advanced economies surveyed by Neely (2008) that central bank intervention can increase the volatility of spot exchange rates. One meeting participant warned that discretionary intervention can adversely affect exchange rates by increasing uncertainty and risk premia.

So far, little work has been done to provide guidance on the impact of central bank intervention on exchange rate expectations in EMEs. Among the few related works, Disyatat and Galati (2007) use market-based option prices as measures of expectations for the Czech Republic and find some impact of intervention. Thus, this study attempts to help shed some light on the impact of central bank intervention on near-term exchange rate expectations.

2. Our approach

This section discusses a theoretical model and an econometric approach to estimate the impact of central bank intervention on exchange rate forecasts.

Model

A key determinant of exchange rates is interest rate differentials. The theory of uncovered interest parity predicts that higher domestic interest rates (relative to US

[3] In the euro/dollar (and earlier the mark/dollar) markets, unexpected interventions tend to increase the heterogeneity of forecasts. In contrast, in the dollar/yen markets, expected intervention increases the heterogeneity of forecasts.

interest rates) should weaken EMEs' exchange rates. This is because the gains from earning higher interest rates should be counterbalanced by weaker exchange rates later once opportunities to make profits have been arbitraged away. We thus start from uncovered interest rate parity conditions to relate domestic and foreign nominal interest rates, *r* and *r**, with the expected rate of exchange rate depreciation.

$$(1 + r_t^*)\frac{E_t[s_{t+1}]}{s_t} = (1 + r_t)$$

$E_t[s_{t+1}]$ is exchange rate forecasts for time *t+1* made at time *t*, and s_t is the spot exchange rate at time *t*. Another key determinant of EM exchange rates is perceived country risk. History has shown that EM exchange rates can sometimes depreciate sharply as country risk deteriorates. With high currency mismatches, EMEs were often forced to tighten policies to help stem currency depreciation, adversely affecting domestic activity and country risk. However, the vicious circle has weakened since EMEs have reduced their currency mismatches (Miyajima et al (2012)). Following Bacchetta and van Wincoop (2006), our model is extended with a risk premium *Z*. After log-linearising,

$$E_t[s_{t+1}] = s_t + r_t - r_t^* + Z_t$$

One important implication of the augmented model is that, despite domestic interest rates being higher, EM currencies can appreciate because the risk premium can change. Given our objective, the model is further extended to include intervention, measured in terms of central bank net dollar purchases. Sterilised intervention does not change the domestic interest rate, but it can affect exchange rate forecasts by either changing the risk premium (the portfolio channel) or expectations of future interest rates (the signalling channel). When included in the model, intervention I is lagged by one period to account for the endogeneity of movements in exchange rate forecasts and central bank intervention. Using contemporaneous values for both of them can bias the results because exchange rate movements can affect intervention decisions. Finally, the spot exchange rate s_t is dropped from the model as it can be correlated with lagged intervention I_{t-1}.

$$E_t[s_{t+1}] = I_{t-1} + r_t - r_t^* + Z_t$$

Therefore, our regression model will relate exchange rate forecasts with intervention, domestic and foreign interest rates and country risk.

Regression model

Based on the theoretical model, we estimate a behavioural equation linking movements in exchange rate forecasts to central bank interventions for a panel of EMEs. Our specification includes a number of controls while allowing for country-specific effects in some of them:

$$dlog\left(s_{i,t}^f\right) = a_i + b * I_{i,t-1} + c * \left(r_{i,t} - r_{i,t}^*\right) + d * Z_{i,t} + +v_{i,t}$$

where $s_{i,t}^f$ is exchange rate forecasts made for country *i* at time *t* (a higher value signifies a weaker EM currency), and *v* is an error term. We are primarily interested in the sign and statistical significance of the term *b*. The sign will be positive if central bank intervention guides exchange rate expectations to the "right" direction

– forecasters expect a weaker EM exchange rate in response to central bank dollar purchases to help weaken the spot exchange rate, and vice versa.

Data

Before discussing estimation results, we summarise the data in four categories: country and estimation period, exchange rates, intervention and other determinants. Graph A1 in the Appendix provides a graphical overview of the data, except for control variables.

Country and estimation period

We focus on a few EMEs with floating exchange rates that typically conduct discretionary intervention. These EMEs are selected from Asia and Latin America, two regions that have probably been more active in intervention in recent years due to strong foreign capital inflows. In order to add a degree of heterogeneity, we selected economies that are perceived to have different degrees of capital openness. Accordingly, we chose Brazil, Peru, Korea and Malaysia.[4]

Guided partly by data availability, we focused on the period spanning June 2004–August 2012 (for Malaysia, mid-2005 onwards, to focus on the period of a flexible exchange rate regime). To prevent exceptionally disorderly market conditions around the Lehman bankruptcy from affecting the results, we excluded the period July 2008–March 2009 from the estimation.[5]

Exchange rates

Three-month exchange rate forecasts are taken from Consensus Economics. For many EMEs, a number of market participants report their exchange rate forecasts during the month and the data provider takes the median of the reported figures.

The exchange rate data have a few distinct characteristics. First, forecasts tend to follow closely the current spot exchange rates but with lower volatility. The left-hand panel of Graph 1 shows that the average monthly returns are similar across spot exchange rates (red bars) and exchange rate forecasts (blue bars). However, the right-hand panel shows that volatility is greater for spot exchange rates. This is consistent with the pattern reported in the literature for advanced market exchange rate crosses (Takagi (1991)).

Second, since the onset of the global financial crisis in 2008, the pace of appreciation in both spot and forecast exchange rates moderated somewhat, shown by the shorter bars for the second subperiod in the left-hand panel of Graph 1.

[4] According to the commonly used Chinn-Ito Index of capital account openness, over the past decade Peru has consistently kept its capital account open during the estimation period, while Brazil has been more restrictive, particularly reflecting measures to cope with the impact of strong capital inflows. Capital account openness has gradually increased in Korea, but has decreased in Malaysia.

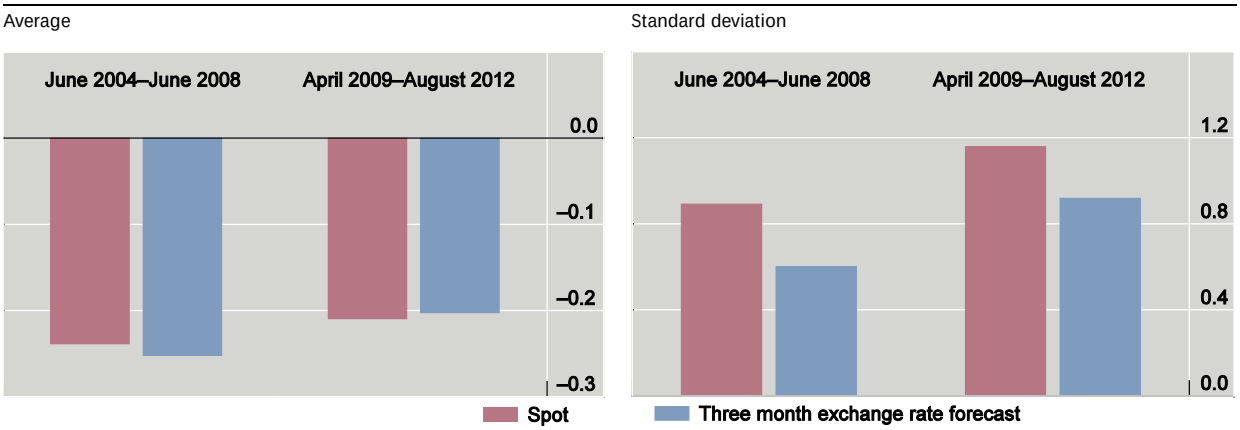
[5] Several studies focusing on the effectiveness of central bank intervention on spot exchange rate movements exclude times of extreme stress. For instance, Adler and Tovar (2011) exclude September 2008–June 2009. Naturally this removes episodes of very large dollar sales.

Moreover, the volatility of exchange rates increased markedly, as indicated by the higher bars for the second subperiod in the right-hand panel.

Monthly change in spot exchange rate and three-month exchange rate forecast[1]

In per cent

Graph 1



[1] Using pooled data for Brazil, Peru, Korea and Malaysia. Exchange rate is against the US dollar; a negative change represents appreciation of the local currency.

Sources: © Consensus Economics; BIS staff calculations.

Intervention

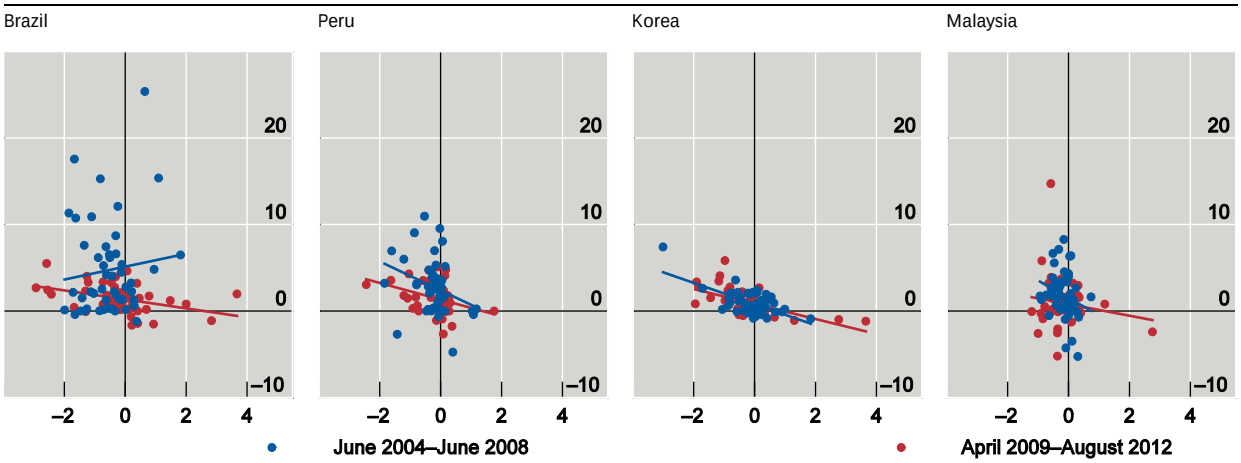
Measuring central bank foreign exchange intervention is a key hurdle in assessing its impact. Many EMEs in Latin America make the intervention data publicly available by instrument (spot, forward, swaps etc), including Brazil and Peru. For the sake of simplicity, we aggregate intervention data across different instruments, assuming their impact on exchange rates is broadly similar. In Asia, as intervention data are in most cases not made public, we proxy intervention with monthly changes in central bank official reserves, further adjusted for changes in the exchange rates based on the assumed currency composition guided by the IMF's Currency Composition of Official Foreign Exchange Reserves (COFER) data.

Graph 2 plots monthly net intervention in terms of dollar purchases as a percentage of official reserves on the y-axis and the monthly change in three-month exchange rate forecasts on the x-axis. Intervention data are lagged by one month. The blue dots are for the first subperiod (June 2004–June 2008) and the red dots for the second (April 2009–August 2012). The scatter plot reveals common patterns of intervention across the four EMEs and the correlation of lagged monthly intervention and the monthly change in three-month exchange rate forecasts.

A number of aspects stand out from Graph 2. First, the four EM central banks have leaned more heavily towards US dollar purchases than dollar sales, as the dots in Graph 2 in most cases take positive values. The intervention data are further summarised in Table A1 of the Appendix, which shows that the four EM central banks bought an average of 1.3–2.5% of official reserves per month, and, in many cases, the largest size of monthly intervention exceeded 10% of official reserves when central banks were net buyers of dollars. There were episodes of outsized intervention, when, for instance, the Central Bank of Brazil was a net buyer of dollars

for up to 25% of official reserves. In contrast, the four EM central banks typically sold much smaller amounts of dollars when they were net sellers of dollars.

Foreign exchange intervention and change in exchange forecasts[1] Graph 2



[1] Y-axis: monthly net intervention in terms of dollar purchases as a percentage of the stock of official reserves. X-axis: monthly percentage change in three-month exchange rate forecasts.

Sources: IMF; © Consensus Economics; Datastream; national sources; BIS staff calculations.

Second, it is also clear from Graph 2 that the four EMEs have reduced their intervention to stem currency appreciation since the onset of the global financial crisis in 2008. The values of the red dots appear to be often smaller than those of the blue dots, which could be due to lower appreciation pressure, greater tolerance for appreciation or higher costs of intervention. Appendix Table A1 confirms this observation. The average size of intervention fell from 2.5% of official reserves during the first subperiod to 1.3% of official reserves during the second subperiod. Similarly, the number of months during which the four EM central banks were net buyers of dollars declined in relative terms.

Finally, there is evidence that central bank dollar purchases are not necessarily accompanied by expectations of future depreciation. The trend lines relating the x- and y-axes are in many cases downward sloping, suggesting that positive intervention (net dollar purchases) is accompanied by a negative change in three-month exchange rate forecasts (appreciation), and vice versa. Note, however, that other key determinants of exchange rates are omitted from the analysis, so the bivariate correlations are insufficient to reach definite conclusions.

Other determinants

To allow for the influence of other determinants on the exchange rate, we included a number of control variables in a regression. The first control variable is the differential between the home and foreign country interest rates. Interest rate differentials are represented by the three-month interest rates and the slope of the yield curve, both relative to the United States. The former represent expectations of future short rates. The latter is the EM international credit risk represented by the change in the premium on international sovereign bonds, or credit default swaps when that is unavailable.

3. Results

When interventions are successful in moving the exchange rate in the desired direction, net dollar purchases by the central bank should prompt forecasters to adjust their exchange rate expectations to the direction of depreciation. Similarly, net dollar sales should be associated with an adjustment of exchange rate expectations to the direction of appreciation. Hence, the coefficient on the intervention variable should be positive. In contrast, if intervention is followed by forecast revisions to the direction opposite from what is desired by the central bank, the coefficient on intervention would be negative.

Fixed-effect panel model of impact of intervention on exchange rate forecasts[1] Table 1

Period	June 2004–August 2012			
	1	2	3	4
Intervention	–0.027*	–0.026	–0.029*	–0.029*
	(2.556)	(2.320)	(2.769)	(2.763)
Interest rate diff (3m)		–0.003		0.007
		(0.170)		(0.434)
Yield curve (12m less 3m)		0.050		–0.001
		(1.877)		(0.022)
Change in EMBI spread			0.013**	0.013**
			(4.089)	(4.015)
Adjusted R-squared	0.017	0.013	0.122	0.118

[1] Dependent variable is monthly difference of the log of three-month exchange rate forecasts. *, ** and *** signify statistical significance at the 10%, 5% and 1% levels, respectively. *t* values in parentheses are based on standard errors using the Huber-White sandwich estimator (Huber (1967), White (1980)).

Sources: BIS staff calculations.

An important finding from the estimated results shown in Table 1 is that interventions do not seem to have the intended effects on exchange rate expectations. The first row of the table shows intervention coefficients corresponding to four different specifications, with different control variables. The coefficient on intervention is consistently negative. In other words, central bank intervention to weaken (or strengthen) the exchange rate typically leads to an adjustment of exchange rate forecasts to the direction of appreciation (depreciation). Other than intervention, the country risk premium seems to be important for exchange rate determination.

To check for the robustness of the intervention coefficient we included a number of other control variables in the regression. These are changes in energy prices (higher oil prices leading to expectations of higher interest rates and probably stronger exchange rates); foreign portfolio inflows, which have surged following recent improvements in EMEs' growth and fiscal prospects; and news

about the US economy, which can have significant effects on EM exchange rates vis-à-vis the US dollar.[6]

Models 5 through 8 in Table A2 in the Appendix suggest that our main finding is unchanged: interventions do not prompt an adjustment of exchange rate expectations to the direction desired by the central bank. The coefficients on intervention remain around –0.03 and mostly significant at the 10% level. Moreover, the coefficients on the EMBI spread remain little changed. Among the new control variables, foreign bond inflows have a significant impact on exchange rate expectations with the expected sign. The coefficients of –0.05 in models 6 and 8 imply that an increase in such inflows equivalent to 1 percentage point of assets under management (AUM) leads to a 5 basis point appreciation of forecasts. To put this into context, the average monthly net inflows to Asia ex-Japan bond funds surged from 1% of AUM in 2007 to 5.8% of AUM in 2010, but moderated to 0.6% of AUM in 2012.

One issue is whether the result is influenced by specific period or development in our sample. The most important event is the global financial crisis that started in 2008, which has been accompanied by significant changes in foreign capital flows and investors' behaviour. Therefore, we re-estimated the model for two subperiods: June 2004–June 2008 and April 2009–August 2012 (models 9 and 10 in Table A1 in the Appendix).

The results show that the intervention coefficient is close to zero and statistically insignificant during the first subperiod, that is, the period preceding the global financial crisis. This suggests that, during this period, intervention had little effect on three month exchange rate forecasts.

In contrast, the intervention coefficient becomes significant and increases in size during the period starting 2009.[7] This suggests that the impact of intervention has changed following the onset of the global financial crisis. The coefficient of –0.09 and the average size of monthly intervention equivalent to 1.3% of reserves during the second subperiod (Table A1) together suggest that three-month exchange rate forecasts "appreciated" by 0.12% per month following intervention to purchase US dollars. This represents about one half of the average rate of appreciation of 0.2% per month during April 2009–August 2012 (Graph 1, left-hand panel). Moreover, the coefficients on foreign bond inflows and energy price inflation become more significant, with expected signs.

4. Concluding discussion

This note highlighted that central bank intervention to guide movements of spot exchange rates does not seem to have a major influence on near-term exchange

[6] Surprise indices represent the difference between expectation and outturn for purchasing managers' index, retail sales and non-farm payroll. Different US data surprises were also included but did not change the main results.

[7] When model 10 was re-estimated for the four individual countries separately, the coefficients on intervention all remained negative, but significant for Brazil and Peru. Those on country risk were all positive, but significant for Brazil and Korea. The coefficients on foreign bond inflows were all negative, but significant only for Malaysia.

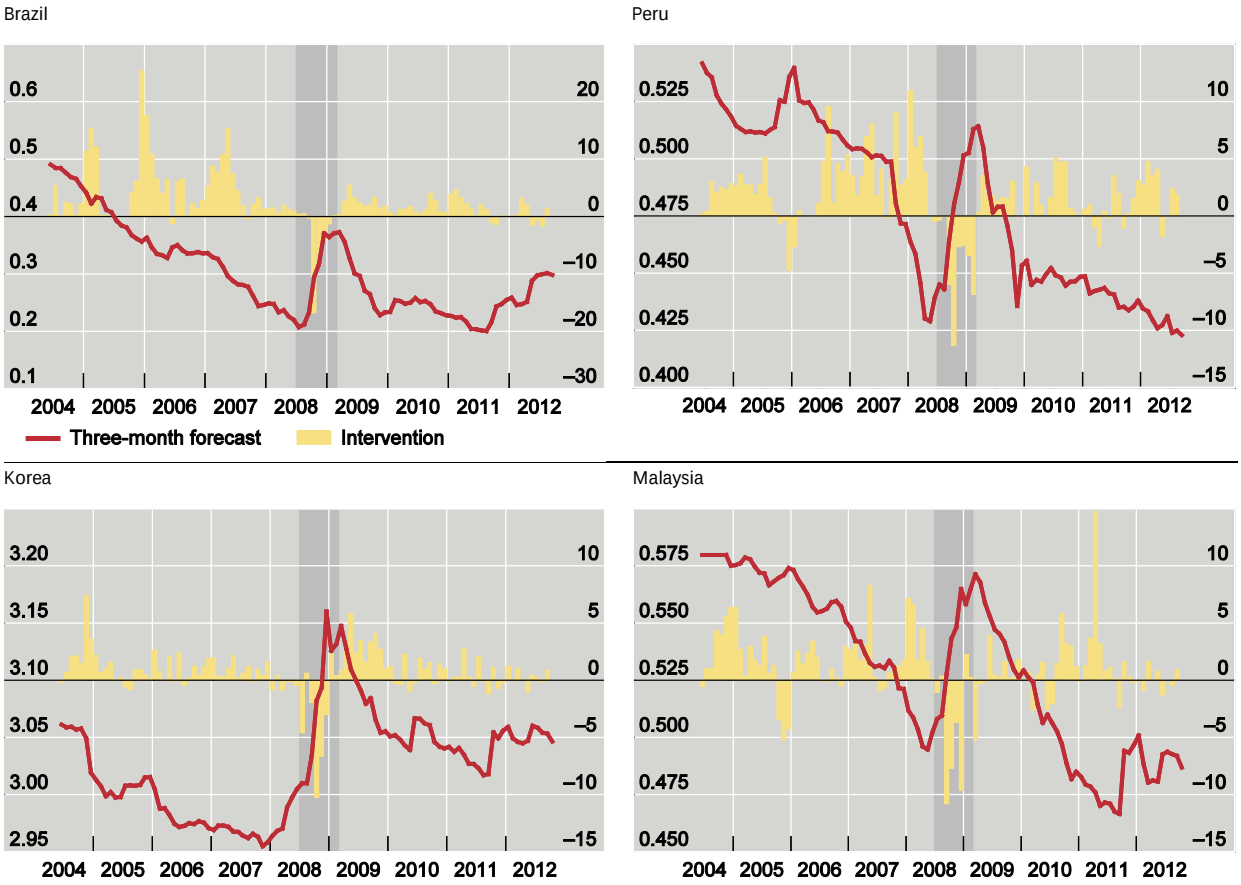
rate expectations. Moreover, during the period starting from 2009, intervention may have had unintended effects on exchange rate expectations. Note that, our findings do not rule out effects to the desired direction during a shorter period. Indeed, an accompanying chapter titled “Capital flow dynamics and FX intervention” finds that central bank intervention helps curb the momentum effect between exchange rate and capital inflows in the short run.

One interpretation of the result is that intervention does not change the near-term exchange rate expectations as they are dictated primarily by fundamentals. A second interpretation is that dollar purchases can increase appreciation pressure because a larger stock of official reserves reduces external credit spreads and attracts more foreign inflows. Similarly, a decline in official reserves reduces investor confidence, and increase both capital outflows and depreciation pressure. Indeed, this “fundamentals” channel may have prompted exchange rate forecasts to adjust to the “wrong” direction in reaction to foreign exchange intervention since 2009.

Appendix

Central bank foreign exchange intervention and three-month exchange rate forecast[1]

Graph A1



[1] Right-hand scale: intervention as a percentage of the stock of official reserves. Left-hand scale: three-month exchange rate forecast in log. Shaded area (July 2008–March 2009) dropped from regression.

Sources: IMF; © Consensus Economist; Datastream; national sources; BIS staff calculations.

Characteristics of central bank foreign exchange intervention

Table A1

	Average	Min	Max	St dev	Frequency[1]		
					Net sale	Net purchase	Zero
	(% of official reserves)				(% of total number of months)		
	June 2004–June 2008						
BR	4.6	–1.2	25.4	5.5	4.1	91.8	4.1
PE	2.7	–4.7	11.0	3.0	12.2	83.7	4.1
KR	0.9	–0.9	7.4	1.4	26.5	73.5	0.0
MY	1.8	–5.2	8.3	2.7	18.4	81.6	0.0
Average	**2.5**	**–3.0**	**13.0**	**3.2**	**15.3**	**82.7**	**2.0**
Median	**2.3**	**–3.0**	**9.6**	**2.9**	**15.3**	**82.7**	**2.0**
	April 2009–August 2012						
BR	1.5	–1.6	5.5	1.7	14.6	82.9	2.4
PE	1.6	–2.7	5.1	1.9	12.2	73.2	14.6
KR	1.0	–1.2	5.8	1.5	31.7	68.3	0.0
MY	1.0	–2.6	14.7	2.8	34.1	65.9	0.0
Average	**1.3**	**–2.0**	**7.8**	**2.0**	**23.2**	**72.6**	**4.3**
Median	**1.3**	**–2.1**	**5.7**	**1.8**	**23.2**	**70.7**	**1.2**

BR = Brazil; KR = Korea; MY = Malaysia; PE = Peru.

[1] Purchase and sale of foreign currency.

Sources: IMF; © Consensus Economics; Datastream; national sources; BIS staff calculations.

Fixed-effect panel model of impact of intervention on exchange rate forecasts[1]

Table A2

Period	June 2004–August 2012								Jun 04–Jun 08	Apr 09–Aug 12
	1	2	3	4	5	6	7	8	9	10
Intervention	–0.027*	–0.026	–0.029*	–0.029*	–0.027	–0.030*	–0.029*	–0.029*	–0.002	–0.087*
	(2.556)	(2.320)	(2.769)	(2.763)	(2.297)	(3.149)	(3.069)	(2.825)	(0.103)	(2.780)
Interest rate diff (3m)		–0.003		0.007	0.008	0.016	0.004	0.014	0.009	–0.036
		(0.170)		(0.434)	(0.498)	(0.815)	(0.257)	(0.625)	(0.353)	(1.298)
Yield curve (12m less 3m)		0.050		–0.001	0.016	0.003	–0.015	0.006	0.081	0.034
		(1.877)		(0.022)	(0.311)	(0.044)	(0.423)	(0.116)	(0.385)	(0.246)
Change in EMBI spread			0.013**	0.013**	0.012**	0.014**	0.013**	0.012**	0.004	0.014
			(4.089)	(4.015)	(3.820)	(4.135)	(4.218)	(4.140)	(2.055)	(2.084)
Energy price inflation					–0.040			–0.040	0.000	–0.077***
					(1.658)			(1.716)	(0.002)	(6.198)
Foreign bond inflows						–0.049**		–0.049**	–0.057**	–0.080***
						(4.651)		(3.805)	(3.988)	(12.603)
US data surprise A[2]							0.008	0.007	0.011	0.009
							(0.321)	(0.311)	(0.272)	(0.279)
US data surprise B[3]							0.008	0.011	–0.115	0.159
							(0.339)	(0.493)	(1.641)	(1.908)
US data surprise C[4]							–0.001	–0.001	0.000	–0.001
							(1.051)	(1.070)	(0.484)	(1.168)
N	363	363	363	363	363	363	363	363	196	166
Adjusted R-squared	0.017	0.013	0.122	0.118	0.131	0.142	0.117	0.155	0.029	0.298

[1] The dependent variable is monthly difference of the log of three-month exchange rate forecasts. Models 1–4 are shown in Table 1. *, ** and *** signify statistical significance at the 10%, 5% and 1% levels, respectively. The numbers in parentheses are *t* values calculated based on standard errors using the Huber-White sandwich estimator (Huber (1967), White (1980)). [2] PMI. [3] Retail sales. [4] Non-farm payroll.

Sources: BIS staff calculations.

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Central bank views on foreign exchange intervention

M S Mohanty and Bat-el Berger[1]

Abstract

This note reviews central banks' views on the objectives, methods and effectiveness of foreign exchange intervention, according to their responses to a survey questionnaire. Due to the recent global financial crisis, objectives have shifted to focus more on curbing capital flows and exchange rate volatility. Central banks prefer less transparent intervention practices, which they time by monitoring the most liquid segments of the market. Interventions are often perceived as being successful in achieving the desired objective. Combining intervention with macroprudential and capital control measures may have contributed to recent successes. Besides analysing these and more findings of this year's meeting, this paper compares them to the results of the last survey from 2004.

Keywords: FX intervention, exchange rate volatility, monetary policy

JEL classification: F31, E58, E52

[1] Bank for International Settlements. We thank Torsten Ehlers, Aaron Mehrotra, Ken Miyajima, Előd Takáts, Philip Turner and Agustin Villar for their contributions and comments.

Introduction

This note summarises the views of central banks represented at this meeting about intervention. It draws on the responses to a survey questionnaire and the papers prepared for this meeting.

Three main questions are addressed:

- How have the objectives and the methods of intervention changed since the Deputy Governors first discussed this topic in 2004?
- How effective do central banks think intervention is in moving the exchange rate in the desired direction?
- What are the effects of intervention on monetary policy and the financial system?

The previous survey conducted for the 2004 Deputy Governors' meeting suggested that many emerging market economies (EMEs) intervened to influence either the level or the volatility of the exchange rate (the results of the survey are summarised in BIS (2005)). Although several central banks held the view that intervention had succeeded in calming disorderly markets and correcting exchange rate misalignment, questions remained about the durability of the impact. While stabilising the exchange rate at the shorter-term horizon was seen as feasible, continuous intervention to attain longer-term exchange rate goals implied large costs. In addition, there was a view that large-scale intervention created challenges for central banks in sterilising excess liquidity and that it raised long-term inflation risks.

A subsequent survey by Neely (2008) summarising the views of a number of advanced and emerging economy central banks concluded that, contrary to the findings in empirical studies, most central banks did not agree that intervention caused higher exchange rate volatility. Several central banks believed that although the portfolio balance channel had weakened, intervention still worked through the signalling, coordination and liquidity channels. Moreover, the same survey noted that "central banks are un-persuaded by most of the common arguments against intervention. The only argument that participants tended to support is that intervention might be used to substitute for other necessary policy changes."

The present survey updates many of the aspects of intervention identified in the 2004 BIS survey. One finding is that, in many cases, intervention in the foreign exchange market has been motivated by efforts to reduce risks to financial and monetary stability in the wake of the 2007–09 global financial crisis. In addition, several central banks have stepped up intervention to support liquidity in the foreign exchange market. In a majority of cases, intervention was seen to be successful in achieving the exchange rate objectives, although the outcome may also partly depend on capital and macroprudential controls. And persistent intervention attenuated the challenges faced by central banks in maintaining consistency in monetary policy and reducing the monetary consequences of issuing large amounts of short-term debt to sterilise their purchase of foreign exchange reserves.

The rest of this note is structured as follows. Section 1 looks at the objectives, methods and techniques of intervention. Section 2 reviews central banks' views about the effectiveness of intervention and the channels it works through. Section 3

discusses the monetary and financial sector effects of intervention. Section 4 concludes.

1. Objectives and methods of intervention

Previous studies have suggested that central banks intervene for various motives, such as to control inflation, maintain competitiveness, ensure financial stability and build foreign exchange reserves; see Moreno (2005) for a review. These motives – not mutually exclusive – depend not only on countries' choice of monetary regime but also on their exposure to external shocks and their balance sheet positions. Moreover, successful intervention depends on the choice of instruments, markets and timing to maximise the impact on the exchange rate.

Have the motives changed?

Table 1 summarises central bank responses regarding the motives of intervention. The motives are ranked according to their importance – high, moderate, low – based on the scores given by the central banks. Although the broad objectives of intervention have remained similar over the past decade, changes are significant in several directions. Curbing excessive exchange rate speculation – the prime motive for intervention – has gained further prominence in the aftermath of the 2007–09 global financial crisis. Of the 19 central banks that responded to this question, 15 (or 79%) considered this to be either highly or moderately important in 2011–12 compared with 12 (or 63%) in 2005–06.

Motives of intervention

Based on the responses of 19 central banks — Table 1

	Importance[1] in 2005–06			Importance[1] in 2011–12		
	High[2]	Moderate[3]	Low[4]	High[2]	Moderate[3]	Low[4]
To curb excessive exchange market speculation	8	4	0	11	4	0
To maintain monetary stability	7	2	2	10	2	2
To discourage sharp capital inflows or outflows	4	3	1	5	5	1
To build or reduce foreign exchange reserves	7	0	2	6	2	2
To smooth the impact of commodity price fluctuations	3	1	3	4	1	3
To maintain or enhance competitiveness	2	2	3	4	1	3
To alleviate FX funding shortages of banks and corporations	4	2	0	5	2	0

[1] On a scale of 1 to 7, where 1 is most important and 7 is least important. [2] 1 or 2. [3] 3 to 5. [4] 6 or 7.

Source: BIS questionnaire, February 2013.

The other crisis-related intervention motive that has gained prominence is the desire to discourage sharp movements in capital flows, with five respondents reporting this motive as highly important and an equal number as moderately important. In addition, five central banks mentioned that alleviating FX shortages was the chief objective of intervention in 2011–12, compared with four in 2005–06.

After the goal of preventing speculation, maintenance of monetary stability remains the second most important objective of intervention, with 63% of respondents reporting this as highly or moderately important in 2011–12, compared with 47% in 2005–06. This is surprising in the light of the recent rapid decline in the pass-through of the exchange rate into inflation in EMEs, which should have reduced the role of the exchange rate in monetary policy. Among other objectives, building foreign reserves continues to be the top priority for several central banks. Enhancing competiveness was not considered to be a primary motivation of intervention in a majority of cases; nevertheless, four respondents consider that objective as highly important, compared with two in the mid-2000s.

To achieve its final objective, the central bank needs to set an intermediate one in terms of either the level or the volatility of the exchange rate, or both. Table 2 summarises what central banks consider as their exchange rate objectives. Most consider limiting volatility and smoothing the trend path of the exchange rate ("leaning with the wind") as more important than influencing the level of the exchange rate. Going by the number of responses, it is interesting to note that the relative position of the three objectives has not changed since the mid-2000s. Where the changes have been most significant is in the desire to limit upward or downward pressures on the exchange rate caused by international capital flows and to inject liquidity into a thin FX market. As shown by the last two columns of Table 2, the number of central banks intervening for these two purposes increased dramatically in 2008 and 2009 but fell in the following years as market conditions improved gradually.

Immediate objectives and success of foreign exchange intervention

Based on the responses of 19 central banks — Table 2

	Influence the level of the exchange rate	Smooth trend path of the exchange rate	Limit exchange rate volatility	Limit upward or downward pressure caused by international investors	Provide liquidity to a thin exchange market
2005	4	7	11	8	2
2006	4	8	12	7	2
2007	5	8	12	7	2
2008	5	8	12	12	10
2009	4	8	13	10	8
2010	3	9	12	7	6
2011	3	8	12	8	4
2012	4	7	11	8	4

Source: BIS questionnaire, February 2013.

In sum, these results suggest that the preference among EMEs for managing the exchange rate has strengthened since the 2007–09 global financial crisis. Note that the results are not affected by responses from economies that have formally fixed their exchange rate, since the respondents included only one fixed exchange rate regime. Although the survey did not seek to identify the factors underlying changes in objectives, there are several candidate explanations. One is an increase in perceived risk to financial stability arising from volatile capital flows. Intervention

may be seen as a tool to break the momentum effect on the exchange rate, as noted in the paper by Ehlers and Takáts.

A second reason could be increased exposure to liquidity shocks caused by the greater interconnectedness of markets. Although many emerging markets avoided going into "free fall" during 2008–09 because of the strength of their balance sheets (in terms of eg reduced currency mismatches, large FX reserves and improved fiscal positions), the crisis also demonstrated their exposure to large deleveraging pressures and sudden loss of liquidity in several markets. The paper from Korea illustrates this point very well. Although Korea enjoys current account surpluses, its vulnerability to capital flow shocks had risen before the crisis because of extensive forward FX hedging by exporters and the increased involvement of banks in supplying these hedges. Because banks have to borrow abroad and/or use the swap markets to hedge their FX exposures, they have been highly vulnerable to international liquidity shocks.

Finally, exchange rate intervention may substitute for interest rate policy in macroeconomic management. The paper from the Czech Republic demonstrates a rather unique challenge for an emerging market, as the policy rate in the economy has dropped to almost zero since November 2012. The central bank has used foreign exchange intervention as a monetary policy tool for stabilising the economy.

Methods and tactics of intervention

Methods and tactics matter, as central banks may use their advantages over market participants – access to information, and market and regulatory powers – to make intervention a success. Previous surveys by Canales-Kriljenko (2003) and Archer (2005) indicated that there is a great deal of consistency in the choice of mechanics of intervention across EMEs. A majority of countries used wholesale spot markets, preferred secrecy to transparent operations, and selected the timing and the size of intervention so as to exert maximum influence on the exchange rate. The current survey attempts to provide further evidence on these aspects.

Table 3 summarises the responses regarding the tactics of intervention on three main dimensions: monitoring of markets; timing of intervention; and instruments of intervention. It is clear that central banks refer to a range of indicators in determining their intervention decisions. There is a strong preference for monitoring global risk sentiment indicators such as the VIX and bond spreads. Of the 21 central banks that responded to this question, 15 stated that they use these indicators regularly, and two use them occasionally. In addition, central banks pay a great deal of attention to cross-border banking activity and possible shifts in international portfolio flows as well as developments in specific markets such as the United States and Europe.

Timing of intervention and markets targeted

Regarding timing, the results suggest an overwhelming preference for intervening only after the market has moved in a certain direction, and very little appetite for pre-emptive intervention. Of 21 respondents, 17 stated that they regularly time their interventions according to market developments, and three said that they do so only occasionally. By contrast, only eight central banks reported that they regularly or occasionally conduct pre-emptive interventions. This is not surprising, as pre-emptive intervention may increase market uncertainty and cause unwarranted volatility. To the extent that pre-emptive intervention is more difficult to justify than

reactive intervention, it also exposes the central bank to political criticism. In contrast, timing intervention relative to a certain positioning of market participants (such as build-up of speculative order flows) can lead to faster and more concrete results.

Intervention tactics

Based on the responses of 21 central banks — Table 3

	Regularly	Occasionally	Never
Monitoring activity for FX intervention			
Monitoring of cross-border bank lending	12	2	5
Monitoring of cross-border security purchases/sales	13	2	4
Monitoring of equity/corporate bond market developments in the US or Europe	11	2	6
Monitoring of risk indicators in industrial countries (VIX, sovereign spreads, etc)	15	2	3
Timing			
Timing of intervention based on observed developments in FX markets	17	3	0
Intervention is pre-emptive, in response to other news	2	6	11
Market-based instruments			
Direct or indirect intervention in spot markets	19	2	0
Intervention in forward markets	2	8	11
Use of derivatives (futures, swaps, volatility options, others)	3	7	11

Source: BIS questionnaire, February 2013.

Table 3 confirms the findings of the previous survey about instruments of intervention. Most central banks (19 out of 22) intervene in the spot market. Only two central banks reported that they regularly use forward markets for intervention, and eight said that they do so only occasionally. The use of derivatives markets also remains limited. One reason for concentration on the spot market could be that it is the most liquid market in many countries, helping to reduce any unintended consequences from intervention in terms of market volatility. A second reason, as mentioned in the note from the South African Reserve Bank, is that spot interventions can help limit central banks' net forward positions, which themselves can be a reason for currency speculation.

Yet the paper from Korea suggests that spot and forward market interventions can serve very different purposes. The Bank of Korea operates in the spot market when the objective is to limit exchange rate volatility, but prefers to use the swap market when the goal is to supply FX liquidity. In Colombia, during the early 2000s the central bank primarily used FX options for its intervention operations (sell/buy US dollars when the exchange rate moves beyond a certain threshold in any one single day) partly because the market for hedging was not well developed.

Average size of daily FX interventions

Table 4

	In USD millions				As a percentage of daily FX market turnover				As a percentage of average monthly FX reserves			
	2007	2010	2011	2012	2007	2010	2011	2012	2007	2010	2011	2012
Latin America[1]	109.2	185.1	194.6	166.6	8.3	5.1	6.0	11.0	0.5	0.5	1.0	0.7
Asia[2]	2.6	...	...	9.7	1.0	...	0.1	0.2	0.2	...	...	0.2
Emerging Europe[3]	50.6	41.3	55.8	81.8	95.0	65.0	70.0	105.0	13.0	4.0	5.5	10.0
Other emerging economies[4]	222.5	230.0	438.0	40.0	0.1	1.4	0.6	0.2	0.1	0.1	0.1	0.1
Total	99.7	133.5	179.6	99.6	21.2	14.4	14.8	26.6	2.7	1.0	1.4	2.2

[1] Based on the responses of six central banks. [2] Based on the responses of two central banks. [3] Based on the responses of two central banks. [4] Based on the responses of two central banks.

Source: BIS questionnaire, February 2013.

Size of intervention

Table 4 shows information about the size of interventions. Note that the regional averages are not strictly comparable, because the number of respondents is much smaller for Asia and emerging Europe than for Latin America. Therefore, comparisons have been made mostly across time. Compared with the levels in 2007, the absolute size of daily intervention has increased in most regions following the recent crisis. The typical average size of daily intervention in EMEs increased from less than $100 million per day in 2007 to about $133 million and $180 million, respectively, in 2010 and 2011. In 2012, the average size of intervention fell to close to the 2007 level.

The size of intervention relative to FX market turnover has often been suggested as an indicator of central banks' market power to affect the current exchange rate, and its share in FX reserves as a measure of their potential "firepower" to influence the future exchange rate. Based on the previous survey, Mihaljek (2005) reported that the typical share of intervention in turnover in EMEs had fallen from 12% in 2002 to 8% in 2004. The middle four columns of Table 4 report the corresponding results of the current survey.

Notwithstanding significant fluctuations over the years, these shares are significantly higher now than they were a decade ago. The last four columns of Table 4 report the ratio of intervention size to the stock of FX reserves. The current survey confirms the findings of the previous survey in that these ratios have remained small in most EMEs (with the exception of emerging Europe), largely because the reserves have in many cases risen over the past decade. This suggests that central banks possess substantial power to defend a weaker exchange rate, should there be a need.

Note that the survey results do not provide evidence on the direction of central bank intervention. Up until 2007, many EMEs faced strong appreciation pressures, so intervention was often carried out to weaken the exchange rate. However, several country papers suggest that the direction of intervention has changed significantly since the 2007–09 crisis. During the crisis, the Bank of Korea sold large amounts of dollars ($10.3 billion to foreign exchange banks through swap transactions) to

contain the depreciation pressure on the won. In Poland, intervention in the second half of 2011 was prompted by the sharp depreciation of the zloty as risk sentiments deteriorated markedly around the world (see the paper from the Bank of Poland). Other countries, such as India, which intervened to limit appreciation for several years, have been combating strong currency depreciation pressures over the past two years (see the paper from India).

Public information provided

Based on the responses of 22 central banks — Table 5

	Regularly	Rarely	Never
Does the central bank preannounce FX intervention?	4	2	15
Accompanied by information on which of the following aspects?			
Size	5		1
Time span	5		1
Instrument(s) used	5	1	
Are intervention-related data made public ex post	13		7

If so, what is the frequency of the data published?	Real time / hourly	Daily	Weekly	Monthly	Annually
	3	5	1	6	1

Source: BIS questionnaire, February 2013.

Transparency of intervention

Table 5 contains survey responses on the transparency of intervention. Many authors have argued that central banks conduct secret interventions to maximise the impact on the exchange rate (Dominguez and Frankel (1993), Neely (2000), Sarno and Taylor (2001)). Some central banks prefer secrecy to transparency, especially when intervention is inconsistent with the goals of monetary policy. Others have argued that transparent intervention is preferable because it increases the power of the signalling and coordination channels, thereby enhancing the efficacy of intervention (Archer (2005)).

It is clear that few central banks conduct preannounced interventions. A majority of EME central banks (15 out of 22) keep intervention secret. Only four central banks reported that they announce their interventions on a regular basis before carrying them out, while two said that they rarely do so. It is not surprising that central banks conducting a preannounced intervention provide full details of timing, size and types of instrument used. Behind many of these interventions, the objective may simply be to accumulate reserves rather than affect the exchange rate. In addition, the survey results show that post-intervention transparency is quite limited. Only a few countries (those conducting preannounced interventions) publish intervention-related data on either a daily or a real-time basis.

2. Effectiveness of intervention

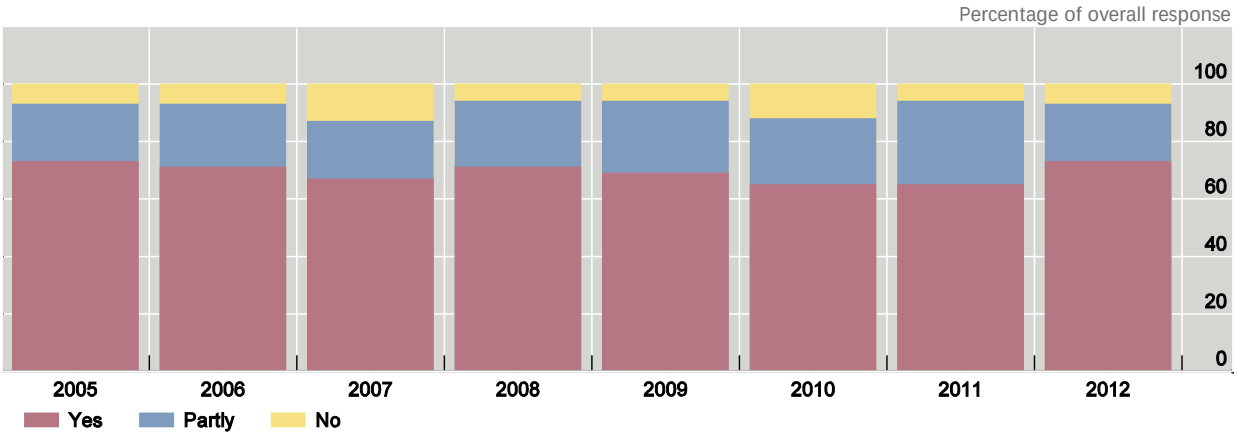
Have interventions been successful? Previous surveys reported that most central banks regarded their interventions as successful in moving the exchange rate in the

desired direction (Neely (2000, 2008), Mihaljek (2005)). This contrasts with some empirical literature, which finds that intervention has had very little or no effect on the exchange rate (see the paper by Miyajima and Montoro for this meeting for a review). This section attempts to provide new evidence on this issue based on survey responses and central bank research.

To enable comparison over time, the survey sought feedback from central banks on the success of intervention since the mid-2000s. The results, shown in Graph 1, are noteworthy in at least two respects. First, they confirm the findings of the previous surveys about the effectiveness of intervention: of the 19 respondents, around 70% reported that interventions were successful in achieving the exchange rate objective, while roughly 20% reported that they were only partly successful. In the remaining cases, intervention was seen to have had no effect on the exchange rate.

Central bank views about the success of intervention

Based on the responses of 19 central banks to the question "Did intervention succeed?" Graph 1



Source: BIS questionnaire, February 2013.

Second, the pattern of responses has not changed much over the past eight years. According to these central bank assessments, there is no significant evidence to suggest that intervention was more successful during the crisis than it was before, even though many countries introduced exceptional liquidity measures and sold large amounts of dollars during the crisis to combat currency depreciation pressures.

Nevertheless, the survey results provide no evidence on the magnitude of the impact, or on its persistence – where disagreement with the empirical literature seems to be the greatest. Indeed, country experiences and recent evidence vary significantly on this issue. For instance, the evidence presented by Miyajima and Montoro for this meeting suggests that interventions do not generally have the intended effect on the expected future exchange rate. The paper from Chile makes a similar point. Although the peso depreciated in the second half of 2011 (following the announcement of dollar purchases by the Central Bank of Chile), it quickly converged back to the path consistent with the scenario of no intervention. Likewise, several recent studies conducted at the Czech National Bank suggest that

intervention has had very little or no effect on the exchange rate (Gersl (2006) and Egert and Komarek (2005)).[2]

By contrast, in the case of Peru most studies by the central bank's staff demonstrate that intervention has been successful in dampening exchange rate volatility in the context of the country's partially dollarised economy (Rossini et al (2011), Humala and Rodríguez (2009)). As pointed out by Batini et al (2008), foreign exchange intervention could be a component of the optimal policy in a dollarised economy, to stabilise inflation and output.

Some studies show that interventions have also been successful in Brazil and Poland, even though these countries have differed markedly from Peru in terms of balance sheet conditions. In the case of Brazil, Kohlscheen (2012) shows that small changes in dollar purchases/sales by the central bank lead to large changes in private sector pricing behaviour, as seen from order flows. This could be taken as indirect evidence that the monetary authority has a coordinating role in price setting in the foreign exchange market. The paper from Poland for this meeting points out that the central bank intervened several times during the second half of 2011. The interventions were successful in influencing FX returns and implied exchange rate volatility in the desired direction for several days.

Compared with Latin America and emerging Europe, evidence in Asia about the impact of intervention is generally scant. Nevertheless, one central bank reported that the impact depends on the direction of intervention, implying a certain asymmetry in the central bank's influence over the exchange rate. While dollar sales by the central bank have had a statistically significant effect on exchange rate volatility, dollar purchases have led to higher rather than lower exchange rate volatility.

Channels of influence

These findings raise issues about the channels through which intervention works. A significant amount of literature (eg Dominguez and Frankel (1993), Taylor (2005)) has focused on the traditional channels, such as the monetary policy channel, when intervention is not sterilised. Even when fully sterilised, intervention may change the risk premium, which occurs when domestic and foreign bonds are imperfect substitutes (the portfolio balance channel); alter the expected future values of the exchange rate and interest rate (the signalling channel); and affect the order flows of traders, and market liquidity more generally (the microstructure channel). These channels are believed to be stronger in EMEs than in advanced economies because of the lower substitutability of EME assets for other assets, and due to smaller market size. And the information advantage of the central bank is often greater, given its role as the regulator and supervisor of the financial system (see Disyatat and Galati (2005) for a review).

Another approach is to examine the impact of intervention in the context of other policies (eg capital controls and macroprudential tools) which can influence

[2] In addition, different authors have come up with very different results focusing on the same intervention episodes. For instance, of the two studies furnished by the Central Bank of Turkey for this meeting, one reported that large and sporadic intervention was successful in changing the trend path of the Turkish lira (Akinci et al (2005)), while the other showed that intervention led to higher rather than lower exchange rate volatility (Herrera and Özbay (2005)).

the success of intervention. Such an approach may also include various macroeconomic and financial sector linkages with intervention in the context of a general equilibrium model (see the paper from Colombia for this meeting).

Table 6 reports the results of the survey with reference to the traditional channels. According to the central banks questioned, intervention is effective mainly through the signalling channel, a finding which confirms the results of previous surveys reported by Lecourt and Raymond (2006) and Neely (2008). Importantly, this channel works primarily by changing the expectations of the future exchange rate rather than the interest rate. Taking the post-crisis period as a whole, nine out of 16 respondents (56%) reported that intervention was often accompanied by a change in expectations regarding the future exchange rate. This is a significantly higher percentage than that reported for the pre-crisis period (37%). Two central banks reported that the signalling channel was sometimes important for the impact of intervention, while three said that it was rarely important (the same number as in the pre-crisis period). By contrast, only two central banks reported that intervention changed expectations regarding the future stance of monetary policy.

Effectiveness of intervention, by channel

Based on the responses of 16 central banks — Table 6

	Unsterilised intervention		Sterilised intervention							
	Monetary policy[1]		Portfolio balance[2]		Expectations about: future monetary policy stance[3]		Expectations about: future exchange rate and interventions		Other[4]	
	Up to 2007	After 2008	Up to 2007	After 2008	Up to 2007	After 2008	Up to 2007	After 2008	Up to 2007	After 2008
Often	2	2	1	2	1	2	6	9	2	3
Some-times	1	1	3	4	3	2	2	2	1	2
Rarely	4	5	4	3	2	4	3	3	2	2

[1] Domestic interest rates are affected when interventions are not fully sterilised. [2] The composition of domestic and foreign assets held by market participants changes after sterilised intervention. [3] Sterilised intervention changes exchange rate expectations by signalling about the future monetary policy stance. [4] For example, the microstructure channel, where intervention affects orders placed by traders who follow past market trends.

Source: BIS questionnaire, February 2013.

What is important to note is that other channels made very limited contributions to the success of intervention. Central banks' views on this have not changed much following the recent financial crisis or with the development of financial markets in EMEs. Interestingly, only two central banks reported that the portfolio balance channel was often important to the success of intervention during the post-crisis period, compared with one in the pre-crisis period. There is some evidence that intervention may work through the microstructure channel (last two columns of Table 6). However, overall, the results do not support the operation of a strong order flow or liquidity channel.

Finally, the importance of the pure monetary policy channel is limited. The survey results indicate that in most EMEs interventions were sterilised, as is to be expected with an independent monetary policy regime. Two central banks reported that interventions were often unsterilized, and one reported that they were

sometimes sterilised. The former group includes Hong Kong SAR, where, given the currency board, all interventions are in principle unsterilised. The paper from Hong Kong notes that the monetary authority has strictly adhered to this rule at all times, even when the interest rate level is incompatible with the prevailing economic and asset market conditions.

A broader question is how far the success of intervention was in some cases influenced by capital controls and other prudential measures that restrict certain types of capital flows or position-taking by market participants. Table A1 in the annex shows the details of the measures introduced over the past five years by countries that answered this question. These measures include reserve requirements on short-term inflows (Argentina, Brazil, Colombia and Russia), taxes on capital flows (Brazil and Russia), a macroprudential stability levy on banks (Korea), enhanced reporting requirements for forward positions (Israel and Korea) and in some cases limits on FX hedging.

Measures to complement FX interventions

Based on the responses of 16 central banks — Table 7

	Capital control measures		Prudential measures		Other	
	Up to 2007	After 2008	Up to 2007	After 2008	Up to 2007	After 2008
Often	2	1	1	4	0	1
Sometimes	3	3	5	4	2	3
Rarely/never	7	7	6	7	6	6

Source: BIS questionnaire, February 2013.

Table 7 shows that, in several cases, interventions were often combined with measures to stabilise capital flows. In the aftermath of the crisis, many countries especially used macroprudential controls as a policy complementing foreign exchange intervention. Half of the 16 respondents used them in conjunction with intervention either often or sometimes, compared with six in the pre-crisis period. In addition, four countries combined intervention with capital control measures, one of them often doing so (compared with five in the pre-crisis period). In four countries, other restrictive measures were in place to support intervention.

The survey did not cover the contribution of these policies to the success of intervention. Although many empirical studies have examined the effectiveness of capital controls in reducing capital flow volatility, few have examined their role in foreign exchange market intervention. One recent study in the context of Colombia reported that intervention and capital controls by themselves were generally unsuccessful in preventing currency appreciation (Rincón and Toro (2011)). By contrast, during 2008–10, the authorities used both policies simultaneously and were successful in stemming currency appreciation without increasing the volatility of the exchange rate.

3. Intervention and monetary policy

Intervention in the foreign exchange market has direct implications for monetary policy. Research has highlighted two major issues: (i) the consistency of intervention with the monetary policy stance; and (ii) implications for domestic monetary

conditions and financial markets (see Mohanty and Turner (2005)). The first issue relates to the possibility that intervention to appreciate or depreciate the exchange rate may run counter to a monetary policy stance geared to stabilising inflation and output. For instance, the monetary authority may find it difficult to combat inflation (or recession) pressures at the same time as attempting to depreciate (or appreciate) the currency. In addition, intervention can send the wrong signals about monetary policy. Such inconsistency can reduce the efficacy of both exchange rate and monetary policy.

As regards the second issue, previous research suggested that the domestic implications of intervention depend not only on the extent to which it is sterilised but also on the instrument of sterilisation (and who holds the sterilisation securities). The associated balance sheet changes can affect bank lending behaviour and monetary conditions more generally in the economy.

When FX reserve purchases are sterilised by selling long-term government bonds to the non-bank sector, private holding of money balances falls. In addition, bank balance sheets are unaffected, eliminating any expansionary implications of sterilisation for bank credit. In contrast, sterilisation of interventions through the selling of government or central bank securities to banks leads to changes in the banking system's balance sheet. In addition, the maturity composition of sterilisation bonds has monetary implications in the sense that short-term debt is a close substitute for bank reserves (see Filardo et al (2012) for a review).

Policy consistency

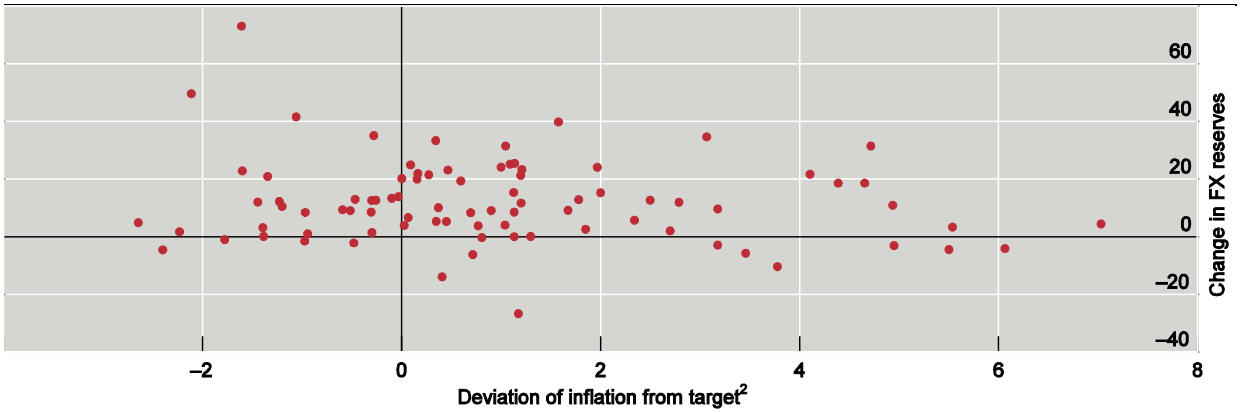
The survey collected central bank responses on both of the above issues. On the question of the consistency of intervention with monetary policy, central banks' qualitative responses suggest that conflicts have indeed arisen in this connection in recent years and have affected intervention decisions. One central bank cited an occasion when it would have been desirable to intervene in the FX market to contain excessive exchange rate volatility; yet no intervention took place, as it might have further accelerated inflationary pressure in an environment where inflation was exceeding the central bank's target. Another central bank mentioned that intervention to stem appreciation was suspended as inflation expectations increased and raised the risks of future inflation. In another case, efforts to curb depreciation pressure through both higher interest rates and intervention in the FX markets created a difficult policy dilemma for a central bank seeking to limit risks to growth.

Graph 2 demonstrates a generalised illustration of policy consistency for inflation targeting countries. The graph shows the deviations of inflation from the target and the change in the foreign exchange reserve in the same year. Policy consistency implies that when intervention is motivated by inflation concerns, and inflation is above target, FX reserves should not increase, as the central bank should allow for more rapid appreciation. In the same way, efforts to resist appreciation by increasing reserves should be accompanied by a decline in inflation below the target. When there is no conflict between the policies for one particular year, the observation for that year should be in quadrants 2 or 4.

Graph 2 shows that there have been cases where above-target inflation was accompanied by an increase in FX reserves (observations falling in quadrant 1), suggesting that intervention possibly came into conflict with the objective of domestic monetary policy. Interestingly, however, when inflation has been below

target, FX intervention has mostly been consistent with inflation targets (observation falling in quadrant 2).

Inflation targeting and FX intervention[1] Graph 2



[1] Year-on-year percentage changes over the period 2001–11; for Turkey, 2003–11. [2] Deviation of inflation is expressed as the difference between actual inflation and the inflation target (point target, or lower or upper bound of target range), based on annual data. Economies included: Brazil, Chile, Colombia, the Czech Republic, Hungary, Indonesia, Israel, Korea, Mexico, Peru, Poland, the Philippines, South Africa, Thailand and Turkey.

Sources: IMF, *International Financial Statistics* and *World Economic Outlook*; national data; authors' calculations.

Intervention and sterilisation

Sterilisation can be implemented in various ways. A traditional way to absorb liquidity on a relatively permanent basis involves an increase in reserve requirements, effectively transforming excess liquidity into required reserves. Another way is to shrink the domestic assets side of the central bank balance sheet through the sale of government paper to commercial banks. Given that prolonged intervention reduces the stock of government securities (particularly in economies that have mostly run fiscal surpluses in the past), however, central banks have increasingly issued their own securities to finance the increase in foreign assets. Based on data reported by the central banks for the meeting, at the end of 2011 the stock of such securities outstanding amounted to $354 billion in emerging Asia (a nearly fivefold increase from 2000) and $197 billion in Latin America (close to a fourfold increase).

The survey asked central banks to rank each sterilisation instrument on a scale of 1 to 3 according to its effectiveness, cost affordability and impact on market development. The survey responses, shown in Table 8, highlight the perceived benefits of using market-based methods, in particular central bank securities, for sterilisation. Of the 21 central banks that responded, 15 said that issuing their own securities is the most effective way to sterilise intervention. And that method is generally seen as conducive to financial sector development. But it is costly, as central banks have to pay the market rate of interest, which could rise given an increased supply of securities. Next in order of importance are FX swaps, although they are not perceived as being as effective as central bank securities. It is not surprising that reserve requirements are viewed by central banks as one of the most cost-effective tools for sterilisation, but at the same time this relatively blunt instrument is not regarded as beneficial for market development.

Sterilisation instruments

Ranked by 21 central banks, with 1 being the highest score and 3 the lowest — Table 8

Instrument	Number of central banks using instrument	Assessment								
		Highly effective			Low-cost			Beneficial to overall market development		
		1	2	3	1	2	3	1	2	3
Market instrument										
Central bank securities	15	14	1	0	4	7	3	11	4	0
FX swaps	7	2	4	0	4	2	0	3	3	0
Government bonds	6	1	3	1	2	1	2	5	0	0
Other[1]	6	2	4	0	0	5	0	2	4	0
Non-market instruments										
Reserve requirements	8	3	1	3	4	2	1	0	1	6
Government deposits	7	4	1	1	3	3	0	3	0	3
Special deposit facilities	2	0	0	1	1	0	0	0	0	1
Other[2]	4	3	1	0	3	1	0	1	2	1
No sterilisation using monetary instruments	3									

[1] Mostly (reverse) repos and uncollateralised borrowing. [2] Mostly bank deposits.

Source: BIS questionnaire, February 2013.

The survey also highlighted two other aspects of sterilised intervention, namely maturity and the identity of the holders of government and central bank securities. As noted above, a shortening of sovereign debt maturities implies an expansionary monetary policy, and an increase a contractionary policy. It is striking that the average maturity of government debt securities in EMEs has increased over the past decade while that of central bank securities has fallen and generally remained below one year (Table 9).

Average maturity of government and central bank securities at year-end

Table 9

	Government securities (percentage of total outstanding)				Central bank securities (percentage of total outstanding)			
	Less than 1 year	Between 1 and 3 years	Above 3 years	Average remaining maturity in years	Less than 1 year	Between 1 and 3 years	Above 3 years	Average remaining maturity in years
2000	32.6%	25.9%	41.5%	3.8	72.7%	14.3%	7.7%	0.8
2005	18.6%	21.2%	57.1%	5.7	78.1%	18.9%	20.5%	1.1
2010	18.4%	24.0%	59.7%	6.2	86.4%	17.5%	6.9%	0.6
2011	17.2%	22.8%	60.8%	6.2	75.4%	15.3%	8.2%	0.8

Sources: BIS questionnaire, February 2013; BIS calculations.

As regards the holders of sovereign securities, it is clear from Table 10 that a large part of the stock has been held by the banking sector. Consistent with the scale of intervention, banks' share of sovereign debt holdings has remained particularly high in Asia, even though it fell from a peak of 56% at the beginning of

the 2000s to 40% at the end of 2011. In emerging Europe, the share has increased rapidly over the past decade, to about 48% in 2011, exceeding the figure for Latin America in recent years.

Holders of government and central bank securities

As a percentage of total holders of government and central bank securities; regional averages[1] Table 10

	Latin America		Asia		Emerging Europe		Other emerging economies	
	Banks	Non-banks	Banks	Non-banks	Banks	Non-banks	Banks	Non-banks
2000	31.9	68.1	55.8	44.2	18.7	81.3	23.3	76.7
2005	36.0	64.0	39.2	60.8	38.5	61.5	25.8	74.3
2010	36.3	63.7	42.5	57.5	46.7	53.3	25.5	74.6
2011	35.8	64.2	39.6	60.4	48.2	51.8	26.2	73.8
Median	36.7	63.3	43.1	56.9	39.2	60.8	25.1	74.9

[1] Averages weighted by US dollar values of securities holdings. "Banks" refers to commercial banks. "Non-banks" refers to other domestic financial institutions, non-residents and other holders of securities.

Sources: BIS questionnaire, February 2013; BIS calculations.

4. Conclusion

The survey highlights a number of facts about central bank foreign exchange intervention which are consistent with the results of previous surveys. While maintaining monetary and financial stability continues to be the primary motive for intervention in most countries, there has been a significant shift of emphasis in the wake of the recent global financial crisis, towards reducing risks to the economy. Most recent interventions have been directed at preventing speculative currency pressures and reducing risks to inflation, as well as curbing volatility in capital flows. Alleviating FX funding liquidity has also remained an important objective in many countries.

The survey results indicate that many countries attempt to achieve these objectives by limiting exchange rate volatility rather than by setting a path for the exchange rate level. The basic intervention strategy has remained unchanged, that is: monitoring of information about international investors' positions; a focus on the most liquid segments of the market; and a preference for less transparent intervention practices to maximise results.

Most central banks believe that their interventions have been successful in achieving the desired exchange rate objective, although differences of opinion exist as to the size and the duration of impacts. As regards the channels of influence, many central banks think that intervention works primarily through the signalling channel, that is, by changing expectations about the future exchange rate as well as signalling forthcoming interventions. The recent success could also be due to the fact that many countries used macroprudential and capital control measures as a complementary tool to intervention.

As regards monetary policy implications, there is some evidence to suggest that intervention may have at times proved inconsistent with the stance of monetary

policy. In addition, prolonged interventions have been accompanied by significant balance sheet effects such as large or growing holdings of sovereign securities in the banking sector and a substantial increase in short-term central bank paper, with implications for bank lending behaviour and monetary conditions in general. These monetary effects will determine the sustainability of interventions in the long run.

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Appendix

Non-market-based measures taken by the central bank or the government in the last five years

Table A1

	Taxes	Reserve requirements	Other
Argentina		Interest-free deposit for 365 days equivalent to 30% of certain capital inflows (financial sector and non-financial private sector financial liabilities)	Time restriction on financial borrowing traded in the domestic foreign exchange market and on rollovers of non-financial private sector external liabilities. Minimum one-year term requirement for foreign financial debts and portfolio investments. Residents require central bank approval to access the local FX market to buy foreign assets. Repatriation of foreign direct investment in banking institutions requires central bank approval. Non-residents can also repatriate portfolio investments up to a monthly limit of USD 500,000.
Brazil	Various increases and decreases of the Tax on Financial Operations (IOF) for foreign transactions	Reserve requirement for banks holding short spot positions larger than USD 1 billion (down from USD 3 billion)	Local banks prohibited from lending, swapping or renting securities to foreign investors. Registration of export prepayments limited to contracts with a maturity below one year.
Colombia		Imposition of a deposit of 50% (up from 40% before May 2008) on inflows towards portfolio investments Imposition of a 40% deposit on foreign borrowing (had been reduced to 0% in 2008), complemented by the imposition of reserve requirements for the purpose of curbing leverage	Minimum period of two years imposed for all foreign direct investments. Limits on pension fund positions, among others.

Non-market-based measures taken by the central bank or the government in the last five years (cont) Table A1

	Taxes	Reserve requirements	Other
Israel	Cancellation of the tax exemption granted to foreign investors on gains from investments in Makam (short-term loans issued by the Bank of Israel) and in short-term government bonds	Imposition of reserve requirements on banking corporations for FX derivatives transactions with non-residents	Residents and non-residents are required to report to the Bank of Israel any transactions in FX swaps and FX forwards exceeding USD 10 million in a single day. Non-residents are required to also report transactions involving Makam and short-term government bonds exceeding ILS 10 million in a single day.
Korea	Reintroduction of a withholding tax on foreign purchases of treasuries and monetary stabilisation bonds Macroprudential stability levy		Limit imposed on local companies' FX hedging ratios. Subsequent reduction in the cap on local companies' FX hedging ratios from 125% to 100%. Reinforcement of regulation on foreign currency lending for domestic use. Limit imposed on banks' foreign currency forward positions: 50% of capital for domestic banks, 250% for foreign banks; subsequently cut to 40% and 200% of capital, respectively. Limit imposed on investment in non-KRW-denominated bonds issued in the domestic market.
Russia	Introduction of special measures that slightly tightened the tax regime with regard to corporate sector foreign borrowing	Use of differentiated reserve requirements for banks' domestic and foreign liabilities (higher level for foreign liabilities)	The Bank of Russia issued recommendations to banks to keep stable net foreign assets and currency positions. Adherence to these recommendations was taken into account when determining banks' individual credit limits for unsecured loans from the Bank of Russia. If a bank ignored these recommendations, its individual limits for Bank of Russia unsecured loans were considerably cut.

Source: Central bank responses to the February 2013 BIS questionnaire.

Recent developments in the BRL market

Central Bank of Brazil

Abstract

During the fourth quarter of 2012, the domestic FX market in Brazil was volatile as massive financial outflows were exerting pressure on the real. With the aim of preserving the smooth adjustment of the exchange rate to economic fundamentals while resisting a disorderly currency depreciation and excessive volatility, the Brazilian central bank made use of a mix of macroprudential and market intervention approaches that proved to be effective.

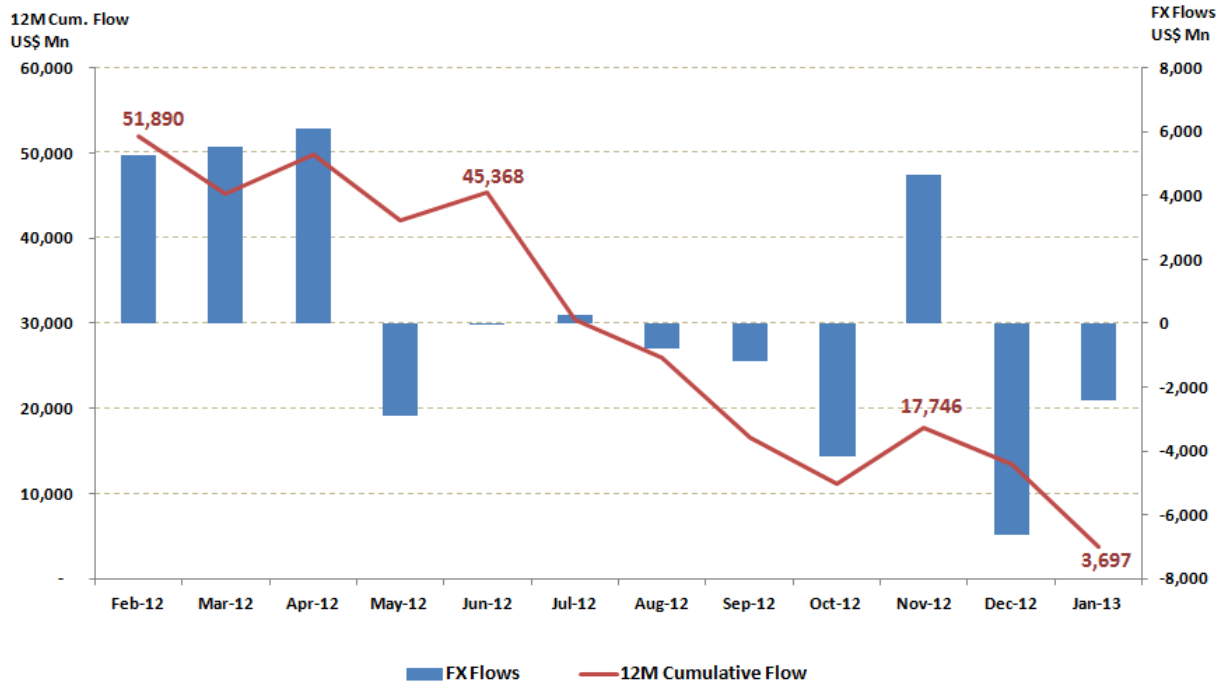
Keywords: FX outflows, foreign exchange intervention, macroprudential measures, Central Bank of Brazil, current account, foreign direct investment

JEL classification: F31, F32, F36

Since December of last year, Brazil has experienced large commercial and financial outflows, amounting to almost USD 9 billion. In December the figure was USD 6,6 billion, evenly shared between both segments. This behavior was expected, especially in the financial segment, as remittance flows are highly expected at the end of the calendar year.

January saw another negative flow, led by a USD 3,5 billion commercial outflow which was partially offset by a USD 1.1 billion financial inflow. As a result, the 12 month cumulative FX flow reached the lowest level in 40 months, USD 3.7 billion (Figure 1). By comparison, the peak of this series was in August 2011, when the cumulative flow reached USD 75 billion.

Figure 1



Despite the disappointing numbers from the external sectors, which raise important concerns about the trajectory of the current account – the Brazilian Central Bank (BCB) forecasts a USD 65 billion deficit for 2013 – foreign direct investment remains very robust. In 2012 FDI totaled USD 65.3 billion and the official forecast points to the same volume in 2013, signaling that FDI alone will likely be able to finance the current account deficit.

In order to deal with the large outflows observed in late December and their potential negative impacts on the liquidity of the local FX market the, BCB announced several credit line auctions. Those auctions were in essence FX swaps where the BCB sold spot dollars combined with outright repurchase. In all, the BCB provided USD 5.5 billion in dollar lines through 16 auctions, with maturities up to March 2013.

A further step taken by the BCB in December to alleviate pressures in the spot market was the decision to extend the threshold for the reserve requirement on banks' dollar short position from USD 1 billion to USD 3 billion. This measure helped to improve banks' ability to accommodate FX outflows on their balance sheets.

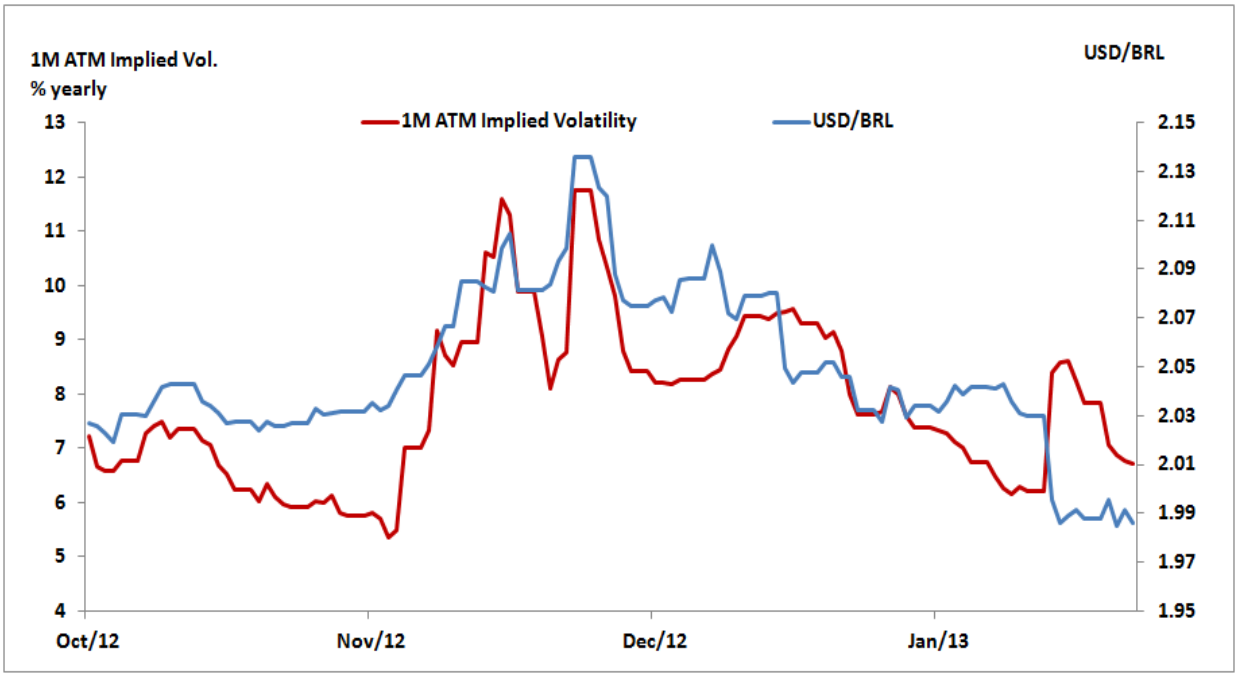
Additionally, the BCB sold USD 4 billion in December through onshore derivatives markets, which was very effective in containing the BRL depreciation trend in course during November. Since then the BCB has held a 1.85 billion dollar short position.

It is also worth mentioning BRL volatility behavior. The BRL's depreciation trend in November spurred a huge surge in implied volatility – the 1 month volatility more than doubled in a two weeks – followed by a sharp decline during December as BCB actions were put in place. In addition, some market participants perceived the BRL as trading within a narrow range between 2.00 and 2.05.

In November BRL price action was notably influenced by developments in the OTC offshore market when the buildup of leverage structures, through a combination of plain vanilla and digital options offshore in fairly sizable amounts, played a relevant role in driving the behavior of market makers and their clients.

The declining pattern of volatility continued until the end of January, when it jumped up again as USD.BRL broke the 2.03 spot level and moved towards 1.98. As the exchange rate has settled around this level since then, volatility has started coming down again (Figure 2).

Figure 2



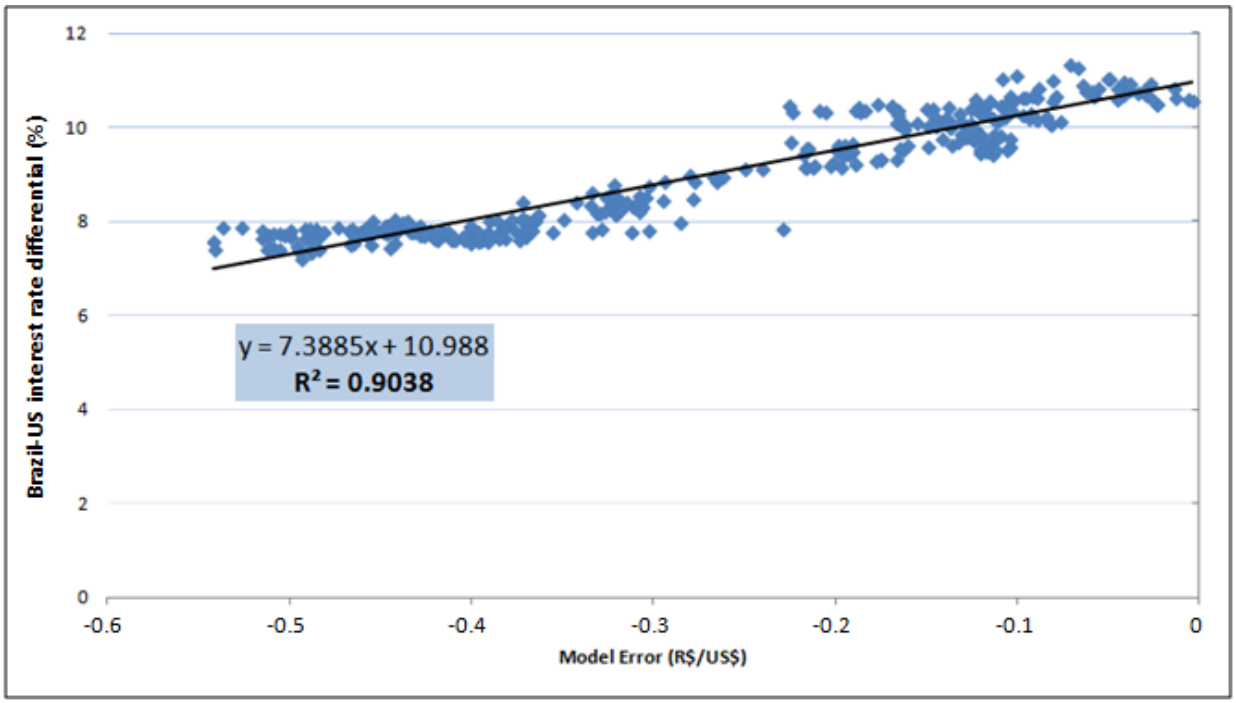
In a recent study conducted at the Foreign Reserves Department, a regression model was used to gauge the impact of interest rate on the exchange rate. Prior to August 2011 much of the BRL's behavior could be explained by variables such as commodities indices, the volatility of the S&P500 Index and a basket of correlated currencies. Interest rate differential was not a key driver back then.

However, in August 2011, the BCB started an easing cycle which ended up by cutting the benchmark SELIC rate from 12,5% to the current 7,25%. Regressions reveal that interest rate differential has been the most important variable by far to explain the trajectory of the BRL since then. This also helps us to understand the poor performance of BRL against its main peers over the last 18 months.

Another interesting aspect to be mentioned is the less evident influence on the BRL of regulatory measures. As is widely known, since 2010 the Brazilian government has adopted several FX and tax regulations designed to inhibit speculative flows. The first measures announced in October 2010 targeted the fixed income market, whereas the derivatives markets were addressed in July 2011.

In both cases a financial operations tax was either imposed or hiked to discourage investors from building up large positions in BRLs, especially in the derivatives market where they were predominantly leveraged. Nevertheless, contrary to the view of many market participants, the same study concluded that regulatory measures had only a transitory impact on the BRL (Figure 3).

Figure 3



Appendix

Date	Law	Announcement
March 9, 2005	Circular 3.280	Issued the Regulation Manual for Foreign Exchange Market and International Capital Transactions (RMCCI), as well as unified Exchange Markets (Floating and Commercial)
August 4, 2006	Resolution 3.389 CMN	Up to 30% of the total proceeds of an export transaction are allowed to be kept offshore deposited in the exporter banking account
March 13, 2008	Decree 6.391	IOF tax increased from zero to 1.5% for foreign investments on equity and fixed income securities
October 22, 2008	Decree 6.613	IOF tax reduction from 1.5% to zero for all transactions (Lehman Brothers crash)
October 19, 2009	Decree 6.983	IOF tax increased to 2% for foreign investments on equity and fixed income securities
October 4, 2010	Decree 7.323	IOF increased for foreign investments in local currency fixed income instruments from 2% to 4%. No change in tax on equity investments.
October 7, 2010	Resolution 3.912	Establishes the types of transactions by foreign investors which will be subject to simultaneous FX operations
October 18, 2010	Decree 7.330	IOF financial transactions tax hike on foreign investors inflows into local currency fixed income securities from 4% to 6% and on margin collateral for derivatives from 0.38% to 6%.
October 20, 2010	Resolution 3.914	Prohibits the local banks from lending, swapping or renting securities to foreign investors
October 20, 2010	Resolution 3.915	Cash received from daily settlement in futures contracts is not subject to IOF tax.
January 6, 2011	Circular 3.520	Establishes a reserve requirement for banks holding short spot positions larger than USD 3 BN. This measure will be effective only after April 4th.
April 4, 2011	Circular 3.520	Date of effectiveness for the measure above.
May 24, 2011	Decree 7.487	Changes de IOF regulation on credit operations
July 8, 2011	Circular 3.548	Changes the reserve requirement for short spot positions threshold from USD 3 BN to USD 1 BN. This measure will be effective on the next week of its presentation.
July 27, 2011	Provisional Measure 539/2011	– Allows the National Monetary Council (CMN), a collegiate decision instance that gathers the Finance Minister, the Planning Minister and the Governor of the Central Bank of Brazil, to require deposits and set limits, tenures and other conditions on the negotiation of any derivative contract; – Establishes the legal basis for charging the IOF (tax on financial operations) on derivatives, setting 25% as the ceiling rate for the IOF; – The IOF shall be charged on the "adjusted notional value", which is the notional value adjusted by the derivative's delta;
July 27, 2011	Decree 7.536	– Imposes a 1.0% IOF tax on the notional amount set in the acquisition, sale or maturity of financial derivatives exposed to FX variation that results in an increase of the net short dollar positions in respect to the previous day position higher than USD 10 million; – Allows authorized clearing houses to calculate and to collect tax due by derivatives market participants, whose positions in different clearing houses will be allowed to be netted; – Imposes a 1.0% IOF tax on loans with maturities longer than 720 days in case of early redemption, partially or completely, by the borrower, which will also be subjected to the payment of arrears of interest and fine.
September 16, 2011	Decree 7.563	Clarifies the IOF on derivatives calculus. Also establishes that the initial tax payment will be delayed to December 14th, 2011.

Date	Law	Announcement
December 1, 2011	Decree 7.632	Finance Minister reduces the IOF tax from 2% to 0% on portfolio investments. Also reduces the IOF on infrastructure debentures from 6% to 0%.
December 2, 2011	-	The files for IOF tax collection were made available to investors/banks.
December 27, 2011	"Portaria" 560 (Ministry of Finance)	Delays from December 29th to January 30rd the tax collection of IOF (this payment will settle tax liabilities regarding the September 16th 2011 to December 31rd operations).
March 1, 2012	Decree 7.683	Extends from two to three years the loans of financial institutions that are subject to the 6% IOF tax.
March 1, 2012	Circular 3.580	Limits the registry of exports prepayment to contracts with a maturity below 1 year.
March 12, 2012	Decree 7.698	Extends from three to five years the loans of financial institutions that are subject to the 6% IOF tax.
March 16, 2012	Decree 7.699	Exempts exports from IOF tax collection if the derivatives contracted are used for hedging purposes.
June 14, 2012	Decree 7.751	Brazil's government has announced that the 6% IOF tax imposed on foreign loans will now only apply to loans up to two years, reduced from five years previously.
June 28, 2012	Circular 3.604	Changes the RMCCI ("Circular 3.280") allowing that any foreign firm, including financial institutions, may anticipate the export payment. The Circular 3.580 (March 2012) did allow only for importers that they could anticipate export payments.
December 4, 2012	Circular 3.617	Modifies the Circular 3,580, now creating a sub-section (2-A) on RMCCI that allows the prepayment of export contracts within 1,800 days (~5 years)
December 5, 2012	Decree 7,853	Reduces from 2 to 1 year the minimum loan-maturity to be IOF tax-exempt.
December 18, 2012	Circular 3.619	Changes Circular 3.548 extending the threshold for reserve requirement for the average short position from USD 1 BN (or 60% of tier 1 net equity, if smaller) to USD 3 BN, no net equity limit.
January 30, 2013	Decree 7.894	Reduces the IOF tax from 6% to 0% on foreigners' investments in real state funds.

Exchange rate policy and exchange rate interventions: the Chilean experience

Sebastián Claro[1] and Claudio Soto[2]

In this paper we review Chile's experience with exchange rate flexibility since the early 2000s. Since the abandonment of the target zone for the exchange rate at the end of the 1990s, the Central Bank of Chile has been strongly committed to exchange rate flexibility, allowing the exchange rate to fluctuate in response to different shocks. As a result, the floating regime in Chile has worked very well in different dimensions. In particular, we discuss how the credibility of the floating regime has significantly lowered the currency mismatch of assets and liabilities in the corporate sector and has enhanced the role played by exchange rate movements in adjusting the economy to financial and terms-of-trade shocks. In spite of its commitment to the floating regime, the Central Bank of Chile has intervened the exchange market on a few exceptional occasions. We review two of these interventions, which occurred in 2008 and 2011, discussing their mechanisms, effectiveness and potential drawbacks.

Keywords: exchange rates, floating, interventions, credibility

JEL classification: E58, E61, F32

[1] Board member, Central Bank of Chile.

[2] Manager, Macroeconomic Analysis Department, Central Bank of Chile.

I. Introduction

Chile conducts its monetary policy under a flexible Inflation Targeting (IT) framework. Although this framework was implemented more than 20 years ago, it was in 1999 that a floating regime was adopted and a fixed target for the annual rate of inflation was set at 3%.[3] Also, since April 2001 the main policy instrument has been the short-term nominal interest rate. During all these years, this policy framework has succeeded at keeping inflation low and stable while at the same time allowing the country to confront severe external shocks with moderate impacts on the domestic economy.

Under the IT framework, the exchange rate floats freely but plays a role in policy decisions, inasmuch as it affects expected inflation – the operational target for the Central Bank of Chile (CBC). Since the adoption of the full-fledged version of the flexible IT regime in the late 1990s, with the abandonment of a target zone for the exchange rate and the establishment of a permanent target for inflation, the Central Bank of Chile has been one of the most committed central banks in terms of exchange rate flexibility, allowing the value of the domestic currency to freely adjust to different shocks. Sticking to a flexible exchange rate regime reflects the conviction of the Central Bank regarding the IT regime. It also reflects the view that a rigid exchange rate may induce some vulnerabilities in the economy, and reduce the degrees of freedom to adjust to external shocks, as the negative experiences of the crisis in 1982 and the recession of 1998 can attest.

As explicitly stated in the official communiqué of September 1999, and more in depth in the report to the Senate that year, the adoption of the fully floating regime at the end of the 1990s was based on the assessment that the Central Bank had gained credibility in terms of controlling inflation, that hedge markets were more developed, and that there were no significant mismatches in the private sector's balance sheets. Also, it was stated that having a floating currency would give the Central Bank more autonomy to manage its monetary policy and that it would enhance its capacity to confront external shocks.

In spite of this, the Central Bank has occasionally intervened in the exchange market during this latter period. In the early 2000s there were two episodes of intervention. In 2001 and 2002, following sharp depreciations of the Chilean peso associated with financial turmoil in Argentina and the political election in Brazil, a sizable increase in expected inflation threatened the fulfillment of the newly established inflationary objective of the Central Bank. The option of adjusting the interest rate to affect the value of the currency and influence the increase in expected inflation was considered not optimal, as the economy was still weak in the aftermath of the recession of 1999. Moreover, the bad experience of 1998, when the Central Bank raised the interest rate substantially to defend the peso, with consequent detrimental impact on domestic demand, contributed to tilting the view in favor of an exchange rate intervention. In 2001, the intervention program consisted of spot sales of US dollars, while the program of 2002 was implemented through the issuance of dollar-denominated debt.[4] In both cases, the total amount

[3] See: http://www.bcentral.cl/prensa/comunicados-consejo/pdf/02091999.pdf

[4] See Tapia and Tokman (2004) and De Gregorio and Tokman (2005) for an evaluation and discussion of the context, rationale and impact of these programs.

of the program was announced the day before the intervention. However, in the second case only a fraction of the resources announced were actually sold.

Between 2002 and 2008 no forex intervention took place. In 2008 and 2011, in the context of appreciative pressures on the Chilean peso, the Central Bank of Chile implemented two programs of foreign exchange purchases. These programs were aimed at increasing the size of international reserves in a situation where the Chilean peso was strong.[5] While these interventions were successful in some dimensions, they were not cost-free. In particular, the two programs increased the currency mismatch in the balance sheet of the Central Bank, leading to large capital losses.[6]

In the rest of the paper, we describe broadly the evolution of the exchange rate and current account in Chile over the past twenty years. We explain the recent foreign exchange interventions, discussing their rationale and their implementation strategy. Then we present a preliminary assessment of the effectiveness of these interventions and discuss their cost. Finally, we present some conclusions.

II. Exchange rate trends and the current account

Since the adoption of the floating regime in September of 1999, the Chilean peso has exhibited more volatility both in real and nominal terms than in the previous period (Figure 1). This higher volatility largely reflects the fact that during the last twelve years the economy has suffered major external shocks (i.e. Russian and Argentinean defaults, a surge in commodity and food prices, and the global financial crisis). To some extent, the higher volatility is the natural consequence of adopting a flexible exchange rate system in a small open economy subject to continuous shocks, in the sense that under this regime the exchange rate is the main adjusting variable vis-à-vis external shocks.

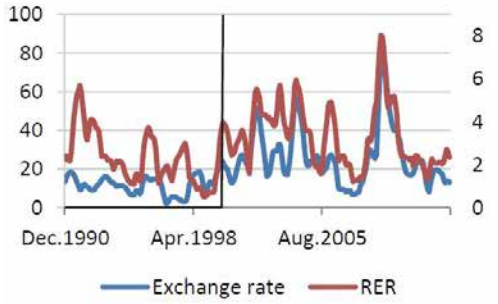
Despite this higher volatility during the 2000s, the real exchange rate has not followed a clear trend, a contrast with the systematic real appreciation of the currency observed during the 1990s (Figure 2). Several hypotheses have been proposed for this. On the one hand, it may reflect a certain slowdown in relative productivity growth vis-à-vis the rest of the world after the Asian crisis. Throughout the 1990s there were major productivity gains and a catch-up in the mining sector that justified an appreciative pressure on the real exchange rate. During the 2000s, productivity gains in Chile were less strong, and the productivity of Chile´s trade partners grew substantially (eg China). According to the Balassa-Samuelson hypothesis, this change in relative productivity trends may justify a less intense tendency toward real appreciation.

[5] Strictly speaking, a third episode of intervention was experienced in late 2008. Right after the Lehman Brothers collapse, the program of purchasing dollars was halted and a series of dollar swaps was offered to the market to provide short-term liquidity in foreign currency. This policy did not involve any change in the Central Bank's net asset position in foreign currency. In that sense, it was a liquidity measure rather than a true intervention in the foreign exchange market.

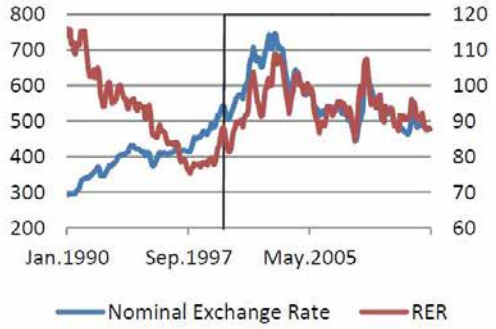
[6] Currently, the negative net worth of the Central Bank is about 3% of GDP. See Restrepo et al. (2009) for a description of the causes of the negative capital of the CBC.

On the other hand, the 1990s were a period of significant capital inflows to Chile as well as to other developing countries – on top of the investment flow directed to the mining sector – a situation that contributed to increased domestic expenditure, and to the systematic appreciation of the real exchange rate. These capital inflows arrived in part as responses to the productivity gains described above. However, they were also part of a broader wave of inflows to emerging markets during that period that goes beyond idiosyncratic development in Chile. Lastly, the strengthening of the Chilean peso during the 1990s might also reflect the outcome of the target zone for the exchange rate that was in place until 1999. When the target zone for the exchange rate was inconsistent with fundamentals, short-term capital inflows were encouraged and a real appreciation of the currency occurred (see De Gregorio, 2011).[7]

Exchange rate volatility Figure 1



Nominal and Real Exchange Rate levels Figure 2



Nominal and real exchange rate volatility measured as the rolling standard deviation within a year, based on monthly data. The nominal exchange rate is measured as pesos per dollar, and that an increase in the Real Exchange Rate index is a depreciation.

Sources: Central Bank of Chile and authors' estimates

The large capital inflows and the appreciation of the currency during the 1990s led to a substantial widening of the current account deficit until 1998, when it reached 5% of GDP (Figure 3). Then, as a consequence of the Asian crisis and the resulting capital outflows, in 1999 there was a significant reversal in the current account, equivalent to 5 percentage points of GDP. The current account deficit was around 1% of GDP between 2000 and 2004. In 2005 the surge in commodity prices – copper in particular – led to a substantial increase in the current account surplus. This increase was driven by high public savings resulting from the application of a structural fiscal rule to anchor public expenditure. This structural rule has been in place since 2001 and it establishes – among other things – that any extra government revenues from copper exports due to transitorily high prices are to be saved.[8] So the surge in copper prices since 2005, considered in part transitory, meant an important surplus in the public balance until 2009.

Since the outbreak of the financial crisis in 2008, the current account has been more volatile, reflecting the impact of changing financial and terms-of-trade conditions. In particular, by the end of 2008 a dramatic fall in copper prices coupled

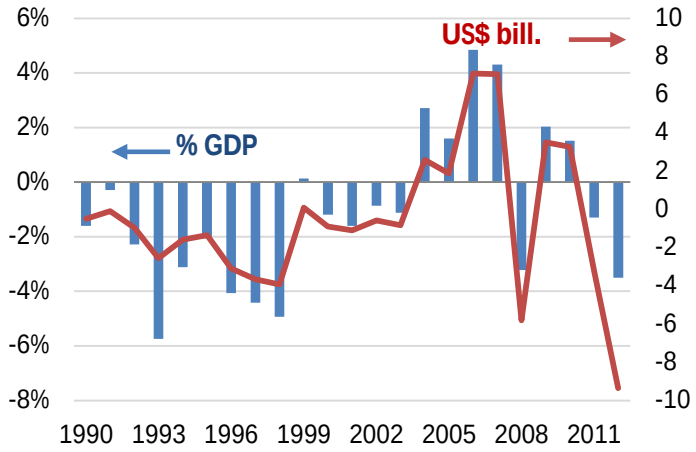
[7] A recent paper by the IMF shows that a more flexible exchange rate helps to dampen an appreciation of the real exchange rate stemming from capital inflows. See Combes et al. (2011).

[8] This rule was self-imposed by the government. The fiscal responsibility act of 2006 defined more explicitly certain procedures with respect to this rule and strengthened the institutional structure surrounding it.

with still dynamic domestic demand resulted in a current account deficit of almost 3% of GDP. The contraction in aggregate demand resulting from the crisis led to current account surpluses in 2009 and in 2010. This contraction in demand occurred despite the strong fiscal and monetary policy reaction implemented during this period. Lately, the sharp rebound in demand – related to the lagged effect of macro policies, high terms of trade, a surge in mining investment and attractive financial conditions for the Chilean economy – has driven the current account back into a deficit, which is estimated at slightly above 3.5% of GDP in 2012.

Current Account

Figure 3



Source: Central Bank of Chile.

III. Foreign exchange interventions and international reserves

The exchange rate market interventions during the 1990s resulted in a high accumulation of foreign reserves, which grew hand in hand with the economy. As a result, the reserve-to-GDP ratio fluctuated around 22% during most of the decade (see Figure 4). With the adoption of the floating regime by the end of 1999, the CBC hardly intervened in the exchange market, with the exception of the two programs of the early 2000s described above and the two programs implemented in the last five years. As mentioned, the first of these programs consisted in sales of international reserves in the spot market, whereas the second involved only the issuing of dollar-denominated liabilities. The first program generated sales of foreign reserves of only 800 billion US dollars, while the second generated none. As a consequence, during the 2000s the dollar amount of reserves stayed virtually constant and the reserve-to-GDP ratio fell almost to 10% by 2007 due to the steady growth of the economy and a real appreciation of the currency during the period.

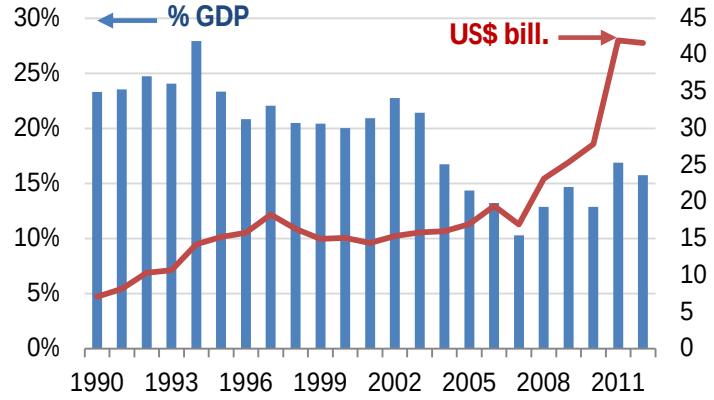
In April 2008 a new intervention was launched. Shortly before that date, the Chilean peso was appreciating significantly in the context of a high – and increasing – domestic inflation rate, and the unfolding global financial crisis. The CBC announced a program to accumulate reserves of up to USD 8 billion throughout the remainder of that year. The program was suspended at the end of September, following the collapse of Lehman Brothers, when the Central Bank had accumulated about

USD 5.75 billion. During the weeks following this event, a new program was introduced to provide short-term liquidity in foreign currency. The three-week program consisted in auctioning USD 500 million in foreign exchange swap contracts with a maturity of one month. Later, this program was extended for the following six months, and the maturity of each swap was also extended to either 60 or 90 days. This program was intended to provide up to USD 5 billion in dollar liquidity to compensate for the lack of foreign short-term financing during the crisis.[9]

In January 2011, again in a context of appreciative pressures on the Chilean peso, a new program of reserves accumulation was launched. This program lasted a year and consisted in buying USD 12 billion in the spot market at an average of USD 50 million per day. By the end of 2011, foreign reserves had climbed to more than USD 40 billion, equivalent to 17% of GDP, above the levels it had reached in 2010 but still below the averages observed during the 1990s.

International Reserves

Figure 4



Source: Central Bank of Chile.

IV. Rationale and mechanics of the latest exchange rate interventions in Chile

As mentioned above, the rationale behind these last two interventions was mainly to accumulate international reserves and to curb excessive short-term fluctuations in the exchange rate, as clearly stated in the official notes released by the Board on those occasions. The precise timing of those interventions was related to the trajectory of the currency, as they occurred at moments when the peso had appreciated more than would be consistent with its long-term fundamentals. In fact, in both cases the Central Bank made references to the situation of the foreign exchange market in its communications.

In the first of these two programs, in April 2008, the main argument for the intervention was to strengthen the international liquidity position of the Chilean

[9] Ex-post, few institutions participated in the auctions and many of the auctions were declared void.

economy to confront a potential abrupt worsening of the external scenario. However, the official communiqué also stated that the program was consistent with the assessment that the real exchange rate had appreciated above what it would be once real and financial conditions in the global economy returned to normal.[10]

The rationale for the second program, in 2011, was also based on the fact that the level of international reserves in Chile was low compared with other similar countries. This time, the communiqué argued that although there were upward pressures on the value of the peso, the expected transitory effects of the intervention on the foreign exchange market would contribute to easing the real adjustment in the economy: *"[T]he program could have a short-lived impact on the exchange rate, but these short-term effects could facilitate and smooth out the real adjustments the economy required to confront the external turbulence."* It also recognized that the financial costs for the CBC of such a program were high. Finally, the communiqué ended by mentioning that a flexible exchange-rate regime had proved good for the country, and that it was important to keep in mind that interventions were the exception rather than the rule.[11]

The two interventions shared the strategy of pre-announced programs of purchases of foreign exchange for a period of about a year each. In both cases, the total amount of reserves to be bought was explicitly stated. In each of these programs the amount of daily purchases was disclosed in advance, and the only degree of freedom the Central Bank kept was to decide the date of the auction. Also, in both cases there was no explicit or implicit conditioning of the program on the exchange rate's level or volatility. However, the CBC made clear that it would reserve the right to suspend or alter the program whenever it deemed this necessary, as was the case in September 2008 with the unfolding of the global financial crisis. Finally, both interventions were sterilized by issuing nominal and inflation-indexed Central Bank debt.

The transparency of the interventions in terms of the amounts to be purchased, the duration, and the schedule of daily auctions, without any conditions regarding the evolution of the exchange rate, was intended to signal the commitment of the Central Bank to a flexible exchange rate system. Thus, any change in the value of the currency would have no impact on the pre-announced program.

V. An assessment of the effectiveness of recent foreign exchange interventions

The effectiveness of foreign exchange interventions should be evaluated in relation to their objectives. In this sense, the interventions of 2008 and 2011 were successful – although the former was suspended before completion – as they contributed to raising the reserve-to-GDP ratio. As mentioned above, in the first program the CBC increased its international liquidity by USD 5.75 billion, while in the second it accumulated an extra USD 12 billion. In all, international reserves increased by more than 5% of GDP under the two programs.

[10] See http://www.bcentral.cl/prensa/comunicados-consejo/otros-temas/10042008.pdf

[11] See http://www.bcentral.cl/prensa/comunicados-consejo/otros-temas/03012011.pdf

However, this criterion is too narrow to measure the impact of the intervention programs. As to the effects of these interventions on the trajectory of the exchange rate, the evidence is unclear. Before the first intervention, in April 2008, the exchange rate had been appreciating to levels that were considered not fully consistent with its long-term fundamentals. After the intervention was announced, the exchange rate depreciated by more than 25% to the end of September 2008, the eve of the collapse of Lehman Brothers. However, given the special circumstances prevailing during that period, it is very difficult to assess how much of this depreciation of the currency can be attributed to the intervention. The program was launched at a moment when inflation in Chile was high: it reached 8.5% in March 2008 – well above the 3% target of the Central Bank – and then it kept on rising to reach 9.9% in October of that year. Therefore, in real terms, the depreciating trajectory of the currency after the intervention was somewhat less intense: about 18% to September 2008. Also, along with the intervention there was a sizable rise in inflation expectations. So if there was an effect on the currency, it could have been the result of a change in perception regarding the commitment of the Central Bank to fighting inflation – the signaling channel – rather than a liquidity or portfolio effect through the operations in the spot market. In any case, real interest rates did not significantly fall after the intervention, which suggests that the signaling channel may not have been that relevant, although some empirical evidence shows that a signaling effect occurred (see below). Lastly, the depreciation of the currency also occurred at a moment when the appetite for risk was decreasing, uncertainty in financial market was rising, and the terms of trade had begun to deteriorate. Overall, it is possible that the intervention helped align the exchange rate with its long-term fundamentals, and allowed it to price in the global financial risk, which until then had not been fully internalized by the domestic foreign exchange market.[12]

In the second intervention, there was a short-lived depreciation of the currency that lasted for about two weeks. Then the exchange rate returned to the levels it had been at before the intervention and continued on an appreciating trajectory until the end of 2011, when a global sell-off in the financial market triggered a major depreciation of the currency. Therefore, in this case if the intervention had an effect on the exchange rate, the effect was short lived despite the amount of reserves being bought.

Preliminary empirical evidence based on event studies finds little evidence of a significant impact of these two interventions on the level or volatility of the exchange rate in Chile. A recent joint-methodology study conducted by the BIS using intraday transactions concludes that the program in Chile had no impact on the level of the exchange rate.[13] If that is the case, this could be the result of the intervention strategy where, as mentioned before, there was a clear pre-announcement of the entire intervention program. This contrasts with the experiences of central banks where interventions have not been pre-announced. It could also reflect that Chile has a financial market that is well integrated with the

[12] In this sense, the intervention may have had an effect through the "coordination channel". Coordination failures may induce the exchange rate to deviate from equilibrium values for extended periods because of autoregressive trading dynamics (Taylor and Allen, 1992). Under this circumstance a central bank intervention could serve to disrupt extrapolative trading and coordinate trading in the direction of equilibrium (Archer, 2005).

[13] BIS Report (2013).

rest of the world and that the risk premium is low. Thus, the portfolio channel would be less effective in our economy.

The BIS study also shows that there is some evidence that in Chile interventions increased – rather than reduced – the intraday volatility of the exchange rate. Although this may sound counterintuitive, the results suggest that the daily spot market operations by the Central Bank could have introduced some noise, raising the risk of sharp movements in the value of portfolios, and thus discouraging carry trade operations. This result is also consistent with Doroodian and Caporale (2001), who find that exchange rate interventions in the US were associated with a significant increase in the intraday conditional variance (uncertainty) of bilateral spot exchange rates.

The small impact of these programs on the level of the exchange rate is consistent with the evidence for earlier interventions in Chile that found that, if at all, interventions affected the exchange rate through the signaling channel (Tapia and Tokman, 2004). As mentioned before, this is not surprising given the intervention strategy implemented in those episodes, where most of the information was provided with the announcement. It is also consistent with other evidence for emerging markets as summarized by Disyatat and Galati (2005). In principle, the portfolio channel could be relevant if interventions materially change the relative supply of domestic- and foreign-currency-denominated assets. In the case of the latest intervention program in Chile, the change in the net position of the Central Bank was large, but probably not large enough for that, given the size of the portfolio position of the different agents.[14] On the contrary, the daily purchases of USD 50 million represented on average only 1.33% of the daily foreign exchange market turnover. Therefore, in terms of the order flow channel, the interventions were rather small.

VI. The cost of intervention

The most evident and direct cost of FX interventions is their financial cost. Typically, countries that intervene have a positive interest rate differential vis-à-vis the rest of the world. In that context, the cost of the liabilities that are used to sterilize the FX interventions is larger than the return on international reserves. This financial cost of international reserves precludes countries from accumulating large amounts of reserves as self-insurance against external liquidity shocks. Moreover, this cost will be weightier if the financial position of the central bank is weak or, more generally, if the consolidated public position is weak.

Systematic interventions in foreign exchange – if they succeed in reducing the volatility of the currency – could send the wrong signals to the private sector regarding the risks of exchange rate fluctuations. This could then affect the willingness to hedge asset positions, and expose the corporate sector to currency mismatches. One of the advantages of a credible floating system is precisely that it tends to minimize currency mismatches in the private sector, which by itself

[14] In this sense, it is likely that the portfolio channel could work more effectively in economies less financially integrated or with a larger external premium and less external investments, as the degree of substitution between domestic-currency-denominated assets and foreign currency assets would be lower.

dampens the possible detrimental balance sheet effects of exchange rate fluctuations. A fully flexible exchange rate, by increasing the variance of the real exchange rate in the short and medium term, should increase the relative risk of dollar debt, tilting the scale in favor of local-currency-denominated debt. For the case of Chile, empirical evidence by Cowan et al. (2006) finds significant changes in the level of currency exposure after the implementation of a floating exchange rate regime in 1999. This evidence thus suggests that an intervention policy that reduces the volatility of the exchange rate could increase the exposure by introducing an implicit exchange-rate insurance.

Somewhat more general is the evidence by Kamil (2006). He shows that the adoption of a floating exchange rate regime leads to a higher degree of currency matching in firms' balance sheets, thus reducing the corporate sector's financial vulnerability to exchange rate fluctuations. This finding is robust to alternative identification methods of exchange rate regimes and different measures of currency exposure at the firm level. Overall, the results suggest that under a floating exchange rate regime, firms (or their creditors) become more aware of the exchange rate risk, and thus mitigate their foreign exchange exposure by closing their foreign currency positions. Based on this view, one of the reasons for the transparent and straightforward intervention strategy of the last two programs in Chile, without any implicit or explicit commitment to a certain value of the currency, was precisely to avoid any jeopardizing of the credibility of the floating regime, and hence not to encourage balance sheet mismatches.

Another dimension of possible moral hazard problems in intervention is that lower exchange rate volatility is related to short-term speculation against the currency. In fact, exchange rate volatility may deter financial speculation against the currency. If the central bank has a weak commitment regarding a defined level for the exchange rate, the absence of currency risk in the short run may encourage financial market participants to take advantage of interest rate differentials. As long as the currency is free to float, and that implies more volatility and uncertainty regarding the currency level, the incentive to arbitrage interest rate differentials could be reduced. Soto and Valdés (1999) present mixed evidence about this phenomenon in Chile and a set of countries. The evidence of the recent BIS report, however, points to increased volatility as a result of the intervention in Chile. If that had been the case, then interventions could have helped to reduce carry trade operations and sustain a more depreciated currency.

One of the main costs of exchange rate intervention is that it may contradict other objectives of the central bank. For example, in a context of high inflation an exchange rate intervention may be interpreted by market participants as a weaker commitment to the inflationary objective of the central bank. If that is the case, then inflation expectations may rise, making it harder for the monetary authority to fulfill its primary objective. In fact, as mentioned above, one of the main mechanisms through which exchange rate interventions operate is by signaling a monetary policy stance consistent with a more depreciated exchange rate. So under some circumstances, the monetary policy signals that the market reads might conflict with the inflation objective.

The experience of Chile during 2008 and 2011 shows some of these tensions. As mentioned before, right after the last two interventions there were some increases in expected inflation. In the first episode, that occurred in a context of already high inflation. Then the Central Bank had to respond by increasing the policy rate. In the second episode, inflation was around target, and the short-lived

increase in inflation expectations did not materialize as higher inflation. Thus, the monetary policy did not differ from its pre-intervention expected path. Pincheira (2013) formally tests whether these increases in inflation expectations were related to the interventions. For the 2008 episode he finds evidence of Granger causality between the amount of accumulated reserves and the distribution of inflation expectations at long horizons (one and two years ahead). Nevertheless, this causality is quantitatively moderate. Also, it seems to have had a relatively short memory, as the distribution of inflation expectations moved back to its initial position about six months after the intervention was announced. Moreover, it is not possible to distinguish whether the increase in inflation expectations was due to a change in the expected path of the monetary policy (the signaling channel) or whether there was a de-anchoring of inflation expectations for a given expected path of monetary policy.

Other recent experiences show that foreign currency market interventions may be uncontradictory with the monetary objective, and may, rather, complement monetary policy. Such is the case of Japan over the last years, and also the case of Switzerland. These economies were experiencing weak activity and had reached the zero lower bound for their monetary policy interest rate. Thus, the exchange rate intervention in their cases has been a non-conventional policy intended to foster their external demand.

It is important to note that the impact of a foreign exchange intervention on inflation – either current or expected – need not be associated with its impact on the exchange rate. Indeed, if there is a genuine misalignment of the real exchange rate, foreign exchange intervention may have an impact on the nominal exchange rate (via the information channel) without a direct effect on the inflation rate. However, it is always difficult ex ante to assess the speculative forces in the foreign exchange market, and hence the degree of misalignment of the real exchange rate.

VII.Summary and conclusion

Chile has conducted its monetary policy under an inflation targeting regime for more than twenty years. Initially, this policy framework was complemented by a target zone for the exchange rate. During this period, the central bank actively intervened in the exchange market and accumulated a large amount of international reserves. In spite of this, the real exchange rate exhibited an appreciating trend for several years, and the current account deteriorated significantly until the Asian crisis. With the adoption of the full-blown version of the inflation targeting regime by the end of 1999, the target zone for the exchange rate was abandoned and the Central Bank allowed the exchange rate to float freely. However – and despite not having an objective for the exchange rate – it did intervene on a few occasions during this period.

The last two interventions occurred in 2008 and 2011. The objective of these interventions was to accumulate reserves as a self-insurance device, and to curb excessive exchange rate fluctuations at a time when the currency was deemed to be overvalued with respect to its long-term equilibrium. The two interventions shared the same strategy. On both occasions a program of foreign exchange buys was pre-announced, specifying the amount to be bought and the length of the program. Neither of these programs was made conditional on the evolution of the exchange

rate, as a way of signaling the commitment of the Central Bank to the floating regime.

The first program was suspended before completion, in reaction to the Lehman Brothers collapse in September 2008. However, the second program was carried on until its end. In all, the two programs allowed the Central Bank to accumulate more than US 17 billion, or around 5.5% of GDP, in foreign reserves. As to their impact on the currency, the evidence is not clear cut. After the intervention of 2008 there was a major depreciation of the currency. However, this depreciation occurred at a time when financial tensions in the world were escalating, Chile's terms of trade were deteriorating and inflation was rising. Therefore, it is not clear how much of the depreciation can be attributed to the intervention. In any case, part of the impact of the intervention could be related to the signaling channel with the consequent impact on expected inflation. Also, the intervention may have acted as a coordination device to market participants, allowing the exchange rate to be more aligned with its fundamentals.

In the second program, there was only a short-lived depreciation of the exchange rate. The small effect of this intervention on the value of the currency could be the consequence of the intervention strategy, and of the fact that it occurred at a moment when Chile exhibited a deep financial integration with the rest of the world, as well as a low risk premium. It could also reflect the currency's being not far from its equilibrium value.

The benefits of these interventions in terms of accumulating reserves for self-insurance and – partially – in terms of smoothing exchange rate fluctuations have to be weighed against their costs. The most obvious cost of intervention is the negative carry of reserves. Before the last two interventions the balance sheet position of the Central Bank of Chile was already weak. With the amount of reserves accumulated over the past years, the balance sheet mismatch has increased, and the cost of carrying reserves has amplified the negative profits of the Central Bank. Another possible cost of exchange rate interventions is that they may generate moral hazard problems. If an intervention succeeds in ameliorating exchange rate volatility, it may induce more risk-taking by the private sector and enhance balance-sheet mismatches. The evidence of the impact of the last two interventions in terms of the exchange rate's volatility is not clear; therefore it is not obvious that these interventions introduced the wrong incentive to the private sector. Lastly, one of the major costs of interventions is that they may contradict other policies of the central bank. In the case of Chile, the episode of 2008 clearly shows tensions of that type. During that period, inflation was high, and the intervention program triggered an increase in inflation expectations with the consequent negative trade-off for the Central Bank. Other experiences around the world show that under certain circumstances it is possible for an intervention not to contradict another policy objective of the central bank.

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Foreign exchange intervention in Colombia[1]

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Abstract

This paper describes the Banco de la República's FX intervention policy, with a focus on its objectives and main features. It then argues, based on a review of the literature on the effectiveness of sterilized intervention in Colombia, that this tool is not a useful way of coping with the challenges posed by medium-term external factors such as quantitative easing in advanced economies, reduced risk premiums in emerging economies or high international commodity prices. The impact of sterilized intervention on the exchange rate (if any) is of much shorter duration than are the effects of those external factors. Finally, the paper argues that if sterilized FX intervention is effective through the operation of the portfolio balance channel, it may also have an expansionary effect on credit supply and aggregate demand. In this case, the macroeconomic outcomes of intervention depend on the monetary policy response. This issue is studied with a small open economy DSGE model. In general, FX intervention creates more volatility of credit and consumption than occurs with more efficient allocation and under alternative monetary regimes without intervention. Furthermore, the more inclined the central bank is to meet an inflation target, the stronger its response to the expansionary effects of the intervention, and consequently the lower the impact of the intervention on the exchange rate.

Keywords: monetary policy, foreign exchange intervention

JEL classification: F31, F32, F33, E37

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1. Introduction

This paper first describes current FX intervention policy by the Banco de la República, emphasizing its objectives and features, and highlighting some issues that have arisen recently in local policy discussions. Preliminary answers are then proposed for the following questions: (i) Is sterilized FX intervention in Colombia effective as an instrument to deal with the challenges posed by quantitative easing policies in advanced economies or high/rising international commodity prices? (ii) Assuming imperfect substitution between different financial assets, given that sterilized FX intervention may influence the exchange rate (through the portfolio balance channel), what are the macroeconomic consequences of sterilized FX intervention if one considers both the effects of the portfolio balance channel on credit supply and the operation of a monetary policy rule?

The first question is relevant because its answer may help define the aim and extent of sterilized FX intervention. The second question is important because discussions on the effectiveness and desirability of sterilized FX intervention are often framed in a partial equilibrium setting, overlooking the possible interplay of sterilized FX intervention, credit supply and monetary policy. The microeconomic basis for the effectiveness of sterilized FX intervention (portfolio balance channel) also implies the presence of effects on credit supply from sterilized FX intervention, which may prompt monetary policy responses that end up shaping the macroeconomic outcomes. A small open economy DSGE model is used to explore this issue here.

2. Current Banco de la República FX intervention policy

2.1 Objectives

FX intervention in Colombia is undertaken (1) to maintain an adequate level of international reserves, (2) to remedy short term exchange rate misalignments and (3) on occasion, to curb excessive exchange rate volatility.

1. Maintaining an adequate level of international reserves

Maintaining a stock of international reserves is a must in a small open economy that is subject to strong external shocks and that cannot issue a reserve currency. This is a key objective of FX intervention by the Banco de la República. Hence, the size of the intervention is determined to a great extent by the criteria used to define a desired or adequate level of international reserves.

Two elements must be taken into account in making this decision. First, the international reserves requirements may vary across countries, depending not only on their size, trade flows and financial activity, but also on macroeconomic characteristics such as the exchange rate regime, price formation mechanisms and the structure and regulation of the financial system. In a country with small pass-through from the exchange rate to prices, and low currency and FX term mismatches, the scope for exchange rate flexibility as a shock absorber is much greater than in a country with high pass-through, significant liability dollarization or large currency mismatches. Accordingly, the appropriate level of international reserves will be lower in the former type of country, even if both economies are of

similar size, face the same (short term) external debt payments, or have the same degree of financial deepening or the same current account balance (Edison (2003)).

In Colombia, the credibility of the inflation target is robust, pass-through is low and there is sound regulation of financial intermediaries' currency and FX term mismatches. The conditions for a high degree of exchange rate flexibility are therefore present. In fact, the Banco de la República FX intervention in the wake of the Lehman crisis was by far the smallest among the large Latin American economies. The volatility resulting from the flexible exchange rate regime helps to maintain the conditions for flexibility, since currency risk is internalized in private sector funding decisions (thereby limiting mismatches), while pass-through is kept low (Vargas (2011)).

More recently, a new source of external liquidity shocks has emerged in Colombia stemming from the expansion of Colombian banks abroad.[5] Liquidity disturbances in the presence of insufficient regulation or lender of last resort (LOLR) facilities in the host countries may end up causing strong demand pressures in the Colombian FX market. A question remains as to whether this situation justifies holding a much greater stock of international reserves, or whether Colombian liquidity regulation must be strengthened to address this exposure. After all, holding international reserves is generally costly, and so forcing banks to internalize the risk seems sensible. Besides monitoring the FX liquidity of the conglomerates, it may be necessary to impose additional FX liquidity requirements on banks operating overseas in order to preserve the resilience of the financial system, especially if host countries' regulations or LOLR facilities are deemed subpar, or if the information needed to gauge liquidity risk is not available. Meanwhile, the cost of the insurance would be borne by the agents originating the risk.

The second element to consider when assessing the adequacy of the international reserves level is that the effectiveness of accumulating international reserves as a way of protecting the economy from external liquidity shocks depends on deeper factors such as the contemporaneous behaviour of macroeconomic savings and the openness of the financial account. Models of "optimal reserves" are commonly used to judge the appropriateness of stocks of international reserves (see, for example, Jeanne (2007), or Calvo, Izquierdo and Loo-Kung (2012)). These models posit that international reserves are useful to face "sudden stops" because they help alleviate the consequences of these episodes (decreased consumption), or because they help reduce the probability of such events. At the same time, these models recognize that international reserves entail opportunity costs. The "optimal" level of international reserves provides a solution to the trade-off between those benefits and costs at the margin.

Although the rationale behind these models informs international reserves policy, their application in practice has several drawbacks. To begin with, they are too simplistic to adequately incorporate the above-mentioned idiosyncratic traits of each economy. Hence, strong and rather coarse-grained assumptions must be made regarding the size, probability and cost of a liquidity shock. The results of

[5] Between 2007 and 2012, 130 Colombian bank subsidiaries were opened or bought abroad. Approximately 67.5% of these are located in Central America. Moreover, the assets of foreign subsidiaries of Colombian banks rose from 9% of total assets in 2009 to 20% in 2011.

these models are extremely dependent on the assumptions, rendering the methods of very limited use for policy purposes.[6]

But perhaps more importantly, these models take the (short term) foreign liabilities as given when calculating "optimal" reserves. This amounts to assuming that the net (short term) foreign asset position of the country increases on a one-to-one basis with the purchases of international reserves. This may not be the case, especially if the purchases are sterilized and there is a high degree of capital mobility in the economy. In the extreme case of perfect capital mobility, as interest rates are kept constant, FX intervention ends up attracting new capital inflows (or reducing the liquid assets of the domestic private sector), thereby leaving the country's (short term) net asset position unchanged. As a result, "insurance" against a "sudden stop" is not obtained simply by the central bank's accumulating reserves.

When capital mobility is imperfect, reserves purchases do achieve some insurance. However, it is less than that initially deemed "optimal," since some capital inflows are attracted at any rate. To reach the optimal level, larger reserve purchases are required, but they entail greater opportunity costs. Thus, the optimal insurance level may now be lower, as may also be the optimal level of international reserves. A simple variation of the Jeanne (2007) model presented in Gerencia Técnica (2012) shows that "optimal" level of reserves decreases rapidly with the sensitivity of external short term liabilities to FX intervention.

The broader point here is that international reserves accumulation does not necessarily constitute increased insurance against "sudden stops". It does, as long as the increases in international reserves are coupled with hikes in macroeconomic savings, or at least with rises in the country's net short term external position. Hence, the effectiveness of reserve accumulation as a tool to protect the economy from external liquidity shocks depends on factors such as the degree of capital mobility and the behaviour of domestic savings.

In practice, the Banco de la República follows a pragmatic approach in which several international reserves indicators are monitored, and reserves purchases are aimed at roughly keeping them stable. These indicators include the ratios of reserves to broad money, short term external debt payments, short term external debt payments plus the current account balance, imports, and GDP. To calculate the indicators, trend values of these variables are used in order to filter out cyclical components that may distort the comparisons of reserve coverage through time. Figures 1 through 5 show the evolution of these indicators over the last decade.

2. Fixing short term exchange rate misalignments

Being the price of an asset, the exchange rate may be subject to sporadic "speculative" behaviour, i.e., not totally related to its fundamental determinants. This is especially the case in some EM currency markets, shallower than their advanced economies' counterparts, after periods characterized by a persistent trend and low exchange rate volatility. In these circumstances, it is possible that a substantial

[6] Gerencia Técnica (2012) illustrates this point by applying the method proposed by Jeanne (2007) and showing that the "optimal" level of international reserves in Colombia could vary from nil to more than USD50 billion (14% of GDP), depending on the assumptions regarding the probability, size and cost of a "sudden stop." The plausibility of the different sets of assumptions proposed is not clear-cut, since they could relate to episodes or groups of countries whose current relevance is quite open to debate.

fraction of market participants may share the same “autoregressive” view of the exchange rate and that a bubble-like path can ensue. This may cause undue damage to tradable sectors (if the currency appreciates), inflationary pressures (in the case of depreciation) or unwarranted volatility in FX and financial markets.

The Banco de la República closely monitors the evolution of the FX market to detect such behaviour. However, such episodes are recognized to be rather infrequent, and a procedure is in place to assess their likelihood and take corrective action when necessary. As explained in Vargas (2011), the conclusion that there is a high probability of a misalignment depends on various elements: a thorough examination of the nature and size of capital flows performed on the basis of FX spot and derivative transactions; a comparison of the trend of the COP with trends in other EM and regional currencies; and an assessment of the contrast between the observed real exchange rate and several "equilibrium" measures. FX intervention is then undertaken if its benefits (effectiveness) outweigh its costs (quasi-fiscal and other).

3. Curbing excessive exchange rate volatility

Immediately after the adoption of a flexible exchange rate regime in 1999, the market of currency risk hedging instruments was not well developed. Hence, a mechanism was put in place to intervene in the FX market and check episodes of excessive exchange rate volatility that could harm financial markets. The Central Bank would auction put/call options to sell/buy US dollars to/from the Central Bank when the exchange rate in one day exceeded/fell below its 20-day average by a specified percentage. This mechanism has not been active since February 2012, but can be activated when needed.

2.2 Features

1. Sterilization

FX intervention in Colombia is sterilized to the extent necessary to keep short term interest rates in line with the policy rate. This means that the expansionary effect of reserves purchases need not be totally offset as long as there are other shifts in money demand and supply that compensate for it. Government deposits at the Central Bank have been the main sterilization mechanism in recent years. They have allowed the Banco de la República to remain a net creditor to the financial system.

However, in case government deposits fall short of the amounts required to sterilize additional reserves purchases, other offsetting mechanisms are in place. The Central Bank still holds a stock of government securities that can be sold for that purpose. Also, to mop up excess liquidity the Banco de la República can open, and has opened, remunerated short term (7-day and 14-day) deposits that are accessible to a wide array of financial institutions.[7] A drawback of this instrument is that deposits are not negotiable in secondary markets, so they entail liquidity risk for deposit holders. Consequently, sterilization may be difficult and incomplete.

To deal with this problem, legislation in 2009 allowed the Central Bank to issue its own securities, and in 2011 the law authorized the issuance of Monetary

[7] Not only commercial banks, but broker-dealers, investment funds and pension funds are authorized to hold these deposits at the Central Bank.

Regulation Government Bonds (MRGBs) specifically designed for controlling the money supply (and not for deficit financing). No Central Bank securities have been issued hitherto. In late 2012 an agreement was reached between the government and the Banco de la República to issue MRGBs and deposit the proceeds at the Central Bank. The idea was to coordinate government debt management policy with sterilization policy. Hence the 1-4 year segment of the government bond market was reserved for sterilization purposes. The remuneration of the government deposits at the Central Bank is equivalent to the cost of the MRGBs.

The first MRGBs were issued in December 2012, with maturities of 1.5, 2 and 3 years. The announced amounts of the auctions are still small relative to the monetary base (16%) and international reserves (12%). The relatively long maturities of these bonds have the advantage of introducing some market risk that could discourage capital inflows in response to sterilization. At the same time, they allow the Central Bank to maintain a short term net creditor position with the financial system and, therefore, a tighter grip on short term liquidity.

2. Mode of intervention

Currently the Banco de la República intervenes in the FX market through announced auctions of fixed-amount, daily purchases of USD. After long and diverse experience with several modes of intervention, the perception at the Central Bank is that this is the best type for the above-mentioned objectives, since it minimizes any signal about the defense of a particular level of the exchange rate. This is the case because the amounts of the intervention are the same regardless of the value of the currency.

Avoidance of strong signals regarding an implicit exchange rate target is crucial for two reasons, inter alia. First, the credibility of the inflation target could be weakened if the market perceives a trade-off between the inflation target and an exchange rate objective. Second, if a perceived exchange rate goal is judged as non-attainable by market participants, additional capital inflows may be attracted, rendering the FX intervention ineffective, possibly introducing unwarranted volatility to the exchange rate and imposing greater costs on the Central Bank should the latter react by increasing intervention.

3. Is sterilized FX intervention useful to deal with medium term currency appreciation forces?

Like other EM currencies, the COP has undergone appreciation in recent years related in part to decreasing risk premiums and ample liquidity provision in advanced economies. At the same time, Colombia has benefited from high and increasing terms of trade associated with the behaviour of international commodity prices (Figure 5). This trend has not only led to a direct increase in national income, but has also sparked large flows of FDI into the mining and oil sectors. As a consequence, output and exports of these goods have expanded substantially. The coincidence of large FDI inflows and increasing prices and volumes of these commodities has been an additional force behind the appreciation of the currency.

A feature common to these factors is that even if they cannot be totally regarded as permanent changes in the external conditions of the Colombian economy, their transitory components are highly persistent. They are medium term

sources of currency appreciation. Hence, concerns about "Dutch Disease" have surfaced and there have been calls for Central Bank sterilized FX intervention to cope with this problem. The appropriateness of such action in this context must be assessed by measuring its benefits and costs. The benefits are clearly related to its ability to have a significant, long-lasting effect on the exchange rate.

Table 1, taken from Rincón (2012), summarizes the results of several studies on the topic for Colombia. Findings are mixed with respect to the impact of sterilized FX intervention on exchange rate returns or levels, depending on the period analyzed, the econometric method used, the frequency of the data, the probability distribution assumed and the measurement of intervention. In some cases no effect is found, while in others intervention depreciates the currency. Findings are also diverse as regards the impact of intervention on exchange rate volatility. However, few studies explore the duration of the effect of FX intervention. As mentioned above, this is a crucial element, given the nature of the shocks being discussed.

In most cases econometric specifications do not allow for the dynamic effects of intervention. The studies employ controls and compare the behaviour of the exchange rate in periods with intervention to its behaviour in periods without intervention.[8] Only two studies explicitly account for possibly changing effects of intervention through time. Based on an SVAR estimated with monthly data, Echavarría, López and Misas (2009) found that an intervention shock depreciates the currency for one month. A recent project led by BIS-CCA using intra-day data identified an effect lasting for some minutes.[9]

These findings indicate that sterilized FX intervention is not an effective tool to confront the challenges posed by long-lasting phenomena such as quantitative easing in advanced economies, reduced risk premiums associated with relatively poor fundamentals in the advanced world, or high international commodity prices. Thus, a cost-benefit analysis would probably militate against using this instrument for that purpose, as costs are certain but benefits are small and uncertain. This is consistent with the findings of Ostry, Ghosh and Chamon (2012), who show that even under assumed effectiveness of sterilized FX intervention, optimal reserve accumulation declines with the persistence of capital inflows. It also provides a rationale for the Banco de la República's FX policy described in the foregoing section, in which sterilized FX intervention is aimed at correcting short term misalignments.

Longer term misalignments related to expenditure or credit excesses may arise as a result of the above-mentioned phenomena. Nevertheless, sterilized FX

[8] In several studies, the dependent variable is the return of the exchange rate, i.e. its first difference. In these cases, the level of the exchange rate has a "unit root," so, by construction, any effect of intervention permanently alters the exchange rate. However, those specifications restrict the impact of the intervention to its contemporaneous effect on the exchange rate return, thereby preventing exploration of its lagging responses.

[9] A third paper, by Echavarría, Vásquez and Villamizar (2010), found significant impacts of intervention on the expected *future returns* of the exchange rate at different horizons. However, with this specification it is difficult to determine the duration of the effects. For example, a permanent effect would show up as a zero coefficient on intervention, but this would be the same as a nil effect. Significant coefficients may indicate a contemporaneous effect of intervention with an indeterminate impact on the expected future exchange rate.

intervention does not seem a suitable remedy.[10] Alternative tools must be evaluated. Capital controls are an option, although their costs and lack of effectiveness (Kamil and Clements (2009)) over the relatively long periods implied by the duration of the aforementioned shocks may raise serious doubts about their appropriateness. Increases in domestic savings through adequate fiscal policy arrangements (especially in the case of the commodity boom cycle) or macro-prudential policies remain policy choices meriting consideration.

4. Sterilized FX intervention, the credit channel and monetary policy: A deeper exploration of the portfolio balance approach

Beyond the issue of the empirical relevance of sterilized FX intervention, a case may be made for the use of this instrument when there is a low degree of substitution between different assets in the balance sheets of the various agents in the economy. This could be a feature especially in EMs with still developing financial markets. Ostry, Ghosh and Chamon (2012) argue that when the financial account behaviour deviates from perfect capital mobility, sterilized FX intervention is a valid tool to manage the exchange rate for a central bank that strictly targets inflation. In this case, there are two instruments (interest rates and FX intervention) to achieve two targets (inflation and exchange rate).

Nonetheless, the foregoing arguments ignore either the microeconomic underpinnings of imperfect capital mobility (Ostry, Ghosh and Chamon (2012)), or the macroeconomic implications of those underpinnings (as in the partial equilibrium analysis of the portfolio balance approach). If sterilized FX intervention influences the exchange rate through the portfolio balance channel, it may have effects beyond those in the FX market – effects that can determine overall macroeconomic outcomes. More specifically, sterilized FX intervention under imperfect substitution between assets may impact the supply of credit. García (2011) shows that sterilized FX purchases in a context of inflation targeting in an economy with an active credit channel have expansionary consequences on aggregate demand through their negative impact on lending interest rates.

In sum, sterilized FX intervention may have significant and persistent effects on the exchange rate when the portfolio balance channel is strong. For the same reason, it may also entail substantial shifts in credit supply and aggregate demand. What happens when an inflation-targeting central bank reacts to those shifts? What are the macroeconomic results of the interplay of sterilized FX intervention, credit expansion and inflation targeting? In what follows, a small open economy DSGE model with tradable and non-tradable sectors is presented to answer these questions.

[10] On a different but related track, Lama and Medina (2012) build a DSGE model that explicitly includes a learning-by-doing externality in the tradable sector and allows monetary policy to work against the appreciation caused by Dutch Disease. Calibrating the model for Canada, they find that even if exchange rate stabilization can restore tradable output to near the efficient level, the volatility introduced to macroeconomic aggregates reduces welfare in comparison with a scenario in which the exchange rate is allowed to adjust.

4.1 The model

Here, we construct a DSGE model for a small open economy that has tradable and non-tradable sectors as well as an oil producing sector (which does not use domestic resources for production, but generates large foreign income flows). Added to this otherwise standard model is a financial sector that includes both the central bank and commercial banks. The setup for the financial system implies that assets in the balance sheet of the commercial banks are not perfect substitutes. Following Edwards and Vegh (1997), and Benes, Berg, Portillo, and Vavra (2012), this characteristic of the financial system also implies that the central bank has the ability to affect the exchange rate through the sterilized accumulation of international reserves. However, the sterilization entails changes in the holdings of bonds by commercial banks as well as shifts in the composition of their asset portfolios. These shifts in turn affect loan supply and the rest of the economy. Hence, any sterilized FX intervention undertaken by an IT central bank has complex macroeconomic consequences.

This section describes the main features of the model. The full set of equations can be found in the Appendix (sections A1-A5, setting forth the model). The model economy comprises households that receive income from labor, profits from firms and banks, and transfers from the government. The budget constraint of a representative household is:

$$y_t^P + w_t h_t + \xi_t^N + \xi_t^B + l_t = \tau_t + \left(\frac{1+i_{t-1}^l}{1+\pi_t^C}\right) l_{t-1} + c_t + \frac{\psi}{2}\left(l_t - \bar{l}\right)^2 \tag{4.1}$$

where w_t is the real wage in terms of the consumption bundle, h_t is the total supply of labor, l_t is loans from commercial banks, ξ_t^N is profits from non-tradable firms and ξ_t^B profits from commercial banks, y_t^P are dividends from the oil sector, and τ_t is a lump-sum transfer from the government. The household buys a consumption bundle c_t at price p_t^C, pays loans from previous periods at a rate i_t^l and also incurs cost when adjusting its demand for loans.[11] This cost also creates a margin between the loan interest rate and the discount factor:

$$\lambda_t\left(1-\psi\left(l_t-\bar{l}\right)\right) = \beta E_t\left[\lambda_{t+1}\left(\frac{1+i_t^l}{1+\pi_{t+1}^C}\right)\right] \tag{4.2}$$

As can be seen from equation (4.1), this margin is a positive function of total loans, and consequently the Euler equation (4.2) becomes a credit demand function. (See Benes, Berg, Portillo and Vavra (2012) for details).

The consumption bundle is composed of tradable and non-tradable goods. The demand for each type of good is proportional to both its relative price and total consumption. The tradable good is equal across countries, and consequently the law of one price holds at every moment. It follows that the relative price of the tradable good in domestic currency is:

$$\frac{p_t^T}{p_t^C} = q_t\left(\frac{p_t^{T*}}{p_t^{C*}}\right) \tag{4.3}$$

[11] Technically, this quadratic adjustment cost guarantees a stationary equilibrium for loans.

where q_t is the real exchange rate and p_t^{T*} / p_t^{C*} is the relative price of the tradable good in foreign currency.

The production function in both sectors is characterized by decreasing returns to scale technology that uses only labor as input. Firms in both sectors determine labor demand by minimizing costs. The equilibrium in the labor market guarantees that $h_t = h_t^N + h_t^T$.

Nominal prices in the non-tradable sector are rigid. In this sector, each firm sets prices by maximizing profits under costly price changes as in Rotemberg (1982). The problem of the representative firm in the non-tradable sector, in other words, is:

$$\max_{p_{j,s}^N} E_t \sum_{s=t}^{\infty} \beta^{t-s} \frac{\lambda_s}{\lambda_{s-1}} \left\{ \frac{p_{j,s}^N}{p_t^C} y_{j,s}^N - \frac{p_t^N}{p_t^C} CT_{j,s} - \frac{p_t^N}{p_t^C} \frac{\kappa}{2} \left(\frac{p_{j,s}^N}{p_{j,s-1}^N \left(1+\pi_{s-1}^C\right)^{\iota} \left(1+\bar{\pi}\right)^{1-\iota}} - 1 \right)^2 y_{j,s}^N \right\}$$

where κ affects the slope of the Phillips curve and ι the degree of price indexation, $CT_{j,s}$ is the total cost of firm j. The above formulation has to take into account the fact that firms in the non-tradable sector have decreasing returns to scale technology, and consequently the firm's marginal cost is not equal to the average marginal cost. In fact, following [19] and [9], the individual firm's total cost is:

$$CT_{j,t} = \frac{mc_t^N}{p_t^N} \left(\frac{p_{j,t}^N}{p_t^N} \right)^{\frac{\varepsilon^N \left(\alpha_N - 1\right)}{\alpha}} y_{j,t}^N$$

where ε^N is the elasticity of substitution in non-tradable goods, α_N is the share of labor in the production of non-tradable goods and mc_t^N is the average marginal cost in the non-tradable sector.

The log-linearized first-order condition with respect to price provides the Phillips curve of the economy:

$$\pi_t^N = \beta E_t \pi_{t+1}^N + \iota^N \pi_{t-1}^C - \beta \iota^N \pi_t^C + \frac{(\varepsilon^N - 1)}{\kappa} mc_t^N \tag{4.4}$$

where π_t^N is the non-tradables price inflation, and π_t^C is the total price inflation (composed of tradable and non-tradable price inflation).

The financial sector comprises the central bank and commercial banks. The central bank intervenes in the foreign exchange market by accumulating reserves. The accumulation of reserves is financed by issuing a non-contingent domestic bond that pays an interest rate i_t. Accordingly, the balance sheet of the central bank is given by:

$$q_t ri_t^* = b_t \tag{4.5}$$

where ri_t^* is real international reserves and b_t is central bank bonds. The cash flow of the central bank is given by:

$$\tau_t = b_t - \frac{\left(1+i_{t-1}\right)}{\left(1+\pi_t^C\right)} b_{t-1} + q_t \frac{\left(1+i_{t-1}^*\right)}{\left(1+\pi_t^*\right)} ri_{t-1}^* - q_t ri_t^* \tag{4.6}$$

and is related to the quasi-fiscal deficit. The central bank receives an interest rate i_t^* on its international reserves and pays an interest rate i_t on domestic bonds. At each point in time the quasi-fiscal deficit of the central bank is an increasing function of the interest rate spread and the amount of foreign reserves.

During each period, the central bank intervenes in the FX market to keep the ratio of reserves to the country's foreign liabilities (a proxy reserve-adequacy indicator) close to a desired steady-state level. In addition, it seeks to reach a given operational target for the real exchange rate measured as $RER_t = p_t^T / p_t^N$. It also determines the interest rate it pays to banks by using a policy rule. One possible rule for the FX interventions is.[12]

$$\frac{q_t ri_t^*}{l_t} = \frac{\overline{qri^*}}{l} - \omega\left(RER_t - \overline{RER}\right). \tag{4.7}$$

Under this rule, the central bank buys reserves when RER_t deviates from an operational target, $\overline{RER}$. ω measures the strength of the intervention. When $\omega = 0$, intervention aims only to keep the ratio of foreign reserves to foreign liabilities constant.

Commercial banks' assets include loans to households and sterilization bonds from the central bank. On the liability side they hold external debt b_t^*. Therefore, the balance sheet of commercial banks is described by the following equation:

$$b_t + l_t = q_t b_t^* \tag{4.8}$$

As in Edwards and Vegh (1997), and Benes, Berg, Portillo, and Vavra (2012), commercial banks are competitive and set the optimal level of b_t, and l_t by maximizing their cash flow subject to a technology constraint given by:

$$\Omega\left(b_t, l_t\right) = \theta_b b_t + \theta_l l_t - 2\theta\sqrt{b_t l_t}$$

This functional form stipulates that loans and sterilization bonds are not perfect substitutes and hence carry different interest rates. After imposing the balance sheet constraint, the first-order conditions of the commercial banks are:

$$E_t \frac{\left(1+i_t\right)}{\left(1+\pi_{t+1}^C\right)} = E_t\left(\frac{q_{t+1}}{q_t}\frac{\left(1+i_t^*\right)}{\left(1+\pi_{t+1}^*\right)}\right) + \theta_b - \theta\sqrt{\frac{l_t}{b_t}} \tag{4.9}$$

and

$$E_t \frac{\left(1+i_t^l\right)}{\left(1+\pi_{t+1}^C\right)} = E_t\left(\frac{q_{t+1}}{q_t}\frac{\left(1+i_t^*\right)}{\left(1+\pi_{t+1}^*\right)}\right) + \theta_l - \theta\sqrt{\frac{b_t}{l_t}} \tag{4.10}$$

Equation (4.9) is the UIP condition adjusted by a risk premium. As explained in Appendix C of Benes, Berg Portillo and Vavra (2012), this risk premium is increasing

[12] As will be explained below, commercial banks' liability side consists entirely of foreign debt, while their asset side consists of loans to households plus sterilization bonds issued by the central bank. Therefore, fixing a ratio of reserves to foreign debt is equivalent to fixing the ratio of reserves to commercial bank loans. From the central bank balance sheet, $q_t ri_t^* = b_t$. From commercial banks' balance sheets: $b_t + l_t = q_t b_t^*$. Hence, $b_t^* / ri_t^* = 1 + l_t / b_t$.

as a function of the ratio of foreign reserves to foreign liabilities. This is the channel through which foreign exchange interventions work. When the central bank intervenes actively ($\omega \neq 0$ in Equation 4.7), it raises the cost to commercial banks because they will hold central bank bonds in excess of their long term value, making external funding less attractive for banks, and affecting the exchange rate.

Equation (4.10) is the supply of loans and describes a positive relation between the lending interest rate and loans. As can be seen in equations (4.9) and (4.10), the composition of the asset side of the commercial bank balance sheet affects the intermediation spread measured by the difference between the loan rate and the policy rate. In fact, the larger the amount of central bank bonds relative to household loans, the lower the loan rate. That is, when the exposure of commercial banks to central bank bonds is larger than its steady state ratio, the commercial banks will try to balance their asset composition by lowering the interest rate on loans.

To summarize, the fact that central bank bonds and loans to households are not perfect substitutes for the commercial banks implies a mechanism through which FX interventions affect the exchange rate (the UIP condition, Eq. (4.9)), but it also implies that FX interventions may affect the supply of credit to the domestic economy. In fact, when the central bank "actively" intervenes in the FX market, it will shift the commercial bank balance sheet towards central bank bonds, and through Eq. (4.10) this will cause a drop in the interest rate on loans.[13]

4.2 Dynamics of the model

In this section, the model is used to illustrate possible effects that sterilized interventions may have on the domestic economy. We do this by simulating two shocks. The first is a temporary reduction in the external interest rate that induces capital flows into the domestic economy. The second is a temporary increase in the oil sector revenue. We discuss results both for active FX intervention (responsive to RER deviations from steady state, $\omega \neq 0$) and for passive intervention (non-responsive to RER deviations from steady-state, $\omega = 0$). The FX intervention is modeled by equation (4.7).

The simulations are carried out using alternative monetary regimes. Specifically, we present the results for three monetary policy regimes. In the first, we assume that the central bank sets the nominal interest rate using the following Taylor rule:

$$i_t = \left(1-\rho_i\right)\bar{i} + \rho_i i_{t-1} + (1-\rho_i)\psi_\pi\left(\pi_t^C - \bar{\pi}\right) + \varepsilon_t^i \qquad (4.11)$$

In the second alternative, the central bank follows a strict inflation target and sets the nominal interest rate in such a way that $\pi_t^C = \bar{\pi}$. Neither of these alternative rules corrects the distortions created by price rigidities. To fix them, the policy rule must fully stabilize non-tradable price inflation, since this is the only source of nominal rigidities in the economy. That is, we define the "efficient" policy rule as the

[13] The model is calibrated in order to match the high ratios of the Colombian economy. The price rigidity parameter $\kappa = 46$ is equivalent to a Calvo´s probability of adjustment every four quarters. The magnitude of the intervention parameter $\omega = 10$ follows the definition of managed floating in Benes, Berg Portillo and Vavra (2012). Based on an estimate of how the lending interest rate spread responds to the loans-to-public-debt ratio in the banks' balance sheets, θ was set to 0.10.

one that sets the interest rate in such a way that $\pi_t^N = \overline{\pi}$. (See Galí and Monacelli (2005)).[14] This policy rule is used as a benchmark in all the exercises.

4.3 Capital inflow shock

The model economy is shocked with a decrease of 100bp in the external interest rate. Results for this shock with the efficient policy rule are displayed in Figure 7. The shock produces an appreciation of the currency that shifts demand away from non-tradable goods and into tradable goods. This produces downward pressure on non-tradable inflation, thereby inducing the central bank to reduce domestic bond interest rates. As a result, lending rates fall, increasing the demand for new loans, and decreasing households' debt burden. These two effects add up to explain the rise in domestic demand for both tradable and non-tradable goods.

The appreciation of the currency increases the marginal cost of tradable goods relative to non-tradables, and shifts the demand for labor towards the non-tradable sector. Consequently, the appreciation of the currency implies a deterioration of the trade balance along with an increase of labor in the non-tradable sector. Finally, given that labor is perfectly substitutable across sectors and that it is the only production input, the increase in the marginal cost of producing a tradable, as opposed to a non-tradable, good implies a reduction in the relative price of the tradable good. That is, a fall in $RER_t = p_t^T / p_t^N$.

Comparing the efficient policy rule (flexible price equilibrium) with the equilibrium obtained either with the Taylor rule or with a strict inflation targeting rule reveals the extent to which these alternative rules deviate from the efficient equilibrium. Any deviation from this equilibrium is consequently not desirable. Hence, the question is whether active FX interventions can close the gap between suboptimal policies and efficient allocation.

The results with the Taylor rule, with and without active intervention, are displayed in Figure 7. A central bank that sets the interest rate using a Taylor rule without active intervention in the FX market will reduce the nominal interest rate below its natural level,[15] because there is a decline in inflation due to the strengthening of the currency. When the central bank actively intervenes in the FX market, the real appreciation is lower and the real interest rate falls less than in the efficient equilibrium case.

However, sterilized active intervention in the FX market by the central bank creates a shift in the asset portfolio of commercial banks towards central bank bonds. Consequently, commercial banks will lower the interest rate on loans and expand credit to households. Note that the credit expansion here is greater than in the efficient equilibrium. In short, when the central bank follows a Taylor rule to set the nominal interest rate, active FX intervention reduces the volatility of the exchange rate, but creates greater expansion of credit and consumption in the domestic economy.

[14] In an alternative exercise where there are nominal wage rigidities this rule is not optimal any more. However, the main conclusions remain valid.

[15] The natural level of the nominal interest rate is the one that prevails at the flexible price equilibrium.

Figure 8 shows the results of the interest rate shock for the case in which the central bank follows a strict inflation regime ($\pi_t^C = \overline{\pi}$). In this circumstance, the nominal interest rate is set at a level that prevents appreciation of the currency, which is the main source of deflation in the economy. In fact, the policy rate follows the external interest rate, implying only a small appreciation. As shown in Figure 8, active FX intervention by the central bank has a minor effect on the exchange rate. However, it affects the loan rate and domestic credit through its impact on the commercial banks' portfolio. As a result, the economy becomes more volatile without any significant gain in exchange rate stabilization. This puzzling outcome is explained by the impulse that sterilized FX intervention gives to domestic demand. With active FX intervention, loans to households increase more, creating an excess demand that the central bank combats via a smaller reduction in the interest rate. Through the UIP, this offsets the effects of FX purchases on the exchange rate.

To recap, there are notable differences as regards efficient equilibrium with, versus without, active intervention in the FX market. Active FX interventions imply a larger drop in the loan rate, because the sterilization affects the balance sheet of the commercial banks. When the central bank increases its stock of international reserves, it also increases the holdings of central bank bonds by commercial banks, affecting the composition of their portfolio. As explained above, this shift in portfolio composition has the effect of lowering the loan rate more than occurs in the case of equilibrium without intervention. Accordingly, loans to households rise by more than their flexible price level, and consumption becomes more volatile (Table 2).[16]

4.4 Oil revenue shock

In oil exporting countries, changes in oil sector revenue can have large impacts on the domestic economy. In this section, our model is used to analyze the effects that such shocks may have on the economy, and to see how those effects change with different monetary and exchange rate policies. As in the previous section, our benchmark is the efficient policy rule, ($\pi_t^N = \overline{\pi}$) (Figure 9).

In the efficient allocation, an increase in oil revenue creates a larger demand for tradable and non-tradable goods along with a decrease in household debt to commercial banks, and an appreciation of the currency. The real appreciation is a consequence of the additional demand for non-tradable goods that raises their relative prices, and of the nominal appreciation induced by the central bank's interest rate hike.

In contrast, under the two alternative monetary policy regimes without active FX intervention, the response of the central bank involves a reduction in the interest rate (Figures 9 and 10). This is a consequence of the fact that the central bank tries

[16] In contrast to Benes, Berg, Portillo and Vavra (2012), in our model the volatility of consumption and loans increases with FX intervention. The difference in the findings could have to do with the specification of the risk premiums in the Benes et al. model, which depends on the real level of central bank bonds in bank assets, while our specification depends on the ratio of bonds to loans. This implies that in Benes, Berg, Portillo and Vavra (2012), any shock that moves banks' bond holdings will shift risk premiums, even if the composition of bank assets remains unchanged. Consequently, risk premiums would move in scenarios without active FX intervention, and this would trigger interest rate responses that exacerbate consumption and loan volatility in those scenarios.

to stabilize CPI inflation. That requires smoothing the price changes of both tradable and non-tradable goods. Hence, sharp appreciation is not tolerated. On the other hand, active FX intervention dampens appreciation, but boosts credit supply and aggregate demand through reduction of the loan rate. Consequently, the central bank reacts by increasing the policy interest rate. This partially offsets the effectiveness of the FX intervention on the exchange rate. The more the central bank cares about the inflation target, the less effect FX intervention has in curbing appreciation of the currency. This can be seen by comparing the behaviour of the RER in the Taylor and strict inflation targeting regimes with active FX intervention (Figures 9 and 10).

As in Ostry, Ghosh and Chamon (2012), FX intervention is coupled with increases in the interest rate in response to the income shock. However, in contrast to the findings of Ostry et al., this is not the result of an optimal policy reaction, but a response to the expansionary effects of intervention. As in the case of the external interest rate shock, FX intervention is associated with higher volatility in most macroeconomic variables but not in the exchange rate (Table 3).

5. Conclusions

The Banco de la República intervenes in the FX market to maintain adequate levels of international reserves, to remedy short term exchange rate misalignments, and occasionally to curb excessive exchange rate volatility. FX intervention is sterilized to the extent required to keep short term interest rates in line with the policy rate. The array of sterilization mechanisms has been expanded in recent years. Currently, an agreement between the Banco de la República and the government is in place to coordinate public debt management policy and Central Bank sterilization policy. Intervention is carried out through announced daily purchases of fixed amounts of USD. This type of intervention is deemed appropriate because it minimizes any signal of a defense of a particular level of the exchange rate.

A survey on the effectiveness of FX intervention in Colombia does not support the notion that it is helpful in coping with the consequences of quantitative easing in advanced economies, reduced risk premiums for EMEs and high international commodity prices. These phenomena are likely to last for years, while FX intervention, when effective, seems to have but a short-lived impact on the exchange rate. Accordingly, perceived medium term exchange rate misalignments must be dealt with by other policy instruments.

When sterilized FX intervention is effective through the operation of the portfolio balance channel, it may also expand credit supply. The macroeconomic outcomes of intervention in this case will depend on the monetary policy rule followed by the central bank. A small open economy DSGE is used to explore this issue. In general, FX intervention implies a volatility of credit and consumption that is higher than under efficient allocation and under alternative monetary regimes without intervention. This is could be a concern for financial stability if intervention reaches a large scale. Furthermore, the more inclined the central bank is to meet the inflation target, the stronger its response to the expansionary effects of the intervention, and consequently, the lower the impact of the intervention on the exchange rate. In effect, monetary policy will (partially) undo the effect of FX policy on the exchange rate. These results cast some doubt on the “two targets, two instruments” conclusions of Ostry, Ghosh and Chamon (2012).

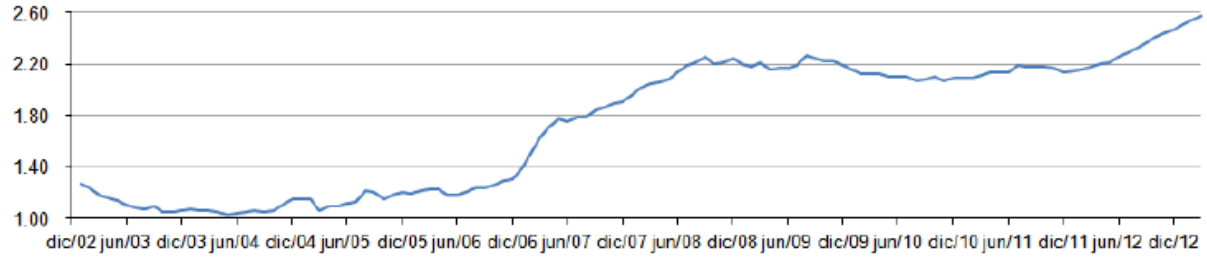
Literature Review on the Effectiveness of the Forex Intervention in Colombia* Table 1

Authors Period of analysis (mm/yy)	Observed exchange rate Average daily return (%)	Observed exchange rate Average daily volatility (%)	Type of intervention being evaluated	Econometric results Return Mean	Econometric results Return Variance	Data and econometrics Data frequency	Data and econometrics Procedure	Data and econometrics Assumed distribution	Data and econometrics Intervention indicator
Toro and Julio (2005)									
Sep/04 - Apr/05	-0.12	0.39	Discretionary intervention	Increase Length: Not estimated	Increase	Intra-day	GARCH	GED	Dummy
Kamil (2008)									
Sep/04 - Mar/06	-0.02	0.28	Purchases (options and discretionary)	Increase Length: "short-lived"	Decrease	Daily	2S-IV, TOBIT, GARCH	Normal	Volume (non-weighted)
Jan/07 - Apr/07	-0.07	0.34		No effect	No effect	Daily		Normal	Volume (non-weighted)
Echavarría, Vásquez and Villamizar (2009)									
Apr/99 - Aug/08	0.02	0.43	Purchases (options and discretionary)	Increase Length: 1 to 6 months?	Decrease	Daily	2S-IV, TOBIT, EGARCH	*t*-student	Volume (non-weighted)
Echavarría, López and Misas (2009)**									
Jan/00- Aug/08	0.04	0.39	Net Purchases (options, volatility and discretionary)	Increase Length: 1 month	---	Monthly	SVAR, Variance decomposition	White noise	Volume (non-weighted)
Rincón and Toro (2010)* **									
Jan/93 - Jul/10	0.02	0.31	Net Purchases (options, volatility and discretionary, preannounced)	No effect Length: Not estimated	Increase	Daily	GARCH	GED	Volume (Weighted by the market turnover)
Jan/93 - Sep/09	0.06	0.15	Net Purchases (discretionary)	No effect Length: Not estimated	No effect	Daily	IGARCH	GED	Volume (Weighted by the market turnover)
Oct/99 - Jul/10	-0.01	0.41	Net Purchases (options, volatility and discretionary, preannounced)	No effect Length: Not estimated	No effect	Daily	IGARCH	GED	Volume (Weighted by the market turnover)
Jan/04 - Jul/10	-0.02	0.58	Net Purchases (options, volatility and discretionary, preannounced)	No effect Length: Not estimated	No effect	Daily	IGARCH	GED	Volume (Weighted by the market turnover)
Jan/08 - Jul/10	-0.001	1.05	Net Purchases (options, preannounced)	No effect Length: Not estimated	No effect	Daily	IGARCH	GED	Volume (Weighted by the market turnover)
Echavarría, Melo, Tellez, and Villamizar (2012)									
Jan/00 - Mar/12	-0.002	0.44	Gross Purchases/ Sales (options, volatility and discretionary, preannounced)	Increase Length: Not estimated	----	Daily	GARCH, TOBIT	*i.i.d.*~*N*(0,1)	Volume (non-weighted)
BIS-CCA (2012)									
May/07 - Nov/11	0.00 (7 minutes interval)	0.01	Net Purchases (options, preannounced)	Increase Length: "short-lived" (some minutes)	Decrease Length: "Long-lived" (at least one day)	Intra-day	GMM	----	Dummy, Volume

* The exchange rate is measured as the amount of COP per USD 1 ** The effect of the forex intervention on the level of the exchange rate is evaluated. *** When both policies, forex intervention and capital controls, were used simultaneously (latest period), their interaction increased the return without increasing its volatility.

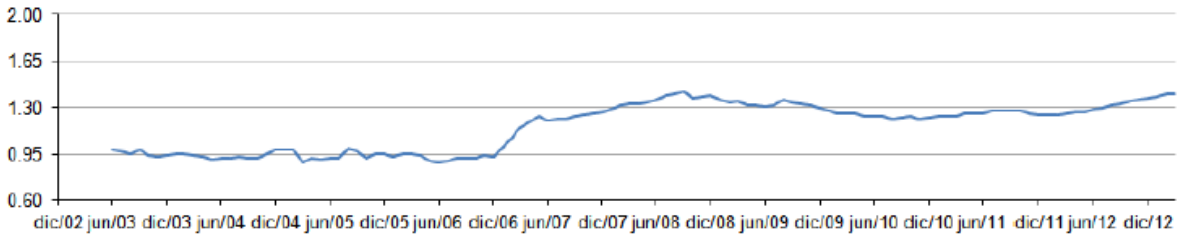
Source: Authors' compilation.

International Reserves*/Amortizations** Figure 1



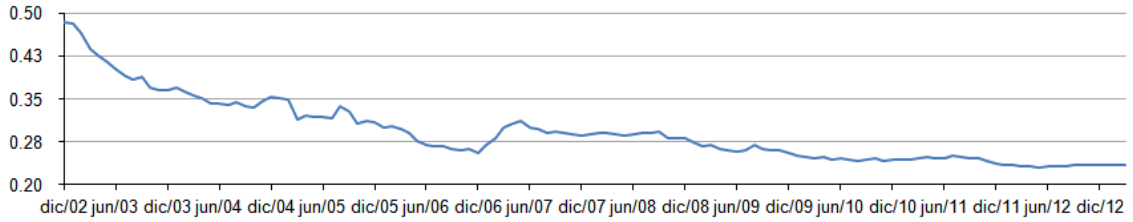
*Projected data from November 28, 2012 to March 2013.
**Projected data from October 2012 to March 2013. Denominator smoothed using Hodrick -Prescott Filter.

International Reserves*/Amortizations + Current Account Deficit** Figure 2



*Projected data from November 28, 2012 to March 2013.
**Projected data from July 2012 to march 2013. Denominator smoothed using Hodrick -Prescott Filter.

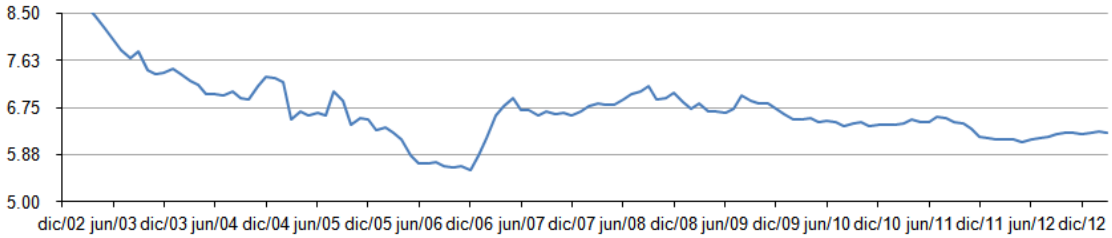
International Reserves*/M3** Figure 3



*Projected data from November 28, 2012 to March 2013.
**Projected data from November 2012 to March 2013. Denominator smoothed using Hodrick -Prescott Filter.

International Reserves*/Imports**

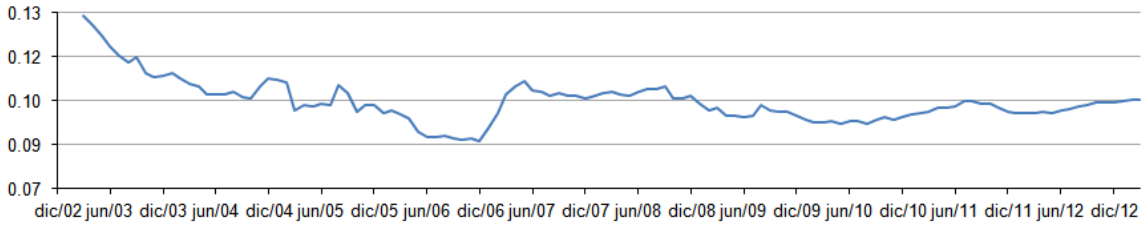
Figure 4



*Projected data from November 28, 2012 to March 2013.
**Projected data from July 2012 to March 2013. Denominator smoothed using Hodrick -Prescott Filter.

International Reserves*/GDP**

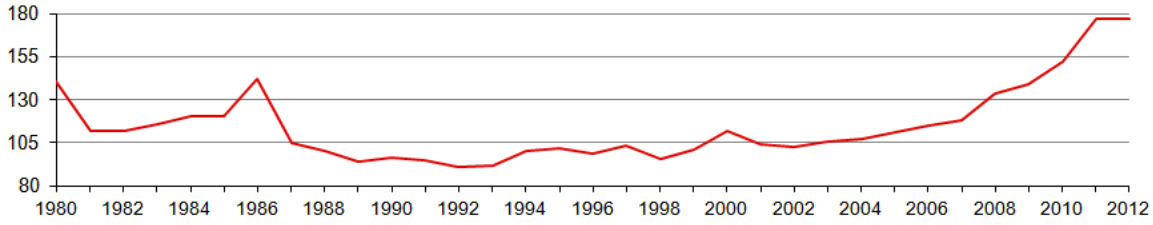
Figure 5



*Projected data from November 28, 2012 to March 2013.
**Projected data from July 2012 to March 2013. Denominator smoothed using Hodrick -Prescott Filter.

Terms of Trade (Colombia)

Figure 6



Source: Banco de la República

Capital inflow shock: Relative variances implied by alternative rules with and without active FX intervention

Table 2

	Taylor Rule	Strict Inflation Targeting
Policy Rate	1.03	0.41
Real Interest Rate	16.28	0.43
Loan Rate	3.71	1.49
RER	0.89	0.98
Total Consumption	13.88	1.99
Tradable Consumption	26.37	2.48
Non-Tradable Consumption	4.62	1.36
Total Labor	4.08	0.55
Non-Tradable Labor	4.62	1.36
Tradable Labor	33.39	3.14
Anual Non-Tradable Inflation Rate	0.18	1.09
Anual Tradable Inflation Rate	3.04	1.00
Anual Inflation Rate	1.96	1.00
International Reserves (FX)	3356.18	295.08
Loans to Households	95.53	4.53
Non-Tradable Marginal Cost	3.10	1.23
Real wage	2.61	1.18
Quasi-fiscal Deficit	1.43	0.38
Non-Tradable Output	4.62	1.36
Tradable Output	33.39	3.14
Real Exchange Rate	0.89	0.98

For each variable, the table displays $var(x_t^i)/var(x_t^j)$ where $x_t^i = x_t^{Ri} - x_t^E$. x_t^{Ri} is the value of the variable under each of the alternate rules and x_t^E is the value of the variable under the efficient allocation. i represents active FX intervention and j represents no active FX intervention. If the ratio is greater than one, active FX intervention yields higher volatility.

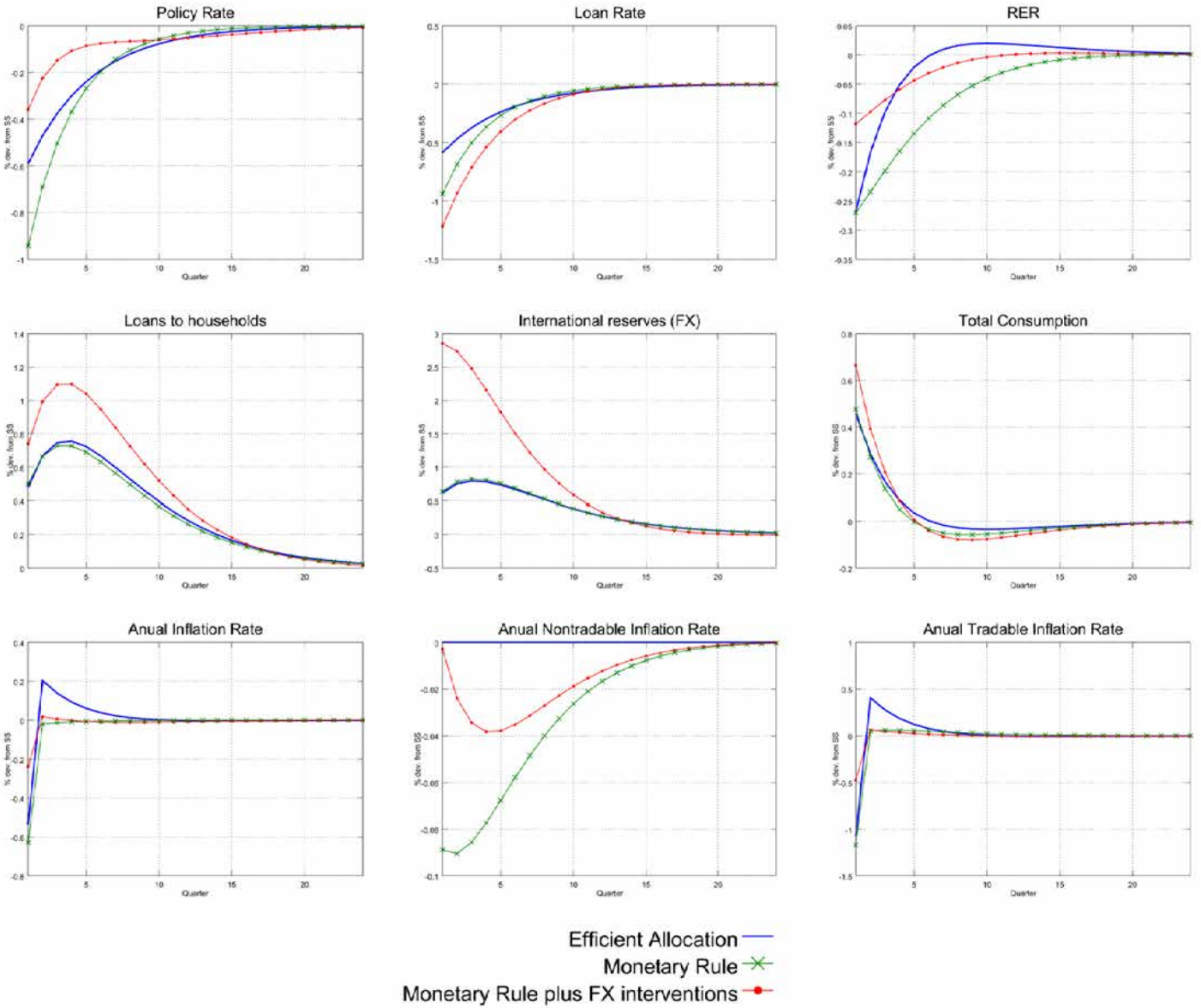
Oil revenue shock: Relative variances implied by alternative rules with and without active FX intervention

Table 3

	Taylor Rule	Strict Inflation Targeting
Policy Rate	2.42	10.62
Real Interest Rate	5.79	32.37
Loan Rate	1.84	7.98
RER	1.23	0.77
Total Consumption	5.29	12.60
Tradable Consumption	2.79	24.44
Non-Tradable Consumption	2.51	3.83
Total Labor	0.19	2.96
Non-Tradable Labor	2.51	3.83
Tradable Labor	12.61	39.68
Anual Non-Tradable Inflation Rate	3.50	1.36
Anual Tradable Inflation Rate	1.32	0.97
Anual Inflation Rate	1.43	1.00
International Reserves (FX)	1896.42	8170.71
Loans to Households	10.13	34.87
Non-Tradable Marginal Cost	2.03	2.56
Real wage	1.87	2.15
Quasi-fiscal Deficit	3.37	14.38
Non-Tradable Output	2.51	3.83
Tradable Output	12.61	39.68
Real Exchange Rate	1.23	0.77

For each variable, the table displays $var(x_t^i)/var(x_t^j)$ where $x_t^i = x_t^{Ri} - x_t^E$. x_t^{Ri} is the value of the variable under each of the alternate rules and x_t^E is the value of the variable under the efficient allocation. i represents active FX intervention and j represents no active FX intervention. If the ratio is greater than one, active FX intervention yields higher volatility.

Figure 7: Capital inflow shock with Taylor rule



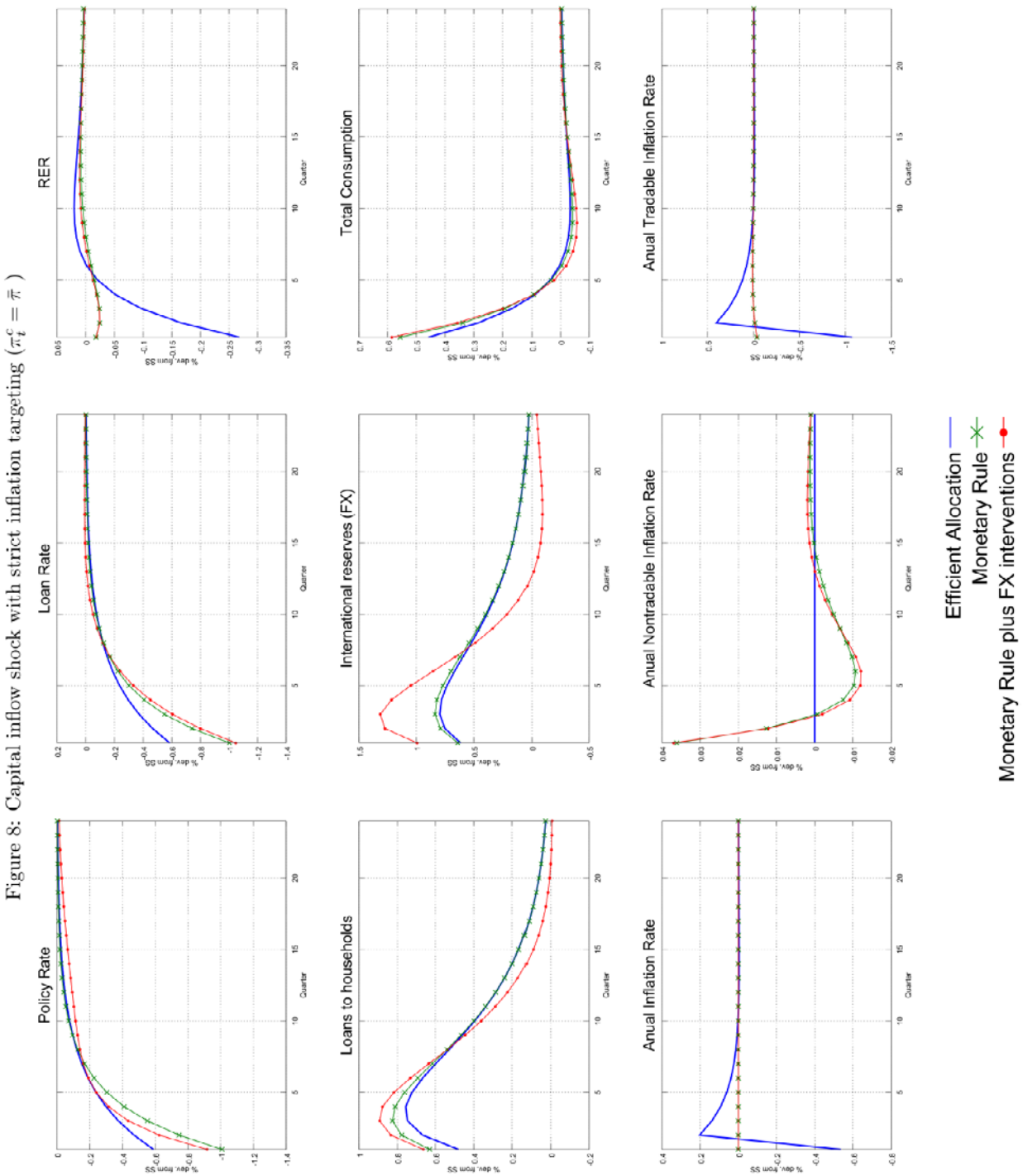


Figure 8: Capital inflow shock with strict inflation targeting ($\pi_t^c = \bar{\pi}$)

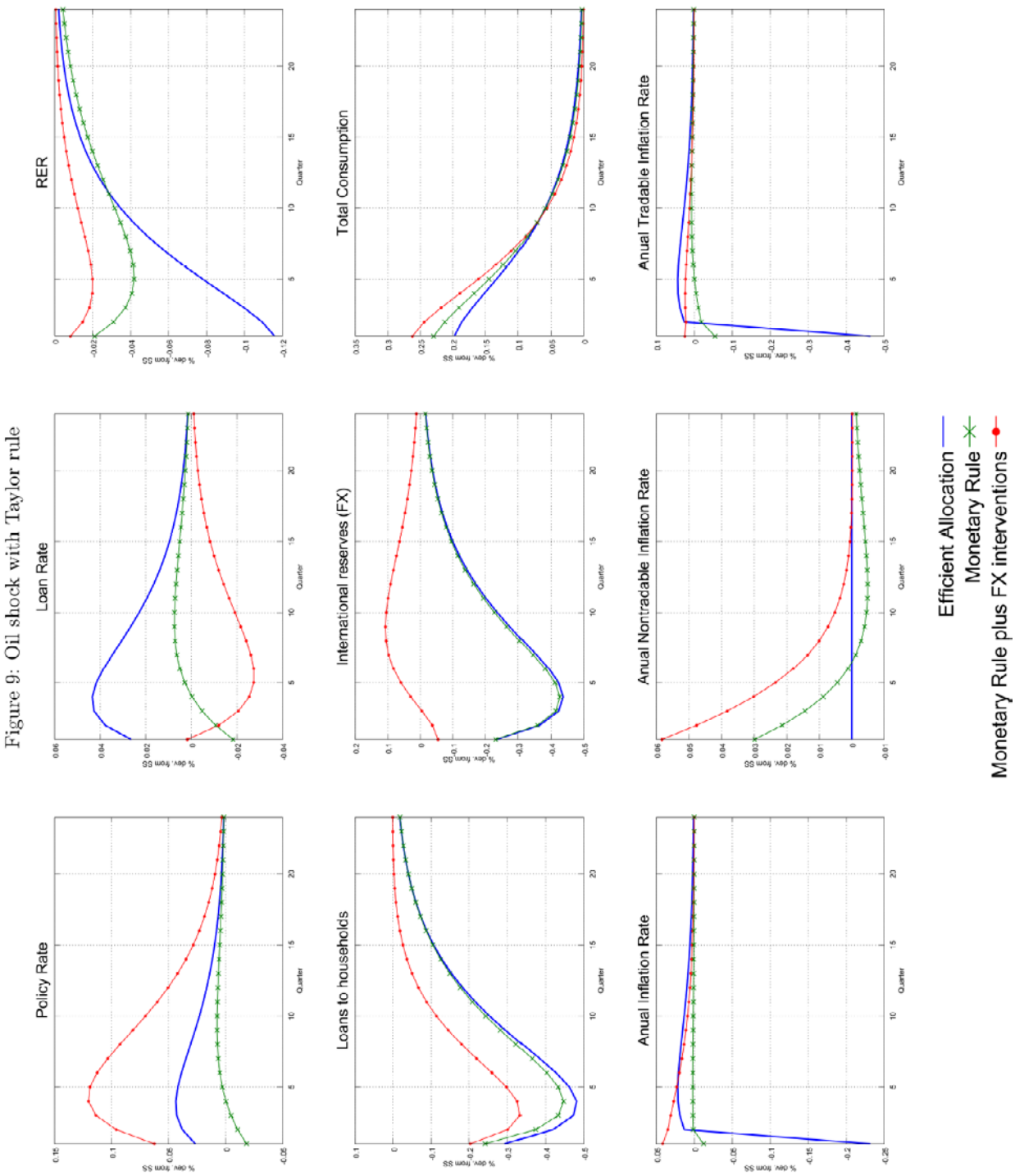
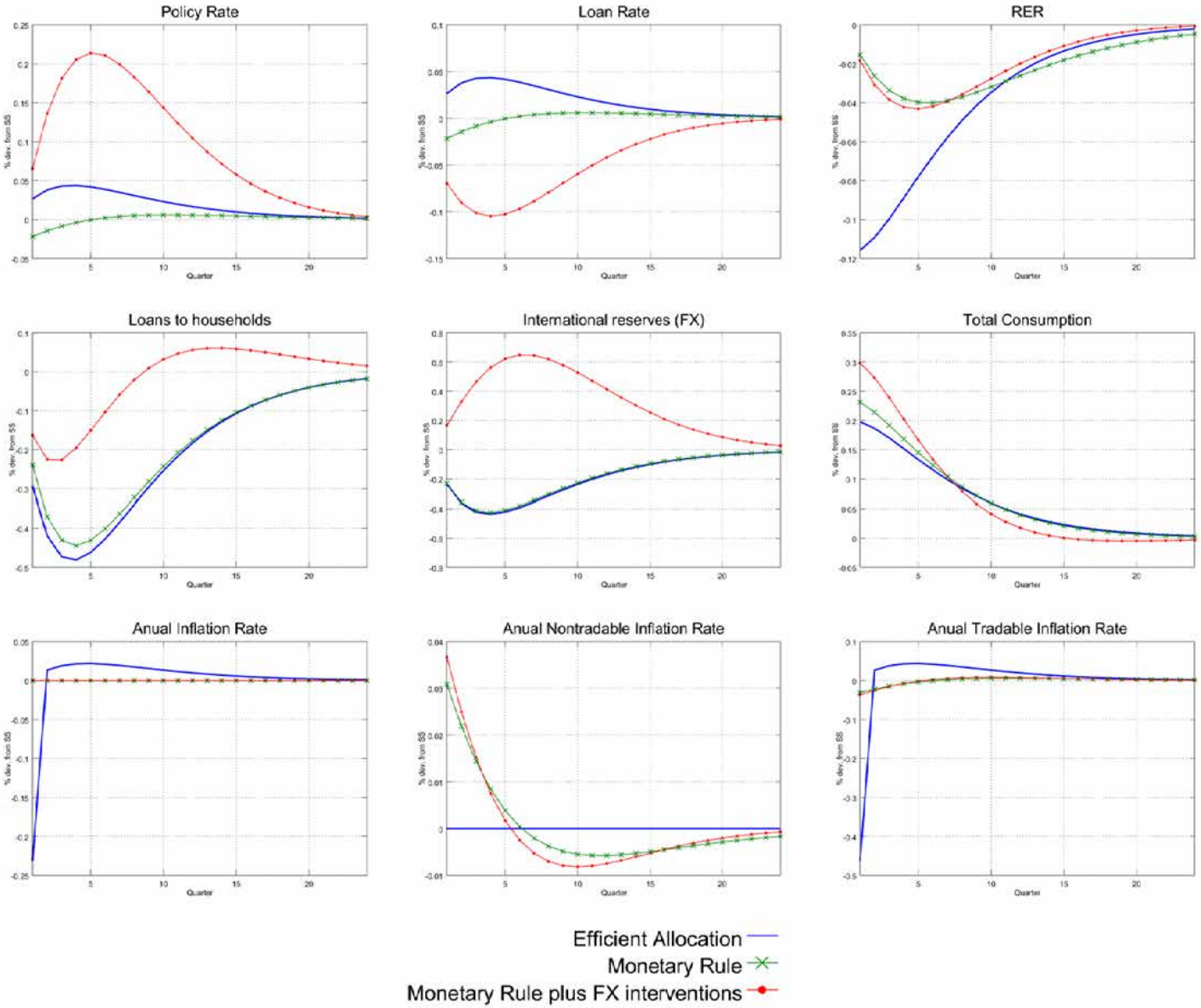


Figure 9: Oil shock with Taylor rule

Figure 10: Oil shock with strict inflation targeting ($\pi_t^c = \bar{\pi}$)



A. The Model

A.1 Households

$$y_t^P + w_t h_t + \xi_t^N + \xi_t^B + I_t = \tau_t + \left(\frac{1+i_{t-1}}{1+\pi_t^C}\right) I_{t-1} + c_t + \frac{\psi}{2}\left(I_t - \bar{I}\right)^2 \tag{A.1}$$

$$\lambda_t = \frac{z_t^U}{c_t} \tag{A.2}$$

$$w_t \lambda_t = \chi h_t^{\eta} \tag{A.3}$$

$$\lambda_t \left(1 - \psi\left(I_t - \bar{I}\right)\right) = \beta E_t \left[\lambda_{t+1}\left(\frac{1+i_t^I}{1+\pi_{t+1}^C}\right)\right] \tag{A.4}$$

$$c_t^T = \left(1-\gamma_c\right)\left(\frac{p_t^T}{p_t^C}\right)^{-\varepsilon} c_t \tag{A.5}$$

$$c_t^N = \gamma_c \left(\frac{p_t^N}{p_t^C}\right)^{-\varepsilon} c_t \tag{A.6}$$

A.2 Commercial Banks

$$b_t + I_t = q_t b_t^* \tag{A.7}$$

$$\xi_t^B = \left(\frac{1+i_{t-1}^I}{1+\pi_t^C}\right) I_{t-1} - I_t + \left(\frac{1+i_{t-1}}{1+\pi_t^C}\right) b_{t-1} - b_t + q_t b_t^* - q_t \left(\frac{1+i_{t-1}^*}{1+\pi_t^{C*}}\right) b_{t-1}^* \tag{A.8}$$

$$-\left(\theta_b b_{t-1} + \theta_I I_{t-1} - 2\theta\sqrt{b_{t-1} I_{t-1}}\right)$$

$$E_t\left(\frac{1+i_t}{1+\pi_{t+1}^C}\right) = E_t\left[\left(\frac{q_{t+1}}{q_t}\right)\left(\frac{1+i_t^*}{1+\pi_{t+1}^{C*}}\right)\right] + \theta_b - \theta\sqrt{\frac{I_t}{b_t}} \tag{A.9}$$

$$E_t\left(\frac{1+i_t^I}{1+\pi_{t+1}^C}\right) = E_t\left[\left(\frac{q_{t+1}}{q_t}\right)\left(\frac{1+i_t^*}{1+\pi_{t+1}^{C*}}\right)\right] + \theta_I - \theta\sqrt{\frac{b_t}{I_t}} \tag{A.10}$$

A.3 Central Bank

$$q_t ri_t^* = b_t \tag{A.11}$$

$$\tau_t = b_t - \left(\frac{1+i_{t-1}}{1+\pi_t^C}\right) b_{t-1} + q_t \left(\frac{1+i_{t-1}^*}{1+\pi_t^{C*}}\right) ri_{t-1}^* - q_t ri_t^* \tag{A.12}$$

$$\textit{Alternative Nominal Interest Rules} \tag{A.13}$$

$$\frac{q_t ri_t^*}{I_t} = \frac{\overline{qri^*}}{I} - \omega\left(RER_t - \overline{RER}\right) \tag{A.14}$$

A.4 Firms

A.4.1 Tradable goods

$$y_t^T = z_t^T \left(h_t^T\right)^{\alpha_T} \tag{A.15}$$

$$\frac{p_t^T}{p_t^C}\left(\alpha_T \frac{y_t^T}{h_t^T}\right) = w_t \tag{A.16}$$

A.4.2 Non-tradable goods

$$y_t^N = z_t^N \left(h_t^N\right)^{\alpha_N} \tag{A.17}$$

$$y_t^N = c_t^N + \frac{\kappa}{2}\left(\frac{1+\pi_t^N}{\left(1+\pi_{t-1}^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}} - 1\right)^2 \tag{A.18}$$

$$mc_t^N\left(\alpha_N \frac{y_t^N}{h_t^N}\right) = w_t \tag{A.19}$$

$$0 = \left(1-\varepsilon_N\right)\left(\frac{p_t^N}{p_t^C}\right) y_t^N + \left(\frac{\varepsilon_N}{\alpha_N}\right) mc_t^N y_t^N \tag{A.20}$$

$$-\left(\frac{p_t^N}{p_t^C}\right)\kappa\left(\frac{1+\pi_t^N}{\left(1+\pi_{t-1}^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}} - 1\right)\frac{1+\pi_t^N}{\left(1+\pi_{t-1}^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}}$$

$$+\beta E_t\left[\left(\frac{\lambda_{t+1}}{\lambda_t}\right)\left(\frac{p_{t+1}^N}{p_{t+1}^C}\right)\kappa\left(\frac{1+\pi_{t+1}^N}{\left(1+\pi_t^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}} - 1\right)\frac{1+\pi_{t+1}^N}{\left(1+\pi_t^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}}\right]$$

$$\xi_t^N = \left(\frac{p_t^N}{p_t^C}\right) y_t^N - w_t h_t^N - \left(\frac{p_t^N}{p_t^C}\right)\frac{\kappa}{2}\left(\frac{1+\pi_t^N}{\left(1+\pi_{t-1}^C\right)^{\iota}\left(1+\bar{\pi}\right)^{1-\iota}} - 1\right)^2 \tag{A.21}$$

A.5 Equilibrium

$$\pi_t^C = \left[\left(1-\gamma_c\right)\left(\frac{p_{t-1}^T}{p_{t-1}^C}\left(1+\pi_t^T\right)\right)^{1-\varepsilon} + \gamma_c\left(\frac{p_{t-1}^N}{p_{t-1}^C}\left(1+\pi_t^N\right)\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \tag{A.22}$$

$$\frac{p_t^T}{p_t^C} = q_t\left(\frac{p_t^{T*}}{p_t^{C*}}\right) \tag{A.23}$$

$$\frac{1+\pi_t^T}{1+\pi_t^C} = \frac{p_t^T}{p_t^C} \Big/ \frac{p_{t-1}^T}{p_{t-1}^C} \tag{A.24}$$

$$\frac{1+\pi_t^N}{1+\pi_t^C} = \frac{p_t^N}{p_t^C} / \frac{p_{t-1}^N}{p_{t-1}^C} \tag{A.25}$$

$$h_t = h_t^T + h_t^N \tag{A.26}$$

$$\frac{\left(1+d_t\right)\left(1+\pi_t^{C*}\right)}{1+\pi_t^C} = \frac{q_t}{q_{t-1}} \tag{A.27}$$

$$RER_t = \frac{p_t^T}{p_t^N} \tag{A.28}$$

$$y_t = y_t^P + \left(\frac{p_t^T}{p_t^C}\right)\alpha_T y_t^T + mc_t^N \alpha_N y_t^N + \xi_t^B + \xi_t^N \tag{A.29}$$

$$\left(1+i_t^*\right) = \left(1+\bar{i}^*\right) z_t^{i*} \tag{A.30}$$

A.6 Shocks

$$z_t^{i*} = \rho_{z^{i*}}\left(z_{t-1}^{i*}\right) + \left(1-\rho_{z^{i*}}\right)\ln\left(\overline{z^{i*}}\right) + \varepsilon_t^{i*} \tag{A.31}$$

$$z_t^T = \rho_{z^T}\left(z_{t-1}^T\right) + \left(1-\rho_{z^T}\right)\ln\left(\overline{z^T}\right) + \varepsilon_t^{z^T} \tag{A.32}$$

$$z_t^N = \rho_{z^N}\left(z_{t-1}^N\right) + \left(1-\rho_{z^N}\right)\ln\left(\overline{z^N}\right) + \varepsilon_t^{z^N} \tag{A.33}$$

$$\pi_t^* = \rho_{\pi^*}\left(\pi_{t-1}^*\right) + \left(1-\rho_{\pi^*}\right)\ln\left(\overline{\pi}^*\right) + \varepsilon_t^{\pi^*} \tag{A.34}$$

$$z_t^U = \rho_{z^U}\left(z_{t-1}^U\right) + \left(1-\rho_{z^U}\right)\ln\left(\overline{z^U}\right) + \varepsilon_t^{z^U} \tag{A.35}$$

$$\frac{p_t^{T*}}{p_t^{C*}} = \rho_{p^{T*}}\left(\frac{p_{t-1}^{T*}}{p_{t-1}^{C*}}\right) + \left(1-\rho_{p^{T*}}\right)\ln\left(\frac{\overline{p_{t-1}^{T*}}}{p_{t-1}^{C*}}\right) + \varepsilon_t^{p^{T*}} \tag{A.36}$$

$$y_t^P = \rho_{y^P}\left(y_{t-1}^P\right) + \left(1-\rho_{y^P}\right)\ln\left(\overline{y^P}\right) + \varepsilon_t^{y^P} \tag{A.37}$$

Symbol	Description
Real quantities	
c	Consumption bundle
c^N	Non-tradable consumption
c^T	Tradable consumption
h	Total labor
h^N	Non-tradable labor
h^T	Tradable labor
l	Loans to households
τ	Quasi-fiscal deficit
b	Sterilization bonds
b^*	External debt
y	Domestic output
y^N	Domestic non-tradable output
y^T	Domestic tradable output
λ	Multiplier for budget constraint
ri^*	International reserves
Interest rates, real exchange rate and relative prices	
i_t	Policy rate
i_t^*	External nominal interest rate
i_t^l	Loan rate
q_t	Real exchange rate
RER	Tradable price / Non-tradable price
$\frac{p_t^T}{p_t^C}$	Tradable price / Consumption bundle price
$\frac{p_t^N}{p_t^C}$	Non-tradable price / Consumption bundle price
Inflation rates and nominal devaluation	
π_t^C	Total inflation rate
π_t^T	Non-tradable inflation rate
π_t^N	Tradable inflation rate
d_t	Nominal devaluation
Profits and marginal cost	
ξ^N	Non-tradable sector's profits
ξ^B	Commercial banks' profits
mc^N	Non-tradable firm's marginal cost
Exogenous variables	
$\frac{p_t^{T*}}{p_t^{C*}}$	External tradable goods relative prices
π_t^{C*}	External inflation rate
z^U	Shock to marginal utility of consumption
z^{i*}	External interest rate shock
z^N	Non-tradable productivity shock
z^T	Tradable productivity shock
y^P	Dividends from the oil sector

Parameters

Table 5

Symbol	Description
$\overline{RER}$	Exchange rate's operational target
$\overline{\pi}^C$	Inflation target
ψ	Quadratic adjustment cost parameter for loans
$\overline{i}$	Long run nominal interest rate
$\overline{i}^*$	Long run external nominal interest rate
χ	Scale parameter in labor supply
η	Inverse of
β	Intertemporal discount factor
γ_c	Non-tradable relative weight in consumption bundle
ε	Elasticity of substitution between tradable and non-tradable goods
ε^N	Elasticity of substitution between varieties of non-tradable goods
θ_b	Exogenous spread between policy and external rate
θ_l	Exogenous spread between loan and external rate
θ	Portfolio channel sensibility
ω	Strength of the Central Bank's FX intervention
α_N	Share of labor in the production of non-tradable goods
α_T	Share of labor in the production of tradable goods
κ	Price changing cost for non-tradable firms
ι	Degree of price indexation for non-tradable firms
$\rho_{z^{i*}}$	Persistence of risk premium shock
ρ_{z^N}	Persistence of non-tradable productivity shock
ρ_{z^T}	Persistence of tradable productivity shock
ρ_{π^*}	Persistence of inflation rate shock
ρ_{z^U}	Persistence of marginal utility of consumption shock
$\rho_{p^{T*}}$	External tradable goods relative prices
ρ_{y^P}	Persistence of dividends from oil sector shock

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Foreign exchange interventions as an (un)conventional monetary policy tool

Lubomír Lízal and Jiří Schwarz[1]

Abstract

The zero level of interest rates constitutes a limit of this standard monetary policy instrument. Based on the example of the Czech Republic we argue that in such a situation foreign exchange interventions represent a meaningful monetary policy tool for small open economies not facing serious liquidity problems. Existing studies also suggest that potential financial losses of central banks stemming from the buildup of international reserves do not necessarily compromise credibility or the ability to pursue monetary policy objectives. We provide an overview of the evidence on the functioning of FX interventions and the exchange rate pass-through to consumer prices. Using simulations which take into account the existence of the zero lower bound, we argue that in such a situation the pass-through can be much larger than the existing evidence suggests.

Keywords: FX interventions, exchange rate pass-through, zero lower bound, central bank loss, inflation targeting

JEL classification: E42, E52, E58, F31

[1] Czech National Bank.

Introduction

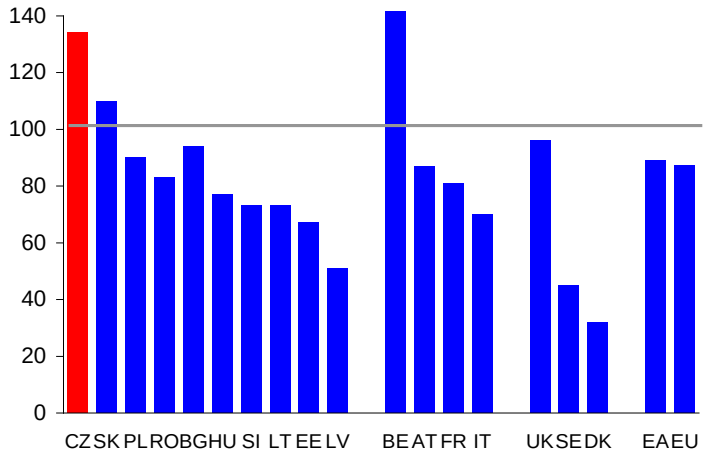
The latest, but lasting, economic difficulties have prompted a prolonged period of monetary easing. A significant number of (important) central banks have lowered their rates in response to the crisis in order to mitigate its consequences and meet their monetary (and other) goals and have announced that they expect rates to be at low levels for a significant period of time. The dismal status of the financial sector has also prompted the use of other, unconventional, tools in order to boost liquidity and maintain the stability of particular segments of the financial sector.

The long-lasting economic stagnation has thus left a number of central banks facing the limits of their standard monetary policy instrument, for policy interest rates are often approaching the zero level. Depending on the particular situation of their economy and financial sector, central banks have turned their attention to various unconventional monetary policy measures, such as a negative interest rates on deposits (as used, for example, by the National Bank of Denmark and the Swedish Riksbank), various forms of liquidity provision through quantitative or qualitative easing, and foreign exchange interventions.

The Czech National Bank (CNB), an inflation-targeting central bank, has also approached the zero level. However, the position of the CNB and the situation of the Czech financial system are rather dissimilar to those faced by the Fed, the BoE, or the ECB. The major difference determining the choice of another monetary instrument in the Czech Republic is neither the size of the economy nor the magnitude of the economic downturn. Whereas most economies have been hit by a severe liquidity crisis and a subsequent credit crunch as a result of the global financial crisis, the Czech financial system is characterized by an abundance of liquidity. Its source was and is the inflow of foreign exchange into both the private and public sectors. Not only is the ratio of deposits to loans well above the EU average (see Figure 1), but total deposits exceed total loans. The significant excess liquidity is absorbed by the CNB using repo tenders.

Ratio of deposits to loans — Figure 1

Ratio of deposits to loans granted in selected EU countries
(%; end of 2011; deposits/loans to residents)



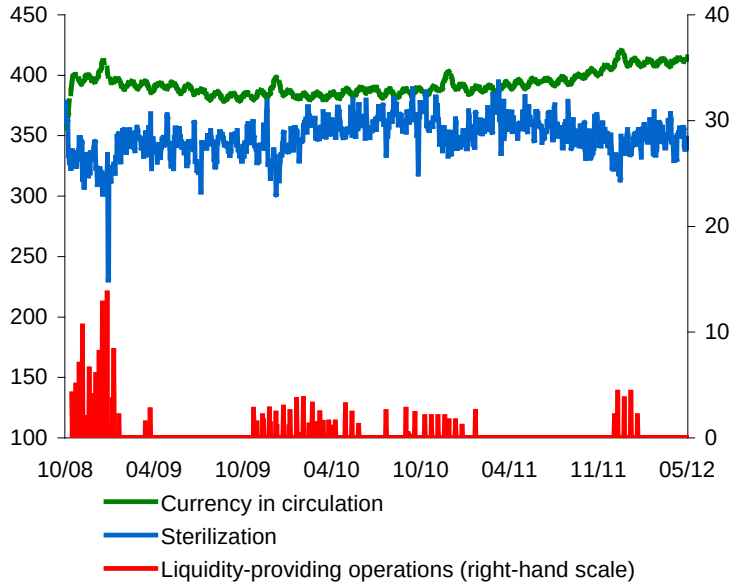
Source: ECB

In 2008, on the eve of the crisis, the CNB even introduced liquidity-providing repo operations, but they were used only very rarely (Figure 2) despite having an important psychological effect. However, due to an excess of liquidity, the introduction of a liquidity-providing program along Fed, BoE, or ECB lines cannot be expected to have a significant impact, if any, on the Czech economic situation.

Open market operations

Figure 2

Open market operations and currency in circulation
(CZK billions)



Source: CNB

Experience with negative deposit interest rates is very limited and their economic consequences are in general very unclear. Moreover, in some pieces of legislation in the Czech Republic, penalty interest is bound in a multiplicative manner to the discount rate. This may lead to severe legal complications if the rate is lowered beyond zero. In addition, the general legislation forbids negative interest rates in certain types of contracts.

As a consequence, foreign exchange (FX) interventions have been selected as the most appropriate monetary policy tool when interest rates hit the zero bound and cannot be lowered any further. Moreover, given that the Czech economy is very open and FX interventions are among the standard instruments of monetary policy, it seems only logical to choose them over the alternatives.

On November 1, 2012, the CNB lowered the two-week repo rate – its key monetary policy rate – to "technical zero" (0.05%). Following an internal debate about the other monetary policy instruments, outlined above, that could be used for further monetary easing, the Bank Board decided that FX interventions would be used where necessary to lower the value of the Czech koruna, and it decided to publicly communicate the choice of this instrument well in advance in order to transparently reduce the market uncertainty about the looming zero-rate threshold, and to maintain its ability to influence monetary-policy relevant inflation and

inflation expectations in the event of a prolonged recession and a need for further monetary easing.

Today, many central banks use inflation targeting (IT) as their means of achieving and maintaining price stability. The CNB switched to inflation targeting in 1998 and has earned a high level of credibility since then. In recent times, the CNB has been highly ranked for its transparency.

Under inflation targeting, the monetary policy tool is the interest rate. The exchange rate is not a tool, but rather an endogenous variable affecting future inflation expectations. The crucial general issue when dealing with FX interventions is therefore the question of their compatibility with inflation targeting. Is influencing FX contradictory to IT? Leaving aside technical and procedural compatibilities, does it compromise the credibility and goals of the central bank? IT theory also states that FX interventions can have an impact only through expectations about depreciation/appreciation of the country's currency or about its risk premium.

The IT theory gives very little, if any, guidance on FX interventions. On the contrary, it assumes, and usually recommends, pure floating with no role for exchange rate management, because in this framework monetary policy affects the exchange rate through the interest rate. The only way in which the exchange rate enters the whole process is by the future inflation forecast's influencing the interest rate.

And it is exactly this implicit reaction of monetary policy to exchange rate shocks that leads one to question FX interventions under standard conditions. Why intervene in the FX market if we have another monetary variable, the interest rate, at hand? Such behavior cannot be credible, since it contradicts the fundamentals of IT.

Under standard conditions, an unexpected depreciation shock eases the monetary conditions. However, in such a situation the interest rate is increased in order both to give the currency an upward push and to tighten the easier monetary conditions directly. The important consequences are that:

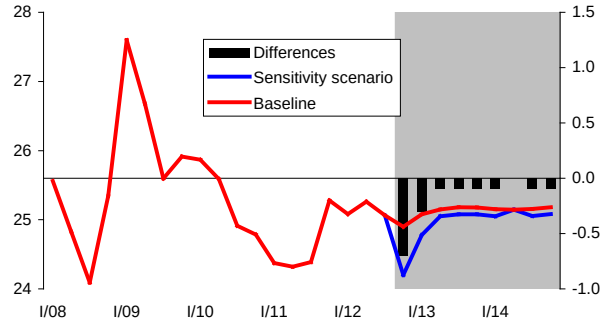
1. the implicit reaction of the monetary policy instrument strongly affects our ability to estimate the true effects that FX interventions have on macroeconomic variables; and
2. in the situation of a zero lower bound, appreciation shocks cannot be accommodated by a standard interest rate cut to ease the tighter monetary conditions caused by the exchange rate shock.

Figure 3 shows an example of the effects on the Czech economy of a 3% exchange rate shock under the standard situation (with no zero bound, and hence with an accommodating monetary policy tool). This exercise is commonly used as a sensitivity scenario by the CNB in its inflation reports. The graphs reveal only a very modest reaction to the exchange rate shock in terms of either CPI inflation or GDP growth.

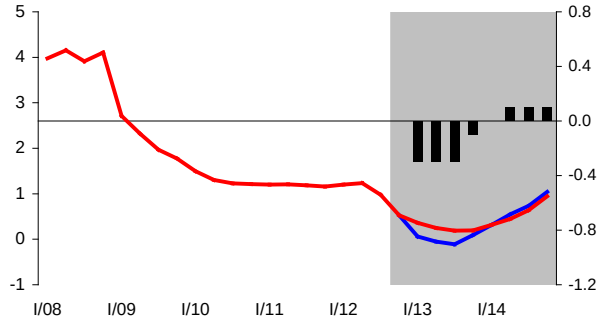
The crucial question is to what extent the results of the exchange rate fluctuations shown hold for the effects of FX interventions on the Czech economy if the need arises to use them to further ease monetary policy. In addition, what is the international and Czech experience with FX interventions? Can we build on that experience, or does everything change as we hit the zero lower bound on nominal interest rates? In the following sections we will try to shed some light on the issues inevitably raised by such questions, in line with the argument outlined above.

The CNB's exchange rate sensitivity scenario (a 3% appreciation shock) Figure 3

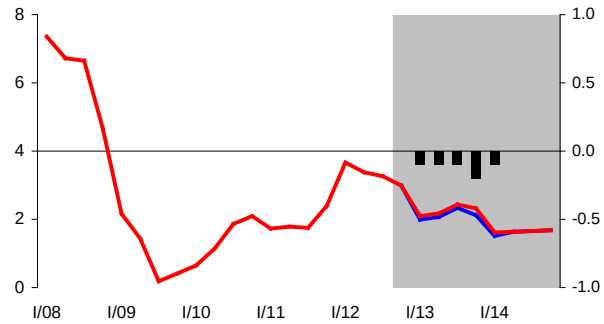
Exchange rate
(CZK/EUR; differences in CZK – right-hand scale)



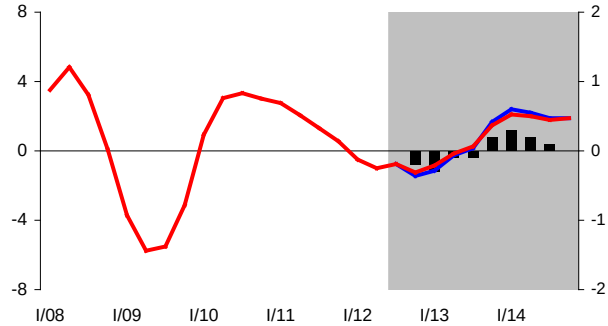
3M PRIBOR
(3M PRIBOR in %; differences in pp – right-hand scale)



CPI inflation
(annual percentage changes; differences in pp – right-hand scale)



GDP growth
(annual percentage changes; differences in pp – right-hand scale)



Source: CNB Inflation Report IV/2012

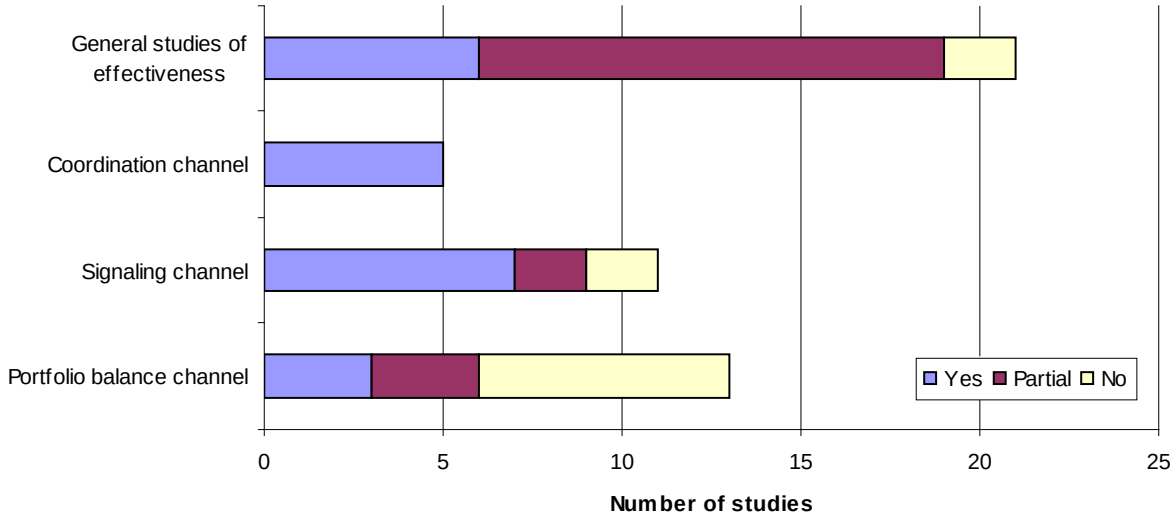
International experience with FX interventions

First, let us focus on the case of known interventions under the standard situation in actual practice. The number of official floaters is steadily increasing, but we still observe a "fear of floating" (Calvo and Reinhart, 2002), as many central banks in open economies do intervene regardless of their official position. According to the IMF's classification, independent floating dominates among IT countries (with 19 countries as of April 2008), but managed floating coexists with this regime (10 countries). Moreover, many independent floaters do actually intervene at least occasionally, with interventions having been more common during the recent crisis: Brazil in October 2008, Chile in January 2011, Indonesia in October/November 2008, Israel in 2008–09, Mexico in 2009, New Zealand in 2007, Poland in April 2010 and from September 2011 to December 2011, South Korea in 2008–09, and Switzerland since 2009.

Numerous proposals for managed floating regimes had already been put forward before the 2008 crisis (e.g., Bofinger and Wollmershäuser, 2003; Goldstein, 2002). The core of the idea is that if the central bank were able to reduce exchange rate volatility, it could achieve a better trade-off between inflation and output variability. However, two important questions remain unanswered: Can the theoretically meaningful outcome really be achieved in practice? And can it be

achieved without harming central bank credibility, the cornerstone of the inflation-targeting monetary policy regime? Cavusoglu (2010), reviewing studies that investigate the effectiveness of interventions, found that interventions have a significant short-lasting effect on exchange rates mainly through the signaling and coordination channels. But only a few studies have provided evidence that interventions have been effective in the longer term. Studies focusing on the general effectiveness of interventions, not on any particular pass-through channels, give a very mixed picture. The findings are summarized in Figure 4.

Do interventions work? Figure 4

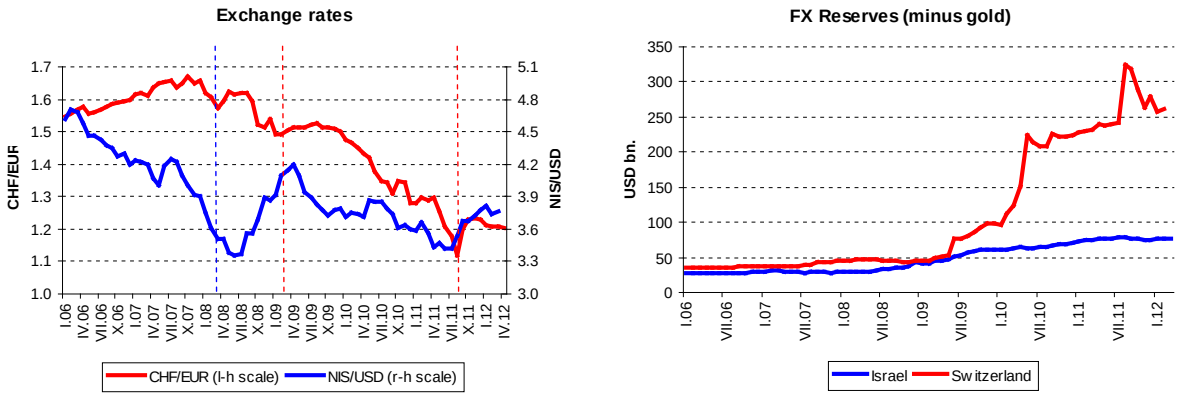


Source: Cavusoglu (2010)

When we limit ourselves to cases where interest rates are close to zero, only two countries have experience with interventions – Switzerland and Japan. Both are, however, very specific cases (safe haven and reserve currencies) where the central banks struggled to keep their currencies from further appreciation during periods of flight to safe assets. The Swiss National Bank (SNB) announced in March 2009 that it would ease monetary conditions in order to prevent any further appreciation of the CHF against the euro. Apart from directly purchasing foreign currency on the FX markets, the SNB started in August 2011 to perform indirect interventions by narrowing the key interest rate range from 0–0.75 pp to 0–0.25 pp, sharply raising the supply of liquidity, and by using FX swaps. On September 6, 2011, the SNB set a minimum exchange rate of 1.20 CHF/EUR, stating that it would buy foreign currency in unlimited quantities if the rate fell below this level. As a consequence, by September 2012 its balance sheet had tripled in size and the monetary base had grown by a factor of six over its 2008 level as a result of liquidity operations and FX interventions. The FX reserves rose by 450%, with 60% of them denominated in the euro. In July 2012 the reserves reached $417 bn, which is almost 70% of GDP, whereas the average for 1999–2007 was 13%. To sum up the Swiss experience, we can say that such a commitment is an effective tool if the bank is ready to purchase an unlimited quantity of assets (see Figure 5).

FX interventions by Switzerland and Israel

Figure 5



Source: IMF IFS

Probably the best example of a country comparable to the Czech Republic with recent experience of large-scale interventions is Israel. Israel, like the Czech Republic, is a small open economy, the Bank of Israel targets inflation, and the Israeli spot FX market is similar in size to the Czech one. However, the purpose of the interventions was different and hence has limited relevance from our perspective: Israel's interventions were motivated by exchange rate policy considerations rather than by FX being a monetary policy tool. The first round of interventions took place in March 2008 with the primary goal of increasing Israel's FX reserves. At the end of March, the BoI started buying about $25 million a day, and in July 2008 the average daily rate of purchases was increased to $100 million. In August 2009 the BoI abandoned regular unidirectional interventions and introduced the possibility of ad hoc bidirectional interventions, i.e., of buying and selling shekels at any time in the event of large movements in its exchange rate, not only in the case of market failure in the FX markets, but also in situations where the development of the exchange rate was inconsistent with economic conditions. Between March 2008 and July 2012 the reserves of the BoI increased from $29.4 bn to $75.4 bn. During the period of the interventions the FX reserves grew by 164% to more than 30% of GDP by the end of 2011. We can conclude that in Israel's case a large volume of purchases was needed, but their impact on the exchange rate was not very clear, as numerous currencies depreciated during the observed period. Also, the fact that the BoI never officially terminated the interventions points to possible exit strategy difficulties.

Czech experience

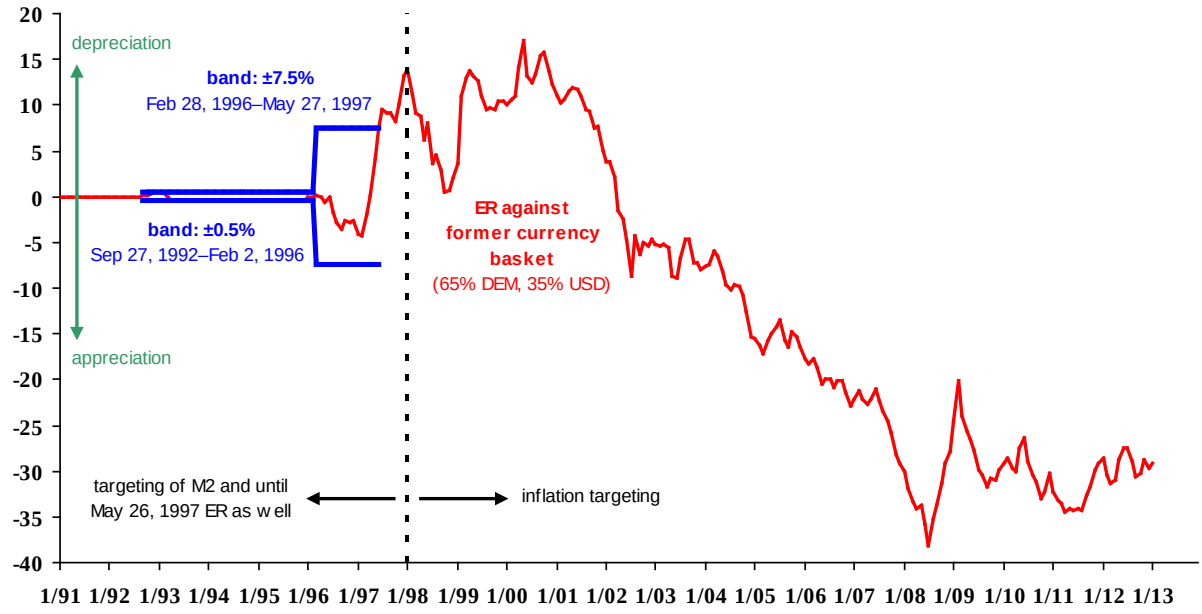
The Czech exchange rate regime shifted from a fixed to a floating one in 1997 (see Figure 6 for the evolution of exchange rate policy). Since then, the CNB has intervened in the FX market in three distinct periods, almost always against appreciation of the koruna. The first intervention period took place between February and July 1998, the second between October 1999 and March 2000, and the third between October 2001 and September 2002. But the evidence on the effectiveness of these interventions, summarized in Figures 7 and 8, is mixed. Sometimes there was a visible immediate impact lasting up to 3 months. In other

cases the effect was less clear, weak, or transient. Of course, without knowing the counterfactual this evidence cannot be used to convincingly address the impact of the interventions in question. However, there are several studies that address the effect of the CNB's FX operations on the FX market.

Disyatat and Galati (2007) found that the interventions of 2001–2002 had some statistically (weakly) significant impact on the spot rate and risk reversal, but that the impact was small. They did not find evidence that the interventions had had an influence on short-term exchange rate volatility. Geršl and Holub (2006) found that the interventions had probably played a minor role in influencing the exchange rate in the short run at best (see Figure 8). According to them, the interventions contributed to increasing the volatility of the exchange rate, but only to a limited extent. According to Geršl (2006), the interventions had only a small short-term effect on the exchange rate level, and to a certain extent contributed to increased conditional and implied volatility. And finally, Égert and Komárek (2006) concluded that from mid-1998 to 2002, koruna sales were effective in smoothing the path of the exchange rate for up to 60 days. This was not the case from 1997 to mid-1998.

Czech exchange rate policy

Figure 6

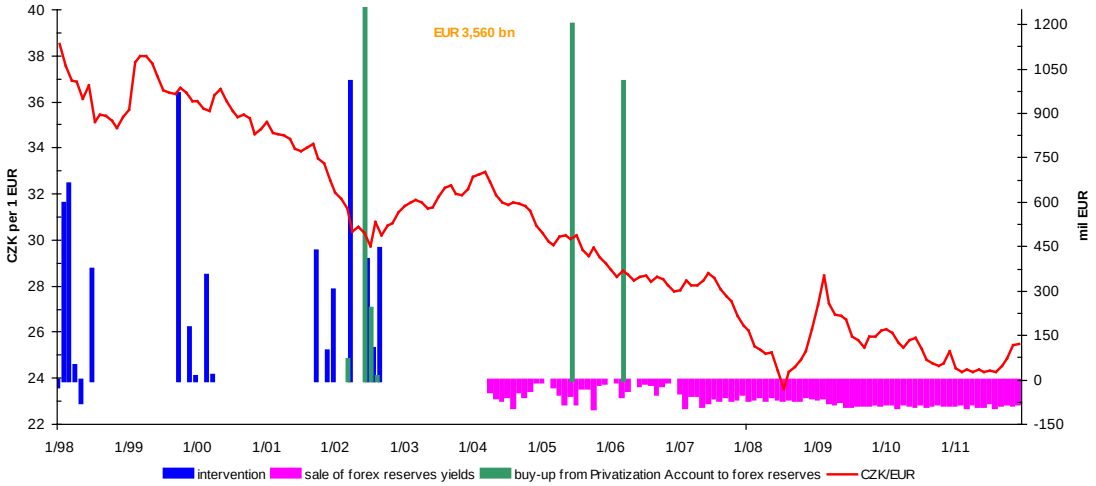


Source: CNB

In 2004 the CNB started selling a portion of its yields on FX reserves (these sales were recently discontinued). Starting in June 2007, the previously discretionary approach to reserve sales, with the timing and size of sales not pre-announced, was changed to a regime of daily sales. Domínguez, Fatum and Vacek (2010) analyze whether the euro-denominated reserve sales influenced the CZK/EUR rate, and reach an interesting and slightly counterintuitive conclusion: over the period of the discretionary regime, there is little evidence that the sales influenced the koruna. However, starting in 2007, when the CNB sold euros every business day, the decumulation of reserves led to statistically significant appreciation of the koruna against the euro. One possible explanation is that in the ad hoc regime the traders intentionally go against the market in order to minimize volatility, and the market trend predominates over the effects of the sales.

Interventions and other operations in the Czech FX market

Figure 7



Source: CNB

Effectiveness of Czech interventions

Figure 8

Starting month	Final month	Overall volume	**CZK/EUR** (ECU prior to 1999)						
(t)	(T)	EUR million	t-3M average	t-1M average	Start of t	Low of [t;T]	End of T	T+1M average	T+3M average
02/1998	**04/1998**	1285	37.87	38.50	38.37	36.30	36.46	36.11	35.11
06/1998	**07/1998**	508	36.95	36.11	36.49	34.35	34.35	35.47	35.17
10/1999	**10/1999**	966	36.52	36.36	35.72	35.68	36.62	36.40	36.03
12/1999	**12/1999**	229	36.36	36.40	36.08	35.83	36.13	36.03	35.60
03/2000	**03/2000**	394	36.05	35.71	35.65	35.53	35.63	36.31	36.02
10/2001	**01/2002**	643	33.86	34.19	33.91	31.46	31.92	31.79	30.36
04/2002	**04/2002**	1009	32.08	31.39	30.62	30.06	30.63	30.56	29.75
07/2002	**09/2002**	954	30.36	30.30	29.25	28.97	30.30	30.65	31.19

Note: red = unsuccessful (no trend reversal), blue = successful

Source: CNB

Exchange rate pass-through to consumer price inflation

The existing international and Czech empirical evidence suggests that FX interventions have the ability to influence the exchange rate, even though this may not always hold in the long term. Fatum and Pedersen (2009) made an interesting observation in this context when studying the effects of sterilized FX interventions by the Danish central bank. They found that interventions exert a significant influence on exchange rate returns only when the direction of intervention is consistent with the monetary policy stance. This is exactly the case when an FX shock is *not* accommodated, but rather *fueled*, by monetary policy inactivity. This also justifies the use of FX interventions as a tool of monetary policy when the interest rate has reached the zero limit and further easing is necessary to meet the

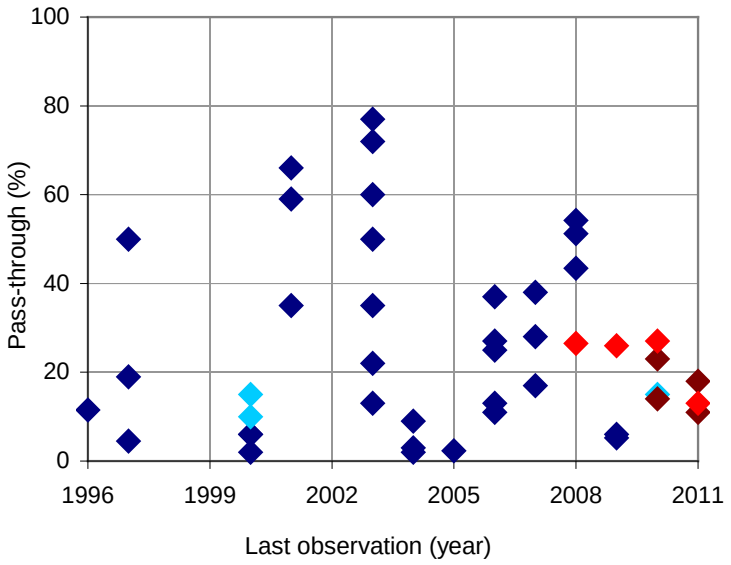
inflation target. When the interest rate can no longer be used or is insufficient to influence inflation expectations and achieve price stability, FX interventions become a viable option.

Knowing that FX interventions have the ability to influence the exchange rate, and that they are not in contradiction with IT under the zero-level limit, is only the first step toward their practical use as a tool for achieving the inflation target.

The next, practical, step is to quantitatively assess the exchange rate tool. The question we need to address first is how exchange rate changes affect prices in the Czech Republic. In other words, we need to address the relevance of existing simulations of exchange rate pass-through.

The results of existing empirical analyses of the transmission of an exchange rate shock to Czech inflation lie in a relatively wide band of 0% to almost 80% (see Figure 9) and are hard to compare due to substantial differences in the methods, empirical specifications, and time series spans used. Also, a slight decreasing tendency in exchange rate shock pass-through over the last decade is apparent. One of the most recent estimates – an impulse response based on a VAR model estimated on quarterly data for 1998-Q1 to 2012-Q3 (depicted in Figure 10) – suggests pass-through of nearly 8%. We do not have any evidence on whether the decreasing trend in the pass-through is due to the methodology used, to better monetary policy adjustment fully compensating the exchange rate shocks, or indeed to a change in the characteristics of the underlying transfer channels.

Exchange rate pass-through to Czech inflation based on a literature review — Figure 9

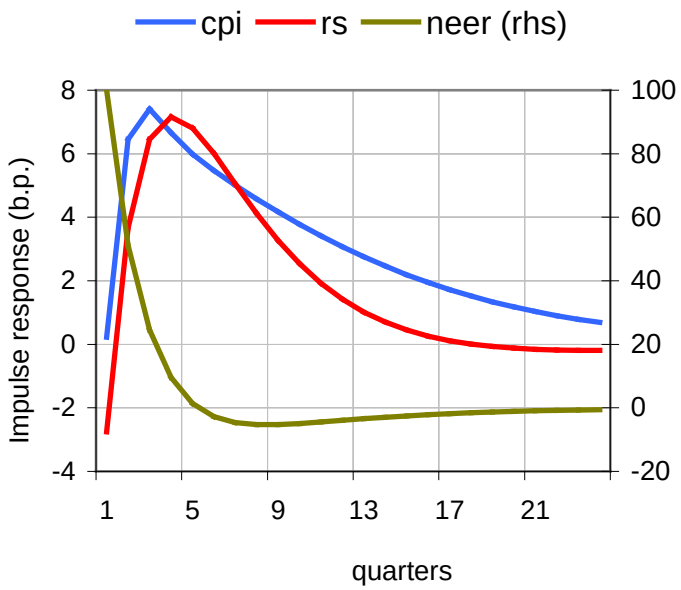


Note: The figure shows the reaction of consumer prices to an exchange rate shock of 1%. It summarizes 43 ERPT estimates for the Czech Republic collected from 22 papers and articles published in 2001–2012. Dark blue points represent time-invariant estimates. Light blue points are medians of time-varying estimates. Results based on the CNB RPN (forthcoming) are in dark red (VAR, VECM) or red (BVAR median and TVP-VAR for 2008-Q1, 2009-Q1 and 2010-Q1).

Source: Hájková and Saxa (forthcoming, 2013)

Impulse response of the CPI and the short-term interest rate to a Czech koruna depreciation of 1% (VAR model)

Figure 10

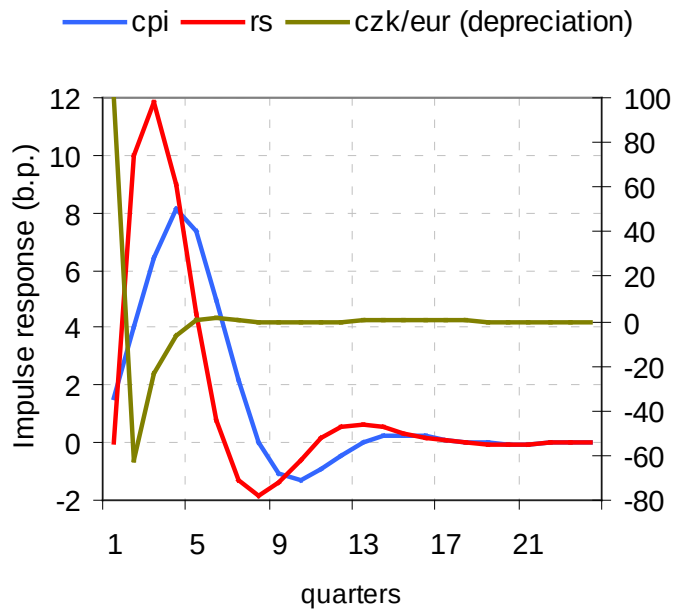


Note: The generalized impulse response is based on a VAR model estimated on quarterly data for 1998-Q1 to 2012-Q3. The vector of endogenous variables contains Czech GDP, the consumer price index (cpi), 3M PRIBOR (rs), the nominal effective exchange rate (neer), and monetary aggregate M2. The exogenous variables are the IFS All Primary Commodities price index, euro area GDP, and 3M EONIA.

Source: Earlier results from Hájková and Saxa (forthcoming, 2013)

Impulse response of the CPI and the short-term interest rate to a Czech koruna depreciation of 1% (g3 model)

Figure 11



Note: The impulse response is based on the CNB's core DSGE forecasting model, called g3. The notation represents consumer price index (cpi), 3M PRIBOR (rs), and nominal exchange rate (czk/eur).

Source: CNB

In the standard inflation-targeting regime, an exchange rate shock transmits through both a direct channel (import prices) and an indirect channel (economic activity), taking into account the endogenous reaction of all other variables, including interest rates. Through the direct channel of import prices the exchange rate change passes through to consumer prices almost immediately. However, exchange rate changes influence not only prices, but also, with some lag, real volumes of imports and exports, which consequently cause changes in the rate of growth of wages and employment. The labor market is thus the means of indirect pass-through of the exchange rate shock to consumer prices. This pass-through, however, is moderated by the reaction of interest rates. The movement of interest rates not only causes a correction in the nominal exchange rate, but also, by changing real interest rates, influences investment and private consumption.

Other estimates, based on BVAR and TVP-VAR models, which appear in a forthcoming CNB Research and Policy Note (Hájková and Saxa, forthcoming, 2013) lie in the interval of 13–26% (see the red points in Figure 9). The reaction of consumer prices to a shock is rather quick, peaking after about four quarters. Figure 11 depicts the impulse response based on the CNB's core DSGE forecasting model, which is very similar to the empirical evidence as regards both the strength and the timing of the pass-through. Analyses conducted in the CNB indicate that the strength of the response to an exchange rate shock gradually decreases along the distribution chain. The largest pass-through (over 50%) is observed for import prices; the transmission of the shock to industrial producer prices and to consumer inflation is an order of magnitude lower.

Influence of the zero lower bound on pass-through

When rates approach the zero lower bound (ZLB), the transmission of shocks to the economy may change, as we document using various instances of similar phenomena (one parameter fixed, decreased degrees of freedom). Take, for instance, Bayesian fan charts, which are used to predict the future development of an economy as it reacts to various exogenous shocks. Nowadays, central banks do not explicitly address the issue of the ZLB on the nominal interest rate when constructing fan charts. However, there are several possible approaches to forecasting at the ZLB.

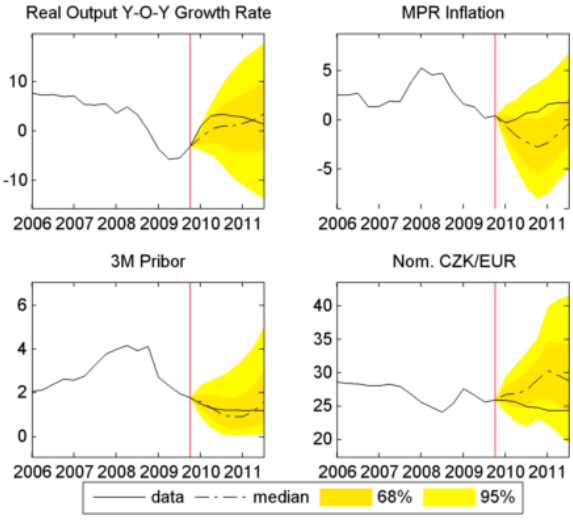
First, forecasts can be conditioned on shocks that lead to a non-negative nominal interest rate. Second, forecasts can be conditioned on the interest rate itself, regardless of the shocks hitting the economy. And finally, the ZLB can be ignored completely.

Franta et al. (2013), based on Czech data, show that, depending on which types of shock we exclude from the construction of the simulated density forecasts, we can introduce different types of bias. In the first approach, all shocks which directly or indirectly imply a decreasing interest rate are filtered out. For example, a negative demand shock, which usually leads to fall in output, in inflation, and in the interest rate, is also discarded by this approach when the economy reaches the ZLB. As a consequence, negative demand shocks are less likely to be included in the simulated density forecast than are positive demand shocks.

The second approach imposes zero on all negative parts of the interest rate path, but constructs the density forecast using all draws of shocks. For example, a

negative monetary policy shock, which is not possible at the ZLB, gets into the sample of forecasts from which the density is sampled. Even though such a shock has no impact on the nominal interest rate, it immediately affects the exchange rate, and thus other variables in the following periods.

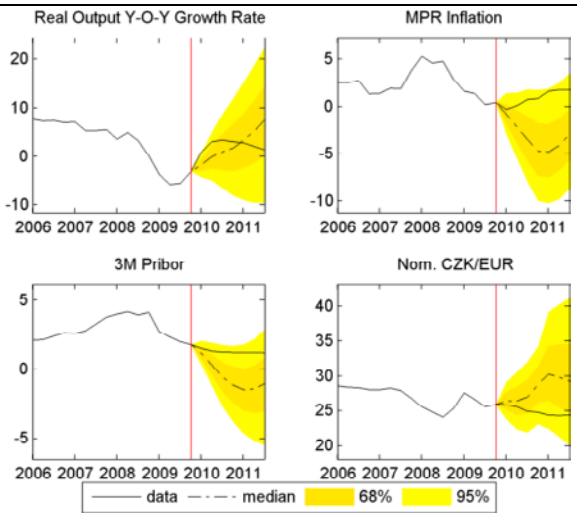
Shocks filtered (ZLB active) Figure 12



Note: Fan charts starting in 2010-Q1. The vertical line denotes the period of the last observed values used for the estimation. The density forecasts are characterized by the centered 95% (light yellow), centered 68% (dark yellow), and median of the marginalized joint distribution.

Source: Franta et al. (2013)

ZLB ignored Figure 13



Note: Fan charts starting in 2010-Q1. The vertical line denotes the period of the last observed values used for the estimation. The density forecasts are characterized by the centered 95% (light yellow), centered 68% (dark yellow), and median of the marginalized joint distribution.

Source: Franta et al. (2013)

In the last case, not only all draws of shocks, but also possible negative lagged values of the nominal interest rate are used to construct the density forecast. We do not intend to discuss the question of the accuracy or usefulness of the individual

approaches, but they do allow us to demonstrate the difference in forecasts, i.e., the theoretical responses of the economy to shocks when the zero interest rate limit is binding. As Figures 12 and 13 demonstrate, the differences in the forecasts can be sizable (note the differences in the vertical scales). Not accounting for the ZLB at all (Figure 13) leads to ex-post observed monetary-policy-relevant inflation being on the edge of the centered 95% of the distribution forecast. A similar result is observed if a zero nominal interest rate is imposed following the second approach mentioned above. Ignoring the ZLB also leads to an over-optimistic outlook for real output growth. These results highlight one important finding: the models we use in normal times will not necessarily work correctly as the economy approaches and hits the zero lower bound on nominal interest rates.

As shown by many authors (e.g., Portes, 1969), fixing one input or binding constraint in effect leads in general to higher responsiveness (or volatility) of the remaining variables, *ceteris paribus*. This is also true for the exchange rate pass-through with the ZLB binding. When monetary policy acts to stabilize the economy and reacts transparently to an exchange rate shock, the exchange rate pass-through to inflation is relatively small, as the above-mentioned empirical evidence suggests. But the transmission of an exchange rate shock changes as the central bank approaches the ZLB and interest rates cannot counteract the shock. Depending on how long economic agents expect monetary policy to operate in the ZLB regime, the pass-through of the exchange rate to inflation increases sizably. The first channel is import prices, which directly cause higher inflation without a stabilizing reaction of interest rates. The second channel is real interest rates: longer-term fixed nominal interest rates due to the ZLB and gradually increasing inflation push down real interest rates and thereby stimulate real economic activity, for instance private consumption. The two channels therefore work in the same direction.

It is not only monetary policy that is sensitive to the existence of the ZLB. Analogously, in a meta-analysis of fiscal multipliers, Gerchert and Will (2012) show that the fiscal multipliers are significantly higher in a ZLB regime regardless of the subsample of models chosen. We can therefore conclude that the existing studies estimating the size of pass-through are not all applicable in a situation of zero rates, and that the pass-through at the ZLB can be several times larger than past estimates.

Costs of FX interventions

A major impediment to conducting FX interventions might be their adverse effect on central banks' balance sheets. However, one has to keep in mind that when intervening with the goal of easing monetary conditions, no costly sterilization is necessary, because in such a situation the monetary consequences of intervention are in line with the monetary policy objective. But that does not mean that FX interventions are without cost. Long-lasting interventions against one's own currency usually lead to a sizable buildup of international reserves. With the local currency appreciating due to the economic convergence of the country, assets denominated in foreign currencies have to be revalued. And if the central bank holds more foreign currency assets than foreign currency liabilities, such revaluation creates financial losses.

As, for example, Stella (2008) and Stella and Lönnberg (2008) point out, the accumulation of losses may have a negative impact on the financial strength of the

central bank and undermine the credibility of monetary policy. However, in order to correctly understand the degree of credibility risk, the central bank's balance sheet situation has to be put in the relevant macroeconomic context that the bank faces. Cincibuch et al. (2009) develop a formal framework for assessing the sustainability of the central bank's balance sheet. Taking the long-run trends from the CNB's forecasts and simulating the long-term development of the CNB's balance sheet, they show that the CNB should eventually get into a profit-making situation as economic convergence progresses, and the risk premium, as well as the real exchange rate appreciation trend, is likely to disappear. They conclude that the CNB will be able to repay its current accumulated loss out of future profits.

The long-term sustainability of the balance sheet and the central bank's credibility, therefore, will not necessarily be compromised even in situations of negative own capital if the losses stem from the country's economic convergence. On the other hand, theoretical expectations are one thing, but the actual ability to pursue monetary policy objectives, such as stabilizing inflation expectations, may be jeopardized when the central bank becomes financially weak. To analyze the issue, Benecká et al. (2012) empirically address the link between central bank financial strength and inflation. On a panel of more than 100 countries between 2002 and 2009, they find in a few cases that there is indeed a statistically significant negative relationship between financial strength and inflation. But the results lack robustness with respect to the choice of alternative measures of financial strength and econometric technique. Also, there is some evidence that the relationship is non-linear, with only substantial financial weakness being associated with higher inflation, and moreover the link exists only for countries with the lowest level of central bank legal independence and/or relatively high inflation rates.

In general, according to Benecká et al. (2012), the explanatory power of central banks' financial strength indicators is rather weak, while other inflation determinants seem to play a more important and robust role.

Concluding remarks

The use of foreign exchange interventions to ease monetary conditions in an open economy is a rational choice. First, this monetary instrument is used only when interest rates are at a zero level, i.e., when the standard natural tool is no longer available. Second, the power of the central bank when intervening against its own currency is not limited by the volume of reserves. Third, the depreciation helps net exports, which is a good side-effect stimulating the economy. And finally, the pass-through at the zero lower bound is significantly higher than that assumed on the basis of past experience during normal times. In essence, in an economy with abundant liquidity in the banking sector, such as the Czech Republic, FX interventions are the most efficient way to implement quantitative easing.

Finally, we would argue that in such a situation, FX interventions do not reduce the transparency and credibility of inflation targeting. The inflation target – including the tolerance band around it – remains unchanged and is publicly known in advance. On the contrary, if further easing is necessary, the zero interest rate bound prompts questions of credibility due to the primary tool having been exhausted. The prediction of the market interest rate path, despite the fact that it reflects the zero level, remains publicly announced. However, the exchange rate itself is still not the target, but rather a new tool for achieving the target.

Consequently, it is not meaningful to specify a "target exchange rate." The desired policy exchange rate changes dynamically over time and is determined by the evolution of the forecasted economic conditions and the targeted inflation rate.

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Monetary operations under the Currency Board system: the experience of Hong Kong

Hong Kong Monetary Authority

Abstract

This paper documents the major policy reforms to Hong Kong's Linked Exchange Rate System (LERS) that have enabled it to evolve into the highly credible, efficient, and transparent system it is today. It discusses the operating mechanism of the system in adjusting capital flows, and the role the Hong Kong Monetary Authority plays in maintaining the smooth functioning of the LERS. It shows that the LERS has stood the test of two major financial crises, large cross-border capital flows, and occasional scepticism over its sustainability and suitability for the Hong Kong economy over the past three decades.

Keywords: linked exchange rate system, HKD currency zone, convertibility undertaking, exchange rate system credibility

JEL classification: E58, E52, N1

I. Introduction

Hong Kong adopted the Currency Board system in October 1983. Over the past three decades, the system has undergone a number of reforms and modifications, allowing it to adapt to the changing macro environment. Through these changes, the system has evolved into a simple and rule-based Linked Exchange Rate System (LERS) governed by Currency Board principles, with a high degree of credibility and transparency. This note provides some background information about the LERS, in particular how it fared during the global financial crisis in 2007-2008. It first discusses the evolution of the system in recent history, outlining the major reforms and the rationale behind them. It goes on to describe how the system works in its current form, with a particular focus on how it operated during the market turbulence of the global financial crisis. The note finishes by discussing why the system is viewed as highly credible, and how this credibility is reflected in financial markets.

II. A brief history of Hong Kong's Currency Board system

Amid considerable financial turbulence stemming from the Sino-British negotiations over the future of Hong Kong, the LERS system was established in October 1983, with the Hong Kong dollar (HKD) pegged to the US dollar (USD) at a fixed rate of HK$7.8 to US$1. The past three decades saw the system refined several times as the market environment changed and economic needs evolved.

The first five years were a period of simple "fixed-rule" operation, with the Hong Kong government directly intervening in the foreign exchange market to maintain the stability of the exchange rate. In July 1988, the then Hong Kong Government introduced a number of new "Accounting Arrangements", which ushered in a new phase of the regime with more discretionary management (Greenwood, 2008). The arrangements enabled the Government to regain some control over money market interest rates through buying and selling the newly issued Exchange Fund Bills and Notes and guide the exchange rate to a level that it deemed acceptable.

The system was put to test by the Asian financial crisis between mid-1997 and late-1998, when the Hong Kong dollar suffered a series of attacks from speculators.[1] In a bid to refine the exchange rate system, the Hong Kong Monetary Authority (HKMA) introduced "Seven Technical Measures" to the LERS, including the establishment of a clear Convertibility Undertaking (CU) for the HKD at a rate of HK$7.75 to US$1.[2] This was a weak-side commitment, in that the HKMA was ready to purchase unlimited amounts of HKD for USD to prevent a weakening of the

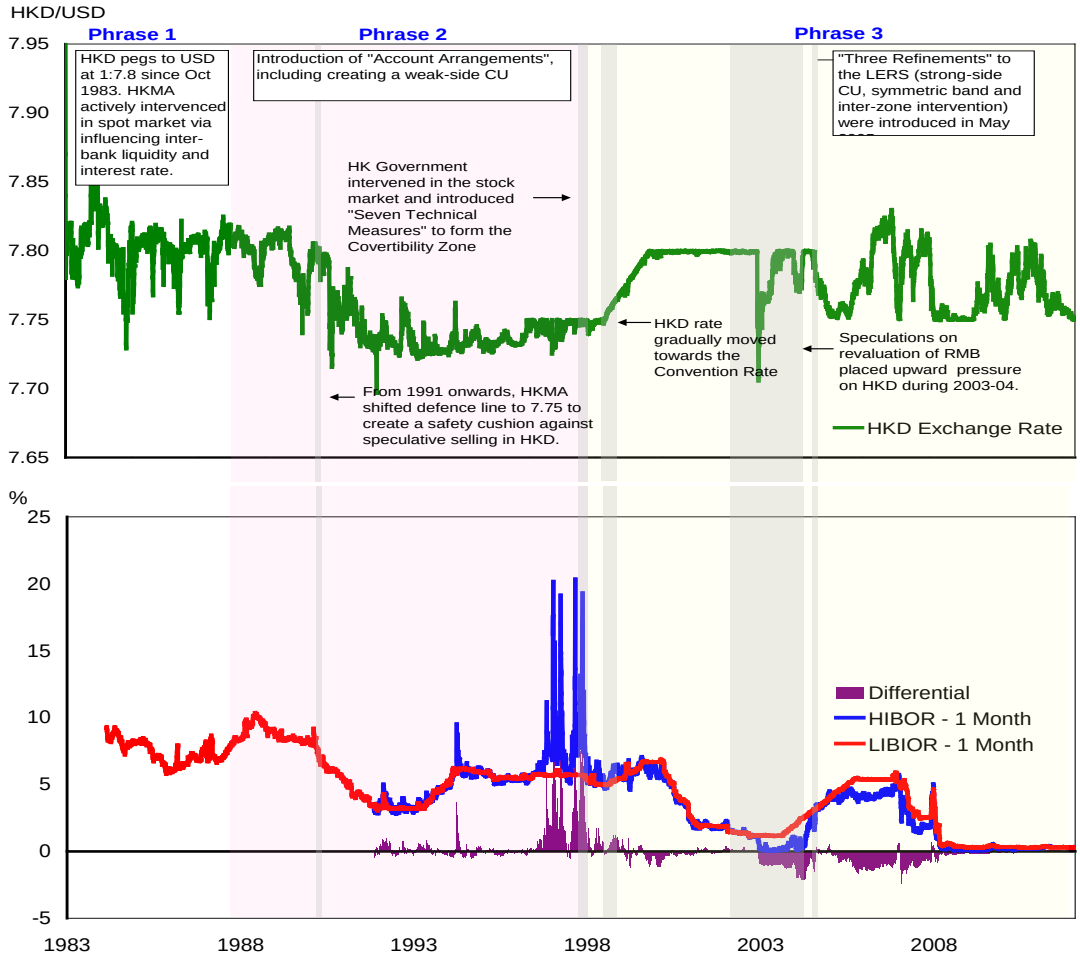
[1] The speculators adopted a "double-market play" strategy, in which they slowly pre-funded themselves with Hong Kong dollars over a period of time, and then suddenly shorted the cash and future stock markets and at the same time sold the currency in large quantities to drive up interest rates. To restore market confidence and the integrity of the LERS, the Hong Kong Monetary Authority intervened in the local stock market to counter the speculative attacks.

[2] The HKMA was established in 1993 by combining the Office of the Exchange Fund and the Office of the Banking Commissioner.

currency beyond that rate. In practice, the weak-side commitment was gradually moved from HK$7.75 to HK$7.8 between April 1999 and July 2000 (Genberg and Hui, 2011). This new fixed CU effectively removed the discretion of the HKMA to intervene on the weak side, returning the system to a more rule-based operation (Kwan et al, 1999).

History of major reforms of the LERS

Figure 1



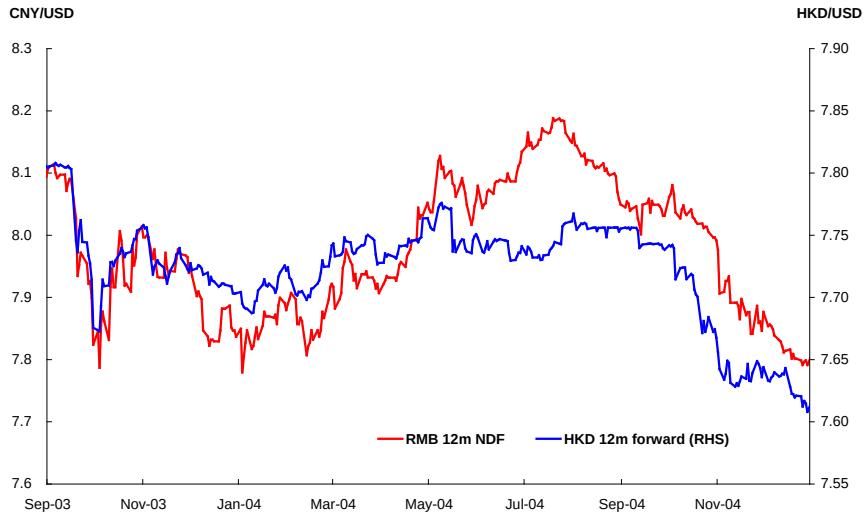
Source: Bloomberg; HKMA estimation

However, the reforms did not stop there. Following the 1998 reform, there were debates about whether there should be a mirroring strong-side CU, and if so, at what level the CU should be set (Yam, 2005a). The argument for the change was later aided by market speculation on a revaluation of the HKD along with that of the renminbi (RMB) (Figure 2). Market participants were unable to buy the RMB due to capital controls, and hence they reportedly traded the HKD as a proxy. The resulting capital inflows put downward pressure on Hong Kong's interbank interest rates. To protect the integrity of the LERS, the HKMA introduced "Three Refinements" in May 2005 (1) establishing a strong-side CU at HK$7.75: US$1; (2) shifting the weak-side CU from HK$7.8 to HK$7.85; and (3) creating a Convertibility Zone around the central parity at HK$7.8, within which the HKMA could conduct market operations consistent with Currency Board principles (Yam, 2005b). These refinements made the LERS much more transparent and rule-based, and made the interest rate adjustment mechanism function more smoothly in aligning Hong Kong interest

rates with those of the US. The modified system stood the test of the global financial crisis in 2008-2009 and has continued to operate smoothly to date.

12-month forward of HKD and RMB

Figure 2



Source: Bloomberg

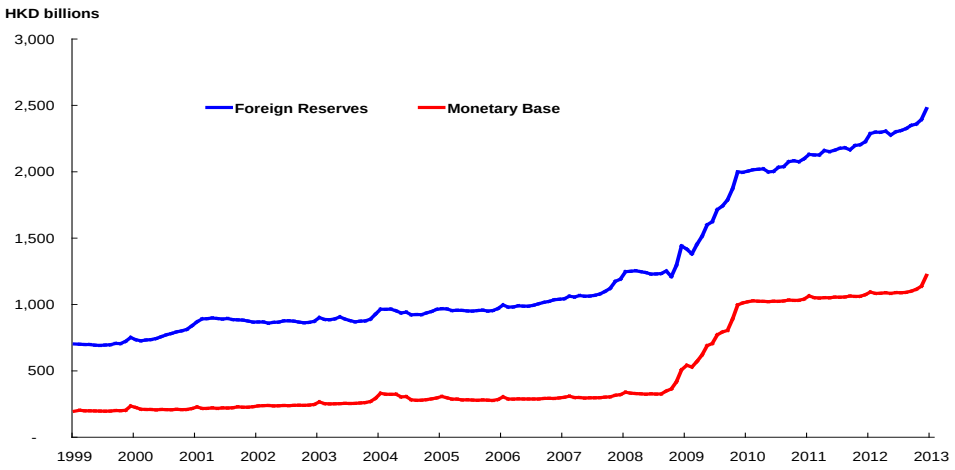
III. An overview of the current system and principles governing market operation

Overview of the system

The Currency Board in Hong Kong requires the Monetary Base (MB) to be fully backed by foreign currency reserves held at the Exchange Fund. This means that any changes in the MB (which includes Certificates of Indebtedness, government-issued notes and coins, and Aggregate Balance and Exchange Fund Bills and Notes) are fully matched by corresponding changes in foreign reserves at a fixed exchange rate. In fact, the MB has historically been more than fully covered by the reserve assets (Figure 3). This greater than 100% reserve backing represents a powerful insurance for the HKMA's ability to defend the currency peg, significantly enhancing the system's credibility.

Under the LERS, interventions in the currency market are a mechanical and passive process of the HKMA. When there are capital inflows (or outflows) in Hong Kong, causing the exchange rate to rise (or fall) to the extent that it touches the boundaries of the Convertibility Zone, the CUs are triggered, allowing the HKMA to step in to sell (or buy) the HKD against the USD. These interventions will cause the MB to expand (or contract), putting downward (or upward) pressure on interbank interest rates, which in turn counteract the original capital flows to ensure that the exchange rate remains stable. In other words, it is interest rates, rather than the exchange rate, that adjust to capital inflows and outflows in Hong Kong under the LERS.

Foreign Reserve Assets of the HKMA, and Monetary Base Figure 3



Source: HKMA

While interventions at the boundaries of the Convertibility Zone are automatic and mechanical, the HKMA retains some discretion to intervene within the zone. These operations are governed by the Currency Board rules, with their implementation taking account of financial market conditions. Officially, there are four broad operational principles set by the Exchange Fund Advisory Committee: (1) all operations should be carried out in strict accordance with Currency Board rules; (2) the primary objective of any operation should be to preserve the exchange rate stability implied by the LERS and to maintain confidence in the system; (3) operations may be undertaken to support such interest rate adjustments as would maintain exchange rate stability under the LERS and that would avoid destabilising behaviour in interest rates; and (4), operations may also be undertaken in order to remove market anomalies (HKMA, 2011).

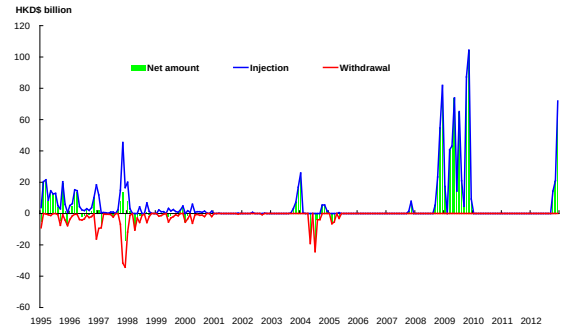
Recent history of market operation

Since the introduction of two-sided CU, the frequency and scale of market operation by the HKMA have been markedly reduced (Figure 4). In fact, between 2005 and the onset of the global financial crisis, the HKMA only conducted one intra-zone intervention to reduce the short-term interest rate spreads with the US. After an extended period of interest rate discount without the market triggering the CU, the HKMA decided to step in to buy a net HK$2.6 billion of HKD in May 2005. The operation resulted in an immediate contraction in total bank reserves (known as the Aggregate Balance in Hong Kong) and a prompt rise in local interest rates that narrowed the spread with the US (Figure 5).

Thereafter, there were no active or passive market interventions until the emergence of the US subprime crisis. In late 2007, the HKD exchange rate appreciated rapidly, moving towards the strong-side CU. A number of factors may have contributed to the phenomenon: (1) jitters about the fallout of the US subprime housing market increasing risk aversion, prompting traders to buy back HKD to unwind carry trade; (2) increased equity-related demand for HKD in anticipation of large-scale Chinese bank IPOs; and (3) potential strong capital inflows from the Mainland due to rumours that Mainland investors were about to

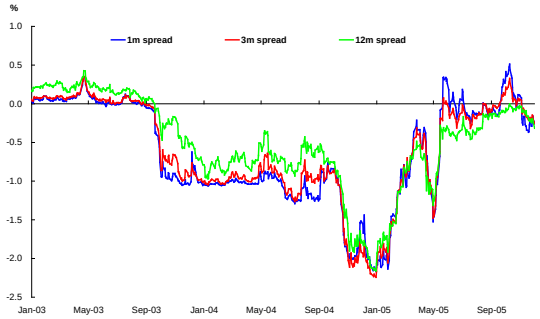
be given access to the Hong Kong stock market. In response, the HKMA first conducted a market operation to inject liquidity in order to ease the anticipated IPO-related liquidity tightening. The operation was later scaled up, after the strong-side CU was triggered by banks, prompting the HKMA to inject about HK$7.8 billion into the system. The impacts of these operations were that interest rate spreads quickly narrowed, and that the spot exchange rate moved towards the central parity.

HKMA market operations Figure 4



Source: HKMA

HK-US interest rate spread Figure 5



Source: Bloomberg

As the crisis deepened, fuelled by the collapse of US investment bank Lehman Brothers in Q3 2008, risk aversion reaccelerated, triggering another round of unwinding of carry trade. In addition, market intelligence suggested that domestic corporates and investors rushed to liquidate their offshore investments, and repatriated funds to Hong Kong in a drive to reduce their business and investment leverage (Chan, 2010). These inflows put tremendous upward pressure on the HKD, quickly pushing it towards the strong-side CU. In November 2008 alone, the strong-side CU was triggered 27 times, inducing the HKMA to sell over $104 billion HKD into the system. The Aggregate Balance expanded sharply as a result, easily surpassing the previous high of early 2004, as the market speculated that the HKD would strengthen in line with the RMB.

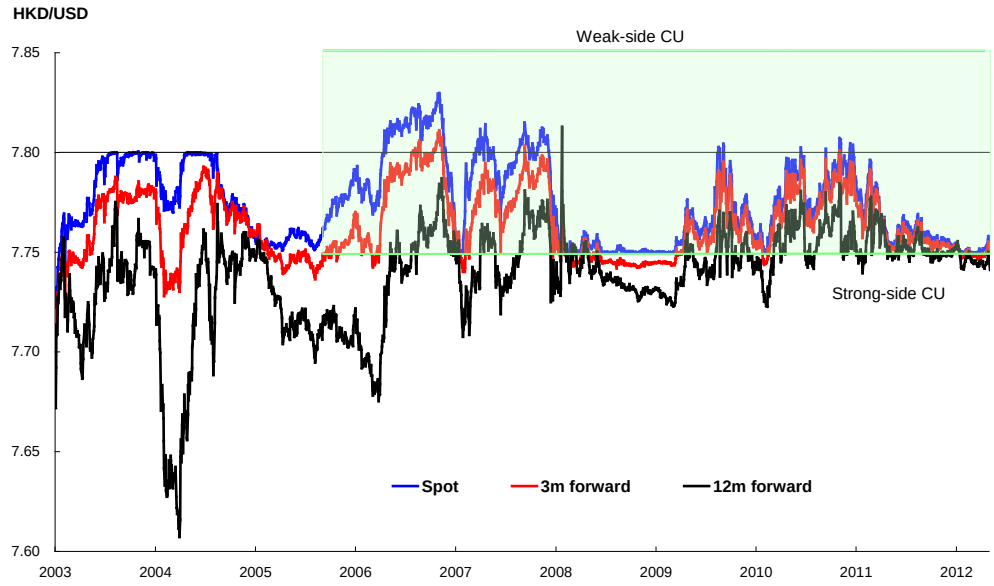
Even after the peak of the crisis passed, capital inflows into Hong Kong continued throughout 2009. Corporate repatriation of offshore investment was again a driving force, but more important was the fact that investors' efforts to reposition for a rebound in the oversold equity market led to significant inflows. Later in the year, speculation regarding HKD revaluation re-emerged, driven by optimism about a fast recovery of the local economy. The Aggregate Balance quickly exceeded its previous high, as the CU was triggered repeatedly. Despite these inflows, the auto-pilot intervention mechanism was effective in anchoring the exchange rate and maintaining a stable interest rate differential with the US. Forward markets also remained calm, with near-term forwards trading closely with the spot, largely within the Convertibility Zone (Figure 6). Longer-term forwards were more volatile, but the extent of swings outside the strong-side CU was considerably more limited than before the Refinements.

As conditions gradually normalised going into 2010, pressure on the exchange rate started to ease, leading the spot rate to drift back towards the centre of the Convertibility Zone. Expectations of currency appreciation in the forward and options market also moderated gradually. The HKMA did not conduct any intervention until late 2012, when inflows into the HKD resumed, prompting the

currency to retest the strong-side CU. In the last quarter of 2012, the HKMA sold around $100 billion HKD to meet increased demand in the foreign exchange market. The scale of the inflow was smaller than that experienced in 2008-2009 and the nature of it was consistent with the normal asset allocation decisions of foreign investors in an environment of strong risk appetite and loose monetary policy (Chan, 2012). Factors driving these inflows included: (1) increased allocation to the HKD assets by foreign investors due to improved market sentiment and abundant liquidity provided by developed-country central banks; (2) optimism about the Chinese economy, given that the end of an economic slowdown was in view; and (3) a pickup in foreign-currency corporate bond issuance by Hong Kong firms, resulting in subsequent repatriation into the HKD.

Spot and forward prices of HKD

Figure 6



Source: Bloomberg; HKMA estimation

IV. Credibility of the currency board and evidence from the market

Over the past 29 years, the LERS in Hong Kong has stood the test of two major financial crises, speculative attacks, sudden and abrupt capital flows, and occasional scepticism over its sustainability and its suitability for the Hong Kong economy. The system has proven resilient, and adaptive to the changing macro environment, and it continues to function smoothly today. This resilience cannot be separated from the high degree of credibility the system has accrued over time, and the confidence of the market in the HKMA's commitment to the currency peg (Genberg and Hui, 2011).

Many factors have contributed to the credibility of the LERS. Some of them come with the design of the system (e.g., 100% reserve backing and non-sterilised intervention); others are due to the HKMA's on-going efforts to ensure that its

operation is transparent, and to make the system flexible to the changing environment.

- ***100% reserve backing:*** As mentioned above, under the LERS the MB is more than fully backed by foreign reserves at the HKMA. Any changes in the MB are matched by changes in the reserve balance and the US dollar assets. This full reserve-backing of the MB ensures that when the HKD touches on the weak side of the CU, the HKMA has more than enough foreign reserves to defend the peg by buying the HKD in the open market. It gives the HKMA the confidence and ability to fight against currency speculation and manage large cross-border capital flows.
- ***Non-sterilisation intervention:*** In contrast to currency interventions of other central banks, market operations undertaken by the HKMA do not involve sterilisation in the inter-bank interest rate market. This reflects the single objective of the LERS, which is to ensure the stability of the exchange rate within the Convertibility Zone. When the HKMA intervenes, the MB is allowed to expand or contract freely, allowing the resultant interest rate movement to automatically counter the original capital flows. The HKMA is strictly committed to this adjustment mechanism, even at times when interest rate levels are temporarily incompatible with prevailing economic and asset market conditions. These occasionally undesirable consequences of the interventions are managed by macro-prudential tools such as loan-to-value ratios for mortgages, and measures such as stamp duties on property transactions.
- ***High transparency:*** Monetary operations under the LERS are carried out with a high degree of transparency. The HKMA makes constant efforts to educate the public about the system, and provides market participants with relevant information about the rules governing its operation. Market operations conducted by the HKMA are announced immediately, with relevant data published daily. Prior to major reforms in the system, senior HKMA officials take action to inform market participants about the changes, and research papers are published to provide background information and explain the rationales behind the changes. The HKMA also releases the minutes of the meetings of the Currency Board Governing Committee, and Currency Board accounts data and other relevant statistics are published every month. This high degree of transparency gives the market confidence in the HKMA's operation and enhances the credibility of the system.

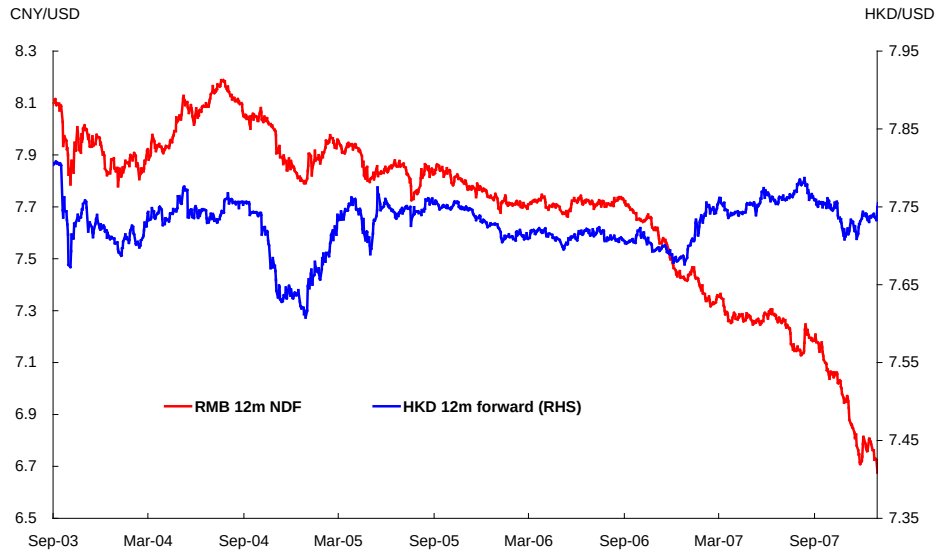
"Market evidence"

In addition to the theoretical arguments presented above, there is also plenty of market evidence to suggest the LERS' high degree of credibility among investors. The currency movement after the introduction of the "Three Refinements" is an example. One of the key reasons for establishing the strong-side CU was that the "implicit ambiguity" (i.e. that the HKMA could conduct "surprise" intervention, creating a degree of uncertainty to discourage speculators) had become less effective in curbing market speculation on a revaluation of the HKD (Yam, 2005a). This speculation had caused the HKMA to intervene repeatedly in the currency market between 2003 and 2004. The establishment of the strong-side CU effectively removed the ambiguity by creating an explicit ceiling for the spot rate. After the reform, the exchange rate stayed close to the upper bound of the zone, but had not triggered the CU. In addition, the interest rate spread quickly narrowed and the

Aggregate Balance remained stable throughout the period—this despite the fact that expectations of a RMB revaluation continued to escalate, and that other Asian economies experienced strong capital inflows. The fact that the HKD had decoupled from the RMB (Figure 7), and that the strong-side CU was not triggered, suggests that the market firmly believed the HKMA's commitment to defend the currency peg (Genberg et al., 2007).

Forward prices of HKD and RMB

Figure 7



Source: Bloomberg

Similarly, during the recent global financial crisis, the HKD exchange rate had stayed largely within the Convertibility Zone, and interest rate spreads were stable throughout the period. Interestingly, the HKD did not suffer from the risk-aversion-induced capital outflows that had hit other Asian economies. Instead, it experienced significant capital inflows, partly because of the HKD's peg to the USD, making it a safe-haven choice in times of market turbulence. The fact that the HKD continued to be seen as a surrogate of the US dollar suggests that market participants believed that the currency peg was highly credible even under market stress.

V. Conclusion

Hong Kong's LERS has undergone three major reforms over the past three decades, evolving into a rule-based currency system with a high degree of transparency and credibility. Market operations of the HKMA are triggered by market participants, and are conducted in strict conformity with the Currency Board principles. The MB is more than fully backed by the reserve assets held at the Exchange Fund, and any changes to the MB caused by official interventions are automatically matched by changes in the reserve assets. The HKMA strives to keep the system highly transparent and adaptive to the changing economic environment, but ensures that any reforms are strictly consistent with the Currency Board governing principles. These characteristics have made Hong Kong's LERS highly credible and effective,

enabling it to stand the test of two major financial crises, numerous speculative attacks and occasional scepticism over its suitability to Hong Kong's economy.

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Foreign currency tenders in Hungary: a tailor-made instrument for a unique challenge

Csaba Balogh, Áron Gereben, Ferenc Karvalits and György Pulai[1]

Abstract

In September 2011 new legislation allowed Hungarian households, under certain conditions, to repay their foreign-currency-denominated mortgages at preferential, predetermined exchange rates. This created an open foreign currency position of significant but uncertain size on the balance sheet of the Hungarian banking system. To close the open position, banks needed to convert Hungarian forints to euros and Swiss francs in large quantities over a short time period. To avoid excessive instability of the exchange rate, the central bank introduced a temporary facility – weekly foreign currency tenders – which in essence was a transparent, targeted, special foreign exchange intervention of significant size. It was designed to prevent speculative front-running on the foreign exchange market, and to provide banks with a hedge against a special type of uncertainty stemming from the unknown quantity of the mortgages to be repaid. The programme supported not only the inflation goal of the MNB, but also the stability of the financial system.

Keywords: foreign exchange, international lending, central banking, intervention

JEL classification: E58, F31, F34, G12, G14

[1] Magyar Nemzeti Bank.

Introduction

In September 2011 the Hungarian Parliament ratified legislation that, under certain conditions, allowed households to repay their foreign-currency-denominated mortgages at preferential, predetermined exchange rates. This legal act created an open foreign currency position of significant but uncertain size on the balance sheet of the Hungarian banking system. To close the open position, banks needed to convert Hungarian forints to euros and Swiss francs in large quantities over a short time period. To avoid excessive instability of the exchange rate, the central bank introduced a temporary facility – weekly foreign currency tenders – which in essence was a transparent, targeted, special foreign exchange intervention of significant size. It was designed to prevent speculative front-running on the foreign exchange market, and to provide banks with a hedge against a special type of uncertainty stemming from the unknown quantity of the mortgages to be repaid. This paper presents the background and details of the foreign currency tender scheme, and evaluates its results.[2]

Household borrowing in foreign currency – policy constraints and financial stability risk[3]

Hungary entered the crisis with significant currency exposure on the balance sheet of the private sector, particularly where households were concerned. By the second half of 2008, Hungarian household debt was close to 40 per cent of the country's GDP, and two thirds of that debt was denominated in foreign currency. Driven by the attractive interest rates, over 90 per cent of the households' foreign currency debt was denominated in Swiss francs, while only approximately 7 per cent was held in euros.[4]

The share of foreign currency lending was also high by regional standards: Hungary's figures were exceeded only in the Baltic States, while in the Czech Republic and Slovakia the foreign-currency-denominated retail debt was below 1 per cent.[5]

The majority of the foreign-currency-denominated debt stock was accumulated between 2004 and 2008. The sharpest increase was experienced after 2006, despite the fact that both the central bank and supervisory authority pointed out the associated risks on a number of occasions and in various forums. Of the new lending on the whole, the share of foreign currency loans had risen to 80 per cent by the end of 2008, and the corresponding figure for mortgage loans was over 90 per cent.

[2] This paper builds heavily on a previous assessment of the foreign currency tender scheme by Pulai and Reppa (2012).

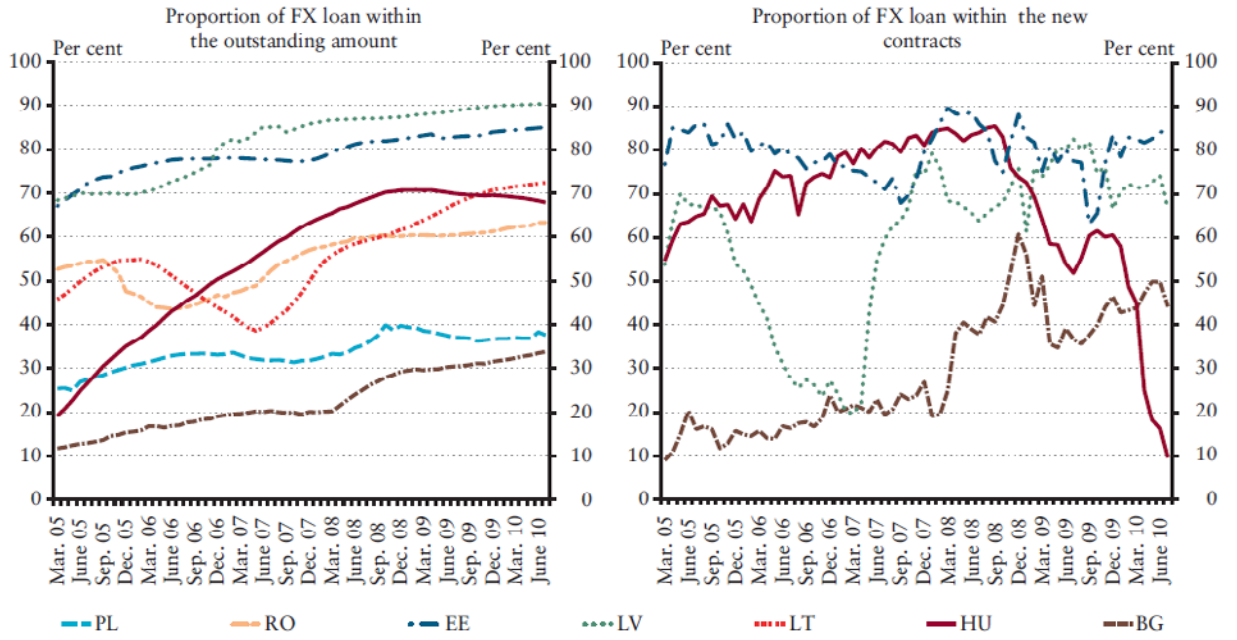
[3] A more detailed analysis of the causes and policy implications of liability dollarisation in Hungary can be found in Gereben et al (2011).

[4] Source: Balás and Nagy (2010).

[5] The share of foreign-currency-denominated retail loans was 2.7 per cent prior to Slovakia's adoption of the euro.

Share of foreign currency debt versus total and newly disbursed household loans in an international comparison

Figure 1



Note: The "proportion of new loans" curve is based on three-month averages.

Source: National central banks.

In response to the global financial crisis, the growth of foreign currency debt ceased by the end of 2008, and then that debt started to decline. The forces that drove foreign currency lending before 2008 faded significantly after the onset of the financial crisis. Namely:

- The economic downturn led to a worsening in households' income expectations, and thus credit demand declined.
- In parallel with a balance sheet adjustment by the banks, global liquidity was drying up. As a result, although the FX risk was hedged by the banks, the financing of foreign currency loans became more expensive and funds were harder to come by. At the same time, the dramatic portfolio deterioration put an end to risk-based competition.
- A government decree on prudent lending, as well as the action to prohibit foreign currency lending, were also crucial in restricting foreign currency lending from mid-2010.

Although new borrowing in foreign currency practically stopped, the high debt stock remained both an important constraint on macro-economic policy and a significant risk to financial stability:

- Such a high share of foreign currency debt significantly impairs the efficiency of both the exchange rate and the interest rate channels of monetary transmission. As a rule, a weaker domestic currency would improve export competitiveness, and in turn stimulate output. However, in the presence of a large stock of foreign currency debt, a weaker currency could also reduce households' disposable income due to higher loan instalments, while the resulting higher foreign currency debt would lead to a decrease in wealth in the

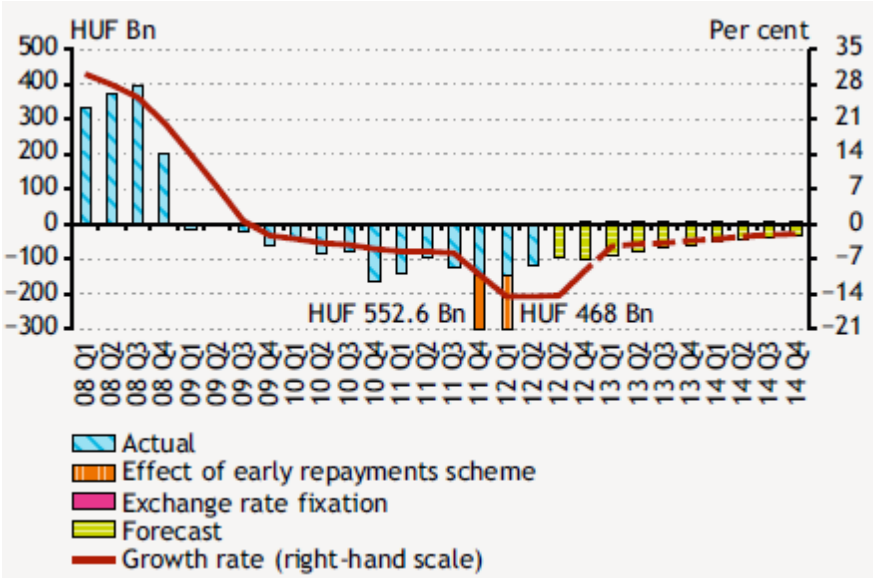
private sector. All in all, the expansionary effect of a weaker currency could be reduced, or even reversed, by the wealth effect.

- Besides weakening monetary transmission, a high proportion of foreign currency loans poses an increased risk to financial stability. Higher instalments weaken debtors' ability to pay and increase the probability of default (PD), which, together with the rising loss given default (LGD) rate, results in increasing loan losses (PD x LGD). A weaker forint also reduces the amount of available capital while it increases the risk-weighted balance sheet total. Overall, depreciation erodes banks' profitability and capital position, which is adverse to financial stability.

The lack of appropriate risk management by banks also contributed to the financial stability risk. Not only were credit risks assessed improperly, but banks' asset-liability management further exacerbated their vulnerability. Specifically, their long-term assets (such as mortgage loans) were financed (and hedged) by short-term liabilities (and off-balance sheet items), which made them subject to a significant rollover risk.

Forecast for net quarterly changes in household loans

Figure 2



Source: MNB.

The Early Repayment Programme and its potential impact on the exchange rate

The Hungarian government that took office in 2010 considered the high foreign-currency indebtedness of Hungarian households and the rising ratio of those unable to pay their instalments to be one of the country's severest economic, financial and social problems. In order to mitigate this problem, it adopted numerous new regulations related to household lending in 2010 and 2011. Some of them aimed to

improve the position of households with foreign-currency-denominated loans; their main objective was to reduce households' debt service burden.[6]

From the central bank's point of view, the most important measure was the so-called Early Repayment Programme, which was announced in September 2011. With this particular scheme the government provided the option of repaying foreign currency mortgage loans at fixed exchange rates. Borrowers with foreign-currency-denominated mortgage loans had the opportunity to repay their total debt at an exchange rate of CHF/HUF 180 for loans denominated in Swiss francs, EUR/HUF 250 for euro-denominated loans and JPY/HUF 2 for loans denominated in Japanese yens. These were far below the prevailing market exchange rates, and thus more favourable to households.[7] The creditor banks, obviously, were to realise a significant loss from these transactions, as they had to cover the difference stemming from the preferential exchange rates and the market rates.

An important feature of the programme, however, was that only those debtors who were able to repay their total outstanding debt in one lump sum qualified for the programme; in other words, partial repayment was not allowed. Moreover, the government provided this opportunity only on a temporary basis. Interested borrowers were asked to submit their intention to participate by the end of 2011, and 60 days were available to the banks and clients to conduct the transactions.

Besides the exchange rate losses, the programme adversely impacted the quality of banks' loan portfolios, as it was mostly their wealthiest, most creditworthy clients who were able to repay total debt. As a result, banks lost a great share of their lowest-risk clients, while retaining those who were barely able or unable to meet their monthly instalment obligations. From the point of view of the Magyar Nemzeti Bank (MNB), the Early Repayment Programme posed a significant threat to exchange rate stability. By nominally fixing the preferential conversion rates, the parliamentary ratification of the scheme, in a single legal act, changed the denomination of a significant portion of the banking system's assets from foreign currencies to the Hungarian forint, while leaving the denomination of the liabilities intact. As a result, the foreign currency position of credit institutions opened up well before the actual launch of the early repayment scheme, creating unintentional exchange rate exposure for them. The banks thus needed to buy foreign currency – and sell the forint – to eliminate their exposure.

The magnitude of the exposure, however, was not known with certainty: it depended on the number of debtors who were both able and willing to repay their FX loans. In September, only vague estimates of their number were available; the true amount was to become known only gradually during the 4 months of the submission period.

The programme posed an immediate risk to the stability of the forint's exchange rate through two direct factors:

[6] These measures comprised the exchange rate cap, the possibility of debt servicing at a fixed exchange rate for 5 years, setting up National Asset Management Ltd., and lifting the foreclosure and eviction moratorium with the introduction of auction quotas.

[7] Market rates at the time of the programme's announcement were CHF/HUF 234 and EUR/HUF 282; therefore the programme was equivalent to 30 and 13 per cent debt relief for the qualified borrowers.

- Had credit institutions simultaneously wanted (with forints) to purchase in the foreign exchange market the large amount of foreign currency necessary for the early repayments, it would have caused an immediate and significant depreciation through a large drop in demand for HUF.
- Moreover, the market received the early repayment programme unfavourably from the outset, as it imposed a significant extra burden on the financial intermediation system, which the market perceived as negatively affecting future lending capacity and propensity. Thus, the early repayment programme itself increased the country's risk premium, thereby contributing to weakening of the forint.

Given the presumable weakening of the forint, two additional, second-round factors could have aggravated the depreciation pressure on the forint:

- With expectations of forint depreciation, banks would presumably have aimed to buy foreign currency in the necessary quantity as early as possible, to minimise the cost; and
- Speculative forint sales by other market participants, who were even not involved in the early repayments, but only wished to realise an exchange rate gain by speculating on forint depreciation, would presumably have increased.

Such speculative "front-running" would have had the potential to significantly increase the volatility of the exchange rate and lead to excessive depreciation of the domestic currency, and thus adversely affect both the outlook for inflation and financial stability – a situation that the MNB wanted to avoid.

Policy alternatives

Considering the MNB's goals, pronounced uncontrolled shifts in the forint's exchange rate were considered to be unfavourable for several reasons. First, a large depreciation could have raised inflation. Second, a significantly weaker forint would have led to a further sudden deterioration of the commercial banks' loan portfolios through an increase in instalment size of the remaining foreign currency loans (presumably those of financially troubled debtors who were unable to effect early repayment), and to an increase in the banks' funding costs due to their worsening capital position. Third, a sudden, large increase in exchange rate volatility might have destabilised the foreign exchange market itself, and could have contributed to a significantly higher expected risk premium on forint-denominated assets.

Given this situation, the MNB had the following policy options:

- To remain passive, and possibly face a potentially self-reinforcing depreciation of the forint of a magnitude and speed that would be clearly harmful in terms of inflation and financial stability.
- To dampen the possible weakening of the forint ex post, if necessary, with ad-hoc exchange rate management instruments such as silent intervention. In this case, however, the risk of spending excessive amounts of foreign exchange reserves to simply satisfy a speculative demand for foreign currency would have been large.
- To somehow provide an ex ante commitment to deliver the foreign currency necessary for the programme from the reserves in an organised, structured

manner, with the aim of minimising motivation for second-round, speculative HUF sales while at the same time conserving foreign reserves.

The MNB chose the third option. However, designing a suitable instrument was not trivial. The aims the central bank had in mind when formulating the specifics were the following:

- The MNB wanted to ensure that banks would be able to obtain the necessary foreign currency coverage for their open currency positions from the central bank, so that they would not be forced to obtain it from the foreign exchange market within a short period of time, which would raise concerns about possible weakening of the forint.
- The instrument must also aim to dispel expectations of a weakening of the forint, thereby reducing speculation. In other words, the availability of the instrument alone was to produce a stabilising effect.
- The central bank also wished to provide the banks a special hedge against the uncertainty stemming from the fact that the number of borrowers that would join the Early Repayment Programme, and therefore the size of the foreign currency exposure, was not known in advance. From this viewpoint, the MNB instrument filled a gap, as obviously no market-based hedging instruments were available for this type of risk.
- Given that a decrease of foreign exchange reserves would have been harmful in terms of the country's external vulnerability, the MNB wanted to specify the instrument in a way that would contribute to stabilising its reserve adequacy indicators.
- It is important to emphasise the MNB did not want to defend any particular exchange rate target; its goal was to avoid market instability that could potentially lead to excessive volatility and depreciation.

The foreign currency tender programme

The MNB decided to offer a regular foreign currency (euro) tender that would allow credit institutions affected by the Early Repayment Programme, under well-specified conditions, to bid for the euro amount necessary to cover their open foreign currency position.[8]

[8] Although most of the foreign currency mortgages affected by the Early Repayment Programme were denominated in Swiss francs, the MNB decided to provide euros to the banks. On one hand, euro reserves were available in a large amount, significantly facilitating the sales. On the other hand, the aim was to prevent forint sales in the market, irrespective of the purchased currency. The EUR/CHF market was sufficiently large and liquid to ensure that even large conversions by the Hungarian banks would not move the exchange rate significantly. Credit institutions were able to convert the euros purchased from the Bank to Swiss francs in the foreign exchange market without any negative consequences.

A hedging instrument against "early repayment risk"

It was announced that the tenders would be held on a weekly basis between early October 2011 and end-February 2012.[9] Banks could submit bids every Monday. With the tenders, credit institutions could buy foreign currency up to an overall amount equivalent to the value of their potentially affected mortgage portfolio as of 31 August 2011. The MNB did not specify any preannounced quantity to be allocated to the tenders. All accepted bids were to be settled at the submitted exchange rate (multiple-rate tender). Results were announced on tender days at 12 noon, at which time the MNB published the lowest acceptable EUR/HUF exchange rate. Up to 3 different bids by the same bank were accepted.

One of the particular features of the programme was that settlement of the transaction was not immediate. Credit institutions received the foreign currency allocated to them only after their borrowers actually made the repayments. Until then, the MNB rolled the foreign exchange over in overnight EUR/HUF FX swaps.[10] Thus, although the counterparties purchased the foreign currency in the tenders, and as a consequence their FX position was hedged, every day they technically "lent" the euro to the Bank for one day through a swap transaction, until they became entitled to the use of the foreign currency through the completed early repayments.

Upon termination of the programme the credit institutions were obliged to convert unused foreign currency to forints at the MNB. In other words, if a credit institution overestimated the capacity of its borrowers to use the Early Repayment Programme, and purchased excessive amounts of foreign currency from the MNB, the surplus was to be converted back at the end of the programme. This reconversion was necessary to ensure that the banks used this facility to purchase foreign currency from the MNB only to cover the early repayments, but not for speculative purposes. The conversion rate was the original exchange rate at which they purchased the euro from the MNB; this was to ensure that in the event of over-hedging, they did not assume the risk of movements in the EUR/HUF exchange rate for the excess amount.

Due to these special conditions, the "product" offered by the MNB on the tenders was a special financial instrument: it did not fully correspond to a standard spot market transaction, as other rights and obligations were associated with it (the purchased euro needed to be kept with the MNB in a specific form, it could only be used for a specific purpose etc.). Thus, the comparability of the price established in the tenders and the market price was somewhat limited from the outset.

A major difference between a simple spot transaction and the MNB's instrument is that in the case of over-hedging, the excess foreign currency was repurchased by the MNB at the original buying rate. The MNB thereby offered banks a product that provided a hedge against the uncertainty regarding the volume of early repayments. In essence, the "product" offered by the MNB was essentially a forward foreign exchange position that automatically became void if

[9] This period matched the Early Repayment programme, where clients had to announce their willingness to repay their loans by 31 December 2011, and an additional 60 days were allowed to complete the transaction.

[10] The Bank published the quantity of allocated and actually paid amounts in the middle of the month following the reference month (together with the statistical balance sheet).

not needed. In this sense, it has properties similar to those of options. Such a product was unavailable elsewhere in the market.

Pricing issues

Pricing the product had its particular challenges. For example, while credit institutions using the central bank instrument could hedge themselves against the risk arising from possible over-hedging, the MNB did not want to encourage banks to purchase much more foreign currency than the expected demand stemming from the Early Repayment Programme. First, in case of substantial over-hedging, market analysts could have anticipated a large decline in foreign reserves, and might have raised questions about the adequacy of reserves. Second, substantial over-hedging might have had started rumours about a larger-than-actual volume of early repayments, and thus higher losses for banks, which again might have triggered unnecessary speculative trades.

All in all, pricing needed to be determined with respect to the following principles:

- To not discourage banks from applying for the central bank instrument, i.e. not to make it too expensive;
- To charge, however, a cost for expected over-hedging, i.e. so that over-hedging is not too affordable;
- To make the exchange rate bids submitted and accepted in the tenders easily comparable to the EUR/HUF exchange rate observed in the market, to ensure transparency.

To implement these goals, the MNB had to determine 3 pricing parameters:

- The lowest bid accepted for the tenders – to be determined on a weekly basis;
- The reconversion rate for the excess foreign exchange at the end of the programme;
- The pricing of the FX swaps used to hold the purchased foreign exchange until the corresponding early repayment actually happened.

On the tenders, the central bank tracked market rates with the lowest accepted bid. This facilitated the bidding for market participants through transparency.

To discourage excessive over-hedging, the MNB decided that unused amounts should be reconverted at an exchange rate that exactly corresponds to the buying rate. Thus, the counterparty lost the interest rate spread – the "carry" – for the holding period, resulting in a weaker motivation for over-hedging.[11] As to the swaps, the MNB eventually decided to price those on the basis of the average market interest rates (HUFONIA and EONIA) of overnight lending/deposit transactions for the previous day, providing banks with a slightly lower implicit return than on comparable market swaps.[12]

[11] At that time the forint interest rate was approximately 6 per cent higher than the euro rate, which would have justified reconversion at a higher EUR/HUF exchange rate.

[12] To determine the pricing parameters of the instrument it was necessary to create a quantitative pricing model. From an asset pricing point of view, the product had similarities with currency

All in all, the actual combination of these pricing parameters resulted in a product that was initially priced close to the spot exchange rate and had an additional hedging component, making it attractive for banks. The extra value of this hedge was highest when a bank purchased its expected necessary FX from the central bank. However, hedging beyond the expected FX need became increasingly expensive due to the punitive reconversion rate.

Considerations regarding foreign reserve adequacy

Obviously, the MNB needed to estimate the amount by which such a programme could reduce its foreign exchange reserves. Experts estimated the volume of early repayments (including those funded by taking loans in forints) to be equal to 20 per cent of the foreign-currency-denominated mortgage loan stock, as, on one hand, some debtors did not have sufficient savings, and on the other, banks' propensity to lend was rather low. The MNB expected the early repayment of loans to be approximately EUR 3.3 billion out of the total EUR 16.7 billion in foreign currency loans within the banking system. This ratio, however, showed significant variations at the level of individual banks, and it was not clear, either, as to which banks would apply for the instrument of the MNB and in what proportion to their loans. It is important to note that although the amount was substantial, it did not even reach 10 per cent of total foreign exchange reserves – that is, there was no threat of a significant decline in the level of reserves as a result of the programme.[13]

Market participants and analysts take into account numerous indicators to measure a country's foreign exchange reserves. Although the MNB also considers a variety of indicators to evaluate its level of reserves, in small, open, emerging economies such as Hungary market analysts most frequently use the Guidotti-Greenspan rule, and therefore it has a particular importance in maintaining investor confidence.[14]

To ensure that the decline in foreign exchange reserves would not significantly hamper compliance with the indicator, the MNB required participating credit institutions to initially reduce their short-term (i.e. within one year) external liabilities if they repaid liabilities towards non-residents – either parent-institution funding or wholesale cross-border borrowing – using the received foreign currency. As a result, not only did the foreign exchange reserves decrease, but the short-term external debt of the country also declined, which reduces the need for reserves based on this indicator.

options. However, the payout function of the product depended on the amount of foreign currency loans repaid by households – a risk not traded on any market. Due to this incompleteness of the market, pricing could not be based on the principle of no arbitrage, and assumptions about the banks' risk preferences had to be made. Details of the pricing model can be found in the appendix of Pulai and Reppa (2012).

[13] According to the official statistics, international reserves equalled 37,554 million euros in August 2011.

[14] According to this rule, foreign exchange reserves should provide cover for the given country's short-term debt, i.e. they should provide sufficient liquid assets, in the event that the country is unable to renew its maturing external debt, for a period of one year. On foreign reserve adequacy in Hungary in general, see Antal and Gereben (2011).

Data and reporting

Before the launch of the programme, neither the MNB nor the Hungarian Financial Supervisory Authority had the data necessary to monitor the programme in general, especially to ensure that banks were fulfilling the commitments that they agreed to by participating in the foreign exchange tenders. A new reporting system was set up to fulfil these needs, and all participating banks had to make a commitment to submit the necessary data.

For the purpose of monitoring early repayments, credit institutions were required to provide data relating to the early repayment applications submitted to them, and the amount of early repayments effected, as a condition for participating in the programme. In addition, credit institutions were required to provide data on forint-denominated loans that they provided to households so that they could repay the foreign currency loans. Also, data on external wholesale funds repaid as a result of the early repayments were to be reported. Provision of data on changes in foreign funding was necessary, as credit institutions participating in the tender were also required to first repay their short-term (i.e. less than one year) external funds. The counterparties met this requirement, according to the data provided.

Implementation

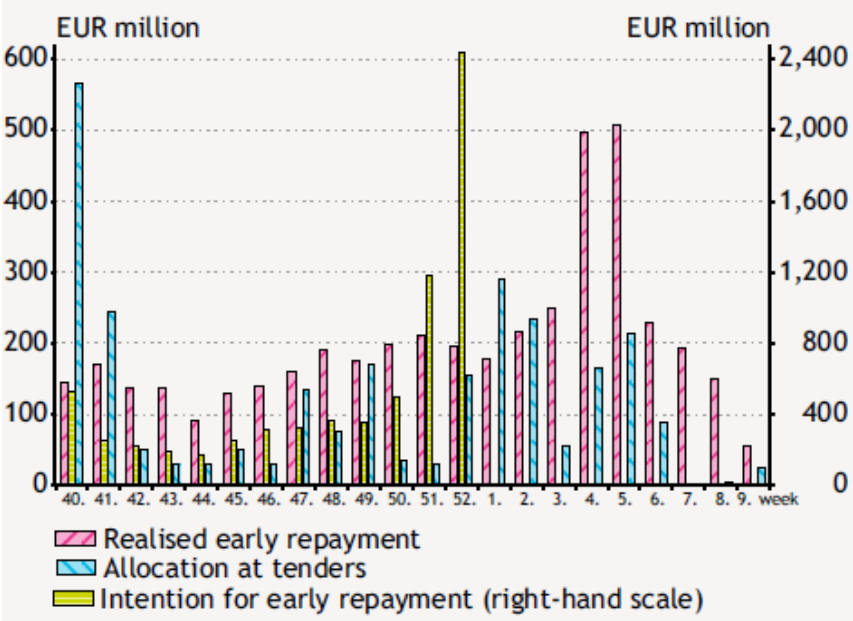
At the beginning, quick and efficient communication about the programme was crucial to prevent overreactions and to avoid a build-up of potentially damaging self-fulfilling exchange rate expectations. A few days after the government's plans about the Early Repayment Programme became public, the MNB's governor indicated at a press conference that the foreign reserves may be used to counteract the impact of the early repayments. This announcement in itself already helped stabilise the exchange rate. The details of the foreign currency tenders were finalised by late September. Together with its public announcement, the MNB held several consultations with the affected banks' senior management and treasury officers. By the time of the first tender, the banks' asset-liability management units and foreign exchange desks were already familiar with the technical details and intricacies of the scheme.

The MNB conducted a total of 22 tenders between early October 2011 and the end of February 2012. The vast majority of bids submitted approximated the market EUR/HUF exchange rate. In each case, the MNB determined the minimum accepted exchange rate close to the prevailing market EUR/HUF rate (average rate during the 15-minute tender) – that is, the Bank did not in any case sell foreign currency at an exchange rate that was more favourable for its counterparties than market rates.

In the course of the tenders, the MNB accepted bids from eight counterparties with a total value of EUR 2,679 million. However, not all of that was actually paid out, based on the actual early repayments reported to the MNB (see below). Of the ten banks with foreign currency loan portfolios of over EUR 100 million, only two institutions decided not to participate in the tenders of the MNB, and another bank obtained only one-third of the foreign currency related to its early repayments through the MNB's instrument. None of the credit institutions with a portfolio of less than EUR 100 million used the central bank instrument. These credit institutions presumably purchased the necessary euro amounts from the market or from their parent banks.

Amount allocated through the tenders and amount of reported and actual early repayments in a weekly breakdown

Figure 3



The counterparties of the MNB reported actual early repayments totalling EUR 4,353 million. On the basis of the above, a total of EUR 2,586 million was actually paid out of the currency allocated through the tenders, i.e. the MNB's instrument covered approximately 60 per cent of total foreign currency demand. The remaining 40 per cent was purchased by credit institutions from their parent banks or in the foreign exchange market; the related forint sales may have contributed to the weakening of the national currency observed in the autumn of 2011.

Amount of bids accepted in the tenders and amounts actually paid in a monthly breakdown

Table 1

	Amount of accepted bids on the euro selling tender		Amount of actual foreign currency payments related to the realized final repayment	
	EUR millions	HUF billions	EUR millions	HUF billions
October 2011	890	262	235	69
November 2011	320	98	291	86
December 2011	390	119	336	101
January 2012	744	232	707	216
February 2012	335	99	921	279
March 2012	0	0	97	29
Sum	2,679	810	2,586	781

Source: Press release on the preliminary statistical balance sheet of the MNB for March.

At the end of the programme, a total allocated amount of EUR 93 million remained with three counterparties, which they were unable to use, as the amount of early repayments by their customers was lower than the amount of foreign currency purchased through the tenders. The MNB repurchased this amount – in accordance with terms announced in advance – at the EUR/HUF exchange rate at

which the counterparties had purchased the foreign currency in the last tender(s), following the FIFO principle.

Assessment and conclusions

Overall, the programme was favourably received and positively assessed by market participants. This was confirmed by the opinions expressed by the banks' representatives, but also by the reasonably high use of the product. Besides, both the banks and other market commentators seemed to understand the goals of the programme well.

The programme also contributed to avoiding any excessive instability of the forint. On one hand, it is true that a sizable (approximately 12 per cent) depreciation of the forint was observed over the course of the last four months of 2011, and we cannot rule out the possibility that market conversions related to the Early Repayment Programme contributed to that. However, the depreciation happened in an orderly manner, without any large-scale front-running observed, and the weakening was more likely associated with other domestic and international factors. All in all, the programme supported not only the inflation goal of the MNB, but also the stability of the financial system, in that it curbed deterioration of commercial banks' loan portfolios stemming from increased instalment payments for the remaining foreign currency loans (presumably associated with financially troubled debtors who were unable to effect early repayment) and curbed an increase in the banks' funding costs as a result of their worsening capital position.

From the point of view of foreign reserves, although obviously the program diminished the MNB's reserves, market commentators have not questioned their adequacy in relation to the tender scheme. Rather, the consensus of the comments was that it was "money well spent". The programme's conditionality, designed to reduce the banking system's short-term liabilities, and thus improve the Guidotti indicator through the denominator, performed well. During the time span of the Early Repayment Programme, the banking system's short-term external liabilities decreased by more than EUR 3bn, a figure that is actually slightly higher than the reserves allocated to banks.

Without any counterfactual, it is very difficult to make any objective assessment of the foreign currency tender scheme's performance relative to the alternative solution of "plain vanilla" silent, ad hoc intervention on the spot foreign exchange market. However, it is likely that such an ad hoc strategy could not have successfully prevented front-running and speculation. Also, regular intervention could not have provided a hedge against the uncertainty stemming from the unknown amount of early repayments, and consequently it would not have reduced the banks' incentive to over-hedge themselves right from the beginning. Given these factors, achieving similar results through "plain vanilla" intervention, if feasible at all, would have resulted in significantly larger sacrifices in terms of reserves.

It is fair to say that foreign exchange intervention is an area which is still surrounded by much secrecy, and into which most central banks' efforts to increase their transparency have not seemed to filter much. This programme has demonstrated that a great deal of transparency can actually pay off, sometimes even in the case of interventions.

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Intervention in foreign exchange markets: the approach of the Reserve Bank of India[1]

Reserve Bank of India

Abstract

The exchange rate of the rupee is determined largely by the market forces of demand and supply. The Reserve Bank of India has intervened occasionally to maintain orderly conditions and curb excessive volatility in the foreign exchange market. Being a current account deficit country, India is dependent on capital flows for financing the current account deficit. Given the dependence on volatile capital flows, there may be a case for augmenting forex reserves when the situation permits without any bias for a particular exchange rate band.

Keywords: capital flows, exchange rate, intervention, foreign exchange reserves

JEL classification: F32, F310

[1] This paper was prepared by Mr. Rakesh Tripathy of the Reserve Bank of India under the guidance of Mr. G. Mahalingam and Mr. Harun R. Khan for the Emerging Markets Deputy Governors' Meeting hosted by the Bank for International Settlements on 21 and 22 February 2013 at Basel.

Exchange rate policy

India moved to a market-determined exchange rate system in March 1993. Under the new system, the rupee's exchange rate against other currencies is determined largely by market demand and supply. The Reserve Bank of India intervenes occasionally, only for maintaining orderly conditions in the market by curbing excessive volatility.

Market microstructure

The Indian foreign exchange market has exhibited significant growth over the last decade, with average daily turnover recording a quantum jump from US$6 billion a year in 2000 to US$60 billion in recent times. The major market participants in the domestic foreign exchange market now include banks, corporates and foreign institutional investors (FIIs). Besides having an active over-the-counter market, India also has an exchange-traded currency futures and options market that has shown reasonable growth since its inception in 2008.

Current and capital account flows

Though large corporates continue to be the active players in the Indian market, the SMEs have also increased their presence. As one of the fastest growing economies in the world, India's demand for crude oil has been growing significantly over the years. With limited proven reserves, the bulk of India's crude requirement is met through imports. Also, in recent years India's gold imports have increased significantly, putting pressure on its current account. Besides the software exports, remittances from the Indian diaspora have been quite robust and have helped contain the current account deficit (CAD). India, as structurally a current account deficit economy, depends on capital flows to finance the CAD. During the last few years, India has witnessed a significant surge in capital flows in the form of Foreign Direct Investment (FDI), portfolio investments by FIIs and External Commercial Borrowings (ECB). Even deposits by non-residents have shown healthy growth. Table 1 provides a comparative look at the composition of net capital flows in the last five years.

Comparative composition of net capital flows

(in billions of US dollars) Table 1

	2011–12*	2010–11*	2009–10*	2008–09*	2007–08*
Current account balance	–78.2	–48.1	–38.2	–27.9	–15.7
Capital account	67.8	63.7	51.6	7.4	106.6
Of which the major headings are:					
FDI	22.1	11.8	18.0	22.4	15.9
FII	16.8	29.4	29.0	–15.0	20.3
ADR/GDR	0.6	2.0	3.3	1.2	6.6
ECB	10.3	12.2	2.0	7.9	22.6
Non-resident deposits	11.9	3.2	2.9	4.3	0.2

* April to March

Source: Reserve Bank of India

During the current financial year, while net FDI inflows moderated somewhat during April–November 2012, net FII inflows have shown a significant uptrend. Net FII inflows during 2012–13 (April 2012 to December 2012), at US$16.0 billion, were significantly higher than the corresponding period of the previous year (US$2.7 billion), thus providing temporary comfort for financing the CAD.

Intervention strategy and recent episodes of large scale intervention

As can be seen from Table 1, India relies heavily on capital flows to fund its CAD. Since these flows quite often prove large and lumpy, and bulk demands for oil imports and government payments get bunched up on many days, the Indian forex market becomes susceptible to bouts of volatility. As stated earlier, Reserve Bank of India's intervention in the market is aimed at cushioning volatility without targeting any specific exchange rate. In fact, the intervention strategy can in a sense be described as "leaning against the wind" to restore orderly conditions in the market and thus facilitate the real sector's access to the market.

The choice of market segment for intervention can vary from spot to outright forward depending on the prevailing market conditions. It may be appreciated that whether the Reserve Bank of India intervenes in the spot or in the outright forward market, the impact on the inter-bank spot rates remains same. The option of operating in either the spot or forward market, depending on the prevailing market conditions, gives the Reserve Bank of India's intervention operations greater manoeuvrability for modulating domestic rupee liquidity conditions in consonance with the prevailing monetary policy stance. Similarly, intervention can be direct or indirect, though the general preference is for indirect intervention through selected banks. Though both approaches have merits and drawbacks, the indirect approach has the advantage of maintaining the confidentiality of the intervention operations, thereby enhancing their effectiveness.

As indicated earlier, any large and lumpy capital flow has the potential to cause undue volatility in the market, and thereby necessitate intervention by the Reserve Bank of India. In recent times, with an eye on the overarching objective of maintaining orderliness in the forex market and curbing speculative tendencies, the Reserve Bank of India has intervened in the market on both sides. The scale of intervention is indicated in Table 2.

Net purchases of US dollars by the Reserve Bank of India

(in billions of US dollars) Table 2

Period	Net purchases
2006–07*	(+) 26.8
2007–08*	(+) 78.2
2008–09*	(–) 34.9
2009–10*	(–) 2.5
2010–11*	(+) 1.7
2011–12*	(–) 20.1
2012–13 (till Jan'13)	(–) 3.1

* April to March

Source: Reserve Bank of India

In 2006–08, the Reserve Bank of India intervened in the market by buying US dollars as the country witnessed large and lumpy capital inflows far in excess of the economy's absorptive capacity. The rupee, however, came under sharp depreciation pressure in the aftermath the of global financial crisis, especially immediately following the Lehman collapse in September 2008, and this forced the Reserve Bank of India to sell US dollars in order to restore orderliness in the market. In 2009–11, domestic foreign exchange markets generally remained stable with the rupee exhibiting range-bound movement. This was reflected in the very limited scale of intervention operations undertaken by the Reserve Bank of India during that period (Table 2). After the US long-term rating was downgraded by one of the rating agencies in early August 2011, the rupee along with other emerging market currencies fell very sharply. Such sharp movements are often associated with heightened volatility. In order to ensure stability in the market, the Reserve Bank of India had to step in by selling US dollars in the market. It should be noted that for durable impact, interventions have often been combined with measures involving capital account management to modulate foreign flows.

Movement of the rupee vis-à-vis other currencies

Table 3 gives the movement of the Indian rupee and some selected currencies against the US dollar. It is quite clear that the Indian rupee has largely moved in tandem with other emerging currencies.

Movement in currency exchange rate vis-à-vis the US dollar

(percentage) Table 3

Currency	2010–11*	2011–12*	2012–13**
Current account deficit countries			
Brazilian real	9.3	–10.6	–8.3
Indian rupee	0.7	–12.4	–4.4
South African rand	7.6	–11.6	–14.6
Turkish lira	–1.7	–13.3	1.3
Current account surplus countries			
South Korean won	3.3	–3.2	4.1
Russian rouble	3.5	–3.0	–2.4

*April–March **To January, 2013

Source: Reuters

While the major trigger for intervention has been the volatility factor, the Reserve Bank of India does track the Real Effective Exchange Rate (REER) of the rupee in trade-weighted terms. It has remained overvalued based on the six-currency index, but undervalued based on the 36-currency REER index (Table 4). The divergence between the two indices only indicates that the REER is not a very effective tool in deciding on the timing of interventions, though it remains useful in assessing the directional movements of the rupee vis-à-vis a basket of other currencies.

Movement of REER & NEER (trade-based weights) of the Indian rupee

Baseline 2004–05=100 Table 4

Year	36-currency		6-currency	
	REER	NEER	REER	NEER
December 2009	96.18	91.10	103.99	87.21
December 2010 (P)	103.62	93.91	117.48	92.29
December 2011 (P)	91.58	80.83	103.75	78.06
December 2012 (P)	90.74	78.01	104.71	75.05

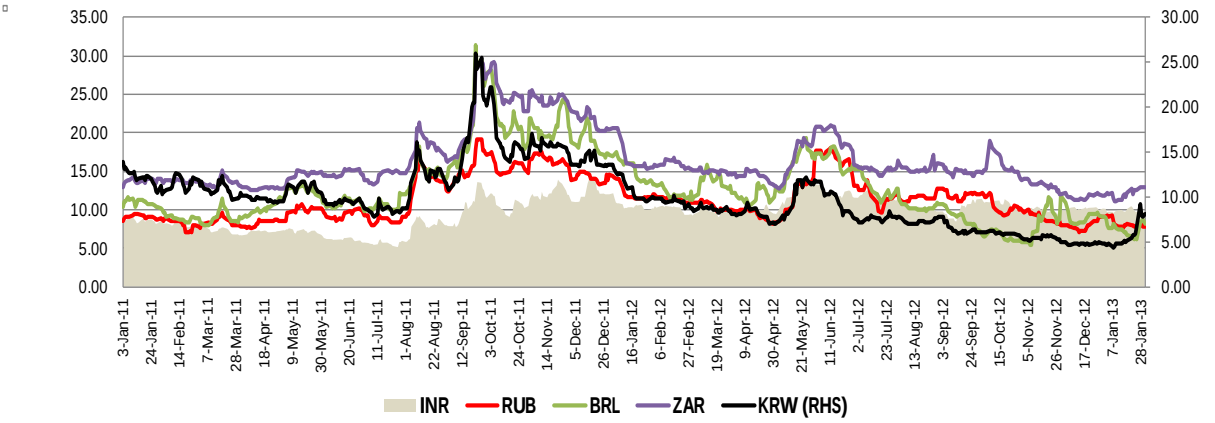
P: provisional

Source: Reserve Bank of India

The rupee has also exhibited reduced volatility during recent months, as can be seen from Figure 1, suggesting that the Reserve Bank of India interventions have been largely successful in cushioning volatility and restoring orderly conditions in the market.

Volatility of select currencies against the US dollar

January 2011 to January 2013 Figure 1



Source: Bloomberg

Sustainability of the intervention strategy

An issue that has been engaging our attention in the last few years is whether our intervention strategy can be uniform irrespective of whether we engage on the buy side or on the sell side. A lot would depend on factors such as prevailing market liquidity conditions and the level of forex reserves. An inherent asymmetry is unavoidable given that the economy is running a large CAD, and hence, from the perspective of available reserves, buying US dollars may seem preferable to selling US dollars. But a significant point that differentiates India's approach is that the country has never resorted to any kind of competitive depreciation to gain export advantage – a factor that may be considered to have additional relevance in the context of so-called "currency war" that is being widely discussed in recent times.

This underlines the issue of adequacy of reserves which has emerged as an important parameter in gauging a country's ability to absorb external shocks.

Adequacy of foreign exchange reserves

The overall approach to the management of India's foreign exchange reserves takes into account the changing composition of the balance of payments, and endeavours to reflect the "liquidity risks" associated with different types of flows, as well as other requirements. India's current level of reserves may seem "large" in comparison with many other countries, but it has to be seen against the backdrop of twin deficits that India runs, i.e., the current account deficit and the fiscal deficit. There is one more dimension to the reserves – their composition. Unlike many other countries, India has not accumulated its reserves by virtue of having a surplus current account, but rather on account of having capital flows far in excess of the absorptive capacity of the economy. In that sense, one can argue that reserves held by India are not truly "earned", but rather "borrowed" in nature, and that they may be required to be "returned" should the capital flow reverse as it did during 2008–09.

With the changing profile of capital flows, the traditional approach of assessing reserve adequacy in terms of import cover has been broadened to include a number of parameters which take into account the size, composition and risk profiles of various types of capital flows as well as the types of external shocks to which the economy is vulnerable.

According to the traditional approach of assessing reserve adequacy in terms of import cover, the situation has worsened as the reserves' ability to cover future import payments has declined in recent months (the import cover was down to 7.2 months at the end of September 2012 from 9.6 months at end-March 2011, and from a high of 14 months about five years back). Even in terms of other parameters, such as the ratio of short-term debt to foreign exchange reserves, and the ratio of volatile capital flows to reserves,[2] the trend has been worsening. This leads to the question of whether there is a need to increase the reserves. In other words, can it be said that besides aiming to reduce excessive exchange rate volatility, the exchange rate policy should also take into account the need for maintaining an adequate level of foreign exchange reserves so as to ensure that, in the case of prolonged uncertainty, reserves can cover the "liquidity at risk" on all accounts over a reasonably long period.

The recent measures announced by the Government and the Reserve Bank of India, which were aimed at increasing the capital flows into the country, may provide an opportunity to recoup some of the reserves utilised for intervention and help in meeting external and domestic commitments. During times when the capital flows are large and lumpy, and exceed the absorptive capacity of the economy, an appropriate intervention strategy might not only achieve the objective of ensuring

[2] The ratio of short-term debt to foreign exchange reserves, which was 21.3 per cent at end-March 2011, had increased to 28.7 per cent at end-September 2012. The ratio of volatile capital flows (defined to include cumulative portfolio inflows and short-term debt) to reserves increased from 67.3 per cent at end-March 2011 to 83.9 per cent at end-September2012.

orderly conditions by curbing the excessive volatility, but also ensure augmentation of forex reserves commensurate with growing external and domestic commitments.

Recent measures

With a view to augmenting capital flows to the country and preventing market participants from making uni-directional speculative bets on the Indian rupee, the Government and the Reserve Bank of India have taken several measures in recent times (Box 1).

Sterilisation strategy

In order to sterilise the impact of forex intervention, the Reserve Bank has a variety of tools available at its disposal, such as open market operations, changes in the cash reserve ratio for banks, and the Market Stabilisation Scheme (MSS). Though all the tools have been used either singly or in combination with other tools to manage sterilisation operations, the MSS remains the most heavily preferred tool in times of large capital inflows. Under the MSS, the Government issues marketable securities that are similar in all respects to other marketable securities issued under the Government's market borrowing programme. The money withdrawn from the system is kept in a separate identifiable cash account that the Government maintains with Reserve Bank of India. The money so collected is not available to the Government for its usual expenses. The cash balances held under the MSS can be utilised only for redemption of maturing securities under the MSS, whereas the periodic coupon payments for the securities issued under the MSS are provided for separately in the Government's annual budget.

Conclusion

India's exchange rate policy framework has not undergone any major change in recent times despite having run a large current account deficit for years now. This has been true since 1993, when India moved to a market-determined exchange rate system. The rupee's exchange rate against other currencies is determined largely by the market forces of demand and supply. The Reserve Bank of India intervenes occasionally to maintain orderly conditions in the market by curbing excessive volatility. India's forex reserves provide a cushion at times of sudden capital flow reversals. On most of the parameters generally used for measuring the adequacy of reserves, India's reserves have fallen in recent times. Structurally current account deficit countries like India have been depending on capital flows, which may often be highly volatile. Hence, for financing the current account deficit, there may be a case for augmenting the forex reserves as and when the situation permits, without any particular bias related to exchange rate movements.

Box 1

Recent measures taken to augment capital flows

Measures aimed at augmenting capital flows

Investments

- Policies relating to FII investment in Government securities (G-sec) and long-term infrastructure bonds have been revised.
- The non-resident investor base has been broadened to include long-term investors like foreign central banks, sovereign wealth funds, pension funds, etc.
- Investment limits for FIIs in G-sec and corporate bonds have been increased to US$25 billion and US$50 billion respectively.
- Qualified Foreign Investors (QFIs) have been allowed to invest in equity shares of Indian companies and corporate debt securities on a repatriation basis.

Non-resident deposits

- Interest rate ceilings on non-resident rupee deposits (NRE/NRO accounts) and NRO accounts have been deregulated, and the interest rate ceilings on non-resident foreign currency (FCNR (B)) deposits have been revised upwards.

External Commercial Borrowings

- The all-in-cost ceiling for ECBs has been rationalized.
- It has been mandated that ECB proceeds meant for rupee expenditure must be brought into India.

Others

- Guidelines related to Exchange Earners' Foreign Currency (EEFC) accounts have been rationalized to enhance short term forex inflows.

Measures aimed at curbing speculative behaviour by market participants

- Rebooking of cancelled forward contracts involving the rupee booked by residents to hedge transactions has not been permitted.
  - Since July 2012, exporters have been allowed to cancel and rebook 25 per cent of the total contracts booked for hedging their export exposure.
- The facility for importers availing themselves of the past performance facility was reduced to 25 per cent of the average of actual import/export turnover of the previous three financial years or the actual import/export turnover of the previous year, whichever is higher.
  - All forward contracts are mandated to be structured on a fully deliverable basis.
- Transactions undertaken by Authorised Dealers (ADs) on behalf of clients are for actual remittances/delivery only and cannot be cancelled/cash settled.
- Rebooking of cancelled forward contracts booked by FIIs is not permitted.
  - The forward contracts may, however, be rolled over on or before maturity.
- The Net Overnight Open Position Limits (NOOPL) and intra-day open position/daylight limit of AD banks has been reduced.
  - Some of the above measures have been relaxed subsequently for the genuine hedging requirements of the real sector and to smooth liquidity pressure in the market.
- Positions taken by banks in currency futures/options cannot be offset by undertaking positions in the OTC market.
- The NOOPL of the banks as applicable to the positions involving the rupee as one of the currencies would not include positions taken by banks on the exchanges.

Indonesia: stabilizing the exchange rate along its fundamental

Perry Warjiyo[1]

Abstract

For a small open economy like Indonesia, exchange rate movement does not always reflect fundamental value. Increasing exchange rate volatility often occurs as a result of volatile capital flows, irrational behaviour of market players, the microstructure conditions of the market, and offshore market influence. In this case, relying solely on interest rate policy to achieve the inflation target and maintain stability is not always sufficient. Our strategy is to include exchange rate policy in the monetary and macroprudential policy mix consisting of five policy instruments, i.e. interest rate policy, exchange rate policy, management of capital flows, macroprudential policy, and monetary policy communication. Under this framework, foreign exchange intervention is implemented with the primary motivation of stabilizing the exchange rate along its fundamental path and maintaining financial system stability. In the case of Indonesia, the intervention has been able to reduce the inflation pass-through effects of rupiah depreciation due to a recent period of capital outflows and current account deficit. The central bank also performed dual interventions in both the foreign exchange and bond markets to support financial system stability.

Keywords: exchange rate, monetary policy, central banking, open economy macroeconomics

JEL classification: E52, E58, F31, F41

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A. Exchange rate policy under inflation targeting

Under the standard inflation targeting framework, interest rate response is the main instrument to achieve the inflation target. A fully flexible exchange rate is usually adopted as a shock absorber for external shocks to the domestic economy. The monetary response to the pass-through effects of the exchange rate on the domestic economy, including achievement of the inflation target, is based primarily on interest rate policy.

For a small open economy like Indonesia, however, exchange rate movement does not always reflect fundamental value. This is particularly so since the onset of global crisis in 2008. Volatile capital flows, increasing risk appetite among global investors, and news on the progress of crisis resolution in the advanced countries may give rise to increasing exchange rate volatility beyond the fundamental. Exchange rate overshooting is often amplified by a relatively shallow and inefficient domestic foreign exchange market. Excessive exchange rate movement has detrimental impact on the domestic economy as well as on monetary and financial stability, and thus, managing the exchange rate cannot be based solely on manipulating interest rates.

Under these circumstances, Indonesia regards exchange rate policy as an integral part of an overall monetary and macroprudential policy mix designed to achieve price stability while paying due attention to economic growth as well as monetary and financial system stability. The general thrust of the policy is to stabilize the exchange rate along its fundamental. Operationally, this involves a number of steps. First, a methodology is developed to assess a number of options for determining a fundamental level of the exchange rate that is consistent with the objective of managing the external and internal balances.[2] Second, a simulation is conducted to assess how consistent the path of the exchange rate's fundamental is with the inflation and macroeconomic forecast, as part of the inflation targeting exercise. Finally, decisions are made with regard to the interest rate response and corresponding exchange rate path that are consistent with the objective of achieving the inflation target.

Thus, under the framework, the monetary and macroprudential policy mix consists of the following five policy instruments. First, the ***interest rate policy*** is the main instrument to achieve the inflation target in the context of the forecasting and policy analysis described above. The decision on the policy rate, i.e. the BI rate, is made so as to ensure that the inflation forecast over the policy horizon (two years ahead) will fall within the inflation target range (4.5%±1% for 2013 and 2014). Second, the ***exchange rate policy*** is geared toward maintaining the stability of exchange rate along the chosen fundamental path that is consistent with the inflation and macroeconomic forecast over the policy horizon. The volatility of day-to-day exchange rate movements along the chosen fundamental path is smoothed out by symmetric foreign exchange intervention.

[2] A number of methods are available to assess the fundamental level of the exchange rate, including those developed by the IMF (the CGER and Macroeconomic Balance). Nonetheless, due to the uncertainties involving these fundamental exchange rate levels, judgment is needed to decide which exchange rate path is consistent with the objective of price stability, given the macroeconomic forecast over the policy horizon.

Third, ***management of capital flows***, especially short-term and volatile flows, is conducted to help stabilize the exchange rate as well as mitigate the risks of capital reversal and financial system instability. This has involved a number of macroprudential measures consistent with the principles of a free foreign exchange system, e.g. applying a six-month holding period for BI's certificates, limits on short-term bank offshore borrowing, and foreign exchange reserve requirements.

Fourth, ***macroprudential policy*** is formulated to ensure financial system stability and support the management of domestic demand in line with the overall inflation and macroeconomic forecast. The objective here is to strengthen the resilience of the financial system, including its ability to withstand exchange rate risk, to mitigate the pro-cyclicality of the intermediation function, and to enhance the efficiency of the financial system. A number of macroprudential measures have been used in this context, including the application of a loan-to-value ratio to contain excessive lending in the real estate and automotive sectors.

Finally, ***monetary policy communication*** is continuously conducted to manage expectations so that they are in line with the inflation and macroeconomic forecast. This is important not only for transparency, but even more importantly to foster more forward-looking expectations and thus strengthen monetary policy responses.

B. Foreign exchange intervention: motivation and tactics

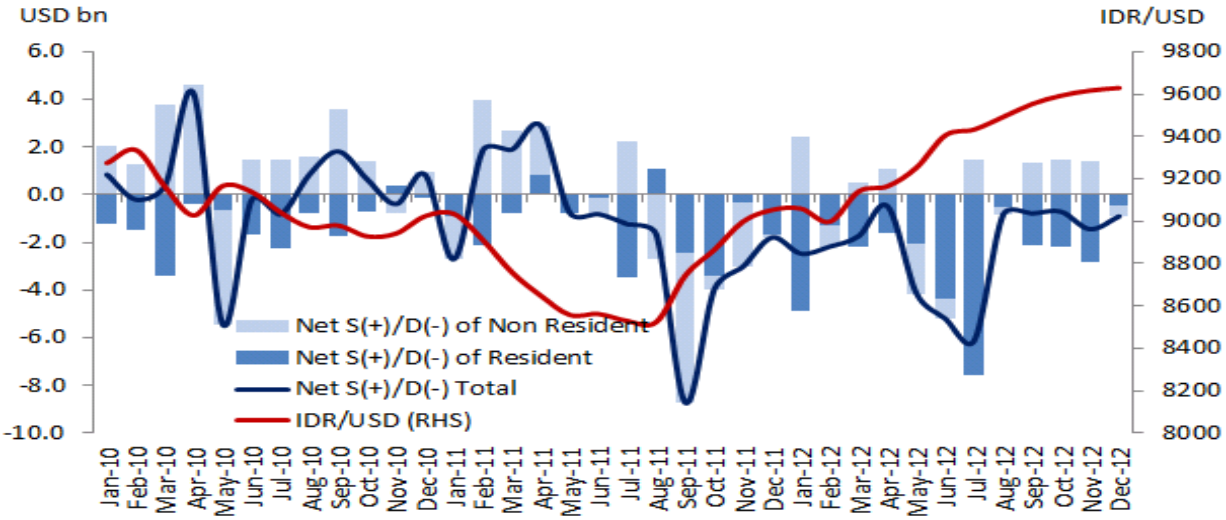
As an element of the implementation of overall monetary and macroprudential policy, the primary motivation of foreign exchange intervention is to stabilize the exchange rate along its fundamental path. The emphasis is more on supporting price stability and financial system stability than on maintaining external competitiveness. Thus, with current account surpluses and sizable capital inflows during the period from the onset of the global crisis up to August 2011, the rupiah appreciated by as much as 14.9% in 2009, then by 4.6% in 2010 and 5.4% up to August 2011 – an appreciation helpful in mitigating imported inflation due to high global commodity prices during the period.

The situation was reversed as the global crisis worsened in September 2011 with the downgrading of the US ratings and the aggravation of the Greek crisis. The immediate impacts took the form of huge capital outflows from Indonesia. Heavy pressures led to exchange rate overshooting, threatening overall macroeconomic and financial system stability as well as the momentum of economic growth. Even though capital inflows resumed in 2012 as the global financial market improved, pressures on the exchange rate continued as the current account went into deficit territory with declining global commodity prices. Overall, the rupiah depreciated 6.9% from August to December 2011, and 6.6% in 2012. Graph 1 depicts the supply-demand situation in the foreign exchange market, while Graph 2 shows the corresponding path and volatility of the rupiah exchange rate.

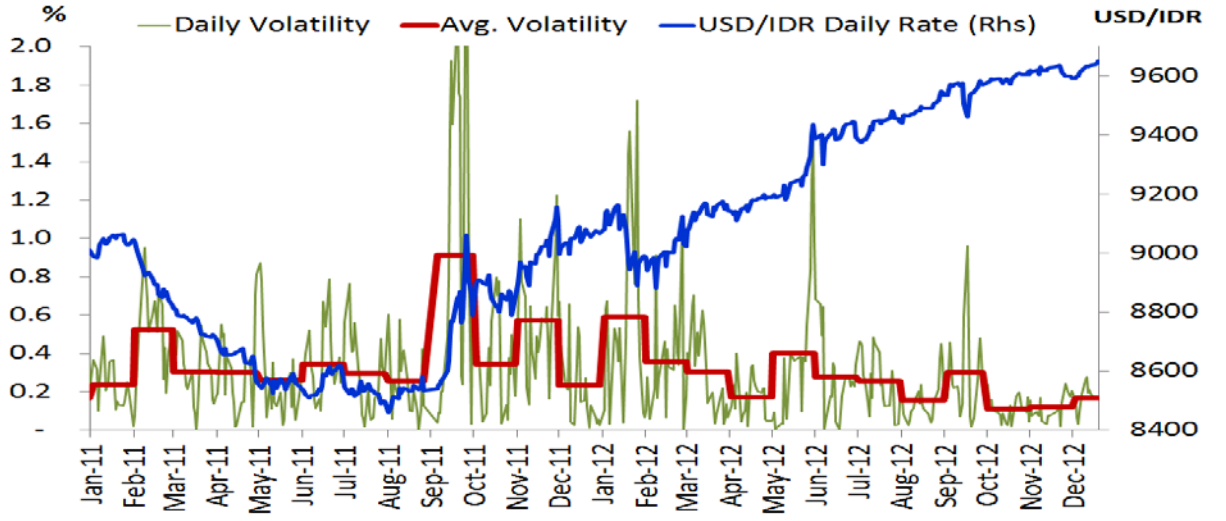
Experience in Indonesia shows that understanding the behaviour of international investors is important for the conduct of foreign exchange intervention, given the effect of that behaviour on the nature and size of capital flows as well as exchange rate movements. Two aspects need to be considered. First, types of international investors, i.e. whether they are hedge fund or long-term investors. Hedge fund investors are typically short-term operators looking for

currency gain (carry trade), and thus often provoke volatility in the capital flows and exchange rate. Long-term investors seek higher yield (interest and capital gains) based on economic fundamentals, and thus they are more stable in their behaviour as regards capital flows and exchange rates.

FX market supply-demand — Graph 1



Rupiah exchange rate — Graph 2



Second, the nature of factors that affect changes in the behaviour of international investors, i.e. whether they are of global or domestic origin, also matters. The origin of the factors does not matter to hedge funds, and any news affecting currency gain may influence their portfolio decisions. On the other hand, the portfolio decisions of long-term investors, as long as they have confidence in the country's economic fundamentals, are not easily affected by any short-term or technical news that influences exchange rate movements.

We are able to study these international investors' behaviour closely, since the central bank functions include custody, settlement and sub-registry of government

bond transactions in the secondary market. The focus is to provide a climate that is attractive to long-term investors. The policy objective of stabilizing the exchange rate along its fundamental serves this type of international investor well. We complement the conduct of foreign exchange intervention with active communication to international investors through our Investor Relation Unit (IRU), e.g. by teleconferencing, meetings, seminars, and our website's continuous updates on recent economic developments and other information.

Tactically, foreign exchange intervention is conducted through agent banks to buy and sell foreign currency (mostly US dollars) depending on excess supply or demand conditions in the market. The aim is to smooth out the volatility of exchange rate movements along the chosen fundamental path. Most transactions are spot, but the central bank is also conducting swap and forward transactions as the bank's needs and foreign exchange liquidity conditions dictate. Since mid-2012, the central bank is also offering foreign exchange term deposits (through weekly auctions) to those banks that are experiencing a temporary excess of foreign exchange liquidity.

The conduct of foreign exchange intervention is integrated with domestic-currency monetary operations to ensure that any impact on domestic liquidity is managed and is consistent with supporting the interest rate policy (sterilized intervention). During periods of heavy appreciatory pressure on the rupiah, the expansion of domestic liquidity from the purchase of foreign exchange to stabilize the exchange rate is absorbed through domestic monetary operations providing more domestic currency term deposits, reverse repo operations using government bonds, and the deposit facility. And the opposite is true when the rupiah faces downward pressures. This sterilized intervention is designed to ensure that the objectives of maintaining price stability, exchange rate stability and financial system stability can be attained.

Since September 2011, particularly during heavy capital outflows, the central bank's foreign exchange intervention has been strengthened by the purchase of government bonds in the secondary market. During these periods, in addition to stabilizing the exchange rate along the fundamental, more intervention by the central bank to supply foreign exchange was needed to provide for the increasing demand from foreign investors who wanted to reverse their Indonesian portfolio investments (mostly in the form of their holdings of government bonds). Central bank purchases of government bonds in the secondary market actually serve a number of purposes. First, such purchasing supports the foreign exchange intervention to stabilize the exchange rate, since it directly addresses the root cause of depreciation pressure, namely, reversals of foreign portfolio investments in government bonds. Second, the purchase of government bonds acts to recycle back into the financial system the domestic currency liquidity that was absorbed by foreign exchange intervention, so that it is consistent with the overall objective of the domestic monetary operations. Third, the operation is also consistent with the central bank's goal of employing government bonds, in preference to its own bills, as monetary instruments. And finally, the dual intervention in both foreign exchange and bond markets helps strengthen overall financial system stability by keeping two of the three financial markets stable.

C. Effectiveness of foreign exchange intervention

To assess the effectiveness of foreign exchange intervention, one could examine a number of aspects that are in line with the central bank's overall objective of maintaining price stability as well as monetary and financial system stability. First, there is the question of what the objective of the exchange rate policy is – merely smoothing volatility, or also managing the path of exchange rate movement, gaining the ability to influence exchange rate expectations, and other things. Second, there is the matter of the depth and behaviour of the microstructure of the foreign exchange market, e.g. the number of players, volume of transactions, availability and variety of financial instruments, liquidity conditions and distribution across players, counter-party risks, and the infrastructure needed for efficient market functioning. The other aspect that is often important for the effectiveness of foreign exchange intervention is the adequacy of international reserves relative to the depth of the markets and the country's external vulnerability. In general, the more reserves there are, the more effective foreign exchange intervention will be.

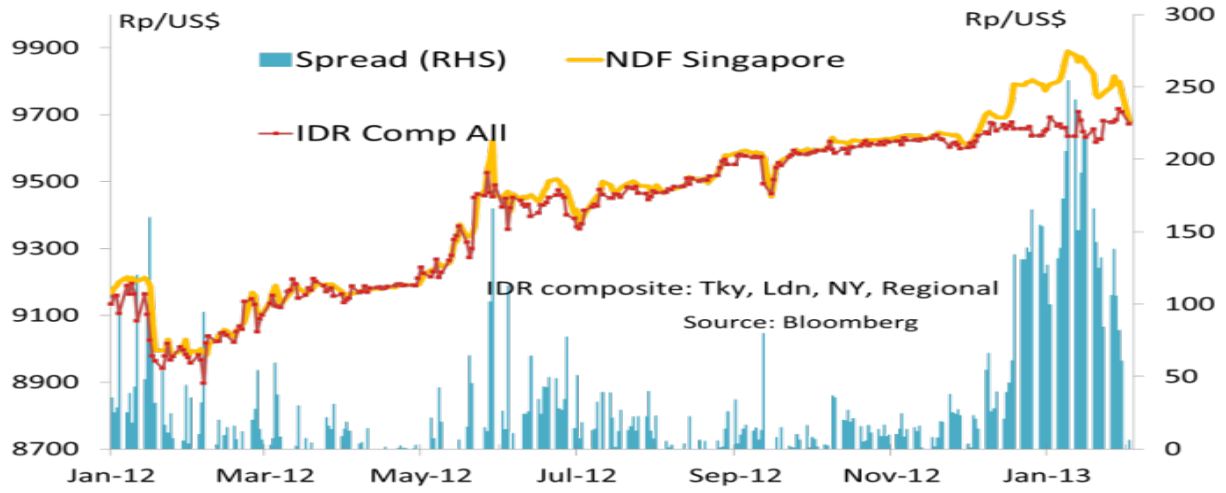
In Indonesia's case, we view exchange rate movement as not always reflecting the economic fundamentals, let alone being consistent with the overall objective of achieving price stability and supporting financial system stability. Exchange rate overshooting occurs because of a number of factors, e.g. volatile capital flows, irrational behaviour of market players, and the microstructure conditions of the market, as well as influence from offshore markets. Thus, as stated above, the objective of foreign exchange intervention is to stabilize the exchange rate along its fundamental path. And judging from the perspective of this objective, the intervention conducted has proven able to manage the exchange rate volatility and ensure a path that is consistent with achieving the inflation target and supporting financial stability. Over the more medium term, the rupiah gradually appreciated during the period up to August 2011 and has been gradually depreciating since, reflecting overall macroeconomic developments during these two episodes in the Indonesian economy.

From the short-term perspective, the effectiveness of intervention in influencing exchange rate expectations is more difficult to assess, since the exchange rate is more susceptible to news developments and market reactions to them. In general, when market reactions are not excessive, supply and demand in the market in most cases can balance each other, and intervention may be more effective in influencing both the spot and forward exchange markets if it is used to deal with any remaining excess demand or supply in the market. Information on the distribution of spot quotations and forward forecasts among market players could be used as input when conducting intervention.

However, when news and market reactions are erratic, these two distributions tend to widen, and even their central tendencies tend to diverge from the central bank's view on where the fundamental exchange rate path should be. The spread between offshore and onshore exchange rates also tends to widen. An example is what happened to the rupiah early this year, when the news included a number of negative items, including widening current account deficits, the issue of increasing fuel subsidy burdens and fiscal sustainability, and worries about foreign exchange liquidity in the domestic market. The spread between offshore and onshore forward rates widened to as much as RP 275 or about 2.8 percent of the RP 9650 per US dollar exchange rate at that time (Graph 3). The spread is closing at present, as the

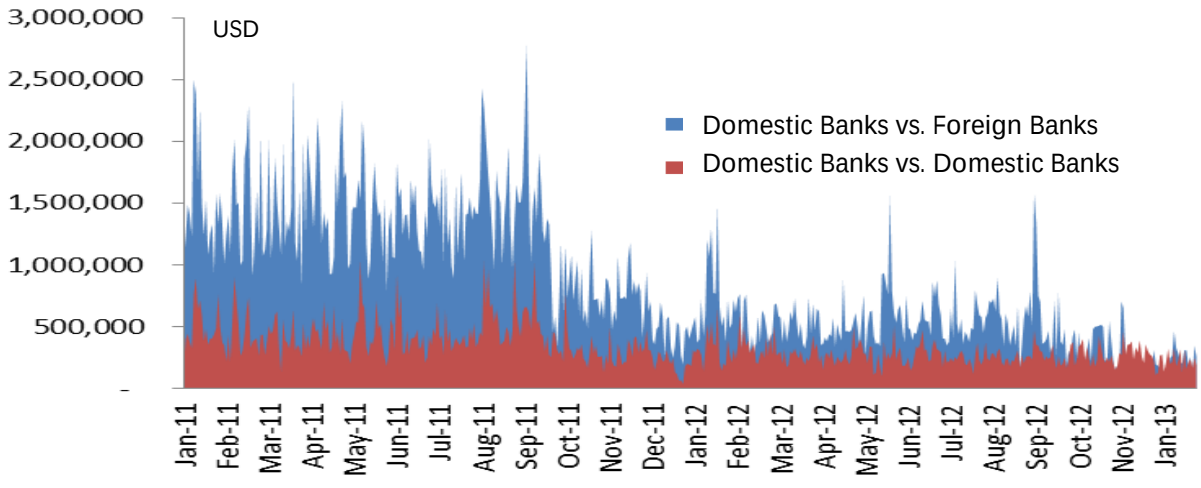
central bank intensifies its efforts to supply foreign exchange to the market and its communications on the balance of payments situation.

Exchange rate: onshore vs. NDF — Graph 3



The microstructure of the domestic foreign exchange market also influences the effectiveness of intervention. Even though there are 72 foreign exchange banks in Indonesia, only about 22 to 38 banks actively trade in the foreign exchange market. Domestic state-owned banks constantly supply foreign exchange, while foreign banks' supply or demand depends on capital inflow/outflow. The volume of transactions is relatively small, and it tends to be larger during periods of heavy portfolio inflows (up to August 2011) but lower afterwards (Graph 4). Most transactions are spot, although forward transactions are developing. There are counter-party transaction limits, especially for smaller banks. Foreign exchange transactions must have underlyings and are limited to domestic players only.

Volume of FX transactions — Graph 4



Under these conditions, rupiah exchange rate movements are prone to changes in perceptions and market conditions, both domestically and offshore. On one hand, the thinness of the market makes the banks heavily dependent on the central bank to absorb any excess supply in the market (during current account surplus and/or large capital inflow periods) and to supply any excess demand in the market (during current account deficit and/or capital outflow periods). Thus, the adequacy of foreign exchange reserves will increase the effectiveness of intervention, and for that reason it needs to be continuously assessed in relation to current balance of payments dynamics. On the other hand, the effectiveness of intervention will also depend on the central bank's ability to influence market expectations, since short-term exchange rate movements are susceptible to any change in perceptions under these microstructure conditions.

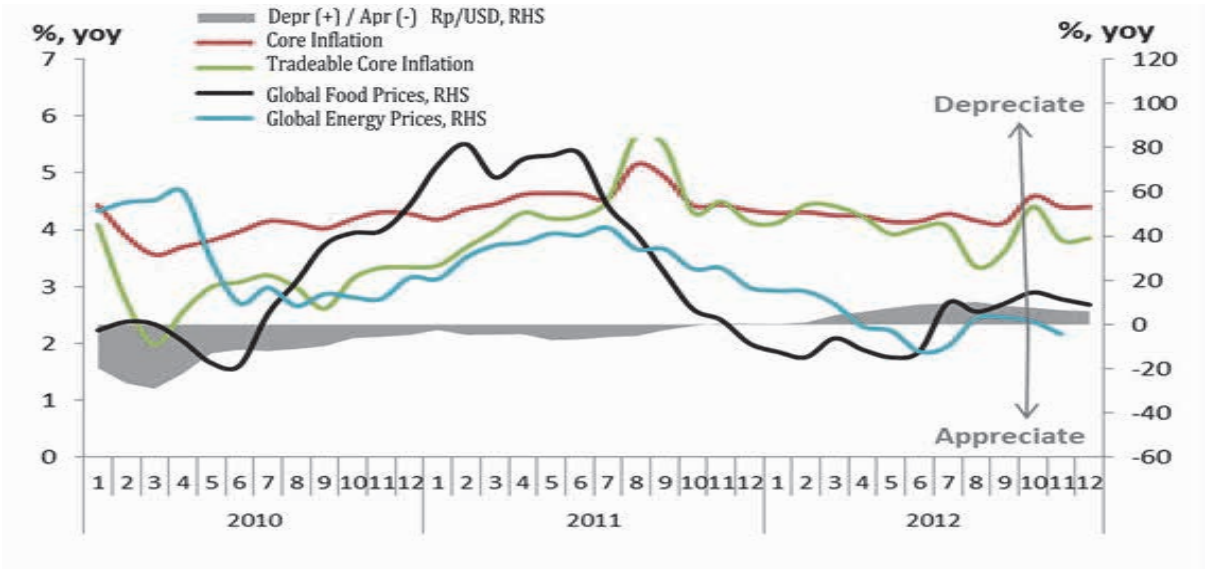
The foregoing discussion points to the need for complementing foreign exchange intervention with other policies that are designed to manage the volatility of capital flows and deepen the domestic market. For that reason, as discussed earlier, a number of policies have been put in place in Indonesia to manage short-term and volatile capital flows, e.g. a holding period for investment in the central bank bills, limits on short-term offshore borrowing, etc. Capital flow management is guided by the following three principles. First, it must be consistent with principles regarding the foreign exchange system. The prudential measures for managing capital flows apply to both residents and non-residents, and thus they are not regarded as capital controls. Second, we welcome long-term capital flows that benefit the economy, and thus our measures target short-term and speculative capital flows. Third, the measures are designed so that they can be monitored and implemented effectively.

To increase the supply of foreign exchange in the market, a regulation has been issued requiring that foreign exchange receipts from exports and offshore borrowing be repatriated to domestic banks. Continuous efforts have also been directed toward deepening the domestic foreign exchange market to include offering foreign exchange term deposits, and toward relaxing forward transactions. The most recent measure in this area is the establishment of a market reference rate for onshore foreign exchange transactions, including forward transactions, thus limiting the impact of the offshore NDF rate on the domestic market.

D. Impacts on price stability and financial system stability

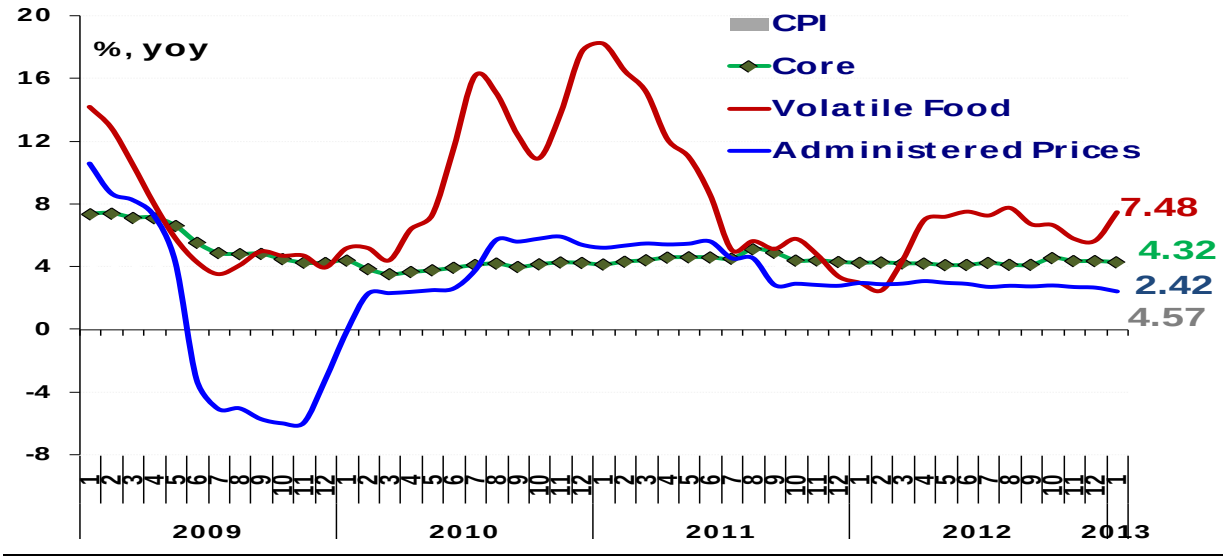
As explained in the first part of this paper, the success of foreign exchange intervention in Indonesia will be judged on its contribution to achieving the inflation target and supporting financial system stability. As to the former goal, exchange rate policy should be able to reduce inflation pressures stemming from foreign commodity prices (imported inflation). Thus, rupiah exchange appreciation in 2009, 2010, and 2011 (up to August) helped to reduce imported inflation during these periods of high commodity prices. This was made possible by a sizable balance of payments surplus due to both the current account surplus and huge capital inflows during the period. Subsequently, the policy has been able to reduce the inflation pass-through effects of rupiah depreciation due to capital outflows and a current account deficit. The decline in global commodity prices since 2012 was helpful to the policy. In 2012, for example, the rupiah depreciation of about 6.6% in nominal terms was less than the decline of Indonesian external commodity prices, which was roughly 14.7%.

Exchange rate, global commodity prices and core inflation Graph 5



Graph 5 depicts developments in the exchange rate, global commodity prices, and core inflation, while Graph 6 breaks CPI inflation down into core inflation, volatile food prices, and administered prices. During the first episode, nominal rupiah appreciation was able to mitigate the impact of high global commodity prices on tradeable core inflation. Subsequently, depreciation of the rupiah has not had significant pass-through effects on tradeable core inflation, as it coincided with the decline in global commodity prices. In most cases, core inflation can be maintained below 4.50% and plays a significant role in the efforts of the central bank to achieve the inflation target. CPI inflation declined from 6.96% in 2010 to 3.79% in 2011 (inflation target 5%±1%) and to 4.32% in 2012 (inflation target 4.5%±1%).

Inflation: CPI, core, volatile food, administered prices Graph 6

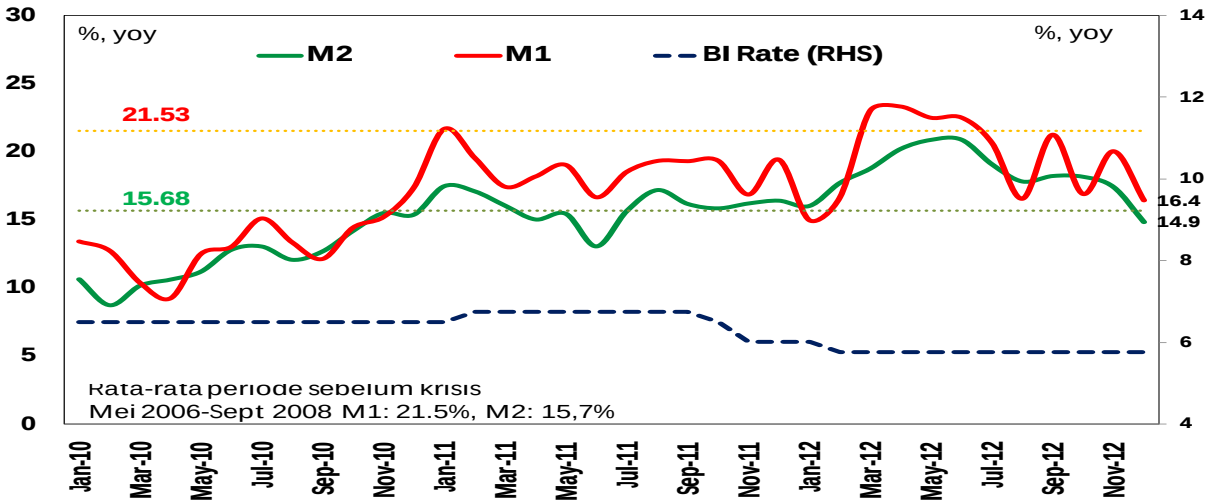


As to supporting financial system stability, this has been managed through dual interventions of the central bank in both the foreign exchange and bond markets. Not only can exchange rate stability thus be maintained, but also the dual intervention has been able to ensure that domestic liquidity is sufficient and consistent with managing monetary and financial system stability. This is in contrast to what happened in 2008, when heavy foreign exchange intervention to defend the rupiah from the impacts of the global crisis caused a shortage of domestic liquidity and put pressures on conditions for banks, especially smaller banks. Furthermore, as discussed above, central bank purchases of government bonds in the secondary market have been able to address the root cause of exchange rate pressures and helped to stabilize the financial markets.

Graph 7 shows the evolution of the monetary policy rate (BI rate) and monetary aggregates. With the help of exchange rate policy geared toward stabilizing the rupiah along its fundamental path and managing imported inflation, the BI rate can be consistently designed to control inflation so that it falls within the target. Monetary operations are conducted to manage domestic liquidity consistent with the interest rate policy, as shown in the evolution of monetary aggregates, which reflect the economy's liquidity conditions. Graph 8 depicts the downward shift in the yield structure of government bonds, in line with inflation that was under control, and the decline in the policy rate. Foreign ownership of government bonds is also stable at about 30% of the outstanding amount, and there has been a shift toward longer-term maturity.

Interest policy rate and monetary aggregates

Graph 7

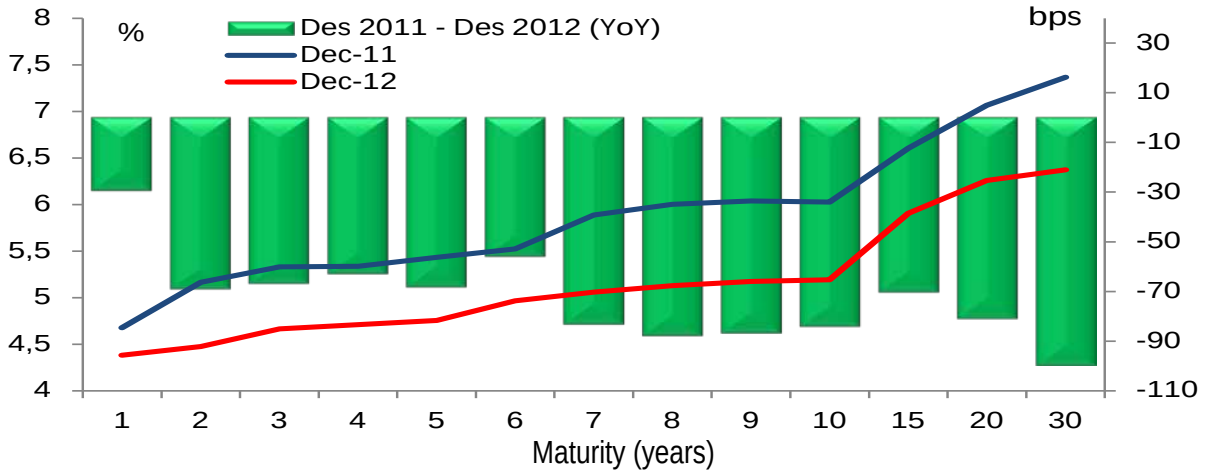


In summary, exchange rate policy in Indonesia is geared toward price stability and financial system stability. The main motivation of foreign exchange intervention is to stabilize the exchange rate along its fundamental, consistent with these objectives. Tactically, this has been done through dual intervention: in the foreign exchange market in addition to the central bank's operations in the secondary government bond market. The policy has been strengthened with other measures

to manage short-term and volatile capital flows, with macroprudential policies, and with on-going efforts to deepen domestic financial markets.

Term structure of government bond yield

Graph 8



Rethinking exchange rate policy in a small open economy: the Israeli experience during the great recession

Karnit Flug and Amir Shpitzer[1]

Abstract

In this paper we describe and analyze the intervention by the Bank of Israel (BOI) in the foreign exchange market during 2008-11. The purchases started in March 2008 with a fixed daily amount of $25 million, and were increased in July to a daily amount of $100 million. In August 2009, the BOI announced that it would cease to purchase a fixed daily amount, but that it could intervene in case of fluctuations in the exchange rate that it judged to be inconsistent with fundamental economic forces. Thus, between August 2009 and July 2011, the BOI occasionally purchased foreign exchange. The initial motivation was the assessment that the foreign exchange reserves needed to be increased. The timing was chosen following a period of rapid appreciation deemed inconsistent with Israeli economic fundamentals. The continued intervention during the recession was aimed at offsetting the forces for appreciation against the background of a sharp drop in demand for Israeli exports. We show that the intervention moderated the over-appreciation of the shekel during part of the period, and thus helped mitigate the negative effects of the global crisis on Israeli exports and growth. The experience of Israel and other economies also supports the upward revision of the level of reserves that is considered adequate.

Keywords: foreign exchange intervention, foreign exchange reserves, exchange rate

JEL classification: F31, E58

[1] Bank of Israel.

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Introduction

Following 10 years without intervention in the foreign exchange market, the Bank of Israel (BOI) began to purchase foreign exchange in March 2008 – on the eve of the global crisis – and continued purchasing until July 2011. The purchases started with a modest fixed daily amount of $25 million, and then increased to a daily amount of $100 million. In August 2009, the BOI announced that it would cease to purchase a fixed daily amount of foreign exchange, but that it could intervene in the market in case of fluctuations in the exchange rate that it judged to be inconsistent with fundamental economic forces. Thus, between August 2009 and July 2011, the BOI continued to occasionally purchase foreign exchange. Since July 2011, the BOI has not intervened in the foreign exchange market.

The initial motivation for the foreign exchange purchases was the assessment that the level of foreign exchange reserves was inadequate and needed to be increased. The timing was chosen following a period of rapid appreciation deemed inconsistent with Israeli economic fundamentals. The continued intervention during the great recession was aimed at offsetting the forces for appreciation of the NIS against the background of sharp drop in demand for Israeli exports resulting from the sharp drop in world trade. The intervention in the foreign exchange market was estimated to have affected the NIS exchange rate by an average of close to 7% over the period of the fixed daily intervention.[2]

The accumulation of $28.1 billion in reserves brought reserves to 28.6% of GDP by August 2009, the equivalent of about 120% of foreign exchange ST liabilities and about 8 month of imports – levels that the BOI considers to be close to the lower bound of the adequacy range. However, continued concern over upward pressure on the NIS resulting from short term capital inflows, related, at least in part, to the interest rate spread between Israel and the major economies, led the BOI to leave the door open for further intervention following the cessation of the daily purchases.

In this note we review and analyse the intervention by the BOI in the foreign exchange market during 2008–11. We begin by providing some background to the intervention episode by reviewing the evolution of the exchange rate regime in Israel over the past two decades, discussing the adequacy of foreign exchange reserves, and describing the shock experienced by the Israeli economy resulting from the Great Recession. We then describe the various stages of the intervention, move on to discuss the consistency of this policy with evolving international practices and standards, and conclude with an assessment of the intervention's effects on the economy.

[2] Avihay Sorezcky, "Did the Bank of Israel Affect the Exchange Rate", *Discussion Papers – Research Department – Bank of Israel* (September 2010), p.18.

1. Background

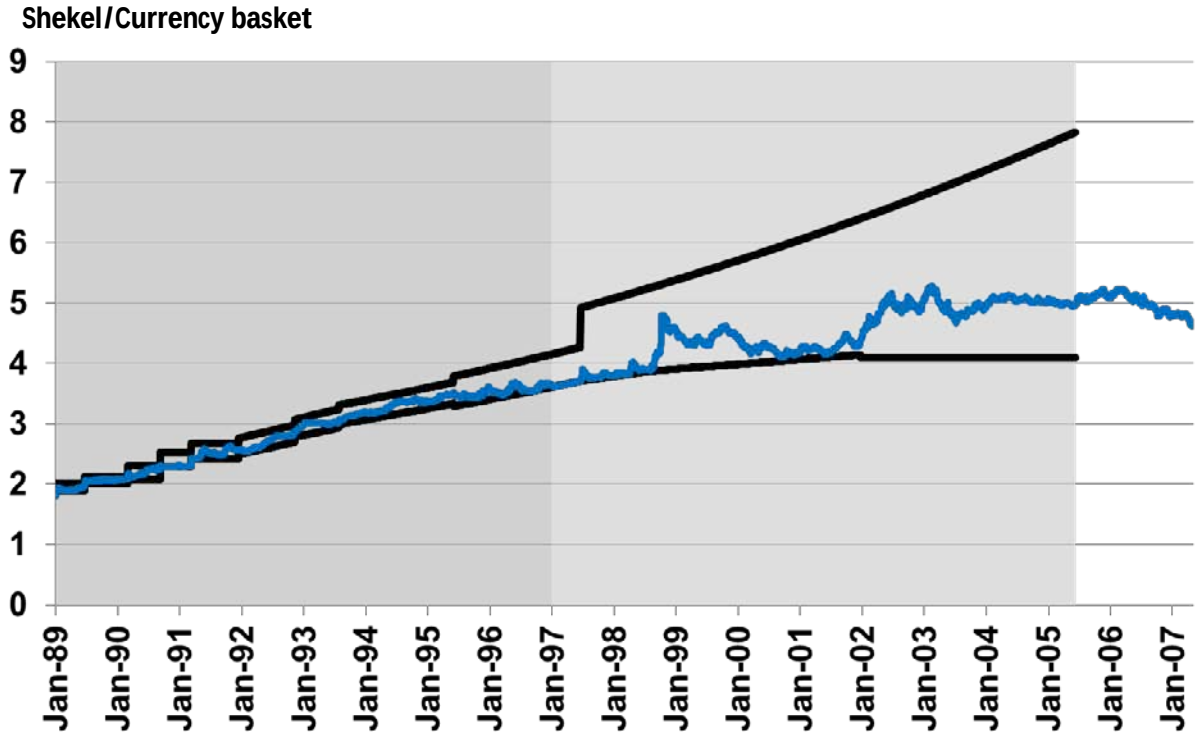
a. The evolution of the foreign exchange regime[3]

The stabilization of the exchange rate of the shekel against the dollar (and later against a currency basket) was a cornerstone of the 1985 stabilization program of the Israeli economy. When the program was launched, it was initially hoped that stabilizing the exchange rate would lower inflation to Western levels. However, the inflation rate continued to be relatively high, and with time a cumulative real appreciation necessitated rate adjustments.

At the beginning of 1992, the exchange rate regime was changed to an upward sloping exchange rate band. At the same time the BOI began to announce inflation targets. From the end of 1994, the BOI began to use the interest rate as the main monetary policy tool for attaining the inflation targets. Initially, the BOI continued to intervene in the foreign exchange market in order to keep the exchange rate along the midpoint of the sloping band. However, the high interest rates that were needed to support disinflation led to substantial capital imports during 1995 and 1996 that pushed the exchange rate down towards the lower limit of the band.

The exchange rate regime in Israel

(1989-2007) Figure 1



[3] David Elkayam, "The Long Road from Adjustable Peg to Flexible Exchange Rate Regimes: The Case of Israel", *Monetary Studies – Discussion Papers*, (November 2003), pp. 1–14.

At the beginning of 1996, the BOI announced that it would no longer intervene in the foreign exchange market unless the exchange rate approached the limits of the band. In mid-1997, the upper limit of the band was expanded appreciably, which changed dramatically the risk-reward trade-off for market participants to buy the shekel, and except for a number of days at the beginning of 1998, the BOI completely ceased its intervention in foreign currency trading. From 1998 to 2005, the band expanded considerably, until it was finally abolished in June 2005 (see figure 1). Since then, the exchange rate has floated freely and the BOI did not intervene in the market until March 2008.

b. Adequacy of the level of foreign exchange reserves[4]

The holding of an appropriate level of foreign exchange reserves is considered to be one of the main indicators of a country's economic stability in the eyes of domestic and foreign financial institutions, firms, households and rating agencies. Increasing a country's foreign exchange reserves improves the economy's resilience as it increases the ability of policy makers to deal with shocks. Large foreign exchange reserves also tend to lower the rates of interest that are paid both by the government and by the private sector for financing from abroad. Thus, an appropriate level of reserves is an important factor in determining the resilience of an economy to shocks. As stated by the IMF: "...holding reserves carries a number of benefits compared with available insurance or financing instruments, such as high degree of certainty of immediate availability and international status, including in the eyes of markets and rating agencies... In empirical studies, a higher level of reserves tends to reduce spreads and exchange rate volatility."[5]

The standard approach to assessing the adequacy of the level of foreign exchange reserves in an economy has evolved over the years. Key variables used in this respect are the number of months of imports that the reserves could finance and the ratio of reserves to foreign currency liabilities (public and private sector). The adequate level was at one point defined as the country's foreign currency liabilities for one year (the Greenspan-Guidotti, or 100%, rule).

Following the global crisis, the adequate level of reserves was revised upward to a range of 100–150% of the short term liabilities "for a typical country", according to the IMF, as presented in the paper "Assessing Reserve Adequacy".[6]

The BOI has adopted an approach that assesses the reserves level relative to potential uses: the "Eclectic Approach" – which is based on potential uses of the reserves in a state of emergency. It takes into account both the level of imports and the size of capital flows as relevant factors.

In the period 2000–07, the level of foreign exchange reserves held by the BOI was stable at about 80% of Israel's short term liabilities, but in terms of months of imports it was gradually eroded from 6 to 4 months of imports. This factor, together with the fact that the level of reserves was only 80% of the economy's short term liabilities over the next twelve months and the geopolitical risks Israel faces, led to the conclusion that the level of reserves was less than adequate.

[4] Bank of Israel, Investment of the Foreign Exchange Reserves, *Annual Report,* (2011).

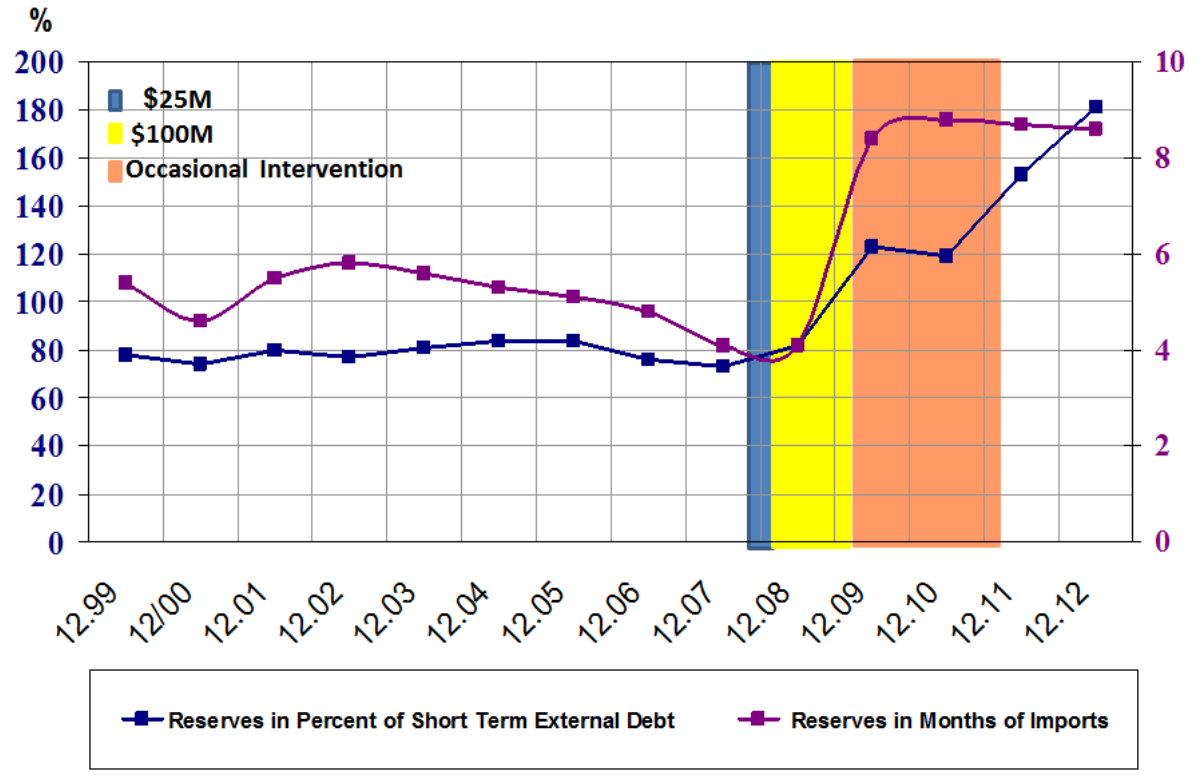
[5] IMF, "The Fund's Mandate – Future Financing Role", (March 2010), p. 10.

[6] IMF, "Assessing Reserve Adequacy", (February 2011), p.13 and p. 27.

During the global crisis that began in 2007, it became clear that countries that held large foreign exchange reserves were better able to handle the crisis. The main examples are Brazil and Russia, each of which held foreign exchange reserves that exceeded 100 percent of their short term foreign currency liabilities. These countries used their reserves effectively to stabilize their exchange rates and/or to maintain financial stability.

Foreign exchange reserves adequacy indicators

Figure 2



In March 2008, the Bank of Israel began purchasing foreign exchange at fixed daily amounts. This policy was first adopted in order to increase the size of the reserves which were considered to be below the appropriate level of $35–40 billion at the time. The Bank's initial plan was to add $10 billion to the reserves over the course of approximately two years (see figure 2).

Subsequent work conducted at the BOI put the adequate level of reserves at $65–90 billion. The upward revision of the level of reserves that is considered adequate was, of course, affected by the experience gained during the global crisis. In August 2009, when reserves reached $57.7 billion – near the lower bound of the adequate level range, and as part of exiting the extraordinary measures taken during the crisis, the BOI announced that it would cease its fixed daily purchases. (On subsequent intervention see section 2.).

c. Israel and the global crisis, 2007–2009[7, 8]

The global crisis hit Israel after five years of rapid growth, which began with the exit from the previous recession in 2001–03, and which was supported by global economic prosperity and growth-oriented macroeconomic policy. The first signs of the global crisis appeared in the financial markets, and at the start these signs were only partial and ambiguous. The financial markets in the second half of 2007 reflected the assessment that the effect of the crisis on the economy would be small relative to advanced economies. This was manifested in share prices, the real appreciation at the end of 2007, the continued flow of foreign investments into Israeli securities, and the repatriation of Israeli foreign investments to Israel. However, tax revenue began to fall in mid-2008, which was one of the earliest signs of a slowdown in real activity.

The situation in Israel, a small open economy, changed dramatically following the bankruptcy of Lehman Brothers, especially during the last quarter of 2008. In the financial markets, stock and corporate bond prices fell sharply and volatility increased significantly, and risk spreads in the credit market rose sharply, thus raising the price of credit. Volatility also increased significantly in the foreign exchange market (against the background of the intervention by the BOI in the foreign exchange market).

The main channel of pass-through from the crisis to the domestic economy was demand for Israel's exports, which decreased sharply due to the collapse of world trade. From the third quarter of 2008 to the first quarter of 2009, total exports of goods and services declined by 20%, matching the rate of decrease in global trade. In addition to the decline in volume, the profitability of Israel's export industries lost ground due to steep currency appreciation in 2007 and early 2008.

By the beginning of the second quarter of 2009, the crisis had passed its peak in Israel. As signs of recovery appeared abroad, a gradual recovery began in Israel, first in the financial markets, and a short time later also in real activity.

2. BOI policy in the period leading up to and during the crisis[9]

The BOI purchased foreign currency on March 13–14, 2008 – after some 10 years of not intervening in the foreign exchange market – due to disorderly markets as identified by certain market indicators (these indicators include intra-day volatility, spreads and nonlinear changes in the exchange rate). On March 13, several of these indicators suggested that the foreign exchange market was trading in a disorderly manner.

[7] Kobi Braude, Zviya Erdman and Merav Shemesh, *Israel and the Global Crisis 2007–09*, ed. by Zvi Eckstein, Stanley Fischer and Karnit Flug (Jerusalem: Bank of Israel, 2011).

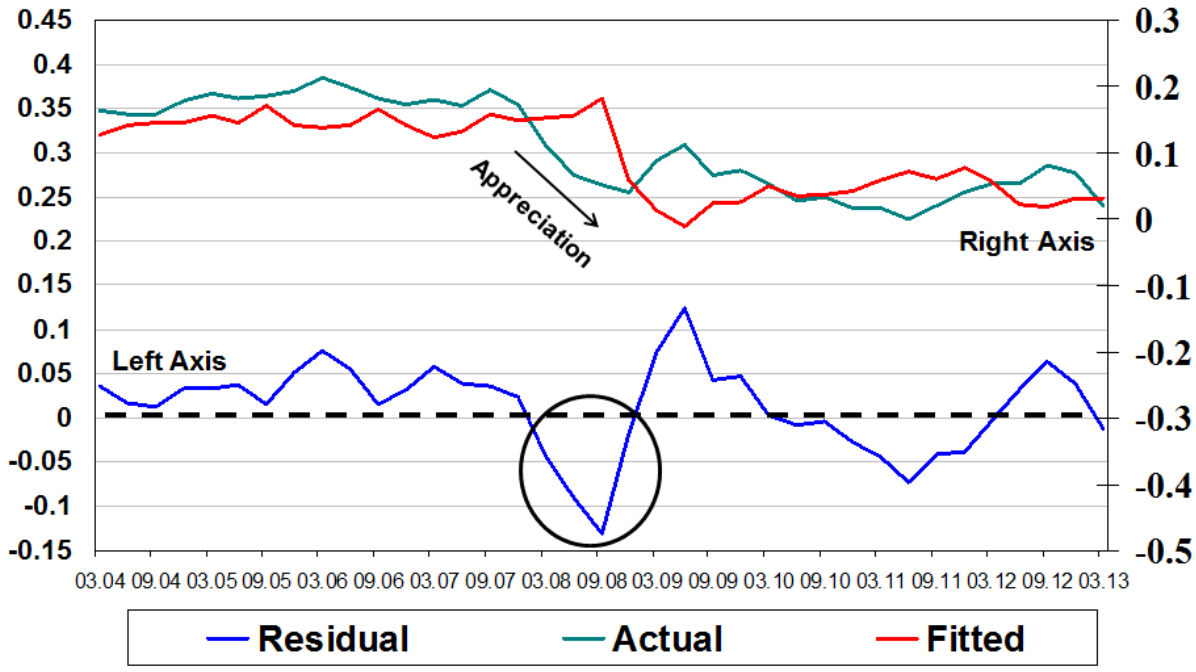
[8] Jacob Braude, "Israel and the Global Crisis: Events, Policy, and Lessons", in *The Great Recession, Lessons for Central Bankers*, ed. by J. Braude, Z. Eckstein, S. Fischer, and K. Flug, (Cambridge: MIT Press, 2012), pp. 307–336.

[9] Kobi Braude, Zviya Erdman and Merav Shemesh, *Israel and the Global Crisis 2007–09*, ed. by Zvi Eckstein, Stanley Fischer and Karnit Flug (Jerusalem: Bank of Israel, 2011).

On March 24, 2008, the BOI began to purchase foreign exchange as part of a program aimed at building up the foreign reserves from $29 billion at the end of February to $35–40 billion. The decision was the implementation of a contingency plan that the Bank had devised several years earlier. The timing of the implementation of this program – beginning in the first quarter of 2008 – was chosen in view of the steep continuing appreciation of the NIS, and the assessment that an overvalued domestic currency would make it hard for the economy to cope with the repercussions of the crisis (see figure 3).

The Equilibrium Real Effective Exchange Rate

2004Q1-2013Q1 Figure 3

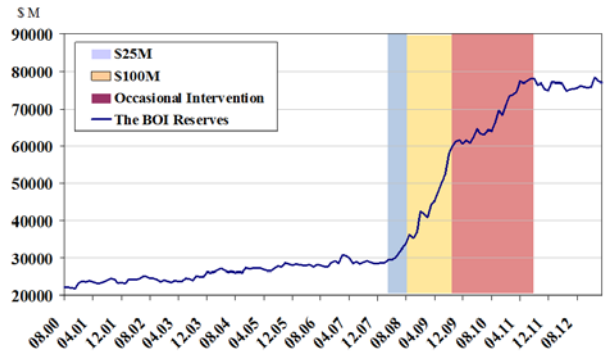


Source: Zvi Eckstein and Amit Friedman, "The equilibrium real exchange rate for Israel", BIS papers, vol. 57, (October 2011).

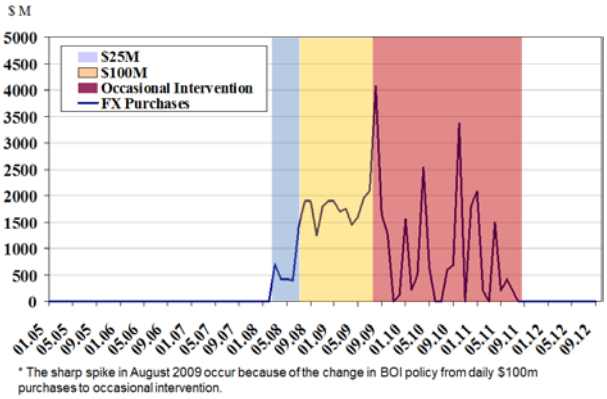
From March 24, 2008 onward, the BOI purchased $25 million in foreign currency daily. From July 2008 onward – against the background of steep NIS appreciation – the bank stepped up its daily purchases to $100 million. In late 2008, the BOI announced that the (updated) desirable level of the reserves was now $40–44 billion, and in March 2009, by which time the reserves had attained the upper limit of this range, it decided to continue buying $100 million daily. This time, due to the prolongation of the global crisis, it didn't set a target for the level of the reserves.

In August 2009, the BOI announced that it would no longer make regular daily purchases. However, it also announced that in cases of unusual exchange rate fluctuations which were incompatible with the economy's fundamentals it could intervene in the market. This policy change was part of the process of gradually withdrawing the exceptional policy measures that the Bank had adopted in response to the crisis (see figure 4).

The Bank of Israel reserves Figure 4a



Foreign exchange purchases Figure 4b



* The sharp spike in August 2009 occur because of the change in BOI policy from daily $100m purchases to occasional intervention.

Source: Bank of Israel

The global crisis increased the awareness of the potential destabilizing effects of short term capital flows. However, continued intervention on a large scale may also be associated with some costs and side-effects. In some cases, domestic markets may not be sufficiently deep to absorb a significant increase in sterilization bonds. Also, there is a fiscal cost associated with the differential between interest paid on domestic bonds and interest earned on reserves. Thus when sterilization possibilities have been exhausted, or the accumulation of further reserves is judged to be too costly, inflows can be reduced through macroeconomic policies or more direct methods (for a discussion of this point see J. Ostry (2012)).[10]

The continued large short term capital inflows during 2010 led the BOI in early 2011 to adopt macro-prudential measures aimed at discouraging such inflows. These included a reporting requirement on activities in the FX derivatives market, and in the *makam* (central bank bills) and short term government bond markets, as well as the imposition of a reserve requirement of 10 percent on FX derivative transactions by nonresidents.[11]

3. The interplay between interest rate policy and foreign exchange market intervention

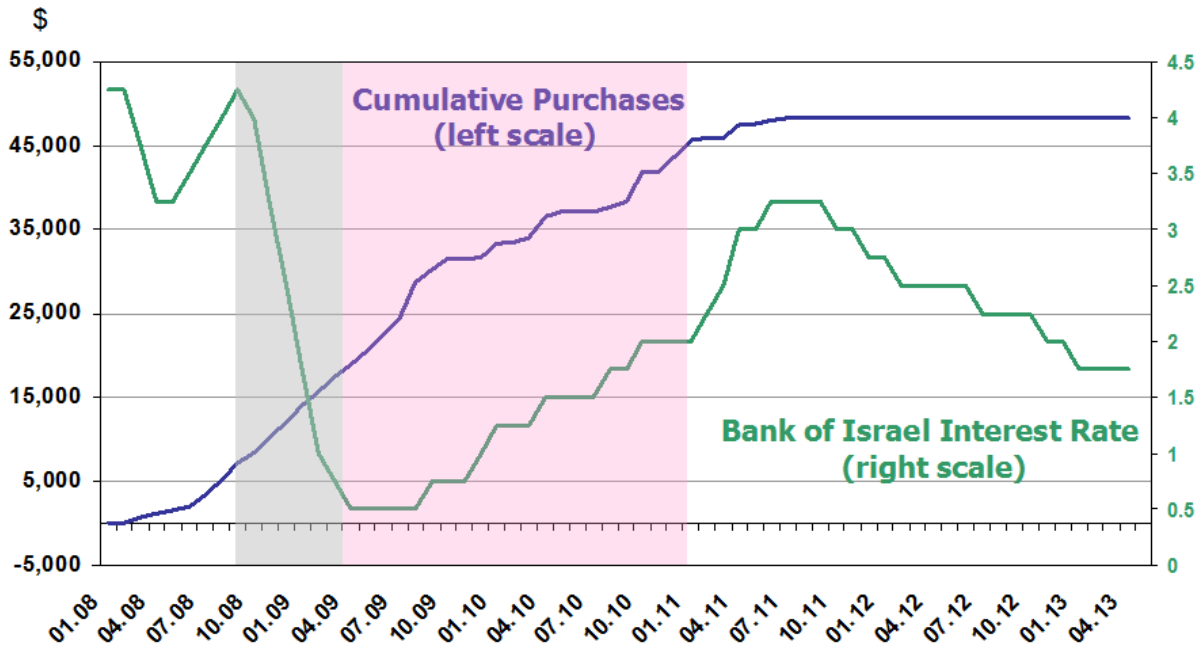
The Israeli experience of intervening in the foreign exchange market in the period leading up to the global crisis, during the crisis, and in the initial phase of recovery can also be looked at from the angle of the use of a set of policy tools. These tools – interest rate and foreign exchange intervention – interacted differently over the cycle (see figure 5). In the period of sliding into a recession and during recession,

[10] Jonathan D. Ostry, "Managing Capital Inflows: Old and New Debates", in *The Great Recession, Lessons for Central Bankers*, ed. by J. Braude, Z. Eckstein, S. Fischer, and K. Flug, (Cambridge: MIT Press, 2012), p. 169.

[11] In addition to the measures taken by the BOI, the tax exemption for foreign residents on interest income from government bonds with maturities of less than thirteen months was cancelled in July 2011, as was the tax exemption on capital gains on those same securities in December 2011.

both policy tools – the sharp reduction of the BOI policy rate, and the purchase of foreign exchange – were enhancing each other in supporting growth, by reducing financing costs and improving competitiveness in the tradable sector.

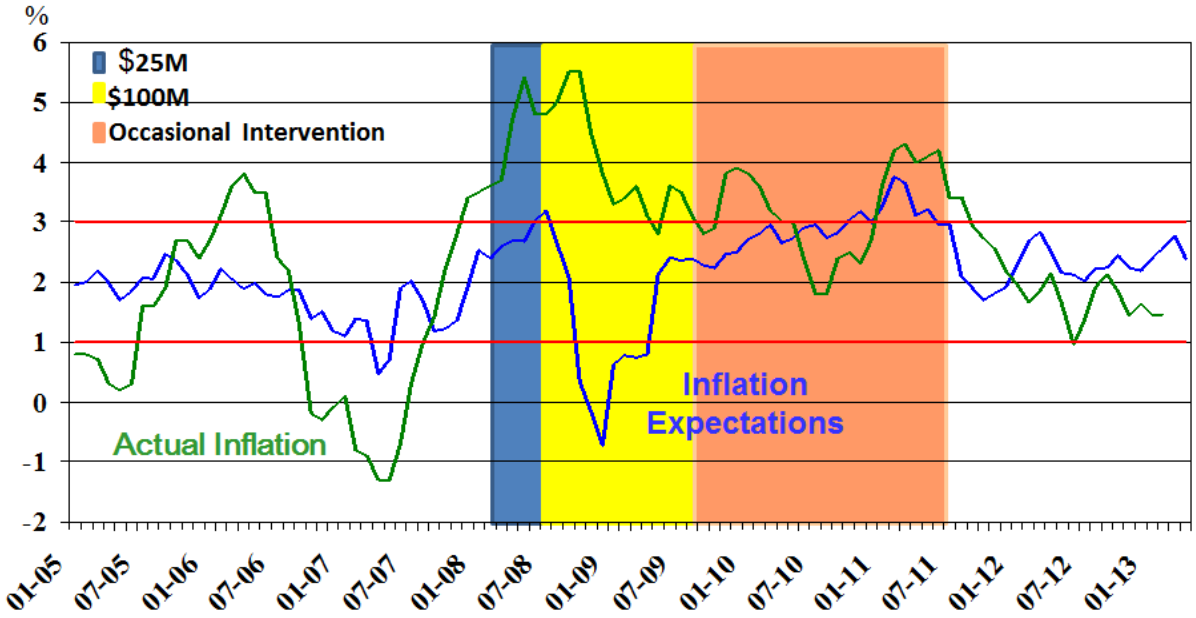
Foreign exchange purchases and Bank of Israel interest rate, 2008-2013 Figure 5



Source: Bank of Israel

Actual Inflation* and Inflation Expectations**

(2005-2013) Figure 6



* Inflation over past 12 months.

**Break-even inflation expectations for 12 months.

During that stage, the inflationary outlook was also for an inflation rate below the lower bound of the inflation target range, and there was even, for a short period, an expected negative inflation over a 12-month horizon. Thus a low policy rate and a more depreciated exchange rate due to intervention also supported bringing inflation up – back into its target range. However, when signs of a recovery (albeit hesitant) became evident, and expected inflation was moving up towards the upper limit of the target range, it was clear that the policy rate needed to be raised (see figure 6). Thus, the BOI started to gradually raise the interest rate. However, during this period short term inflows persisted and led to a persistent upward pressure on the NIS exchange rate. The result was an exchange rate that was rapidly appreciating in a movement that was inconsistent with the economy's fundamentals. Therefore, the BOI continued to intervene in the foreign exchange market.

The intervention in the market, while increasing the interest rate, implies that the transmission of monetary policy through the exchange rate channel was somewhat muted. The burden of the adjustment was to some extent shifted from the export sector to the rest of the economy.

4. Foreign exchange intervention

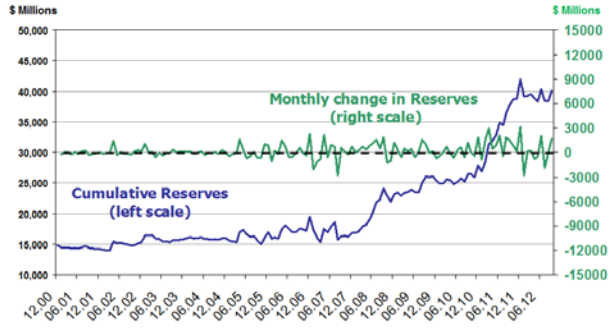
a. International practices[12]

Israel is not unique in having intervened in the foreign exchange market in recent years. While some economies have had a fairly regular presence in the FX market in the years prior to the Great Recession (eg Brazil and Uruguay), others had not been intervening in the market and, like Israel, began to do so following a long period of no intervention (eg Chile, Thailand and Switzerland; see figure 7).

During the crisis and upon emerging from it, foreign exchange intervention was evident in other countries, particularly those that are very open to capital flows, highly dependent on international trade, and significantly affected by the exchange rate. It also characterized economies that were only moderately affected by the crisis and thus became an attractive destination for capital flows (see figure 8).

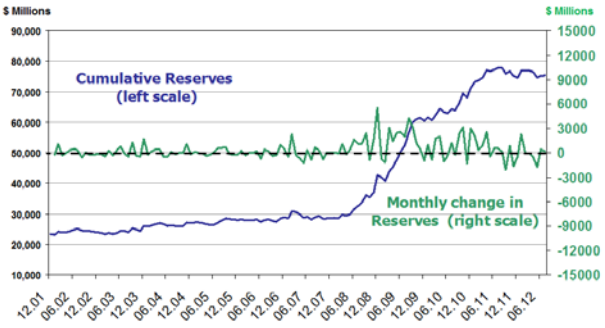
[12] Gustavo Adler and Camilo E. Tovar, "Foreign Exchange Intervention: A Shield against Appreciation Winds?", *IMF Working Paper*, (July 2011), pp. 3–8.

Foreign exchange reserves Chile Figure 7a



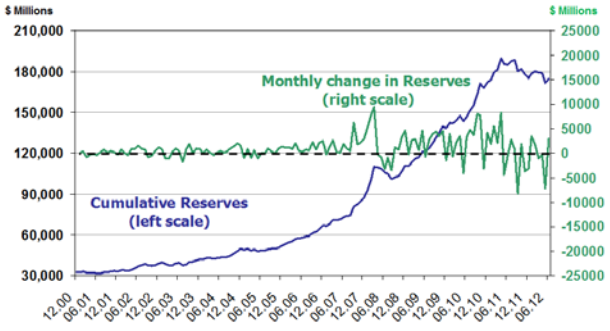
Source: IMF data and Bank of Israel calculations

Foreign exchange reserves Israel Figure 7b



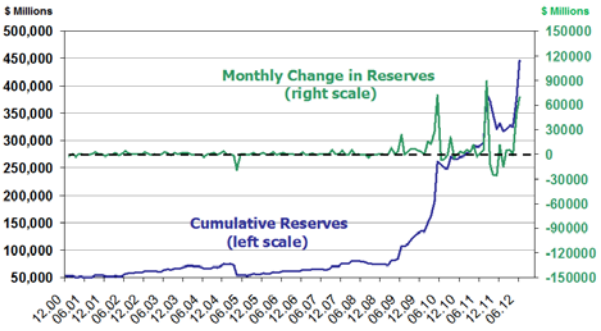
Source: IMF data and Bank of Israel calculations

Foreign exchange reserves Thailand Figure 7c



Source: IMF data and Bank of Israel calculations

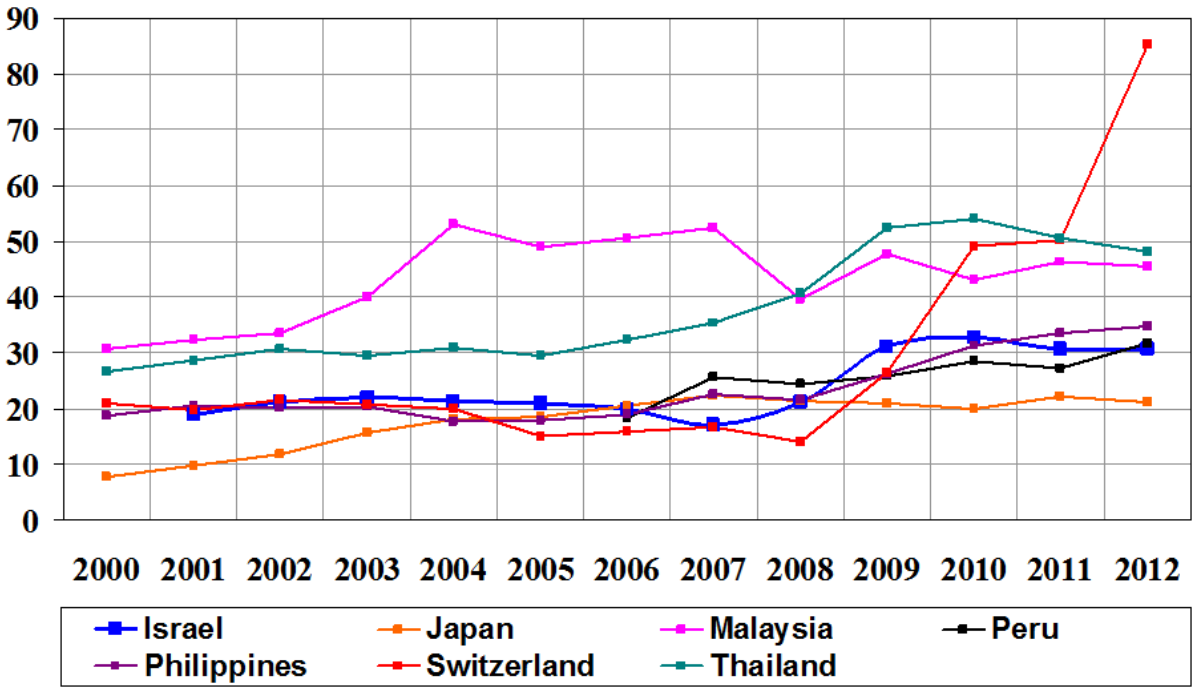
Foreign exchange reserves Switzerland Figure 7d



Source: Bank of Israel

Official Reserve Assets

(Percent of GDP) Figure 8



Source: IMF Database

b. IMF policy guidelines and BOI policy[13, 14]

According to the IMF, the appropriate policy mix for addressing macroeconomic stability risks to which inflow surges can give rise depends on a variety of country-specific considerations. The appropriate policies would include rebalancing the monetary and fiscal policy mix, consistent with inflation and growth objectives, allowing the currency to strengthen if it is not overvalued relative to the fundamentals, and building foreign reserves if these are not more than adequate.[15]

According to the IMF guidelines, countries with foreign exchange reserves that are not more than adequate from a precautionary perspective can respond to inflows by building reserves. Reserve accumulation can also help to limit excess exchange rate volatility in the short term, and smooth the impact on balance sheets. However, the IMF also notes that countries need to be cautious about intervention: excessive reserve holdings are associated with diminishing marginal benefits and rising costs. Moreover, heavy intervention during a period of sustained inflows can exacerbate the inflows by fuelling expectations of further appreciation.

The BOI policy in the foreign exchange market can be characterized as broadly consistent with these guidelines as they are characterized for the different phases. The BOI did not intervene in the market as long as the NIS exchange rate was not considered overvalued.

Following a continuous appreciation and a long period of erosion of the foreign exchange reserves, in March 2008 the BOI started intervening and began purchasing foreign exchange. This policy was adopted in order to increase the reserves, which were considered to be below the appropriate level at the time (they amounted to 82% of the short term external debt and about 4 months of imports). Furthermore, when the BOI reached 120% of ST liabilities and 8 months of imports, it announced that it would stop the daily purchases, but that it would intervene in the FX market in cases where fluctuations in the exchange rate did not match fundamentals. The BOI continued to intervene in the FX market until July 2011. At that time, reserves reached $77.9 billion, a level which was considered within the range of adequate reserve levels.

According to the IMF guidelines, in cases where (a) the exchange rate is not undervalued on a multilateral basis, (b) reserves are in excess of adequate precautionary levels or sterilization costs are excessive, and (c) the economy is overheating (where the inflation outlook is not benign or there is a developing credit or asset-price boom), precluding monetary easing, Capital Flow Management Measures (CFMs) may be needed. CFMs are needed to mitigate macroeconomic and financial-stability risks related to capital inflows, and they could be used to complement fiscal tightening plans already in place. Furthermore, the design and implementation of the CFMs should be targeted, temporary, preferably equal for residents and nonresidents, and should be lifted once the surge abates.

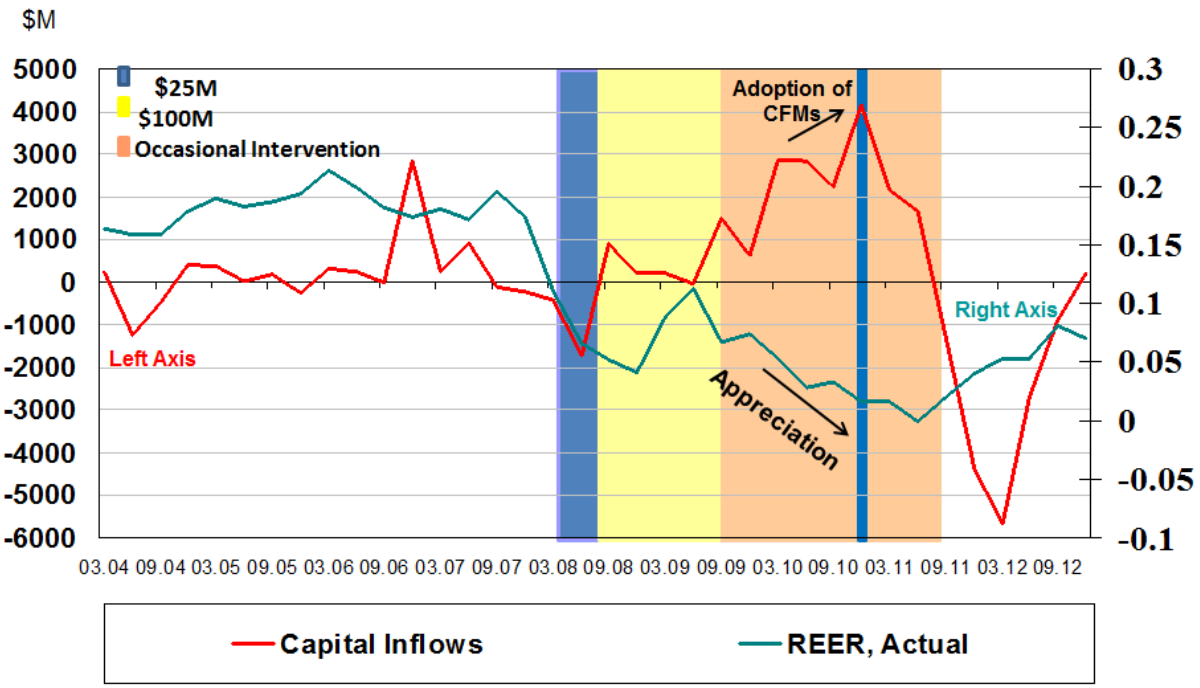
[13] IMF, "The Liberalization and Management of Capital Flows – An Institutional View" (November 2012), pp. 17–38.

[14] IMF, "Recent Experiences in Managing Capital Inflows – Cross-Cutting Themes and Possible Policy Framework" (February 2011), pp. 4–50.

[15] According to the VEE (Vulnerability Exercise for Emerging Markets) criteria, reserves are judged to be adequate if the ratio of reserves to the sum of short term debt and the current account deficit exceeds 100 percent.

Short term capital inflows and real effective exchange rate

2004Q1-2012Q4 Figure 9



* The short term capital inflows include the Makam (short term BOI bonds), government bonds traded in TA stock exchange and deposits in Israeli banks from abroad (non-residents and foreign banks).

In January 2011, the BOI adopted macro prudential measures (or CFMs in the IMF's terminology) to mitigate macroeconomic and financial stability risks associated with ST inflows (see figure 9). These measures, as mentioned above, included a reporting requirement on activities in the FX derivatives market and the *makam* (central bank bills) and short term government bond markets, as well as the imposition of a reserve requirement on FX derivative transactions by nonresidents. This policy can be described as generally consistent with the IMF guidelines: Criteria a-c (above) were met, and the measures were published and targeted at short term transactions, in order to reduce these inflows and their potential destabilizing effect. The reserve requirement on derivative transactions deviates from the guidelines in that it referred only to nonresidents and didn't have an expiration date.

5. Macroeconomic effects of the foreign exchange intervention

A study performed at the BOI regarding the effect of the intervention on the nominal effective exchange rate of the NIS during the period of the global crisis suggests that over a period of approximately 12 months from the beginning of the intervention, NIS levels were 6.75% more depreciated, on average, than those that would have prevailed in the absence of intervention. In the short run, given the very low pass-through from changes in the exchange rate to inflation, and especially in a period of dampened inflation pressure due to low demand, one can assume that

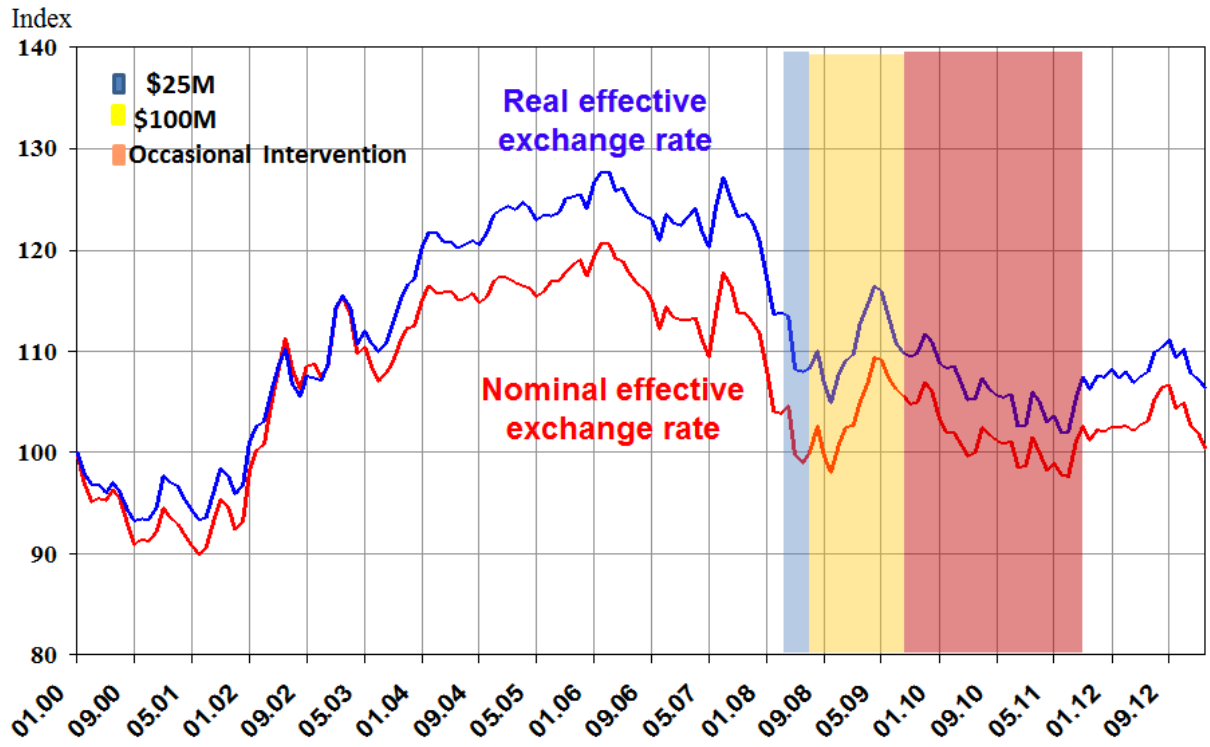
most of the depreciation of the nominal effective exchange rate was also translated into a depreciation of the real effective exchange rate (see figure 10).

Under this assumption, it is possible to quantify the contribution of the intervention to growth. Estimates based on a macroeconomic model for the Israeli economy suggest that the elasticity of exports to the real effective exchange rate (REER) is about 0.2, and that GDP elasticity to the REER is about 0.1.[16] This is somewhat lower than estimates obtained by Rodrik (2008).[17] His estimates for developing countries suggest that undervaluation of 20 percent boosts annual growth by 0.4 percentage points.

On the basis of these elasticities, a rough estimate of the magnitude of the contribution of the foreign exchange purchases made by the BOI during the Great Recession to growth in Israel was 0.7%. This is two thirds of the estimated overall contribution of the expansionary policies to growth during the Great Recession in 2008–09.[18]

Real and nominal effective exchange rate*

(Monthly, 2000-2013) Figure 10



* Trade-weighted

**01/2000= 100

16 Jacob Lavi and Amit Friedman, "The Real Exchange rate and the External Trade in Israel", Bank of Israel Survey, December 2006, pp.37–86, (in Hebrew).

17 Dani Rodrik, "The Real Exchange Rate and Economic Growth", *Brookings Papers on Economic Activity* (revised 2008), pp. 366 and pp. 404–405.

18 Kobi Braude and Karnit Flug, "The Interaction between Monetary and Fiscal Policy: Insights from Two Business Cycles in Israel", *BIS Papers*, vol. 67 (April 2012).

6. Concluding remarks

Israel's experience suggests that it is possible to intervene successfully in the foreign exchange market over an extended period of time on a large scale with the goal of mitigating the appreciation of the exchange rate, through the purchase of foreign exchange. (In the case of mitigating depreciation, the feasibility of continually selling foreign currency is, of course limited by the size of reserves).

Our analysis suggests that the intervention moderated the over-appreciation of the shekel during part of the period and thus helped mitigate the negative effects of the global crisis on Israeli exports and growth. The experience of Israel and other economies also supports an upward revision of the level of reserves that is considered adequate. This is the result of markets' becoming increasingly open to capital flows, and financial institutions' becoming increasingly exposed to foreign currency risk. Thus the build-up of reserves that started even before the intensification of the global crisis after the collapse of Lehman Brothers enhanced the resilience of the economy in the face of the crisis.

There are a number of issues regarding foreign exchange market intervention that merit further analysis: (1) What is the relationship between, and what would be the optimal sequencing of, intervention in the foreign exchange market and using CFMs? (2) What are the effects of sterilization? How does the need to sterilize intervention interact with interest rate policy undertaken in parallel with intervention in the foreign exchange market? (3) What are the quasi-fiscal costs of sterilized intervention? (4) From an international perspective, what are the implications of a few, or many, large or small countries' pursuing intervention?

These issues should be part of a comprehensive discussion of intervention in the foreign exchange market, but are beyond the scope of this paper.

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Foreign exchange market developments and intervention in Korea

Sangdai Ryoo, Taeyong Kwon and Hyejin Lee[1]

Abstract

This paper provides an overview of the developments in the Korean foreign exchange market and the Bank of Korea's foreign exchange interventions since the introduction of the floating exchange rate regime in Korea. It deals with institutional aspects such as the objectives, instruments employed, tactics and strategies of the interventions, as well as the sterilisation practices. It also explains why the Korean won has been so volatile during the crisis period, and how the Korean authorities have addressed the vulnerability of the won via interventions and other macro-prudential regulations.

Keywords: foreign exchange intervention, exchange rates, sterilisation

JEL classification: E58, F31

[1] Bank of Korea.

1. Introduction

This note provides an overview of the characteristics of the Korean foreign exchange market and the Bank of Korea's foreign exchange market intervention over the last decade. The Korean authorities have intervened in the market when it was judged necessary, although we hold the view that under a free floating regime like the current Korean exchange rate system the exchange rate should in principle be determined in the foreign exchange market, reflecting economic fundamentals. This note discusses why and how the Korean authorities intervene in the FX market, and describes the consequences of their intervention.

We once before examined our foreign exchange market developments and FX intervention in a BIS country note (2004). Since then, the environment surrounding the Korean FX market has changed greatly. Above all, the experience of the global financial crisis in 2008 sharply revealed the vulnerabilities of Korea's foreign exchange system to external shock. Therefore, our main policy issues and methods of intervention have been modified to cope with the Korean won's vulnerability. Also, therefore, the present note points out what has changed since the last review.

The rest of the note is organised as follows: As background, section 2 briefly describes developments in the foreign exchange market, as well as the institutional setup as regards Korean foreign exchange policy. Section 3 goes on to explain the objectives and tactics of FX intervention. This is followed in section 4 by a discussion of the effectiveness of each intervention channel, and of what happens in the domestic financial market after intervention. Section 5 introduces the recent macro-prudential measures adopted in Korea, and their effects.

2. Developments in the foreign exchange market after adoption of the floating regime

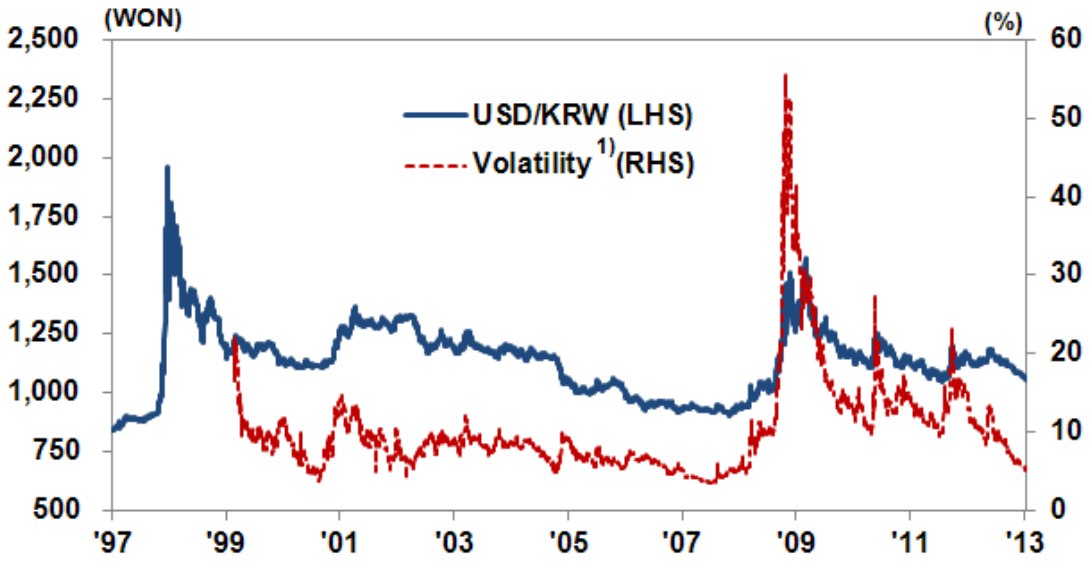
2.1 Movement of the Korean won

The USD/KRW exchange rate has for the most part fluctuated in line with global financial market circumstances. It has generally shown slow downward trends during periods when risk-on sentiments have dominated, owing to the won's nature as a typical risk currency and to Korea's continuing current account surplus. For example, we experienced long-term moderate appreciation of the won in the mid-2000 decade. However, the exchange rate has shown sharp increases during times of market turmoil such as the global financial crisis in 2008 and the European sovereign debt crisis in 2010 and 2011.

The volatility of the USD/KRW exchange rate has shown similar behaviour. It tends to be moderate during periods of risk-on sentiment, and then surges during risk-off sentiment. Although these asymmetric features are commonly observed in many developing countries that have adopted floats, the Korean won was one of the most severe cases during the global financial crisis in 2008 specifically.

Movements of Korean won and its volatility

Figure 1



1) Implied volatility of 3-month USD/KRW options (data not available before 1999).

Sources: Bank of Korea; Bloomberg.

2.2 Why has the Korean won been so vulnerable?

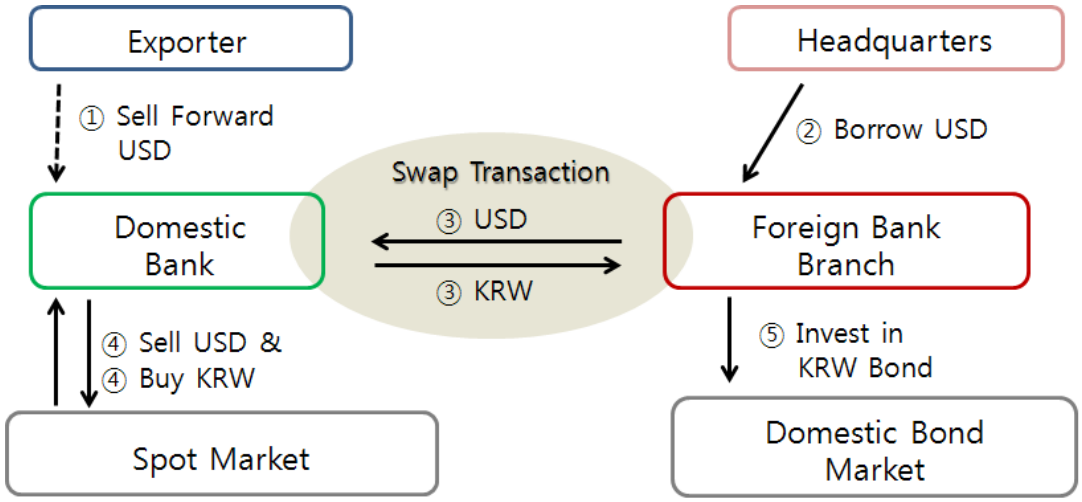
Regarding the sharp depreciation and high volatility of the Korean won during past financial crises, previous studies usually pointed to Korea's high degree of capital market openness, to its geopolitical risks, and to the large amount of banks' external debt and their maturity mismatches. It is quite obvious that Korea's high capital market openness combined with the pro-cyclicality of international capital flows has exposed the country's foreign exchange market to volatile swings. Sporadic geopolitical events reminding investors of the geopolitical risks surrounding the Korean Peninsula have also played a part in the won's vulnerability. It might be asked, however, why Korean banks have had large amounts of external debt despite the nation's continuing current account surplus. The answer to this is also related to the country's current account surplus.

Banks' external debts have been driven by the demand for FX hedging since the mid-2000 decade. Korean exporters and asset management companies have sold forward foreign currency to hedge the values of their future export proceeds or their foreign-currency-denominated assets. In the years leading up to the global financial crisis, bank demands for FX hedging were spearheaded mainly by shipbuilders whose overseas orders were increasing thanks to the shipping industry boom, and by asset management companies that were rapidly expanding their overseas securities investments due to the bullish global stock market and the government's policy of encouraging overseas investment.

Exports have exceeded imports for several years. Unlike exporters, moreover, importers tend to acquire foreign currency in the spot market rather than the

forward market.[2] In the face of companies' forward selling, and given the shortage of forward buying by importers, banks have sought to square their positions by taking short positions. This has been done by either borrowing foreign currency (typically via foreign bank branches) or creating short FX swap positions (typically a domestic bank transaction). After borrowing foreign currency, foreign bank branches have exchanged it for Korean wons and invested the proceeds in domestic bonds. This is the main reason Korean banks have had such a large amount of external debt.

Banks' typical positioning — Figure 2



In addition, banks have built up liquidity mismatches. They raised short-term external debt to offset their long-term long positions because of the cheaper interest costs of funding and the low perceived liquidity risk, given the abundance of global liquidity before the financial crisis. Ree et al. (2012) pointed out that these maturity mismatches, combined with the large amount of banks' external debt, have brought about dollar squeezes when crises have occurred, and banks have suddenly faced rollover difficulties, forcing them to sell their securities to obtain dollars – the safe haven currency – despite the losses that result. This puts downward pressure on the Korean won. The depreciation of the won in turn sends negative signals about the Korean economy and can make banks' FX funding more difficult again. In summary, stresses in the on-shore FX funding market and the off-shore FX market feed each other.

Against this background, the foreign exchange authorities in Korea supplied dollar funds to banks during the global financial crisis in 2008, and introduced macro-prudential measures designed to address banks' wholesale funding problems and reduce their maturity mismatches.

[2] Importers in Korea usually feel no need to hedge their foreign exchange risk, as it is relatively easy to shift the additional costs onto customers in the domestic market. Hence, they usually participate in the spot market or the short-term (less than 2-week) forward market.

2.3 Institutional setup

Two administrative bodies are involved in Korean exchange rate intervention: the Ministry of Strategy and Finance (MOSF) and the Bank of Korea (BOK). These two institutions serve in partnership as the foreign exchange authorities. The Foreign Exchange Transaction Act (FETA) states that the MOSF has overall responsibility for the stability of the foreign exchange market and for foreign exchange policy, including market intervention. The BOK, under the Bank of Korea Act, also formulates foreign exchange policy in cooperation with the government (i.e. the MOSF).

The BOK, as the central bank, manages the nation's foreign reserves, consisting of the Foreign Exchange Stabilisation Fund and the BOK's own reserves. The Foreign Exchange Stabilisation Fund was established by the Korean government in 1967 and has been managed for the purpose of achieving foreign exchange market stability. As the legal administrator of the Foreign Exchange Stabilisation Fund, the MOSF makes overall decisions concerning its funding and operation. The operational details and ordinary management of the fund, however, are delegated to the Governor of the BOK. The BOK, in consultation with the MOSF, is also in charge of implementing the actual foreign exchange market interventions.

3. Objectives and tactics of foreign exchange intervention

3.1 Objectives of FX intervention

The main objective of foreign exchange intervention in Korea is to contain excessive exchange rate volatility. Large movements of foreign exchange rates have negative effects on a small economy like Korea's. Excessive exchange rate volatility increases economic participants' uncertainties as to costs and benefits, and thus has potential to lead to a decline in the nation's trade and investment. It is also known that inflationary pressures tend to increase when exchange rate volatility goes up, as companies facing uncertainties about future prices set product prices higher to forestall possible losses. We attempt to limit upward or downward pressures only when such pressures cause large volatility in the exchange rate or lead to speculative movements.

Another objective of intervention is to alleviate the FX funding shortages of banks, which have experienced severe dollar shortages, especially in periods of crisis. As noted above, an FX funding shortage puts depreciatory pressure on the Korean won and increases exchange rate volatility. When it is judged necessary, the Korean authorities provide dollar liquidity in the FX swap market to ease imbalances in the FX funding markets.

For several years after the currency crisis of 1997, the accumulation of foreign exchange reserves was one of the objectives of intervention. A strong stock of FX reserves helps to minimise external vulnerability and to increase confidence in the economy. Since a substantial amount of reserves has now been accumulated, however, our FX intervention is no longer designed with further accumulation in mind.

3.2 Basic strategy of FX intervention

The decision on when and how to intervene in the market depends upon the authorities' discretionary judgment rather than on any implicit rule. Many elements, such as the strength and nature of the external shock, the movements of other market indices, market sentiment, and the volume of funds available, are all taken into account in the discretionary decision-making.

In determining the timing of intervention, no comprehensive set of indicators is adequate in all situations for deciding whether intervention is necessary. Nor is there an economic model that reliably integrates all of this information in a form that indicates the degree to which intervention is needed. To make such decisions, the authorities monitor exchange rate developments and the various related conditions on a real-time basis. The conditions considered include, for example, fund flows of international investors as well as exporters and importers, liquidity conditions in the swap market, market positions, important technical levels, and so on. Meanwhile, actual intervention is based on developments at least being observed – not pre-emptively before the FX market shows reactions to certain events.

Similar considerations apply to the magnitude of the intervention. The domestic financial market situation, as well as the elements mentioned in the foregoing paragraph, must be considered when a high-volume intervention is carried out, since the domestic money market could be distorted in the sterilisation process, hindering the effect of FX intervention. When it comes to limiting excessive depreciatory pressures on the Korean won by using the foreign exchange reserves, we try to preserve an adequate volume of reserves, since too much of a reduction in reserves erodes confidence in the Korean economy, and hence accelerates depreciation.

As to the intervention tools used, direct interventions in both the spot and swap markets have been employed. Which instrument the authorities choose depends upon the objective of the intervention. Spot market intervention is usually preferred when the objective is to contain exchange rate volatility, and swap market intervention when the aim is to provide dollar liquidity in the market. The Bank of Korea began participating in the FX swap market in September 2007 in order to ease imbalances in the country's FX funding market. During the global financial crisis in 2008, the BOK also supplied 10.27 billion dollars to foreign exchange banks through swap transactions using a competitive bidding method. The bank at that time also provided 16.35 billion dollars through lending transactions, utilising a currency swap agreement with the U.S. Federal Reserve. We also use verbal intervention to give speculative forces warning by conveying the authorities' concerns and intentions related to foreign exchange market developments. Verbal intervention must be used limitedly, as its effects on the market will lessen if it is used frequently.

The Korean FX authorities do not publicly disclose any information related to intervention, because we believe that such information could stimulate speculative trading in the FX market. We thus intervene in the market through agents selected from among major banks. The Bank of Korea imposes a confidentiality requirement on these agent banks to maintain secrecy concerning intervention. As for the criteria used to select the agent banks, priority is given to institutions with the following characteristics: no danger of default risk, ability to provide the Bank of Korea with instant market information, and active role in the market.

4. Channels of intervention, and domestic consequences

4.1 Channels of intervention

Of the various channels for intervention, the signalling channel seems to be generally the most effective in Korea, by changing market participants' expectations about future exchange rates and intervention. Through the signalling channel, the Korean authorities give speculative forces warning and provide market participants an opportunity to rethink whether recent movements in the FX market are rational. The portfolio balance channel and the microstructure channel also sometimes work, depending upon the situation. The overall effects of intervention through all of these channels have become weaker than they were in the past as the size of the Korean exchange market has expanded. Meanwhile, there is no room for going through the monetary policy channel, because we fully sterilise any changes in the domestic money supply brought about by intervention.

4.2 Sterilisation in Korea

The Bank of Korea sterilises changes in its domestic money supply brought about by FX intervention, using market instruments for the purpose. The major sterilisation instrument for the Bank of Korea is issuance or withdrawal of Monetary Stabilisation Bonds (MSBs, Korean central bank securities). Deposit to / withdrawal from the Monetary Stabilisation Account and transactions in the repo market are also used to control short-term money market liquidity. Using MSBs can be a more effective way of adjusting changes in the money supply, as the impacts of the other instruments tend to reverse after a few days. However, sterilisation using MSBs is more costly, as long-term interest rates are usually higher than short-term rates. In cases where the government covers the expenses of intervention by using the Foreign Exchange Stabilisation Fund, sterilisation by the Bank of Korea using MSBs is not necessarily required, since the base money supply does not change.

4.3 FX intervention and monetary policy

Along with the change in the exchange rate regime in 1997, inflation targeting was chosen as the monetary policy framework to achieve the Bank of Korea's aim of price stabilisation. Given free movement of capital, the Bank of Korea sometimes has difficulties in achieving low exchange rate volatility while maintaining stable inflation. This is related to the impossible trinity theory argued by Mundell, which states that a country cannot simultaneously have perfectly free capital movement, a perfectly floating exchange rate and perfectly autonomous monetary policy. A recent conflict between FX and monetary policy occurred in mid-2011, when inflation rose to 4.7%, exceeding the central bank's target range (3%±1%), while the Korean won was appreciating rapidly and exchange rate volatility was high. There was a possibility that a hike in the policy rate could lead to more capital inflows and thus accelerate exchange rate volatility. Meanwhile, if the Bank of Korea had tried to limit excessive exchange rate volatility by intervention to prevent additional appreciation of the won at that time, the action could have hindered the curbing of inflation, in that import prices would not have fallen without additional currency appreciation.

On the other hand, FX market intervention and monetary policy in Korea can sometimes be complementary. In the face of huge capital inflows and high inflation, for instance, the central bank faces a double bind. If it raises the policy rate to curb inflation, capital inflows will be increased. Inflation will, on the other hand, rise if the bank cuts the policy rate to limit capital inflows. In this case, intervention to absorb foreign currency in the FX market could reduce additional capital inflows without the need for a policy rate cut, by stemming the flows due to self-fulfilling expectations of currency appreciation, and by reducing deviation from the covered interest rate parity. Ostry et al. (2012) have also pointed out that FX intervention in certain circumstances may be an optimal instrument even under an inflation targeting regime.

5. Other recent foreign exchange measures and their effects

To fundamentally reduce the vulnerability of the Korean won, the Korean authorities have introduced strengthened macro-prudential regulations since 2010, such as limiting banks' foreign currency forward positions, re-introducing a withholding tax on foreign purchases of Treasury and Monetary Stabilisation Bonds, and imposing a macro-prudential stability levy on banks' non-deposit FX liabilities. These measures are aimed at improving foreign exchange market soundness by addressing banks' FX funding problems and reducing their maturity mismatches.

Since the adoption of these various measures, Korean banks' reliance on short-term FX funding has declined. Banks' external funding profiles have improved considerably, particularly at foreign bank branches whose short-term debt as a proportion of total external debt has declined steadily, from more than 90 per cent right before introduction of the regulations nearly to 60 per cent at the end of the third quarter of 2012. The amount of foreign bank branches' external debt has also decreased somewhat, although that of domestic banks has increased. Fortunately, USD/KRW exchange rate volatility has also generally diminished since 2010, despite several ups and downs, as banks' external funding profiles have improved. The volatility of the Korean won during the recent European sovereign debt crisis has also gradually lessened.

Have these improvements, then, been attributable to the Korean authorities' introduction of the various new regulations? Even though this is hard to measure, we think that the regulations adopted have played a role in improving the banks' external funding profiles, and thus affected the exchange rate volatility. For now, therefore, it can be said that these macro-prudential measures have helped to reduce the need for direct intervention.

We must, however, be cautious about jumping to conclusions. The improvements might have also come from changes in the environment surrounding the Korean FX market. First, the demand for medium- to long-term FX hedging, particularly by Korean shipbuilders, has declined in the face of a sharp global drop in ship orders. This has helped to reduce the amount of external debt and the liquidity mismatches of banks. On the other hand, offshore entities, including real money and sovereign investors, are increasingly replacing foreign bank branches as

investors in domestic bonds.[3] As a result, the government's long-term external debt, which has relatively high solvency, has increased at the same time that banks' short-term debt has decreased. In addition, foreign banks and sovereign investors clearly have different investment objectives and horizons, and their responses to liquidity shocks are hence likely to differ, reducing herding behaviour in the capital markets. It seems that all of these changes have contributed to the recent improvement in the Korean FX market. Further research is needed to measure how much of the improvement has been attributable to the regulations we have adopted, and to verify whether the need for direct intervention has ultimately been reduced.

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[3] The relative dominance of these two groups of investors as net buyers of domestic bonds has reversed since late 2009.

Foreign exchange intervention in Malaysia

Norzila Abdul Aziz[1]

Abstract

Given the rapid and volatile capital flows that emerging market economies (EMEs) have experienced in the years following the global financial crisis, foreign exchange market developments and the corresponding intervention by EME central banks have quickly become pertinent issues. To shed light on some of these issues from Malaysia's perspective, this paper first highlights the motives for and recent trends in Malaysia's foreign exchange interventions, followed by a discussion of their effectiveness. The paper then elaborates on Malaysia's efforts to improve the management of foreign exchange volatility. Finally, the paper concludes by highlighting the importance of collaborative efforts to address the root cause of volatile capital flows.

Keywords: capital flows, FX intervention, liquidity management, volatility, reserves accumulation

JEL classification: E58, E61, F31

[1] The views expressed in this paper are those of the author and do not necessarily represent those of the Central Bank of Malaysia. The author would like to thank Dr Norhana Endut, Raja Syamsul Anwar, Beh Cheng Hoon, Sim Wee Haw, Tengku Muhammad Azlan Ariff Tengku Mohamed Fauzi and Eva Suria Nadiah Abdul Karim for their assistance and research input.

When capital flows into emerging market economies (EMEs) are high and volatile, their impact on the efficient functioning of the foreign exchange market – and hence the effectiveness of foreign exchange intervention – become pertinent issues for EME central banks. While strong capital flows into EMEs are nothing new, what is different this time are the stronger external drivers – prolonged low interest rates in the advanced economies combined with substantially weaker growth outlooks, in a landscape of excess global liquidity arising from quantitative easing measures in those same economies. These factors have amplified short-term portfolio flows seeking higher returns. The influx of capital flows into the EMEs[2] and the resulting impact on exchange rates have raised macroeconomic and financial stability concerns, as well as the questions of what central banks in EMEs can do about it and how the resultant balance sheet expansion can be managed effectively by means of sterilised foreign exchange interventions.

In this light, a formal framework is critical to ensuring the effectiveness of foreign exchange interventions. Intervention operations are conducted with the aim of achieving various macroeconomic objectives relating to inflation, competitiveness and financial stability.[3] According to the literature, the motive behind interventions is generally to counter short-term trends or volatility in the exchange rate, and to bring a misaligned exchange rate back onto its "fundamental path".[4, 5] This is especially true for EMEs in recent times, as they face the threat of potential surges in capital flows and the resulting deviation of the exchange rate from its long-term trend, with the associated threat of disruptions in both the real sector and financial markets.

To shed light on some of these issues from Malaysia's perspective, this paper will start by highlighting the motives for and recent trends in Malaysia's foreign exchange interventions, followed by a discussion of their effectiveness. The second part elaborates on efforts to improve the management of foreign exchange volatility. Finally, the paper concludes by highlighting the shortcomings of stand-alone actions, and the importance of collaborative efforts worldwide to address the root cause of volatile capital flows.

[2] The International Institute of Finance has projected that capital flows to EMEs will reach USD 1.1 trillion in 2013 (2006: USD 0.8 trillion) and that they are expected to remain high in the near term. This is also reflected in Malaysia's financial accounts, where the level of gross portfolio flows has grown approximately twentyfold since 2005.

[3] R Moreno, "Motives for intervention" in Foreign exchange market intervention in emerging markets: motives, techniques and implications, BIS Paper, no 24, 2005.

[4] C Neely, "The practice of central bank intervention: looking under the hood", Federal Reserve Bank of St. Louis Review, May–June 2001.

[5] R Baillie and W Osterberg, "Central bank intervention and risk in the forward market", Journal of International Economics, no 43, 1997.

I. Motives and recent trends

Orderly market conditions are the key motive for FX intervention in Malaysia

After pegging the ringgit to the US dollar following the 1998 Asian financial crisis, Malaysia moved to a managed float exchange rate regime in July 2005. In this arrangement, the ringgit is referenced against a basket comprising the currencies of the country's major trade partners and is allowed to move according to market forces. Since then, the focus of central bank intervention has been limited to maintaining orderly foreign exchange market conditions with a view to avoiding extreme movements in the ringgit exchange rate that could destabilise the real economy.

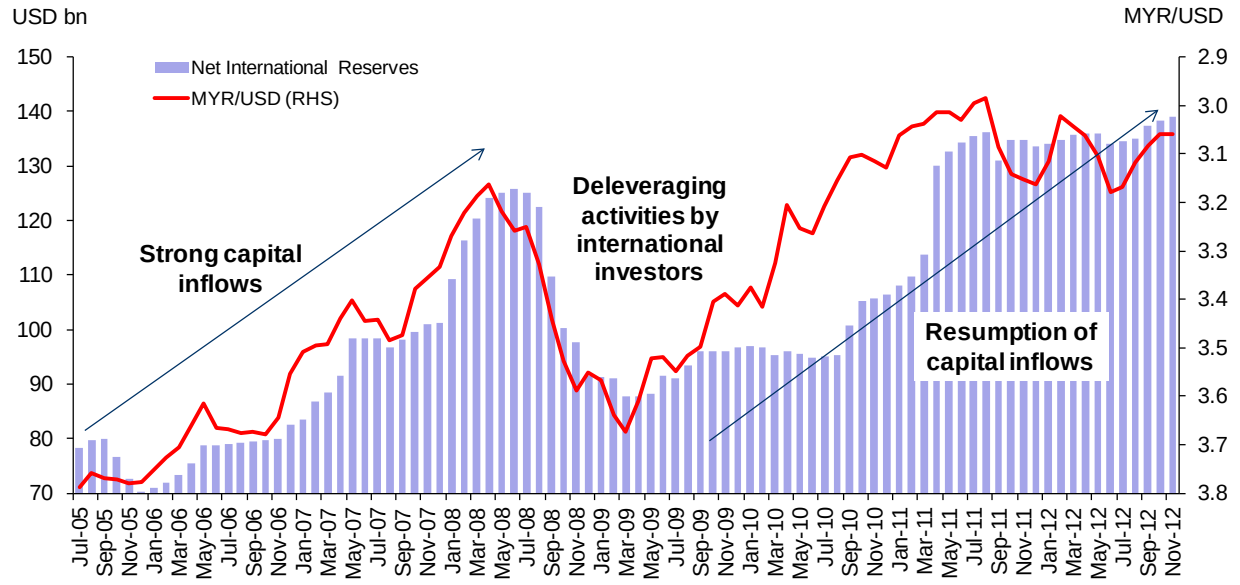
Since the floating of the ringgit, the approach to foreign exchange intervention has further evolved, in line with the development of the Malaysian foreign exchange market and as market participants have become better equipped to manage their own foreign exchange risks. During this period, the Malaysian foreign exchange market has grown from average daily transactions of USD 2.3 billion in 2005 to USD 10.8 billion in 2012, along with the gradual liberalisation in the foreign exchange market. Interventions were more intensive immediately after the floating of the exchange rate, with the intention of reassuring financial market players and real sector participants that the ringgit exchange rate would remain stable under the new regime. As, at this time, the foreign exchange market was less developed with only a limited range of hedging tools, the interventions served several purposes. By smoothing exchange rate movements with a gradually increasing tolerance of higher volatility, they not only provided stability to the overall market and the real sector, but they also helped to develop the risk management capabilities of market participants.

Over the years, foreign exchange interventions have become much less frequent. At the same time, they have focused more on addressing periods of market dysfunction. Experience has shown that portfolio flows are the main factor influencing ringgit volatility, given that such flows are often sizeable, short-term and sensitive to market news. When inflows or outflows have reached extreme levels, the central bank has intervened with the aim of mitigating volatility, maintaining orderly market functioning and reducing any destabilising effects on the real economy. In all cases, the decision to intervene has hinged on whether the financial markets are judged capable of intermediating these excessive flows.

For example, between 2007 and 2008, the central bank intervened to counter strong portfolio inflows against the US dollar that sharply increased international reserves, from USD 83.5 billion in January 2007 to USD 125.8 billion in June 2008, a rise of just over 50%. But the onset of the global financial crisis caused a sudden reversal of portfolio investment, exerting a significant downward pull on the ringgit. The central bank again intervened to moderate the sharp depreciation pressure on the ringgit. As a result, international reserves fell by more than a quarter, from more than USD 120 billion in September 2008 to USD 88 billion at the end of April 2009.

Net international reserves and the ringgit exchange rate

(Jul 2005–Nov 2012) Chart 1



Source: Central Bank of Malaysia.

Effectiveness of intervention

Interventions by the central bank appear to have achieved their objectives in managing ringgit volatility and maintaining orderly foreign exchange and financial market conditions, even during periods of high volatility in global currency markets. At the height of the 2008 turmoil in global financial markets, Malaysia's interventions were relatively effective in moderating excessive exchange rate volatility by providing two-way flows (see Table 1). But during times of low global volatility, as in January 2007, interventions were on a more limited scale than elsewhere in the Asia-Pacific region. This seems to suggest, at least in Malaysia's case, that higher reserves volatility is associated with lower exchange rate volatility.

Reserves and exchange rate volatility for Asia-Pacific countries (% chg) Table 1

	Asia-Pacific countries[1]		Malaysia	
	Reserves volatility, 1 s.d.	Exchange rate volatility, 1 s.d.	Reserves volatility, 1 s.d.	Exchange rate volatility, 1 s.d.
January 2007 (VIX at lowest point[2])	±2.67%	±1.55%	±1.33%	±1.00%
September 2008 (peak of financial crisis)	±3.41%	±2.41%	±4.09%	±1.94%
April 2011 (high portfolio inflows into EMEs)	±2.71%	±2.33%	±3.62%	±1.62%
September 2011 (high global risk aversion)	±2.45%	±2.54%	±3.45%	±2.65%

[1] Selected Asia-Pacific countries are Australia, China, India, Indonesia, Japan, New Zealand, Pakistan, Philippines, Singapore, South Korea, Chinese Taipei and Thailand. [2] VIX data from January 2000 to December 2012.

Sources: Bloomberg; IMF; Central Bank of Malaysia calculations.

II. Improving the management of foreign exchange volatility

Continuing efforts to enhance resilience

Capital flows to EMEs are likely to increase in the future, with net capital inflows most probable over the medium to long term given the balance of push and pull factors. In this regard, the central bank is making continued efforts to enhance its capacity in managing volatile capital flows.

A robust surveillance framework in place

Fostering an open and close relationship with market players for surveillance purposes is an important tool in anticipating changes in market sentiment and gauging the intensity of capital flows. In addition to engaging continuously with market participants when assessing early warning indicators, the central bank also tracks cross-border flows via a monitoring system that provides near real-time information. The system captures details of flows across local financial markets including volumes, the instruments involved and the nature of transactions. This provides the central bank with the information needed to manage capital flows. At the regional level, surveillance has benefited from a regular exchange of information between EMEAP central banks through Dealing Room Network teleconferences and meetings on financial markets. The periodic teleconference allows EMEAP members to share sensitive information including insights on capital flows in each market.

Managing the challenges of foreign exchange intervention

Given that most emerging economy central banks have continued to intervene in foreign exchange markets, the sustainability of reserves accumulation naturally becomes important. Two of the key challenges in managing the accumulation of reserves from intervention operations relate to the currency mismatch in the central bank's assets and liabilities as well as the rising differential between interest rates in the advanced economies and emerging economies.

First, the central bank's balance sheet may experience significant volatility from foreign exchange translation gains or losses due to the mismatch between its foreign currency assets and its local currency liabilities. A strengthening local currency may lead to negative capital on the balance sheet as foreign currency-denominated assets are revalued downwards due to currency movements. In addition, during a period of significant capital inflows and heavy intervention, the local currency has a tendency to appreciate for the same reasons that led to the inflows in the first place. To mitigate the impact of such a currency mismatch, the Central Bank of Malaysia has increased the diversification of its foreign currency assets.

Second, carrying costs can arise from the growing differential between the interest returns of advanced and emerging economies. This is especially the case for emerging Asian economies into which US dollar-denominated funds flow from advanced economies, in search of higher yields. Without the capacity to invest in assets with a lower credit quality or instruments of greater complexity, the cost of the central bank's interventions would normally be higher than the returns from its investments. Other steps to mitigate these carry costs include taking duration position and moving into less liquid investments. The central bank manages its investments actively, diversifying between short- and longer-term assets (duration) or between lower and higher-rated

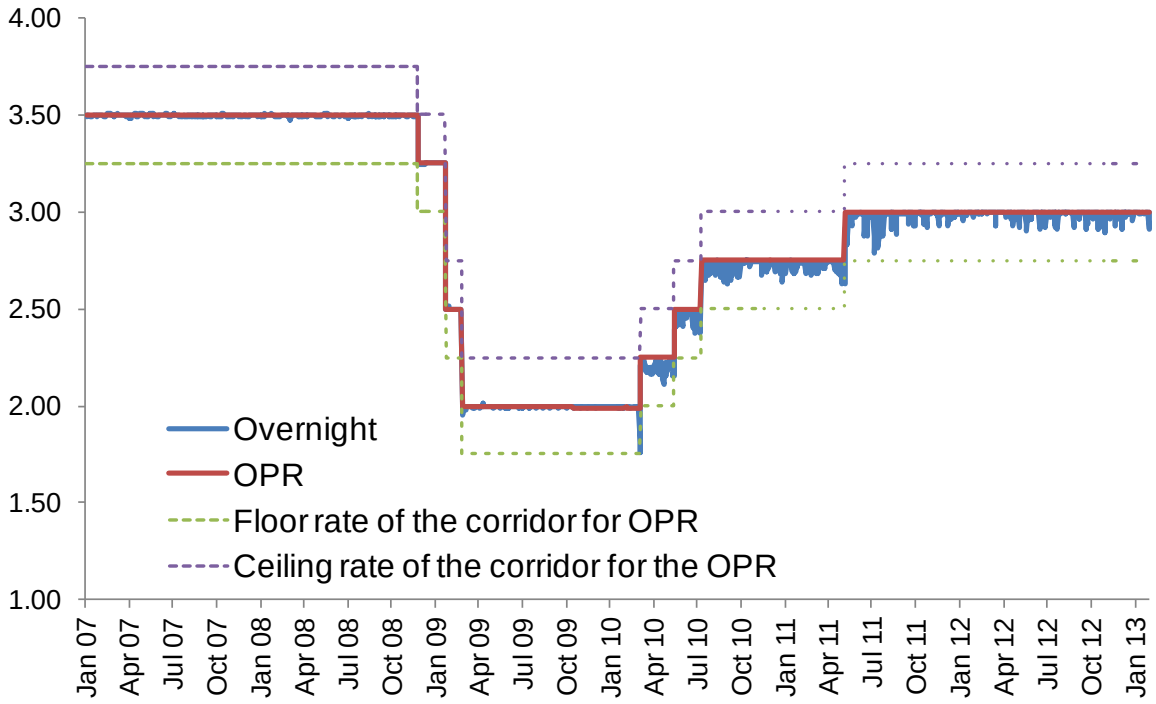
fixed income assets (credit), based on market conditions and with a view to optimising the balance between risk and return.

Wide range of monetary instruments has allowed effective and flexible liquidity management

In addition to cost considerations, a further challenge following an intervention is the need to manage liquidity creation or withdrawal and hence the impact on monetary conditions. In this respect, effective and flexible liquidity management has benefited from advances in Malaysia's financial market development and a broadening range of instruments. Traditional liquidity management instruments such as direct borrowing and reserve requirements are now accompanied by the use of repo operations, BNM bills and FX swaps. Direct borrowings and BNM bills are potent instruments for the management of excess liquidity as they are subject to flexible issuance limits[6] and issuance tenure. BNM bills have additional advantages in managing duration and liquidity risks.

The wide range of monetary instruments has enabled the efficient sterilisation of liquidity, thus avoiding overly expansionary monetary conditions. The effectiveness of the central bank's sterilisation operations can be seen by the stability of the monetary base even in the course of intervention operations. At the same time, interest rates in the interbank market have remained stable without experiencing downward pressure from excess liquidity (Chart 2).

Policy rate (OPR) and interbank rate — Chart 2



Source: Central Bank of Malaysia.

[6] The issuance of BNM Notes is limited to the prevailing level of international reserves.

Reduced need for central bank intervention

Despite its intervention capabilities, the central bank appreciates the need to find a longer-term solution. Over the years, continuous financial market development and liberalisation of foreign exchange administration (FEA) rules in Malaysia have effectively reduced the central bank's presence in the foreign exchange market. Indeed, intervention has recently been minimal. The central bank's international reserves remained within the range of USD 134.1 billion and USD 139.1 billion in 2012 (for comparison, reserves ranged between USD 108.1 billion and USD 136.3 billion in 2011).

Central to this has been the development of both the domestic financial market and financial instruments and also the increased occurrence of two-way flows. The central bank has no doubt that intervention operations need to go hand in hand with market development, as the availability of liquidity management instruments equip the market to manage the volatility of the exchange rate. In addition, there are growing signs that measures taken over the years have resulted in a better matching of inflows and outflows, thanks to an open trade environment and the liberalisation of rules for investment abroad.

Malaysia currently imposes no restrictions on any movement in the current account, allowing international trade to flourish, as reflected in the growth of total trade, which has grown by 124% over the past decade. Furthermore, in 2010, Malaysia accorded residents the option of conducting settlement with non-residents for goods and services in ringgit (previously, this was permitted only in foreign currency), further easing the movement of trade flows. A recent observation is that domestic infrastructure development projects have necessitated higher imports of capital goods, allowing total imports to grow faster than total exports[7] and naturally leading to higher trade outflows. This has led to an improved balance of inflows and outflows, effectively reducing the need for the central bank to intervene in the foreign exchange market. In 2012, on a cash basis, the 34% increase in gross inflows (driven by portfolio flows) during the year coincided with a 39% increase in gross outflows (driven by trade flows).

The central bank has also progressively liberalised rules for investment in foreign currency assets by providing greater flexibility for such investments by resident corporations. This has helped reduce the need to intervene in at least two ways. First, liberalisation measures have facilitated direct investment outflows and have therefore led to better matching of inflows and outflows. The capacity of resident corporations to invest in foreign currency assets has increased dramatically following certain liberalisation measures that provide greater flexibility on the use and source of foreign currency funds for investment purposes. This is reflected in increased direct investment abroad, which has grown from a yearly average of USD 0.8 billion in 1990–2000 to USD 7.1 billion in 2001–11. Such flexibility also enhances the capacity of resident corporations to manage foreign currency risks effectively. Second, the freedom to open foreign currency accounts for the purpose, among others, of investment and retention of export proceeds has contributed to a greater decentralisation of reserves due to rising foreign currency deposits held within the domestic banking sector. This has reduced the need for businesses and

[7] On a year-on-year basis since 2010, Malaysia's total imports grew at an average of 19% while total exports grew at 15%.

financial institutions to constantly approach the central bank to purchase foreign currency. Between 1999 and 2012, the total amount of foreign currency deposits placed with domestic financial institutions rose fifteenfold,[8] of which placements by domestic business enterprises accounted for more than half.

III. Global problems call for global solutions

Fixing the root of the problem

While Malaysia has the capacity to manage the impact of volatile capital flows, the central bank recognises that addressing the problem's root cause – the drivers of volatile capital flows – is critical to achieving a sustainable solution. The literature on foreign exchange intervention by central banks shows that discussions on this area generally revolve around short-term solutions such as the motivations for intervention, the efficiency and effectiveness of intervention and the management of intervention costs.[9] But most such studies address symptoms when efforts should really be focused on fixing the root of the problem. Fixing the root of the problem, however, is not straightforward. Any solution would require not only a collaborative effort globally but a strong willingness and commitment to implement and follow through with an agreed restructuring roadmap. Given the nature of capital flows, the optimal solution would naturally require efforts from both the supplier and recipient of the capital flows.

Collaboration for an optimal solution

Thus far, countries have usually resorted to standalone action based on each country's individual need and with a view to containing domestic risks. Unfortunately, while unilateral actions may provide some temporary relief, standalone actions are generally not sufficient to achieve the desired outcome. Worse, what looks like the best solution for one country could have unintended and detrimental consequences for the rest. Thus, in dealing with capital flows volatility, a collective action plan is the key to increasing the likelihood of success and to avoiding regulatory arbitrage between member countries. It is therefore, a necessity for countries to share collective responsibility and accountability in ensuring global financial stability.

[8] Total foreign exchange deposits placed with domestic financial institutions rose from USD 1.8 billion as at end-1999 to USD 28 billion as at end-Nov 2012.

[9] See for example J Frait, "Exchange rate appreciation and negative central bank capital: is there a problem?", paper presented at the Expert Forum on Central Bank Finances and Impact on Independence, Bank of England, 2005; C Yin, "A discussion of official foreign exchange intervention", 2008; J Benes, A Berg, R Portillo, and D Vavra, "Modeling sterilized interventions and balance sheet effects of monetary policy", *IMF Working Paper*, January 2013.

Interventions and expected exchange rates in emerging market economies[1]

Santiago García-Verdú[2] and Manuel Ramos-Francia[3]

Abstract

We study variations in the distributions of the expected exchange rates in Brazil, Chile, Colombia, Mexico, and Peru due to interventions implemented in these countries. To this end, we first estimate the risk-neutral densities of the exchange rates based on derivatives market data, for one-day and one-week horizons. Second, using a linear regression model, we assess potential effects on the distributions of the expected exchange rate given these interventions. We find little evidence of an effect on the expected exchange rates' means, volatilities, skewness, kurtoses, and risk premiums. In the few cases for which we do find statistical evidence of a possible effect, it tends to be short-lived or not economically significant.

Keywords: interventions, expected exchange rate, emerging market economies, risk-neutral density

JEL classification: E5, F31, G12

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Banco de México.

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Introduction

As part of the recent global financial crisis's aftermath, the unprecedented monetary policy stances in advanced countries have provided leeway for significant surges in capital flows. At the same time, significant variations in risk appetite and global financial volatility have impacted the rate with which capital flows enter and exit emerging market economies. Although capital flows undoubtedly provide benefits to the recipient countries, eg more financing, improved risk-return profiles, and a lower cost of capital, they surely entail potential costs, eg sudden stops, abrupt currency depreciation, and loss of competitiveness, asset price bubbles, and risk mispricing. In this context, some policy makers have responded by intervening in their exchange rate markets with different specific aims, along with implementing other policy measures.

Central to interventions in the exchange rate markets is their effectiveness, a topic that has been a matter of debate. To assess their effect, a plethora of methods has been used (see, for example, Sarno and Taylor (2001)). Yet, comparisons are generally burdensome, as interventions are seldom analyzed together. It thus seems fitting to assess interventions in various emerging countries under a common methodology. Doing so presents some challenges but also has some key advantages, such as being able to make comparisons.

Against this backdrop, we assess the potential effects on the expected exchange rates in Brazil, Chile, Colombia, Mexico, and Peru due to interventions implemented by these countries. To this end, we proceed as follows. First, we obtain the risk-neutral densities from options data on the individual exchange rates. Second, we estimate key statistics based on these densities. Third, using a linear regression model, we analyze how these statistics might have changed as a result of the implementation of interventions in the respective exchange rate markets.

Literature review

We divide our abridged literature review into three parts. In the first, we recap a selected number of topics in the interventions literature germane to our paper. In the second, we cite relevant papers that extract the risk-neutral densities from options prices aiming to analyze how such distributions might have been affected by various economic events. In the last one, we briefly compare our paper to Miyajima and Montoro (2013), which is part of this volume.

First, whether an intervention is sterilized or not is crucial to its potential effects. On the one hand, provided there is no sterilization, the effects of an intervention are similar to those of an open market operation, as the monetary base is in effect changed. The key difference is that in an unsterilized intervention a central bank only uses foreign assets, while in an open market operation it only uses domestic assets.

On the other hand, for sterilized interventions, the literature has considered mainly two possible channels through which interventions might have an effect on the exchange rate. It is worth mentioning that all of the interventions we consider in this paper are in principle sterilized. The mentioned two possible channels are the portfolio balance and expectations or signaling channel, as we now explain.

In the portfolio balance channel, as an intervention takes place, e.g. when financial institutions buy dollars from the central bank, in the sterilization process the central bank buys domestic bonds from the public. Thus, the relative supply of domestic to foreign bonds decreases. If domestic and foreign bonds are imperfect substitutes then their relative price changes, thus leading, in our example, to an appreciation of the exchange rate. The converse effect takes place when financial institutions sell dollars to the central bank.

The expectations (or signaling) channel has an effect if participants perceive the intervention as signaling the central bank's intentions with regard to its future policy, for example, monetary stance (for example, see Mussa (1981)). For this channel to be operative, it is irrelevant whether domestic and foreign bonds are substitutes or not.

Another related issue is whether an intervention should be public, rules-based, and transparent, or discretionary and private. On the one hand, paraphrasing Kenen (1988), the rules of the exchange rate market need to be as transparent as possible to maintain credibility. Thus, the authorities have an incentive to convey their intentions to render the expectations channel more effective. On the other hand, Dominguez and Frankel (1993) have considered whether the authorities might have the incentive to minimize the effects of an intervention under some circumstances and, if such is the case, make it private and discretionary. We leave these issues aside and consider an intervention of the same type irrespective of whether it is rules-based or discretionary.

Second, extracting the risk-neutral distribution from options prices to see how it is affected by economic events is an interesting application of asset pricing. For example, Figlewski and Birru (2010) study how the risk-neutral distribution of the S&P 500 index changed through the fall of 2008. Abarca et al. (2012a) analyze how the risk-neutral distribution for the peso/dollar exchange rate changes with monetary policy announcements, while Abarca et al. (2012b) consider how the implementation of capital controls and banking regulations affect the risk-neutral distribution of the exchange rate in a group of emerging market economies.[4]

Gnabo and Teiletche (2008) and Roger and Siklos (2001) analyze the expected exchange rate using methods similar to those we use. The former paper studies how announcements impact the US dollar/Japanese Yen exchange rate risk-neutral density. The latter paper considers the interventions of the Bank of Canada and the Reserve Bank of Australia in their respective exchange rate markets. Here, volatility is measured using the implied volatility, and uncertainty is approximated with the kurtosis of the risk-neutral probability density function.

Finally, our paper is similar to Miyajima and Montoro's (2013), since both analyze the effects of interventions on exchange rate expectations. Yet ours differs in some key aspects. First, while they consider survey expectations, we consider market-based expectations. Second, we have access to daily data and densities for short-term horizons. In contrast, surveys typically entail data with lower frequencies

[4] Bayoumi and Saborowski (2012) have recently underscored the importance of analyzing interventions and capital controls together to adequately measure the effectiveness of interventions. Thus, a natural step in our study would be to consider how interventions and capital controls together (and perhaps with other macroprudential policies) might have affected the expected distribution of exchange rates. This is a topic where our paper and that of Abarca et al. (2012b) intersect. We leave this important exercise for future research.

and densities for longer horizons. Third, in a survey there is the issue of when exactly a piece of data was collected from each forecaster, which is not necessarily the same date as when the survey was published. Our data do not have this problem.

Interventions

Although different countries have different aims when intervening, common ones have been, among others, to reduce the volatility of the exchange rate and to provide liquidity to the exchange rate market. We leave the countries' stated aims aside and, as mentioned, study the effects on the expected exchange rate distribution by analyzing the possible effects on the risk-neutral density. This provides a way of examining an aspect of the expectations or signaling channel, possibly as an unintended effect.

Our sample includes five countries, Brazil, Colombia, Chile, Mexico, and Peru. The following country-specific descriptions refer to our database. Brazil is probably one of the most active countries in terms of intervening in the exchange rate market. We specifically consider those interventions implemented in the spot market (i.e. *Intervenção do Banco Central: mercado pronto*). Nonetheless, Brazil in addition intervenes actively in other markets, for example in the swap exchange rate market. To account for this fact, we estimate a regression controlling for three interventions not implemented in the spot market (i.e*. Intervenção do Banco Central: mercado a Termo, Leilões do Banco Central de swap cambial,* and *Leilões do Banco Central de swap cambial reverso*). The sample of interventions in the spot market is from 1999 1Q to 2012 2Q.

Chile has been relatively active intervening in the exchange rate market. We consider those Chilean interventions involving the selling and buying of US dollars through auctions (i.e. *compra y venta de dólares por licitación*). The recent Chilean intervention activity can be characterized by three periods, an initial buying period from 2008 2Q to 2008 3Q; second, a selling period from the middle of 2009 1Q to the middle of 2009 4Q; and finally, a buying period from 2011 1Q to 2011 4Q.

Colombia has also intervened in the exchange rate market in recent years. They have done so for the most part buying dollars through auctions (i.e. *subastas de compra directa de dólares*). We consider those interventions which started around 2008 3Q and have also taken place more recently.

For the case of Mexico, we similarly consider all of the interventions implemented in the spot market in recent years, except for one for which detailed data are not publicly available.[5] More specifically, our database has interventions from 1997 4Q to part of 2013 1Q. It is worth mentioning that Mexico has mostly implemented interventions involving the sale of US dollars through auctions. The

[5] This type of intervention took place on September 10, 1998, and in a second period on February 4, 5, 6, 20, 23, and 27, 2009.

one exception is the intervention aiming to increase the rate of reserves accumulation, which involves the sale to banks of US dollar put options.[6]

Finally, Peru has intervened in the exchange rate market at least since 2003 1Q. It typically has sold and bought dollars in the spot market. The case of Peru stands out for the fact that its exchange rate market's turnover is small relative to its international reserves, which can be considered an advantage in terms of its interventions' potential.

In addition, central to our study are two common characteristics of these economies. First, they are small open economies. Thus, for each country, the exchange rate is a fundamental price in its economy. Second, they all essentially have floating exchange rate regimes, which implies that (at least, in some cases, nominally) none of these countries targets its exchange rate.

In sum, we are only considering broadly similar interventions, in the sense that they are all implemented in the spot market. This is so, mainly to make the comparison as direct as possible. In addition, in emerging market economies the most common place in which interventions take place is typically the spot market, with Brazil being an exception.

Data and methodology

Data

Some preliminary comments are in order. The theoretical price of an option is a function of several parameters, including the volatility of the underlying asset's return. All of the parameters are observable except for this volatility. The implied volatility is such that the option's theoretical price equals its observed market price, having plugged all of the other parameters into the formula. Similarly, some options' characteristics such as the delta, defined as the partial derivative of the option's value with respect to the underlying asset, are a function of a set of parameters including the volatility. It is customary for options data to be provided in terms of the implied volatilities of specific positions on derivatives' deltas.

More specifically, we use daily data on the implied volatility of 10 and 25 risk reversals (RR), 10 and 25 butterflies (BF), and at-the-money (ATM) options. For example, the 10 risk reversal implied volatility (denoted by V) is the difference between the 10 Delta Call and the 10 Delta Put implied volatilities.

V(RR 10) = V(10 Delta Call) – V(10 Delta Put)

where the 10 refers to the value of the delta (0.1) of the associated call or put. In this case the underlying is the exchange rate (local currency per US dollar). The 10 butterfly is defined as:

V(BF 10) = (V(10 Delta Call) + V(10 Delta Put)) /2 – V(ATM)

[6] There were two episodes in which such interventions were active: first, from August 1996 to June 2001, and then from February 2010 to November 2011. Since these interventions were not implemented in the spot market they are not considered as part of our data base, as explained in the main text.

Likewise, for the 25 risk reversals, 25 butterfly, and ATM option we have:

V(RR 25) = V(25 Delta Call) – V(25 Delta Put)

V(BF 25) = (V(25 Delta Call) + V(25 Delta Put)) /2 – V(ATM)

This set of equations indicates that, in terms of implied volatilities, we have the following relationships:

V(25 Put) = V(BF 25) + V(ATM) – V(25 RR)/2

V(10 Put) = V(BF 10) + V(ATM) – V(10 RR)/2

V(10 Call) = V(BF 10) + V(ATM) + V(10 RR)/2

V(25 Call) = V(BF 25) + V(ATM) + V(25 RR)/2

where the implied volatility for a call (or a put) at-the-money gives us the implied volatility associated to a delta close to 50 (i.e. 0.5). This set of equations provides us with five (delta, implied volatility) data points for each day.

We use daily data on: the exchange rates, each country's one-month risk-free rate, and the one-month risk-free rate of the US. Since one of our aims is to compare the effects across countries, we chose comparable rates across them. We found that comparable risk-free rates with shorter horizons are not available for some countries in our sample. Also, interest rates with small differences in horizons (i.e. close to a month) have very high correlations. The risk-free rate from the US is needed for the options pricing.[7] Thus, the rates we use are representative of short-term horizon rates.[8]

Data description

Table 1

Data Description

	Interventions		Options		Interest Rates		Exchange Rates	
	Start	End	Start	End	Start	End	Start	End
Brazil	27-Oct-99	15-Feb-15	5-Jan-06	28-Feb-13	28-Mar-07	28-Feb-13	4-Jan-00	28-Feb-13
Chile	5-Jan-08	16-Dec-11	11-Sep-06	28-Feb-13	30-Sep-05	28-Feb-13	4-Jan-00	28-Feb-13
Colombia	29-Feb-00	31-Jan-13	11-Sep-06	28-Feb-13	1-May-06	28-Feb-13	4-Jan-00	28-Feb-13
Mexico	27-Oct-97	28-Feb-13	5-Jan-06	28-Feb-13	11-Aug-03	28-Feb-13	4-Jan-00	28-Feb-13
Peru	3-Jan-03	28-Feb-13	17-Jun-08	28-Feb-13	16-Jul-98	28-Feb-13	4-Jan-00	28-Feb-13
US	-	-	-	-	31-Jul-01	28-Feb-13	-	-

Sources: The interventions data are from the respective Central Banks' websites, except for Peru, for which they were obtained directly from the Bank. Options, Interest Rates, and FX Data are from Bloomberg.

[7] It is analogous to considering the dividend (rate) of a stock of a company when pricing an option.

[8] We could have also used target rates that are generally available across countries. Yet, these commonly do not include the markets' high frequency information.

A dummy variable is constructed based on the intervention data, as we explain in more detail below. Our country sample is in Table 1 with the periods for each data category. We could have considered other countries, but as mentioned, we were unable to obtain access to all the necessary data to perform a complete analysis.[9]

One would like to consider the complete periods where interventions take place. However, the linear regressions we estimate have a common component that involves data from all the countries in the sample. This is one of the reasons we were forced to leave some countries out of our study. In short, the time series' dates have to coincide.

In addition, one can presuppose a potential break point as part of the recent financial global crisis, with respect to a number of parameters in any model considered. Thus, bearing in mind both elements, the specific period we use for our estimation goes from January 1, 2009 to February 28, 2013. The idea in choosing this initial date is that agents at the time had gained "full" knowledge of the crisis's full force and implications. In other words, a "new normal" regime had been generally assimilated.

We consider two horizons in the options data, one-day and one-week. This allows for examining the effects of the interventions for various horizons. Although there are options data available for longer horizons, we thought it was unlikely that there would be an effect on longer horizons. This is in line with what we later found in our estimations: as will be seen in the estimated models below, any possible effect fades away rather swiftly.

Methodology

Derivatives are typically priced based on their associated so-called risk-neutral density. Its use greatly simplifies many asset-pricing problems, although the name can be considered a misnomer, as no agent is risk-neutral in the option pricing model. Its interpretation should be conducted with some caution. For example, an increase in the risk-neutral probability must be due either to an increase in the real probability of the underlying asset having a set of values, or to an increase in the marginal utility of the representative agent in the states of nature associated to the referred set of values of the underlying asset.[10]

We obtain the implied volatilities on several derivatives on the exchange rate for various horizons, as explained. These implied volatilities are typically reported as a function of the deltas and as a function of the option that is at-the-money, i.e. the current price of the underlying asset equals the strike price. Next, we directly obtain the implied volatilities as a function of the strike prices. Then we use spline interpolation to obtain a denser set of strike prices, each one being associated to a

[9] We would be grateful if any of our readers would call our attention to data sets available with a daily frequency, specifically any including options market data and interventions.

[10] Technically, we have assumed that the real probability distribution and the risk-neutral distribution are absolutely continuous measures with respect to each other. Intuitively, this means that if one distribution assigns zero probability to an event, the other one does as well. Then, as a result of the Girsanov Theorem, these densities differ only in their means. What is relevant to us is that we are generally able to take the risk neutral distribution's moments as bona fide moments, except for the first one.

level of implied volatility. In turn, we find the prices of various calls and puts based on strike prices and their implied volatilities. Finally, we make use of the formula due to Breeden and Litzenberger (1978) to extract the risk-neutral density as a function of the calls' and puts' values second partial derivatives with respect to the underlying asset.

In what follows we describe our method in more detail. To this end, we consider a fixed horizon, for example one week. Thus, for every period t, we proceed with the following steps.

1. From the data in terms of the 10 and 25 risk reversals, the 10 and 25 butterflies, and the at-the-money option, we calculate the implied volatilities associated with 10 call and put, 25 call and put, and the at-the-money call, as a function of the associated deltas, i.e. data points in the (deltas, implied volatilities) space.

2. Then, we estimate the implied volatilities as a function of the strike prices, i.e. data points in the (strike prices, implied volatilities) space.

3. We obtain a denser set of strike prices using spline interpolation. The interval was initially constructed considering the historical behavior of the exchange rates, and revised to completely include the densities' supports.[11]

4. Using Breeden and Litzenberger (1978) formulae, we then obtain the probability density function of the underlying asset, in this case the exchange rates:

   $$f(K) = \exp(rT)\frac{\partial^2 C}{\partial K^2} = \exp(rT)\frac{\partial^2 P}{\partial K^2}$$

   where C and P are the value of the call and the put, respectively. Their discrete counterparts are used to approximate the partial derivatives. It is worth mentioning that we only consider options that are either in the money or at-the-money.

5. Finally, from the risk-neutral density function, *f*(K), we estimate five key statistics: the mean, the volatility, the skewness, the kurtosis, and the risk premium.

The formula proposed by Breeden and Litzenberger (1978) is quite general. In particular, it does not assume the same volatility for different strike prices; thus, the so-called volatility surface as observed in the data is accounted for. This is key to our results, as strictly assuming the Black and Scholes framework would remove much flexibility from our analysis. Otherwise, the spot exchange rate and the implied volatility would be sufficient statistics to obtain the complete risk-neutral density.

This approach has the clear advantage of being based on market information and not merely on expectations, as can be the case when using surveys. Although there is a reputational aspect to surveys, market information is based on prices that agents use to make buying and selling decisions. Centrally, using market-based expectations allows for daily frequency data and short horizons, which is considered a key aspect in the analysis of interventions.[12]

[11] A probability density's support is the set in its domain for which it is strictly positive.

[12] One could also consider expectations based on surveys, but the frequency in the data would probably be fortnightly or, perhaps, lower.

Thus, we specifically estimate the following linear model:

$$s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} I_{t-1,c} + \beta_{2,c,i} CF_{t,-c,i} + \beta_{3,c,i} s_{t-1,c,i} + e_{t,c,i}$$

where t is the time period (day), c is the country (c = Brazil, Chile, Colombia, Mexico, or Peru), and i is the type of statistic estimated based on the risk-neutral density. Thus, $s_{t,c,i}$ is the statistic i (i = mean, volatility, skewness, kurtosis, or risk premium) of the risk-neutral distribution on day t, for country c.

$I_{t-1,c}$ is the intervention dummy variable, which equals one if there is an intervention that involves buying dollars on day t-1 in country c, minus one if the intervention involves the sale of dollars, and zero in any other case.

We use intervention in period t-1 to mitigate potential simultaneity in our regressions. In this context simultaneity might be an issue, as the variable $I_{t,c}$ might depend on $s_{t,c,i}$. Thus, the information used to decide whether to intervene (in the discrete case) or the information used by the triggering rule (in the rules-based case) in t-1 occurs before the data to price the option is determined in t.

$CF_{t,-c,i}$ is a common factor or component. Following Abarca et al. (2012b), this factor is defined as the average of the percentage changes in $s_{t,-c,i}$ for all the countries in the sample except for c, hence the notation –c. Specifically, $CF_{t,-c,i} = (\Delta\% s_{t,1,i} + ... + \Delta\% s_{t,c-1,i} + \Delta\% s_{t,c+1,I} + ... + \Delta\% s_{t,N,i})/(N-1)$, where $\Delta\%x$ denotes the percentage change of x, and N is the number of countries in our sample. Thus, this factor controls for various macroeconomic and financial effects that could be affecting the exchange rates markets jointly.

The lagged term $s_{t-1,c,i}$ accounts for the possible presence of autocorrelation in the error term of the same regression but without such term. Recall that the data frequency is daily. Thus, the presence of autocorrelation in the error term is very likely. Finally, $e_{t,c,i}$ is the error term associated with time period t, country c, and statistic i.

A common way of defining a risk premium is to consider the percentage change of the real probability density's mean against the risk-neutral density's mean. Although this would be an ideal situation, it is statistically difficult to accurately estimate the (real) probability density of the exchange rate. Thus, we approximate this risk premium with the realized value of the exchange rate, as follows:

$$\text{Risk Premium} = (\mathbf{E}_t(S_T) - \mathbf{E}_t^*(S_T)) / \mathbf{E}_t^*(S_T) \cong (S_T - \mathbf{E}_t^*(S_T)) / \mathbf{E}_t^*(S_T)$$

where * denotes that this expected value is taken with respect to the risk-neutral probability, S_T is the value of the exchange rate at time T, and $\mathbf{E}_t(S_T)$ is the expected value of the exchange rate at time T taken with respect to the real probability at time t, where it is assumed that t<T.

Results

To set the stage, consider the average of the five statistics we are analyzing for the countries in our sample (Table 2), and the coefficient of variation (defined as the ratio of the volatility over the mean). Several comments are in order. First, the means reflect the averages of the exchange rates. Recall that their expected growth rate through time is adjusted under the risk-neutral distribution. Second, as the horizon increases, the volatility increases, as one would expect to observe.

Average statistics for the expected distribution of the exchange rates Table 2

	Mean	Volatility	Coefficient of variation	Skewness	Kurtosis	Risk Premium
Horizon One day						
Brazil	1.86379 [0.193]	0.01871 [0.0092]	0.01004	0.02892 [0.0197]	2.99581 [0.0158]	-0.00589 [0.0093]
Chile	509.50393 [38.6303]	4.89185 [2.418]	0.00960	0.04385 [0.0339]	3.00391 [0.0074]	-0.00272 [0.0067]
Colombia	1924.18072 [176.1797]	17.41341 [7.4563]	0.00905	0.02857 [0.0149]	3.00120 [0.004]	-0.00304 [0.0067]
Mexico	12.96482 [0.6879]	0.12341 [0.0568]	0.00952	0.03406 [0.0237]	3.00270 [0.0053]	-0.00310 [0.0082]
Peru	2.80703 [0.1552]	0.01456 [0.0102]	0.00519	0.01604 [0.0394]	2.95523 [0.1695]	-0.00386 [0.0026]
Horizon One week						
Brazil	1.86625 [0.1933]	0.03868 [0.0186]	0.02073	0.08221 [0.0368]	3.01558 [0.0161]	-0.00752 [0.0186]
Chile	509.29340 [37.5895]	9.80394 [5.0021]	0.01925	0.10303 [0.1525]	2.99994 [0.085]	-0.00339 [0.0162]
Colombia	1923.14999 [172.1936]	35.50612 [16.6277]	0.01846	-0.00169 0.09209 [0.1458]	2.99826 [0.0951]	-0.00326 [0.0172]
Mexico	12.98162 [0.6878]	0.25556 [0.1096]	0.01969	0.07793 [0.0402]	3.01212 [0.0154]	-0.00446 [0.0172]
Peru	2.80814 [0.1555]	0.02752 [0.0221]	0.00980	0.04607 [0.0241]	3.00101 [0.0111]	-0.00494 [0.0055]

The mean and volatility are in local currency per USD. The risk premium is in percentage for the respective time period. Standard deviations are in brackets.

Since the mean and volatility are not comparable across countries, the coefficient of variation is included. Its value is very similar across countries, and it visibly increases as the horizon rises.

As for the skewness, which captures the degree of asymmetry in the density function, all five countries share the same two properties. Namely, they are positive and increase with the horizon. This means that these exchange rates have a right tail that is slightly fatter, indicating proportionally a greater probability of potential depreciations. Also, as the horizon increases, the densities deviate further from a normal distribution.

With respect to the kurtosis, the exchange rates seem to behave similarly. In effect, all values are around three, close to a normal distribution in this respect, and have a similar value as the horizon increases.

As for the average risk premium, all of the estimates are close to zero. The largest absolute values are associated with Brazil, regardless of the horizon. These are followed by Colombia, which is, in turn, closely followed by Chile and Mexico. A negative risk premium entails an appreciation of the local currency or a higher local short-term rate compared to the one in the US.

In addition, these statistics are useful to get an idea of the statistics' magnitudes for the different horizons considered. More specifically, the standard deviations provide a yardstick to assess the economic significance of the expected exchange rates' variations due to the interventions, which will be useful when we comment on the estimations of the linear model.

Moving on to our main results, we now consider the estimates of the different variants of our linear model. In our tables, the statistic being considered is constant; what changes along the rows are the countries. The one-day and one-week horizons are included in that same order. Starting with the mean and the one day-horizon (Table 3), several comments are in order. In terms of the intervention, there seems to be no statistically significant effect for any of the countries. Note that under the risk-neutral distribution the expected growth rate of the exchange rate is the domestic risk-free rate minus the US risk-free rate. Thus, one would expect not to observe economically significant effects, as these interventions are sterilized. On the other hand, the common factor certainly plays a role with respect to the determination of the expected exchange rate. For all the countries, the associated coefficients are statistically significant. This underscores the relevance of the common factors determining the exchange rate dynamics.

Second, considering the volatilities and a one-day horizon (Table 4), the interventions seem to have an effect in the Mexican and the Peruvian cases. In these cases, an intervention entailing a sale of dollars (a negative intervention dummy) seems to imply a slight increase in volatility. Moreover, the coefficients are only 10% and 1% of the standard deviations (Table 2) of the respective volatilities, not economically significant effects. As for the one-week horizon, no country seems to show a statistically significant variation in its exchange rate volatility due to an intervention. Similarly, for both horizons the common factor is significant for most cases. This bespeaks the important role played by the common factors in determining the exchange rate volatility.

Third, considering the one-day horizon skewness (Table 5), Brazil, Mexico and Peru show statistically significant effects. A dollar sale is associated with a decrease of 0.00154 in the Brazilian case, and with increases of 0.0033 and 0.00985, in the Mexican and Peruvian cases, respectively, as regards the exchange rate distributions' skewness. For Brazil, it implies a slight decrease in the probability of an abrupt depreciation, while for Mexico and Peru it implies a marginal increase in the probability of an abrupt depreciation. Moreover, these stand for changes near 7%, 13% and 24% in terms of the respective standard deviations of their skewness (Table 2), hardly economically significant. As for the one-week horizon, only Chile has a statistically significant coefficient associated with an intervention. Yet, it is only 1% of the standard deviation of the skewness for a one-week horizon, and thus of no economic significance. With respect to variations in skewness, one should also consider the following. For example, an increase in skewness implies an increase in the probability of an abrupt depreciation, but in tandem the probability mass of the distribution tends to move towards the left of the median, thus assigning greater probability to a small appreciation.

With respect to the kurtosis for a one-day horizon (Table 6), three countries seem to show a potential effect, namely, Chile, Mexico, and Peru. For all three cases, the kurtoses increase when selling dollars as part of an intervention. The associated changes are barely economically significant, representing 26%, 18%, and 31% of their respective standard deviations (Table 2). An increase in the kurtosis, reflecting fatter tails, means an increase in the probability of an extreme appreciation or depreciation. Moreover, for the one-week horizon no estimation seems to reflect a statistically significant effect.

Fifth, as for the risk premium (Table 7), for the two horizons and five countries considered there seem to be no statistically significant effects at all. As a caveat, one should take the estimates for the one-day horizon with caution, as in this case the R^2's are low.

Some comments on two additional extensions to our model are as follows. First, if one considers a two-week horizon (estimates not reported), the results are similar, which is not surprising. In the cases for which the coefficients associated with the interventions that are statistically significant, they are not economically significant.

Second, hitherto we have not considered the fact that Brazil actively intervenes in other markets besides the spot market. To account for this difference we estimate the following model: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i}I_{t-1,c} + \beta_{2,c,i}CV_{t-1,c} + \beta_{3,c,i}CF_{t,-c,i} + \beta_{4,c,i}s_{t-1,c,i} + e_{t,c,i}$, where all the variables are defined as usual, and in addition $CV_{t-1,c}$ is a control variable which equals one if an intervention in one of the three markets other than the spot market has taken place at time t-1 and it is zero in other cases. For these three markets only one dummy is used since it is only very rarely that interventions in these markets take place on the same day, and since we are mainly interested in understanding interventions in the spot exchange rate markets. Similarly, the estimation is done for two horizons and for the five statistics we have thus far considered. Interestingly enough, it is only for the one-day horizon and skewness (Table 8 in the appendix) that the intervention dummy is now statistically significant. It stands out that the control dummy, which involves those interventions in associated markets, is generally not statistically significant.

All in all, although there were some minor differences in the more general regressions for the Brazilian case, our results for the most part stand. Effects on the expected exchange rate, when statistically significant, are generally economically not significant or short-lived.

Estimated linear model for the mean

Table 3

	Mean			
	Constant	Int. Dummy	Common Comp.	Lagged variable	R-squared/F-stat.
Horizon	**One day**				
Brazil	0.01049 *	0.00037	0.62033 *	0.99452 *	0.99463
	(0.00568)	(0.00103)	(0.02388)	(0.00285)	66624.88462
	(0.00511)	(0.00090)	(0.03655)	(0.00265)	
Chile	3.64132 *	-0.16850	79.18348 *	0.99266 *	0.99370
	(1.44581)	(0.18034)	(4.42433)	(0.00282)	56777.53113
	(1.76473)	(0.22898)	(6.32834)	(0.00349)	
Colombia	2.51260	0.37866	338.76077 *	0.99847 *	0.99537
	(5.12064)	(0.88754)	(17.56114)	(0.00250)	77363.65492
	(9.34354)	(0.90523)	(27.74882)	(0.00483)	
Mexico	0.11317 *	-0.00908	3.73233 *	0.99131 *	0.98505
	(0.05079)	(0.00773)	(0.13645)	(0.00394)	23724.20935
	(0.05743)	(0.01179)	(0.23985)	(0.00453)	
Peru	0.00518	-0.00022	0.13751 *	0.99802 *	0.99807
	(0.00442)	(0.00047)	(0.00874)	(0.00155)	186489.59065
	(0.00574)	(0.00037)	(0.01746)	(0.00206)	
Horizon	**One week**				
Brazil	0.01187 *	0.00056	0.59960 *	0.99381 *	0.99427
	(0.00587)	(0.00107)	(0.02518)	(0.00294)	62519.22684
	(0.00567)	(0.00090)	(0.03554)	(0.00294)	
Chile	2.58067	-0.08958	72.27480 *	0.99477 *	0.99340
	(1.49427)	(0.18150)	(4.47064)	(0.00291)	54162.23043
	(1.76956)	(0.22879)	(7.48654)	(0.00350)	
Colombia	3.74109	0.39571	303.16306 *	0.99781 *	0.99456
	(5.56903)	(0.94482)	(18.84352)	(0.00273)	65867.24622
	(9.54990)	(0.91190)	(29.74545)	(0.00494)	
Mexico	0.12079 *	-0.01104	3.79713 *	0.99070 *	0.98511
	(0.05076)	(0.00772)	(0.13983)	(0.00393)	23819.80557
	(0.05606)	(0.01138)	(0.23891)	(0.00441)	
Peru	0.00565	-0.00026	0.13865 *	0.99786 *	0.99806
	(0.00444)	(0.00047)	(0.00897)	(0.00155)	185221.17805
	(0.00596)	(0.00038)	(0.01770)	(0.00214)	

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i}I_{t-1,c} + \beta_{2,c,i}CF_{t,-c,i} + \beta_{3,c,i}s_{t-1,c,i} + e_{t,c,i}$. The dependent variable is the mean. The first column indicates the country considered in the regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$, and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

Estimated model for the volatility

Table 4

	Volatility												
	Constant		Int. Dummy		Common Comp.		Lagged variable			R-squared/F-stat.			
Horizon	**One day**												
Brazil	0.00130	*	0.00005		0.00656	*	0.91871	*		0.853			
	(0.00030)		(0.00021)		(0.00033)		(0.01219)			2095.388			
	(0.00030)		(0.00020)		(0.00050)		(0.01433)						
Chile	0.11067	*	-0.03960		0.13562	*	0.97474	*		0.962			
	(0.03548)		(0.02580)		(0.02957)		(0.00645)			9127.598			
	(0.04519)		(0.02401)		(0.03702)		(0.01035)						
Colombia	0.43043	*	-0.10743		1.16846	*	0.97349	*		0.955			
	(0.18736)		(0.11683)		(0.10308)		(0.00781)			7697.733			
	(0.21631)		(0.10909)		(0.22776)		(0.01078)						
Mexico	0.00801	*	-0.00620	*	0.04827	*	0.91493	*		0.866			
	(0.00156)		(0.00195)		(0.00202)		(0.01219)			2319.466			
	(0.00157)		(0.00175)		(0.00330)		(0.01480)						
Peru	0.00009		-0.00007	*	0.00007		0.99314	*		0.995			
	(0.00005)		(0.00005)		(0.00004)		(0.00242)			68431.811			
	(0.00005)		(0.00003)		(0.00005)		(0.00347)						
Horizon	**One week**												
Brazil	0.00065	*	-0.00006		0.00777	*	0.97955	*		0.978			
	(0.00024)		(0.00016)		(0.00043)		(0.00469)			16234.707			
	(0.00032)		(0.00015)		(0.00275)		(0.00869)						
Chile	0.28980		-0.07801		0.93984	*	0.96792	*		0.961			
	(0.07138)		(0.05343)		(0.14109)		(0.00645)			8839.313			
	(0.17076)		(0.06421)		(0.34224)		(0.01858)						
Colombia	2.51068		-0.84739		4.96217	*	0.94041	*		0.910			
	(0.53765)		(0.35926)		(0.74971)		(0.01077)			3632.707			
	(1.99066)		(0.75768)		(2.02030)		(0.04611)						
Mexico	0.00555	*	-0.00171		0.05258	*	0.97514	*		0.967			
	(0.00154)		(0.00182)		(0.00314)		(0.00582)			10655.462			
	(0.00147)		(0.00212)		(0.01912)		(0.00670)						
Peru	0.00075		-0.00011		0.00051	*	0.97157	*		0.952			
	(0.00029)		(0.00032)		(0.00074)		(0.00731)			7152.588			
	(0.00064)		(0.00020)		(0.00024)		(0.02336)						

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} I_{t-1,c} + \beta_{2,c,i} CF_{t,-c,i} + \beta_{3,c,i} s_{t-1,c,i} + e_{t,c,i}$. The dependent variable is the volatility. The first column indicates the country considered in the regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$, and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

Estimated model for skewness

Table 5

	Skewness			
	Constant	Int. Dummy	Common Comp.	Lagged variable	R-squared/F-stat.
Horizon	**One day**				
Brazil	0.00570 *	0.00154 *	9.54E-05	0.82782 *	0.715
	(0.00073)	(0.00063)	(8.20E-05)	(0.01687)	903.996
	(0.00085)	(0.00064)	(7.84E-05)	(0.02125)	
Chile	0.01308	-0.00713	5.76E-06	0.70275 *	0.743
	(0.00084)	(0.00086)	(1.12E-05)	(0.01523)	1041.577
	(0.00707)	(0.00398)	(3.69E-06)	(0.15994)	
Colombia	0.01232 *	-0.00240	7.21E-06 *	0.61315 *	0.412
	(0.00093)	(0.00071)	(8.29E-06)	(0.02389)	252.167
	(0.00525)	(0.00144)	(1.44E-06)	(0.15638)	
Mexico	0.00482 *	-0.00330 *	-8.74E-07	0.84148 *	0.761
	(0.00062)	(0.00112)	(8.39E-06)	(0.01654)	1147.372
	(0.00090)	(0.00135)	(1.16E-06)	(0.02732)	
Peru	0.01288 *	-0.00985 *	1.14E-06	0.36984 *	0.168
	(0.00137)	(0.00216)	(2.64E-05)	(0.02810)	72.912
	(0.00240)	(0.00299)	(2.23E-06)	(0.10155)	
Horizon	**One week**				
Brazil	0.00152 *	-0.00016	0.00064	0.97829 *	0.971
	(0.00053)	(0.00036)	(0.00020)	(0.00520)	12266.000
	(0.00047)	(0.00032)	(0.00036)	(0.00609)	
Chile	0.01065 *	-0.00169 *	0.00207	0.88621 *	0.834
	(0.00224)	(0.00305)	(0.00231)	(0.01207)	1808.278
	(0.00379)	(0.00080)	(0.00196)	(0.04510)	
Colombia	0.00972	-0.00488	0.00222	0.92264 *	0.860
	(0.00291)	(0.00343)	(0.00185)	(0.01172)	2207.438
	(0.00561)	(0.00296)	(0.00182)	(0.05743)	
Mexico	0.01047	0.00039	0.00173	0.86450 *	0.755
	(0.00132)	(0.00177)	(0.00065)	(0.01547)	1110.463
	(0.00616)	(0.00160)	(0.00121)	(0.07957)	
Peru	0.00128	-0.00013	0.00014	0.97105 *	0.949
	(0.00043)	(0.00035)	(0.00027)	(0.00747)	6752.135
	(0.00092)	(0.00021)	(0.00008)	(0.02017)	

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} i_{t-1,c} + \beta_{2,c,i} CF_{t,-c,i} + \beta_{3,c,i} s_{t-1,c,i} + e_{t,c,i}$. The dependent variable is the skewness. The first column indicates the country considered in the regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$, and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

Estimated model for the kurtosis

Table 6

	Kurtosis											
	Constant		Int. Dummy		Common Comp.		Lagged variable		R-squared/F-stat.			
Horizon	**One day**											
Brazil	1.64746	*	-0.00096		-0.00064		0.44991	*	0.203			
	(0.08132)		(0.00081)		(0.00545)		(0.02714)		91.897			
	(0.21498)		(0.00116)		(0.00429)		(0.07183)					
Chile	1.36122	*	-0.00196	*	-0.00008		0.54694	*	0.556			
	(0.05421)		(0.00022)		(0.00158)		(0.01805)		451.300			
	(0.48799)		(0.00077)		(0.00051)		(0.16242)					
Colombia	1.52742	*	-0.00045		0.00034		0.49114	*	0.253			
	(0.07925)		(0.00021)		(0.00134)		(0.02640)		121.928			
	(0.45270)		(0.00028)		(0.00027)		(0.15081)					
Mexico	0.76456	*	-0.00096	*	0.00106		0.74532	*	0.614			
	(0.06089)		(0.00031)		(0.00126)		(0.02028)		573.143			
	(0.19243)		(0.00037)		(0.00059)		(0.06409)					
Peru	2.11601	*	-0.05266	*	-0.41310		0.28905	*	0.124			
	(0.08583)		(0.00954)		(0.73612)		(0.02884)		50.738			
	(0.39934)		(0.01262)		(0.63069)		(0.13410)					
Horizon	**One week**											
Brazil	0.09241	*	0.00004		-0.00955	*	0.96933	*	0.964			
	(0.01812)		(0.00018)		(0.00251)		(0.00600)		9504.085			
	(0.03014)		(0.00015)		(0.00422)		(0.01001)					
Chile	0.61981	*	-0.00055		0.35437		0.79373	*	0.762			
	(0.04062)		(0.00191)		(0.04169)		(0.01354)		1155.621			
	(0.15215)		(0.00051)		(0.23649)		(0.05055)					
Colombia	0.45212		0.00355		0.67345		0.84841	*	0.712			
	(0.04941)		(0.00313)		(0.07897)		(0.01651)		891.609			
	(0.27614)		(0.00286)		(0.52800)		(0.09157)					
Mexico	0.44755	*	-0.00237		0.06363	*	0.85126	*	0.758			
	(0.04503)		(0.00066)		(0.00638)		(0.01495)		1128.102			
	(0.20762)		(0.00146)		(0.02631)		(0.06899)					
Peru	0.07865		-0.00009		0.00040		0.97379	*	0.955			
	(0.02173)		(0.00016)		(0.00195)		(0.00723)		7631.919			
	(0.05793)		(0.00016)		(0.00036)		(0.01929)					

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} i_{t-1,c} + \beta_{2,c,i} CF_{t,-c,i} + \beta_{3,c,i} s_{t-1,c,i} + e_{t,c,i}$. The dependent variable is the kurtosis. The first column indicates the country considered in the regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$ and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

Estimated Linear model for Risk Premium

Table 7

	Risk Premium				
	Constant	Int. Dummy	Common Comp.	Lagged variable	R-squared/F-stat.
Horizon	**One day**				
Brazil	-0.00611 *	0.00035	-2.66E-07	-0.06738	0.005
	(0.00043)	(0.00053)	(2.45E-06)	(0.03041)	1.744
	(0.00043)	(0.00047)	(2.02E-06)	(0.03513)	
Chile	-0.00242 *	0.00016	-8.88E-07	0.11755 *	0.014
	(0.00022)	(0.00033)	(2.11E-06)	(0.03022)	5.225
	(0.00024)	(0.00034)	(8.81E-07)	(0.03408)	
Colombia	-0.00303 *	0.00063	-4.53E-06	0.12405 *	0.021
	(0.00032)	(0.00041)	(2.42E-06)	(0.03014)	7.810
	(0.00042)	(0.00044)	(3.19E-06)	(0.04206)	
Mexico	-0.00329 *	0.00053	-2.37E-06	-0.08179	0.009
	(0.00029)	(0.00071)	(2.15E-06)	(0.03034)	3.148
	(0.00029)	(0.00100)	(2.12E-06)	(0.04790)	
Peru	-0.00431 *	-0.00016	-8.30E-07 *	-0.12584	0.017
	(0.00014)	(0.00015)	(6.53E-07)	(0.03039)	6.376
	(0.00034)	(0.00014)	(4.13E-07)	(0.07884)	
Horizon	**One week**				
Brazil	-0.00184 *	0.00008	3.30E-06	0.75021 *	0.564
	(0.00054)	(0.00071)	(8.40E-06)	(0.02022)	462.628
	(0.00059)	(0.00067)	(5.29E-06)	(0.02334)	
Chile	-0.00060 *	0.00021	-2.20E-06	0.82899 *	0.688
	(0.00029)	(0.00046)	(6.21E-06)	(0.01712)	792.165
	(0.00030)	(0.00048)	(5.40E-06)	(0.01872)	
Colombia	-0.00083	0.00059	-1.47E-05 *	0.84005 *	0.709
	(0.00043)	(0.00057)	(1.10E-05)	(0.01649)	873.576
	(0.00061)	(0.00065)	(6.51E-06)	(0.01925)	
Mexico	-0.00113 *	-0.00023	-1.83E-06	0.75472 *	0.569
	(0.00038)	(0.00098)	(8.00E-06)	(0.02002)	473.924
	(0.00037)	(0.00134)	(9.29E-06)	(0.02596)	
Peru	-0.00113 *	-0.00002	-2.17E-06	0.77170 *	0.597
	(0.00015)	(0.00021)	(2.64E-06)	(0.01965)	529.914
	(0.00022)	(0.00020)	(1.62E-06)	(0.04070)	

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} i_{t-1,c} + \beta_{2,c,i} CF_{t,-c,i} + \beta_{3,c,i} s_{t-1,c,i} + e_{t,c,i}$. The dependent variable is the risk premium. The first column indicates the country considered in the regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$ and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

Final remarks

We have analyzed potential variations in the expected exchange rates of Brazil, Chile, Colombia, Mexico, and Peru given interventions implemented in these countries. The expected exchange rate distributions have been obtained implicitly from data on the derivatives market. These represent an advantage in terms of frequency, availability, and the fact that they are based on prices.

The leitmotif in our paper is clear; we find little statistical evidence of an effect on the exchange rates risk-neutral density given an intervention, and when we do, it tends to be short-lived or not economically significant

We believe that our results add to the evidence that the effects of interventions on the expected exchange rate are, if any, short-lived and economically not significant. In addition, it is clear that as the horizon increases the possibility of any effect swiftly vanishes. Moreover, in the cases of the mean and the volatility, to a great extent the common factor explains changes in the corresponding statistics, reflecting the relevance of economic fundamentals for the determination of the expected exchange rate. This poses in general a dilemma with respect to interventions in terms of their costs and benefits. In effect, if they are costly and at the same time have short-lived effects, then their use should be warranted only under truly exceptional circumstances.

Although our results seem robust in general, some caveats are in order. First, it seems worthwhile to incorporate more countries, something we will do as we gain access to more data. Second, the interventions analyzed have been in a sense considered as the same type, except that we have distinguished between selling and buying dollars. Third, there may be some limitations to the tools we have used to measure the interventions' effects. Fourth, in some cases, the fact that there is an existing rule that triggers the intervention might create a more significant effect in the expected exchange rate than does the actual intervention itself. Fifth, the benefits of interventions might be assessed considering other dimensions. Further research is warranted.

Appendix

Estimated linear model for Brazil with controls

Table 8

Brazil	Constant		Int. Dummy	Control	Common Factor		Lagged		R-squared /F-stat.
Mean	0.01047	*	0.00037	0.00012	0.62031	*	0.99452	*	0.9946
One Day	(0.00569)		(0.00104)	(0.00229)	(0.02390)		(0.00286)		49922.51
	(0.00511)		(0.00091)	(0.00277)	(0.03672)		(0.00265)		
Mean	0.01186	*	0.00056	0.00012	0.59957	*	0.99382	*	0.9943
One Week	(0.00588)		(0.00107)	(0.00237)	(0.02520)		(0.00295)		46846.12
	(0.00567)		(0.00091)	(0.00277)	(0.03573)		(0.00294)		
Volatility	0.00130	*	0.00004	-0.00043	0.00658	*	0.91894	*	0.8535
One Day	(0.00030)		(0.00021)	(0.00057)	(0.00033)		(0.01220)		1571.07
	(0.00030)		(0.00020)	(0.00045)	(0.00050)		(0.01421)		
Volatility	0.00066	*	-0.00009	-0.00072	0.00778	*	0.97963	*	0.9784
One Week	(0.00024)		(0.00016)	(0.00044)	(0.00043)		(0.00469)		12195.35
	(0.00031)		(0.00016)	(0.00043)	(0.00275)		(0.00841)		
Skewness	0.00571	*	0.00152 *	-0.00061	0.00010		0.82797	*	0.7152
One Day	(0.00073)		(0.00063)	(0.00170)	(0.00008)		(0.01688)		677.48
	(0.00085)		(0.00063)	(0.00082)	(0.00008)		(0.02125)		
Skewness	0.00153	*	-0.00017	-0.00030	0.00064		0.97829	*	0.9715
One Week	(0.00053)		(0.00036)	(0.00100)	(0.00020)		(0.00520)		9191.76
	(0.00047)		(0.00032)	(0.00088)	(0.00036)		(0.00606)		
Kurtosis	1.65054	*	-0.00100	-0.00153	-0.00043		0.44889	*	0.2037
One Day	(0.08147)		(0.00081)	(0.00230)	(0.00546)		(0.02719)		69.00
	(0.21550)		(0.00118)	(0.00203)	(0.00434)		(0.07200)		
Kurtosis	0.09234	*	0.00004	-0.00004	-0.00955	*	0.96936	*	0.9635
One Week	(0.01815)		(0.00018)	(0.00049)	(0.00251)		(0.00601)		7121.51
	(0.03008)		(0.00016)	(0.00043)	(0.00422)		(0.00999)		
Risk Premium	-0.00613	*	0.00037	0.00063	-2.85E-07		-0.06748		0.0050
One Day	(0.00043		(0.00053)	(0.00151)	(2.45E-06)		(0.03043)		1.35
	(0.00043		(0.00047)	(0.00136	(2.02E-06)		(0.03516)		
Risk Premium	-0.00183	*	0.00007	-0.00047	3.23E-06		0.75016	*	0.5635
One Week	(0.00054)		(0.00071)	(0.00199)	(8.41E-06)		(0.02023)		346.68
	(0.00059)		(0.00067)	(0.00152)	(5.27E-06)		(0.02333)		

The model is: $s_{t,c,i} = \beta_{0,c,i} + \beta_{1,c,i} l_{t-1,c} + \beta_{2,c,i} CV_{t-1,c} + \beta_{3,c,i} CF_{t,-c,i} + \beta_{4,c,i} s_{t-1,c,i} + e_{t,c,i}$.

The dependent variables are indicated above. The first column indicates the statistic and horizon considered in each regression. The second column corresponds to the estimate of $\beta_{0,c,i}$, the third to the estimate of $\beta_{1,c,i}$ and so forth. Below each estimate the ordinary standard errors are in parentheses. Further below, the HAC standard errors are in parentheses. An asterisk next to the estimate indicates that one fails to reject the null hypothesis that it is equal to zero with 95% confidence, based on the HAC standard error.

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Foreign exchange intervention in Peru

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Abstract

The unprecedented monetary expansion implemented by central banks in developed economies during recent years has induced an extraordinary flow of funds to emerging economies and supported high commodity prices. This has created upward pressures on the value of local currencies and a further expansion of available funds and lending. This situation gave rise to concerns about a possible misalignment of the real exchange rate relative to its equilibrium level, especially because it can be deemed a temporary response to the current phase of the cycle in developed economies, but with a potentially lasting negative impact on the tradable sector of the economy. In Peru, the response to this situation has been an intensification of sterilized intervention in the foreign exchange market and the use of reserve requirements on local banks' foreign currency liabilities, reinforcing macro-financial stability in an economy with a partially dollarized financial system. Both instruments have contributed significantly to reducing excessive exchange rate volatility, building up an international reserve buffer, and ensuring a normal flow of bank credit.

Keywords: monetary policy, central banking, foreign exchange intervention, reserve requirements

JEL classification: E52, E58, F31

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1. Introduction

The unprecedented monetary expansion implemented by central banks in developed economies during recent years has induced an extraordinary flow of funds to emerging economies and supported high commodity prices. This has created upward pressures on the value of local currencies and a further expansion of available funds and lending.

The response of Peruvian policy makers includes greater foreign exchange interventions and adjustments in reserve requirements by the Central Bank, accompanied by fiscal tightening and further prudential measures to prevent increases in foreign currency loans. The use of foreign exchange interventions as a possible tool needs to be assessed taking into account both the design and implementation of monetary policy. For this reason, this paper analyzes the difficulties associated with foreign exchange intervention and the possible solutions for facing them.

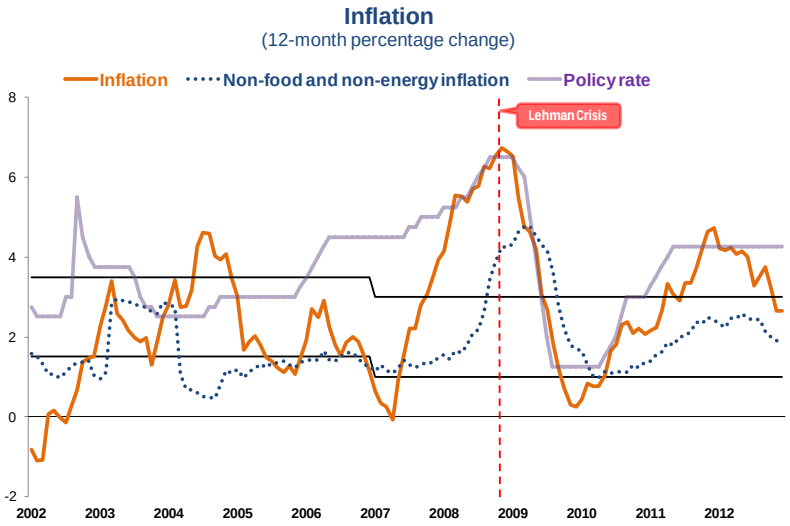
After introductory remarks in the first section, we explain in section two the general features of Peru's monetary policy framework, which can be characterized as a hybrid inflation targeting (IT) regime. Third, we discuss the general features and challenges of foreign exchange intervention as an instrument to address mainly macro-financial considerations in an economy with a partially dollarized financial system. Fourth, we assess the limitations of sterilization of foreign exchange interventions and the alternative policy tools used to ensure its effectiveness. In section five, the role of reserve requirement ratios (RRRs) imposed on banks' liabilities is explained, highlighting the strategy of using higher RRRs on dollar liabilities. Sixth, given the growing concern about a possible misalignment of the exchange rate from its equilibrium level, we discuss the estimation of the Equilibrium Real Exchange Rate (ERER) and the recent intensification of policy measures adopted to neutralize the currency appreciation resulting from the surge in capital inflows. The final section presents conclusions.

2. Monetary policy

Monetary policy in Peru follows an IT scheme, with the overnight interbank interest rate as operating target, with the aim of stabilizing the inflation rate at 2 percent ± 1 percent. Since 2002, the average annual inflation rate has been 2.6 percent and has been within the inflation target range in 39 percent of the months between January 2002 and January 2013.[4] Another important indicator for assessing this policy scheme is inflation expectations, which have remained well anchored within the target range in 92 percent of the months between January 2002 and January 2013.

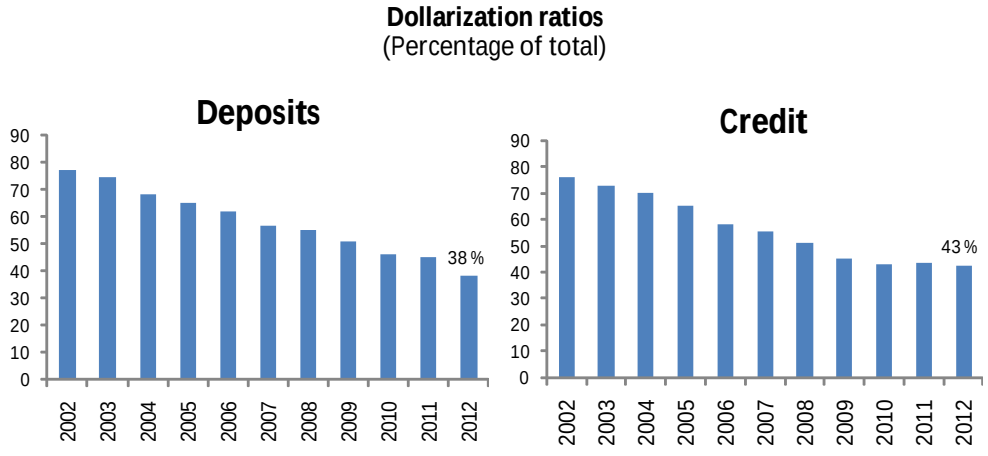
[4] The number of months with an inflation rate within the target range is 59 percent if we use the inflation indicator that excludes food and energy, the more volatile components of the CPI.

Figure 1



One characteristic of Peru's financial system is that an important share of its assets and liabilities are held in foreign currency. Even though this share has been declining in recent years, it is still an important source of financial vulnerability with respect to credit risks associated with abrupt movements in the exchange rate and risks associated with the availability of adequate levels of international liquidity. First, currency depreciation can increase the amount of non-performing loans and potentially induce a financial crisis. Second, banks' dependence on foreign currency liabilities can create pressures on international reserves when Central Bank liquidity support is needed. These two vulnerabilities have been identified by the Central Bank as the main reasons for intervening in the foreign exchange market and using higher RRRs on foreign currency liabilities.[5]

Figure 2



[5] Rossini and Quispe (2010) explain how the sudden stop of foreign credit lines during the 1998 Russian Crisis caused a deep financial crisis in Peru. A sharp depreciation and the decline of foreign funds paralyzed the flow of local credit, worsening the country's financial conditions. The two main lessons of this event were that foreign exchange intervention should be aimed at reducing exchange rate volatility, and that it is crucial to build a credible amount of international reserves in order to provide, when needed, liquidity support to financial intermediaries.

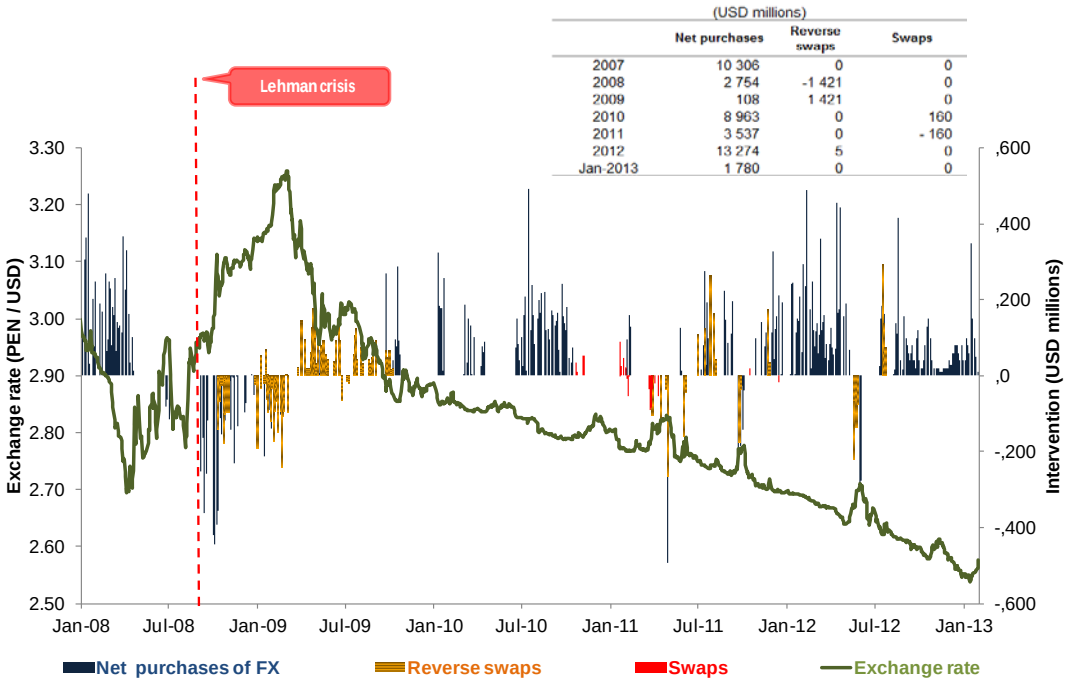
3. Foreign exchange intervention

The main purpose of foreign exchange intervention in Peru is to reduce the volatility of the exchange rate and to accumulate international reserves in order to prevent balance sheet effects on the partially dollarized financial position of the domestic private sector. Dollarization amplifies the reaction of financial intermediaries to sharp movements in their funding or to high exchange rate volatility. As a result, the economy is prone to credit booms and busts associated with flows of foreign currency deposits, foreign credit lines or other capital flows, and to exchange rate movements that affect the quality of the credit portfolio. Dollarization therefore alters the transmission mechanism of monetary policy and increases the liquidity and solvency risks of the financial system.

Foreign exchange interventions are carried out avoiding any signaling about the level of, or a possible ceiling or floor for, the exchange rate. No announcement regarding the amount of the interventions is made, because having to adjust this amount could have a high cost, and because the volatile nature of foreign exchange flows requires a more discretionary approach to Central Bank intervention.

Figure 3

Nominal exchange rate and net FX intervention



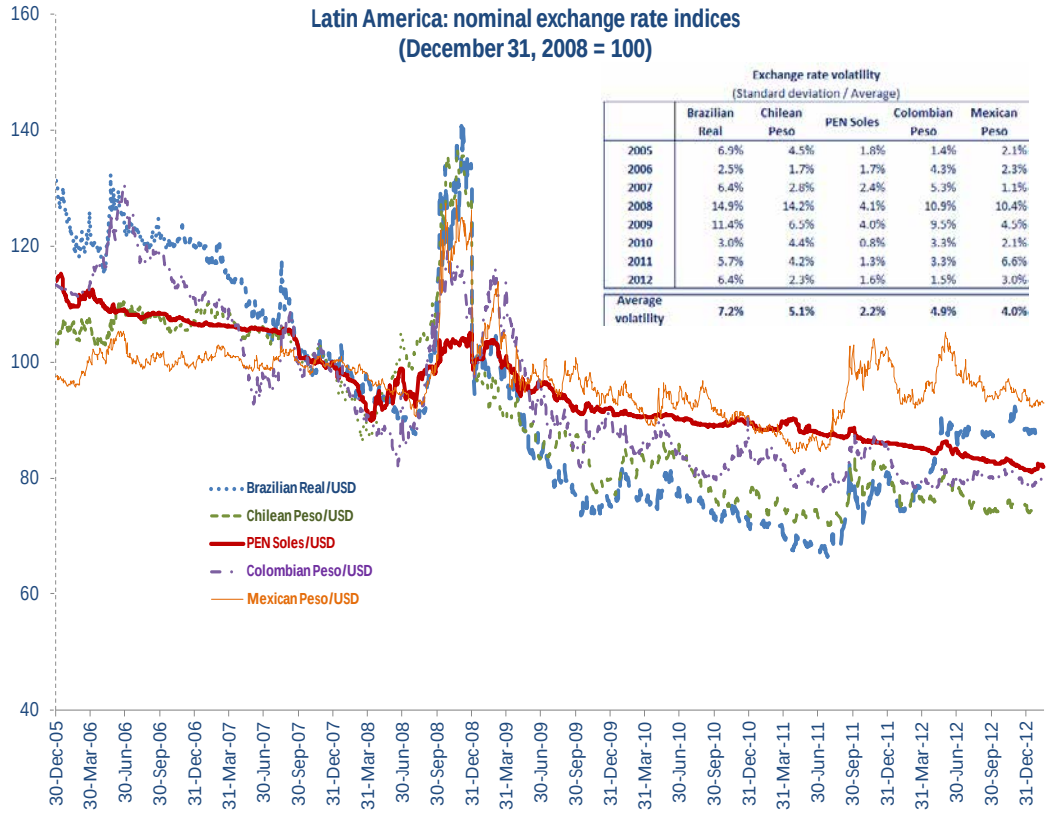
Interventions are implemented by purchases or sales of dollars in the spot market and by carrying out swaps and reverse swaps. Swaps and reverse swaps are used mainly when there are pressures from the non-delivery forward (NDF) market that could force banks to transfer this pressure into the spot market. In this regard, a swap operation with the Central Bank can provide temporary coverage against the risks involved in an NDF. Figure 3 shows that the Central Bank's daily foreign exchange interventions since 2007, which appear to be concentrated on the buying

side, are mainly oriented to reducing exchange rate volatility without influencing its trend.[6]

Indicators of relative volatility of the exchange rate among peer economies are an initial measure of the effectiveness of foreign exchange intervention (Figure 4). In Latin America, despite different levels of FOREX intervention, exchange rate trends look similar; however in some economies (such as Peru) the volatility is much lower.

Expected depreciation is shaped by fundamental variables and by the weight of the amount of intervention relative to the previous stock of international reserves, implying that FOREX intervention plays the expected role in the formation of those expectations. An estimation of the relationship of the expected depreciation (measured as the deviation of the expected exchange rate 12 months hence from the current spot exchange rate) is presented in table 1. It varies directly with deviations of core inflation from the inflation target and inversely with deviations of USA core inflation from its inflation target; it also varies directly with the USA output gap. FOREX intervention, as a proportion of international reserves, seems to have an influence that takes the form of varying directly with expected devaluation, and contrary to what we should expect, it also varies directly with changes in the terms of trade.

Figure 4



[6] This result is documented in various studies on foreign exchange interventions: Arena and Tuesta (1999), Broto (2012), Humala and Rodriguez (2008), IMF (2009) and Rossini, Quispe, and Gondo (2008).

When we include the prior effective depreciation as an indicator of persistency, as well as the PEN-USD policy rate differential, the estimation improves, keeping the expected relationships. We also included the EMBI index for Peru as an indicator of country risk (which is positively correlated with expected depreciation). Finally, we included as an explanatory variable the deviations of the effective real exchange rate from the equilibrium real exchange rate (estimated, and presented in Table 10 and Figure 10) which, as expected, correlates negatively with the expected depreciation.

Table 1

Dependent variable: annual expected depreciation
Method: least squares
Date: 03/25/13 Time: 16:48
Sample (adjusted): 1999M11 2012M12
Included observations: 158 after adjustments

Variable	Coefficient	Standard error	t-Statistic	Probability
(Peru core inflation - inflation goal)$_{t-1}$	0.9714	0.1073	9.0530	0.0000
(USA core inflation - inflation goal)$_{t-4}$	-0.4595	0.2337	-1.9666	0.0511
USA output gap$_t$	0.1893	0.0393	4.8119	0.0000
(FOREX intervention$_t$ / NIR $_{\text{previous year}}$)	0.0719	0.0407	1.7676	0.0792
Annual depreciation$_{t-1}$	0.1930	0.0302	6.3941	0.0000
Policy interest rate spread (Peru-USA)$_t$	-0.3081	0.0627	-4.9148	0.0000
Terms of trade (annual variation)$_{t-1}$	0.0248	0.0097	2.5459	0.0119
Spread EMBI Peru$_{t-1}$	0.0036	0.0008	4.7267	0.0000
(FDI flow / Annual GDP)$_{t-3}$	-1.2221	0.5279	-2.3149	0.0220
(Real exchange rate - Equilibrium real exchange rate)$_{t-1}$	-0.1779	0.0682	-2.6080	0.0100

R-squared	0.8132	Mean dependent variable	1.1953
Adjusted R-squared	0.8005	S.D. dependent variable	2.6457
S.E. of regression	1.1817	Akaike info criterion	3.2389
Sum squared residuals	205.2824	Schwarz criterion	3.4521
Log likelihood	-244.8738	Hannan-Quinn criterion	3.3255
F-statistic	63.9938	Durbin-Watson statistic	0.9927

4. Sterilization

To sterilize the liquidity created by foreign exchange interventions, the Central Bank issues its own certificates with maturities of up to 18 months, auctioned on a daily basis. These are complemented by banks' required reserves and Treasury deposits. Table 2 shows a summary of the Central Bank balance sheet in percentages of GDP, where 12.2 percent represents sterilization through Treasury deposits (associated with a solid fiscal position), 9.4 percent is explained by required reserves, Central Bank Certificates explain 5.9 percent of the sources of net international reserves, and currency in circulation accounts for 6.3 percent.

In general, as shown in Figure 5, the Central Bank assets have higher yields than the interest rates on its liabilities, which also is reflected in its positive net income since 1992, the only exceptions being in 1994 and in 2012. The recent temporary switch, with higher yields on the liability side of the balance sheet relative to the

yields of the international reserves, is a particular event associated with the extremely low international interest rates, as in the case of December 2012 (Table 3), when the cost of sterilization (1.8%) was higher than the average yield on international reserves (1.2%).[7]

Table 2

Balance sheet of the Central Bank as of December 2012

(As percentage of GDP)

Assets		Liabilities	
International reserves	**34.1**	**Treasury deposits**	**12.2**
		In domestic currency	7.9
		In foreign currency	4.4
		Reserve requirements	**9.4**
		In domestic currency	4.1
		In foreign currency	5.4
		Central Bank's instruments	**5.9**
		Currency in circulation	**6.3**
		Other net liabilities	**0.1**

A possible drawback of sterilized foreign exchange intervention is the difficulty of anchoring the interbank interest rate to the policy rate. However, as shown in Table 4, interest rate volatility relative to exchange rate volatility declined significantly with the adoption of the IT scheme.

Table 3

Balance sheet of the Central Bank: interest rates as of December 2012

(In percentages)

Assets		Liabilities	
International reserves	**1.2**	**Treasury deposits**	**2.6**
		In domestic currency	3.1
		In foreign currency	0.2
		Reserve requirements	**0.8**
		In domestic currency	2.3
		In foreign currency	0.1
		Central Bank's instruments	**4.0**
		Currency in circulation	**0.0**
		Other net liabilities	**0.6**
		Total	**1.8**

[7] The Central Bank Charter establishes that "In the case of a loss… the reserves accumulated from previous surpluses shall be capitalized. If the reserve proves insufficient, within thirty days of the approval of the Central Bank Balance Sheet, the Treasury shall issue and deliver to the Central Bank nonnegotiable and interest-bearing debt securities equivalent to the outstanding amount."

Figure 5

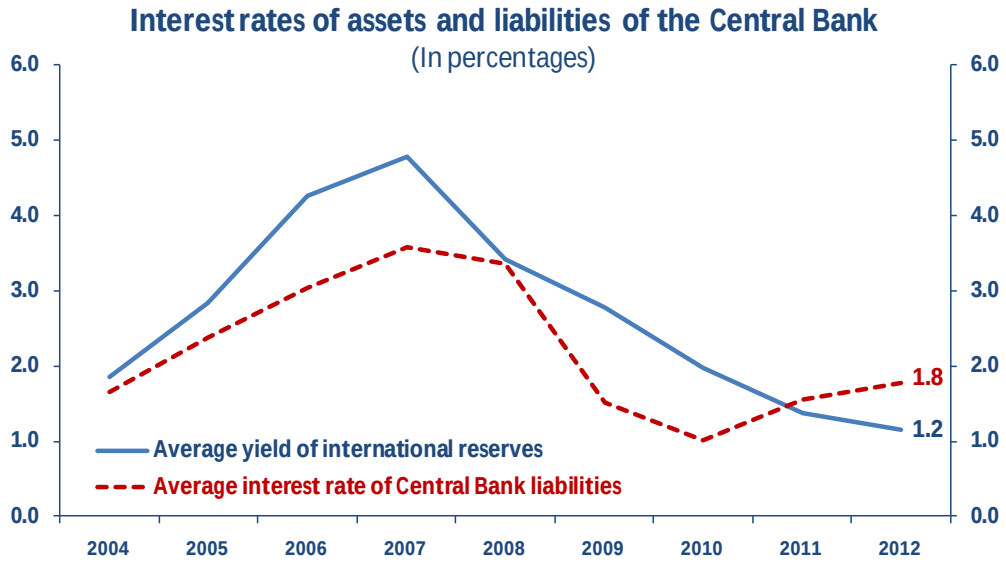


Table 4

Interbank interest rate and exchange rate: 1995-2012

		Degree of volatility		Ratio of relative volatilities (a)/(b)
		Interbank interest rate[1/] (a)	Exchange rate variation[2/] (b)	
Monetary targeting	1995	25.9	13.0	1.99
	1996	44.6	4.5	9.83
	1997	40.1	9.5	4.23
	1998	53.5	4.3	12.54
	1999	51.7	8.7	5.95
	2000	28.0	97.0	0.29
	2001	69.0	20.0	3.44
Inflation targeting	2002	48.6	37.1	1.31
	2003	15.6	18.9	0.82
	2004	8.6	7.0	1.23
	2005	2.5	10.5	0.23
	2006	5.8	9.4	0.61
	2007	4.8	5.6	0.86
	2008	10.0	30.1	0.33
	2009	62.5	11.4	5.47
	2010	35.1	9.7	3.60
	2011	7.6	13.6	0.56
	2012	0.4	7.5	0.05

1/ Ratio of the standard deviation of daily interbank interest rates to their annual average.
2/ Ratio of the standard deviation of daily annual variations of PEN/USD exchange rate to their annual average.

Another issue related to sterilized intervention is its potential ineffectiveness when the securities used to sterilize attract more funds from abroad, creating a vicious circle of intervention-sterilization-inflows. This may arise especially during periods of a persistent carry due to local interest rates that are higher than international interest rates, as in the current scenario of persistent and unusually low interest rates in developed markets. This situation may worsen if intervention causes

large reductions in exchange rate volatility, creating a scenario for safe bets without exposure in local currency investments and, therefore, a reduced need for hedging against exchange rate risk, at least in the short run.

The policies adopted by the Central Bank to improve the effectiveness of FOREX intervention are the following:

- 4.0 percent fee on transfers of Central Bank Certificates (issued for sterilization purposes) to non-financial agents in general.
- Most of the sterilization operations are carried out using Treasury deposits and reserve requirements, the two representing up to 78 percent of the total balances of sterilization instruments (which also include Central Bank Certificates).
- In order to close a possible liquidity parking spot in a local asset, the RRR on local currency deposits held by non-resident investors in domestic banks is 120 percent, which generates no incentive to pay any interest for these deposits. This measure was adopted in April 2008, when a capital inflow surge increased PEN deposits by 35 percent from December 2007 to April 2008.

Additionally, the policies adopted by the Central Bank to allow a degree of volatility in the exchange rate in order to prevent predictability about its future path and to reduce incentives for non-resident investments in local currency have changed the form of intervention, with the aim of increasing exchange rate volatility.

- Since August 2012, the volatility of the daily amount of intervention has been reduced, with more stable amounts of intervention even during upward exchange rate movements. Intervention amounts are kept unannounced.
- Table 5 shows that when the volatility of the amounts of daily interventions decreased, the exchange rate volatility moved in the opposite direction.

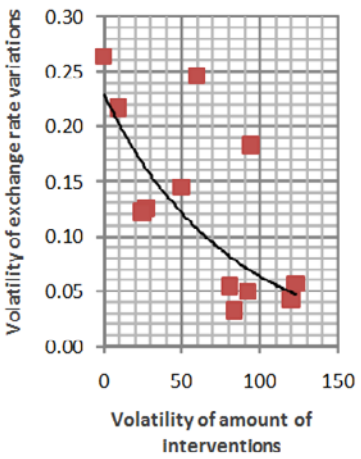
Table 5

Standard deviations of daily amount of foreign exchange interventions and of exchange rate variations

	Intervention (1)	Exchange rate variations (2)
Jan 2012	84	0.03
Feb 2012	120	0.04
Mar 2012	80	0.05
Apr 2012	123	0.06
May 2012	94	0.18
Jun 2012	0	0.26
Jul 2012	60	0.25
Aug 2012	92	0.05
Sep 2012	27	0.13
Oct 2012	50	0.14
Nov 2012	10	0.22
Dec 2012	24	0.12

(1) Standard deviation of daily amount of foreign exchange interventions in each month.
(2) Standard deviation of daily annual variations of the PEN/USD exchange rate during each month.

Graphical representation



Despite these measures, the main asset in local currency used for parking capital inflows has been Treasury bonds in domestic currency. Table 6 shows that the amount and share of non-resident investors in Treasury bonds have been constantly growing since 2010. However, it can be said that the overall contribution of public finances to counteracting the negative effects of capital inflows can be measured by the evolution of the net public debt, which decreased from 47 percent of GDP in 2003 to 20 percent in 2012.

Table 6

Treasury bonds in domestic currency and total net public debt

	Treasury bonds in local currency		Share of foreign investors %	Net public debt (Percentage of GDP)
	In millions of PEN soles	As percentage of GDP		
2002	6 017	3.0	0	47
2003	6 497	3.0	0	47
2004	6 672	2.8	0	43
2005	11 555	4.4	23	39
2006	13 009	4.3	25	32
2007	22 304	6.6	23	28
2008	22 354	6.0	23	26
2009	23 889	6.2	17	26
2010	31 718	7.3	38	23
2011	31 293	6.4	42	21
2012	31 723	6.1	54	20

5. Reserve requirements

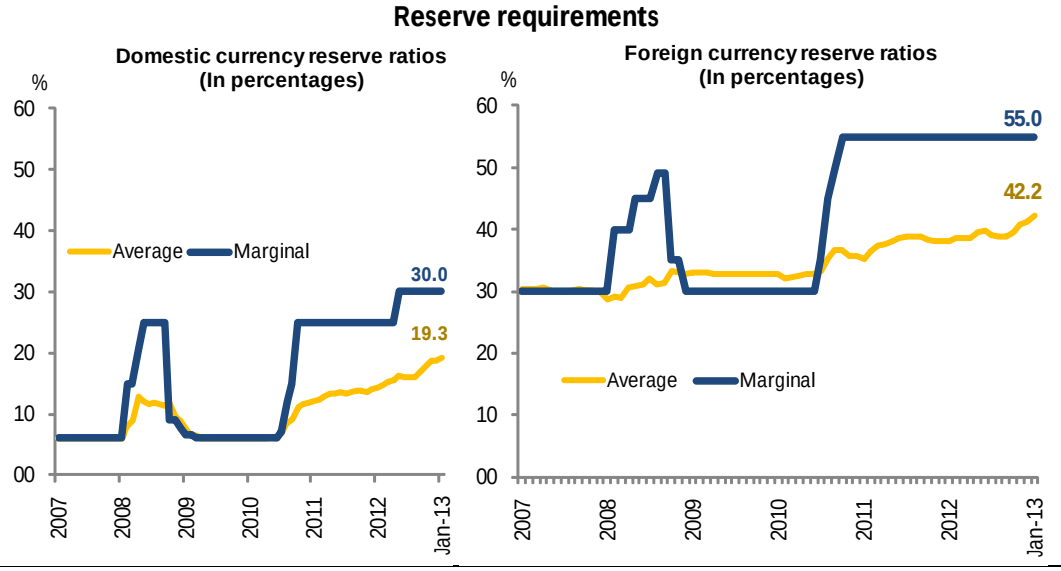
Partial financial dollarization creates vulnerabilities for macro-financial stability: (i) if the local currency depreciates, the quality of credit deteriorates, and (ii) a possible decline in foreign currency deposits associated with a crisis of confidence or a sudden stop of external credit lines may induce a systemic liquidity crisis.

To reduce liquidity risks, the Central Bank of Peru has maintained a higher RRR on foreign currency liabilities, with an even higher RRR on external short-term credits. The design of this instrument takes into account the different sources of macro-financial risks linked to the structure of financial institutions' liabilities. For example, the RRR is 19.3 percent for domestic currency liabilities, 42.2 percent for foreign currency liabilities, 60 percent for foreign short-term credit lines, and 120 percent for non-resident investors' local currency deposits.

The recent moves in reserve requirements on banks' domestic and foreign currency liabilities (table 7) have been carried out, changing the average RRR. The main effect of the recent increase in the average RRR in foreign currency has been a

200 basis-point increase in the overnight interbank interest rate and in the prime rate for foreign currency loans (155 basis points).[8]

Figure 6



The main objective of RRR changes is to avoid credit expansions financed by a sharp rise in capital inflows. These flows are directly sterilized in the form of international reserves. Table 8 shows balance of payments flows over the last decade, in particular the increasing size of the financial account, albeit mostly long-term in nature, and the size of the stock of international reserves.[9] Table 9 shows that foreign exchange intervention is not the only important source of international reserve accumulation (59 percent on average), but that Treasury deposits and reserve requirements (18 percent on average) also are.

With international reserve accumulation, the Central Bank gains resources to react against adverse events, such as a credit crunch originated by capital outflows or a run on foreign currency deposits. In contrast with what happened in 1998, during the recent financial crisis that followed the collapse of Lehman-Brothers, the Central Bank of Peru was able to inject liquidity by an equivalent of 9 percent of annual GDP during the fourth quarter of 2008, thus ensuring adequate bank credit during the crisis.[10] For this reason, the Central Bank argues that the accumulation of international reserves through foreign exchange interventions and higher RRRs are key preventive measures. Table 10 shows that the level of international reserves covers a substantial share of potential international liquidity draw-downs.

[8] Between September 2012 and January 2013, the average RRR on dollar deposits has been raised by 250 basis points.

[9] The amount of mining investments in Peru for 2012-2016 is equivalent to USD 30.6 billion, or 15 percent of the 2012 GDP. The production of copper, which represented 7.3 percent of world output in 2012, will increase by 130 percent in 4 years.

[10] The measures adopted during the fourth quarter of 2008 included foreign exchange sales (and the reduction of the maturity for the sterilization of Central Bank Certificates), a reduction in reserve requirements, and one-year liquidity facilities. The Central Bank also reduced the policy rate, demonstrating the monetary independence gained when the interest rate was no longer used as a tool to avoid currency depreciation. See De Gregorio (2009).

Table 7

Reserve requirement ratios 2010-2013

	Legal minimum required ratio	Domestic currency		Foreign currency			
				General regime		External liabilities	
		Marginal requirement for deposits	Policy increases in the average ratio	Marginal requirement for deposits	Policy increases in the average ratio	Short-term	Long-term
Feb.10	6%			30%		35%	0%
Jul.10	7%			35%		40%	0%
Aug.10	8%	12%		45%	0.10%	50%	0%
Sep.10	8.5%	15%		50%	0.20%	65%	0%
Oct.10	9%	25%		55%	0.20%	75%	0%
Jan.11	9%	25%		55%		60%	0%
Feb.11	9%	25%	0.25%	55%	0.25%	60%	0%
Mar.11	9%	25%	0.25%	55%	0.25%	60%	0%
Apr.11	9%	25%	0.50%	55%	0.50%	60%	0%
May.12	9%	30%	0.50%	55%	0.50%	60%	0%
Sep.12	9%	30%	0.50%	55%	0.50%	60%	0%
Oct.12	9%	30%	0.50%	55%	0.50%	60%	0%
Nov.12	9%	30%	0.75%	55%	0.75%	60%	0%
Jan.13	9%	30%	0.25%	55%	0.75%	60%	0%
Feb.13	9%	30%		55%	1.00%	60%	0%
Mar.13	9%	30%		55%	0.50%	60%	0%
Apr.13	9%	30%		55%	0.25%	60%	0%

Table 8

Balance of payments and international reserves (Percentages of GDP)

	Current account	Financial account	NIR[1/] flows	Long-term financing	NIR[1/] balances
2002	-1.9	3.6	1.7	4.1	16.9
2003	-1.5	1.0	1.0	2.6	16.6
2004	0.1	3.0	3.5	3.3	18.1
2005	1.5	0.2	1.8	2.1	17.8
2006	3.2	0.4	3.4	3.3	18.7
2007	1.4	8.0	9.7	7.2	25.8
2008	-4.2	6.7	2.8	6.6	24.5
2009	-0.6	1.9	1.5	6.6	26.0
2010	-2.5	8.8	7.1	9.9	28.6
2011	-1.9	5.2	2.7	6.8	27.6
2012	-3.5	10.7	7.6	10.6	32.1

1/ NIR: net international reserves

Table 9

Sources of international reserves accumulation

	NIR flows (Millions of USD)	Sources (Percentages of total NIR flows)				
		Total	FX intervention	Reserve requirements	Treasury deposits	Other
2002	985	100	13	19	37	31
2003	596	100	167	-82	-23	38
2004	2 437	100	76	1	15	8
2005	1 466	100	52	85	-40	2
2006	3 178	100	90	-22	8	24
2007	10 414	100	68	11	6	15
2008	3 507	100	14	53	-1	34
2009	1 939	100	-2	-40	55	87
2010	10 970	100	82	11	3	4
2011	4 711	100	7	29	54	11
2012	15 175	100	78	11	7	4

Table 10

Coverage of net international reserves
(In millions of USD)

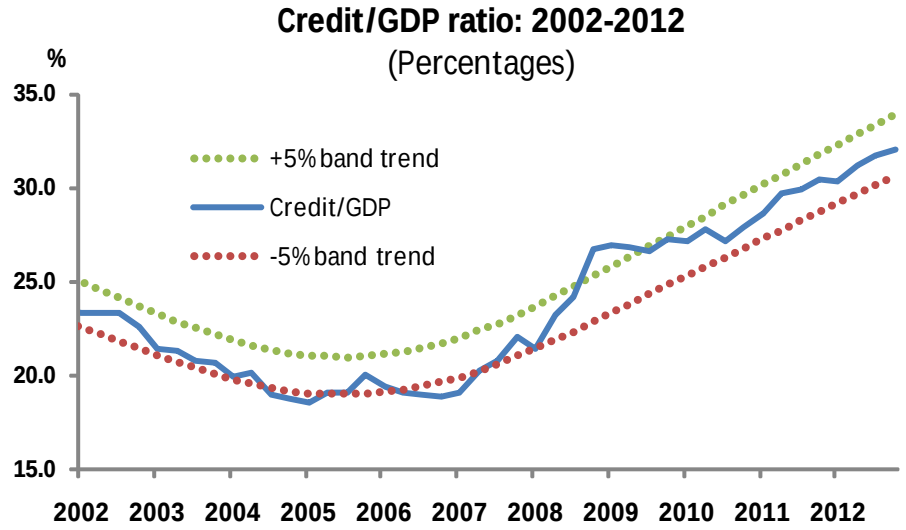
	Net international reserves (a)	Potential outflows			Coverage ratio (a)/(b)
		Short-term external liabilities[1/]	M4[2/]	Total (b)	
2002	9 598	2 589	12 343	14 932	0.64
2003	10 194	2 525	12 774	15 299	0.67
2004	12 631	2 769	15 135	17 904	0.71
2005	14 097	3 208	17 815	21 023	0.67
2006	17 275	3 220	21 286	24 506	0.70
2007	27 689	6 098	27 939	34 037	0.81
2008	31 196	6 240	33 519	39 759	0.78
2009	33 135	4 726	38 900	43 627	0.76
2010	44 105	6 315	48 695	55 010	0.80
2011	48 816	6 325	58 134	64 459	0.76
2012	63 991	7 522	69 011	76 533	0.84

1/ Includes the maturing component of long-term external liabilities.

2/ Total deposits. Includes domestic currency deposits and currency under the assumption of currency substitution.

The effectiveness of foreign exchange intervention in contributing to macro-financial stability, especially in containing a credit expansion resulting from capital inflows, is assessed using indicators of a sustainable band for the credit-to-GDP ratio and for housing prices. Figure 7 shows that the evolution of the credit-to-GDP ratio has been kept mostly within the boundaries of the tolerance range, except during the run-up to the Lehman crisis, when a substantial surge in inflows was behind the temporary excess.[11] In fact, 2012 ended with a 16.3 percent credit expansion, above the 9.0 percent nominal GDP increase, but more moderate than the previous year (23.9 percent).

Figure 7



A second front on which the effects of capital inflows can be assessed consists of possible financial excesses in the housing market and the risk of a price bubble. The mortgage market is still small in Peru, representing only 4.5 percent of GDP, but its growth rate in terms of the volume of credit (25.7 percent in 2012) and of prices (13.2 percent annually on average in 2008-2012) raises questions about a housing boom and an eventual crash. To track this risk, the Central Bank follows different housing price indices and the price-to-annual-rent ratio as an indicator of the time required to recover an investment in the housing market. Figure 8 shows that prices are mostly within the safe risk band, and that in recent months they have tended to stabilize. Additionally, the price-to-annual-rent ratio is tending to stabilize at around 15, without an upward trend.[12]

Changes in reserve requirements on foreign currency liabilities affect not only lending rates, but also the interest rate in the interbank foreign currency money market – the relevant rate for pricing in the derivatives market. In this regard, the higher the interbank interest rate in the foreign exchange funds market, the higher the cost of selling foreign exchange in the forward market. These developments have been more evident recently, when the rate in the funds market was 4.25 percent in domestic currency and 5.0 percent in foreign currency, independently of the Fed rate. In this regard, reserve requirements create room for

[11] See IMF (2009) for an ample discussion.

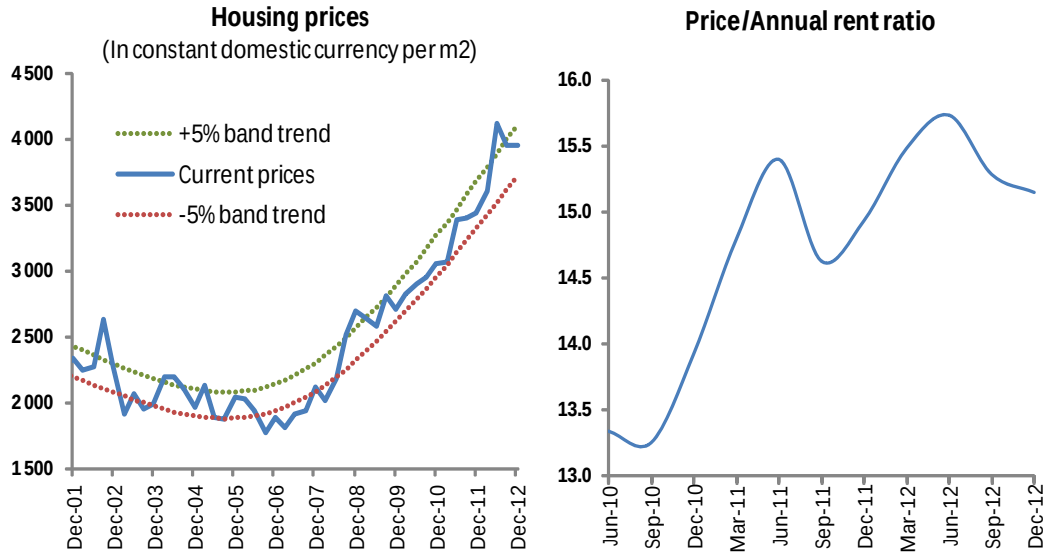
[12] See Cubeddu, Tovar and Tsounta (2012).

maintaining an independent monetary policy with less intervention in the foreign exchange market. Figure 8 shows the evolution of the interbank interest rate for dollar loans and the average RRR on foreign currency liabilities, showing the effect of changes in reserve requirements on this interest rate. Therefore, independently of the level of international interest rates, reserve requirements create room for a more effective monetary policy.

An issue concerning the effectiveness of reserve requirements is the degree to which currency substitution of liabilities is subject to this instrument in the case of other liabilities. For example, long-term credits and bonds issued by banks are not exempt from reserve requirements. As a result, banks' foreign liabilities are mostly long-term, and the amount of these obligations has grown substantially. To limit this source of financing, the Central Bank has introduced a ceiling equivalent to 2.2 times a bank's share capital.

Figure 8

Housing market



Another form of substitution induced by persistently high RRRs comes from local firms' borrowing directly from commercial banks abroad or issuing their own bonds. This form of disintermediation in Peru is favored by asymmetric tax treatment that imposes a lower income tax rate on the earnings of foreign suppliers of funds (4.49 percent, in contrast to the local 30 percent income tax rate). As a result, there has been a recent round of international bond placements by local firms, as well as increasing borrowing from abroad. In the absence of a possible correction of tax asymmetries, the wedge between local and foreign interest rates created by reserve requirements cannot be maintained for a long period when some form of prudential measure or capital control over these kinds of inflows is in place. These controls will affect the financing costs of projects that are needed for sustained growth, creating room for more neutral policies like equal tax rates or prudential measures to reduce excesses or imbalances in individual firms.[13]

[13] For example, an additional capital requirement on assets subject to exchange rate risk or excessive leverage, specifically targeting inflows, rather than more intrusive and distortionary capital controls.

Figure 9

Interest rate for loans in foreign currency in the interbank market and average reserve requirement

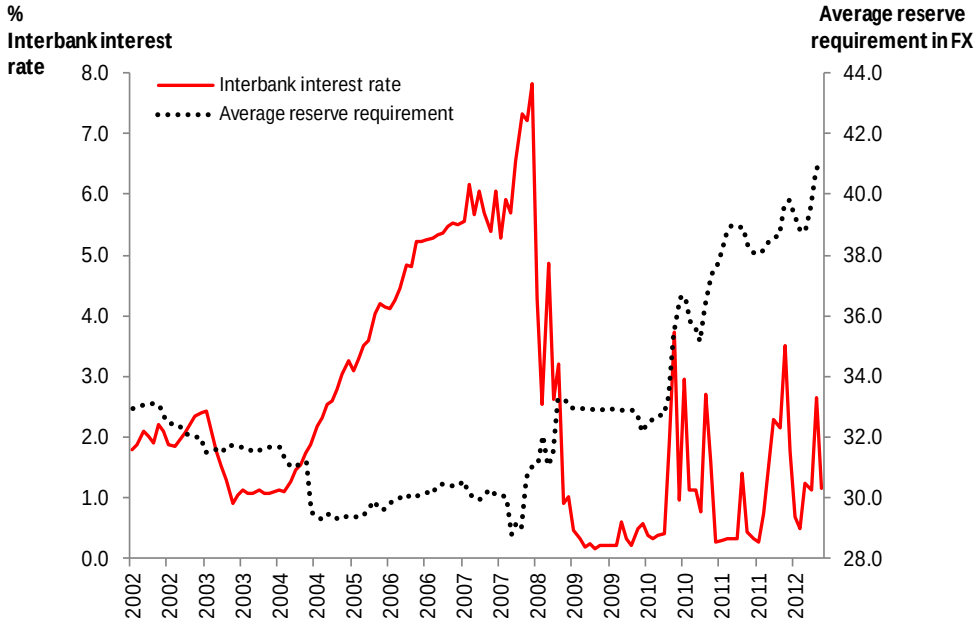
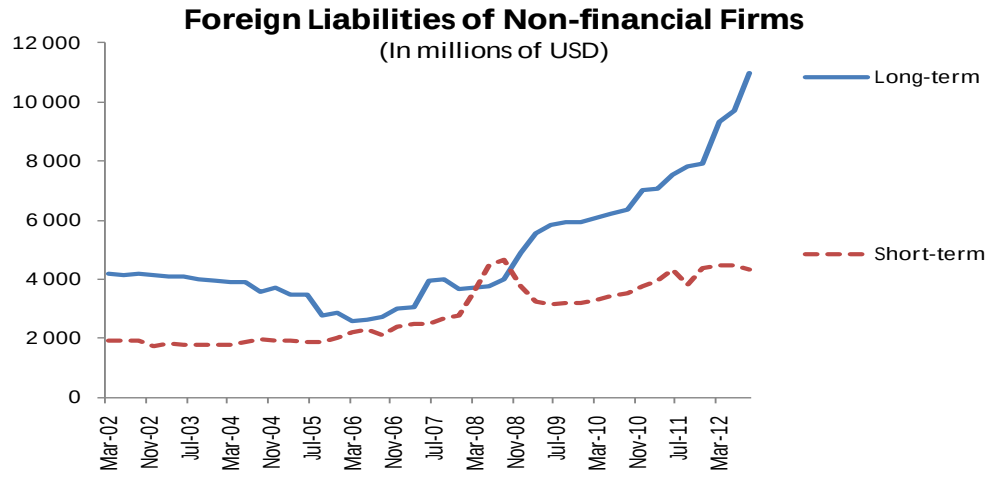


Figure 10



6. Real exchange rate

The effective real exchange rate has declined 10 percent between 2011 and 2012, reflecting mainly the effect of significant capital inflows, in particular those related to project financing in the mining and energy sectors. However, this would become a policy issue if there was evidence of a possible real exchange rate misalignment relative to its equilibrium level. We present estimation of the ERER, considering as fundamentals the trend of the terms of trade, government expenditure, public debt,

domestic vs. trade partners' productivity, interest rate differentials, the output gap, and the degree of openness of the economy (Table 11 and Figure 11).

It can be seen that there has been a recent appreciation of both the equilibrium and effective real exchange rates, but with a certain degree of deviation from equilibrium. This has prompted initiatives to tackle strengthening the local currency.

The policy measures announced by the authorities are the following:

i. The Central Bank has stepped up the amount of foreign exchange intervention (USD 1.78 billion in January 2013).

ii. The Central Bank raised the average RRR on foreign currency liabilities by 75 and 100 basis points in January and February 2013, respectively.

iii. The limit for the exemption from reserve requirements on long-term liabilities has been reduced from 2.5 to 2.2 times the bank's capital.

iv. A 25 percent deduction on investments of local banks abroad has been introduced.

v. The Central Bank increased the limit for pension funds' investments abroad from 30 to 32 percent of their total managed funds.

vi. The Treasury announced a fiscal surplus target of 1 percent of GDP for 2013, and a USD 1.8 billion plan of foreign debt prepayments. Additionally, the Public Stabilization Fund will be increased from USD 7.2 billion to USD 8.4 billion.

vii. Recently the Superintendency of Banks (SBS) approved a set of policies to contain risks related to foreign currency indebtedness. The main changes are:

    a. Regulatory capital requirements are defined according to type of credit – mortgage loans, revolving and non-revolving consumer loans – and the currency in which the loans are granted, and greater requirements for credit in foreign currency have been established.

    b. To control foreign exchange risks, the SBS reduced the limit of the overall oversold position from 15 to 10 percent of regulatory capital, the limit of the overall overbought position from 60 to 50 percent, and the limit of the absolute value of the net position in financial products derived from foreign currency from 30 to 20 percent of capital.

viii. The Ministry of Finance's structural reform agenda includes completing new trade arrangements, launching infrastructure projects with private sector participation, and implementing a reform of capital markets.

The deviations of the real exchange rate from its equilibrium level can be addressed through measures with short-term impact, but this is also an opportunity to accelerate reforms to improve productivity and competitiveness. According to comparative surveys,[14] Peru is lacking in elements like infrastructure, labor market flexibility, development of institutions, and education. Therefore, progress in these

[14] World Economic Forum (2012). On the trade side, Peru has signed free trade agreements, now in force, with 22 countries (USA 2006, China 2009, Chile 2006, and the EC 2012, among others), and additional agreements will soon become effective. The other components on the structural reform front are an expansion in infrastructure through concessions and PPPs, and a reform of capital markets.

areas is urgent, while macroeconomic policies, like foreign exchange intervention and other measures, are instruments with short-lived effectiveness.

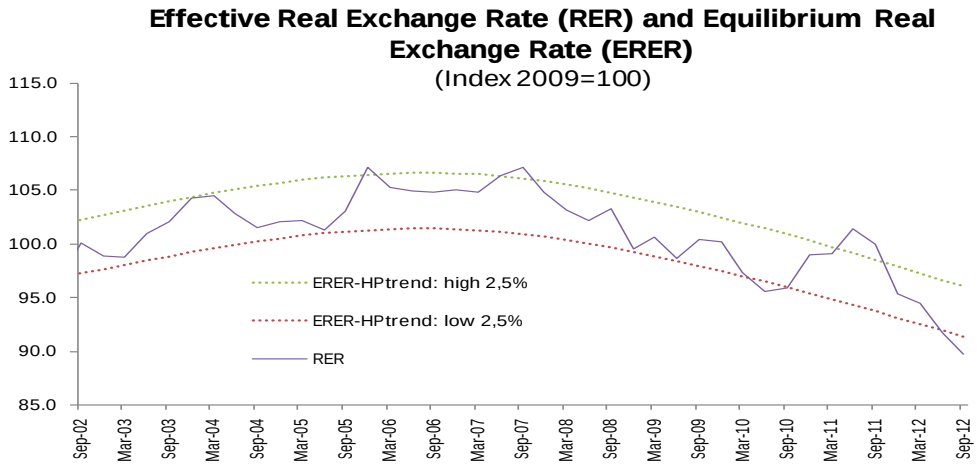
Table 11

Determinants of the equilibrium real exchange rate

Dependent variable: real exchange rate
Method: least squares
Sample: 2002Q1 2012Q3

Variable	Coefficient		t-Statistic
C	5 470.2		4.5
Public expenditure (t)	-193.0		-3.4
Terms of trade (t-2)	-0.7		-3.6
Relative productivity (t-2)	-23.6		-4.2
(Policy interest rate - FED interest rate) (t-1)	-13.1		-4.4
Output gap (t-2)	-3.7		-3.6
External public debt	6.5		1.8
Relative openness to trade (t-2)	-6.0		-2.3
R-squared	0.86	Mean dependent variable	100.80
Adjusted R-squared	0.83	S.D. dependent variable	3.97
S.E. of regression	1.64	Akaike info criterion	3.99
Sum squared resid	93.67	Schwarz criterion	4.32
Log likelihood	-77.75	Hannan-Quinn criterion	4.11
F-statistic	30.27	Durbin-Watson statitic	1.29

Figure 11



Concluding remarks

Foreign exchange interventions and reserve requirements on dollar liabilities are two monetary policy instruments that have been used to reinforce macro-financial stability in an economy with a partially dollarized financial system. Both instruments have contributed significantly to reducing excessive exchange rate volatility,

building up an international reserve buffer, and ensuring a normal flow of bank credit.

The recent massive increase in international liquidity has created concerns about the possible misalignment of the real exchange rate relative to its equilibrium level, especially because it can be deemed a temporary response to the current phase of the cycle in developed economies, but with a potentially lasting negative impact on the tradable sector of the economy. The domestic response to this situation has been an intensification of sterilized intervention in the foreign exchange market and the use of reserve requirements on local banks' foreign currency liabilities. Additionally, changes in the fiscal liabilities management and further prudential supervision measures are being introduced by the Treasury and by the Supervisory Agency to limit the exposure of local agents to foreign exchange risks. In view of these considerable challenges to real sector competitiveness, the acceleration of the structural reform agenda must be an important part of the policy effort.

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A note on the effectiveness of intervention in the foreign exchange market: the case of the Philippines

Diwa C Guinigundo[1]

Abstract

This study primarily examines the extent of daily foreign exchange intervention by the Bangko Sentral ng Pilipinas (BSP) between 2005 and 2010, and its effectiveness in controlling the daily volatility of the exchange rate. Using an exponential GARCH model, we find that participation in the spot market remains the main method used by the BSP to influence the volatility of the exchange rate, while intervention in the foreign exchange market through derivatives is secondary. The results also show that the BSP is sensitive to large swings in the exchange rate. However, we find no evidence that the BSP targets a particular exchange rate level over thirty-day or hundred-day trading horizons. With regard to effectiveness, our estimates indicate that the BSP's intervention in the spot market has been effective in containing same-day volatility. The effectiveness of intervention in the foreign exchange market is measured by how significantly spot market intervention and forward transactions influence the daily return on the exchange rate. Over longer trading days, our results show that intervention at larger volumes or sustained central bank actions are significant in managing large fluctuations in the exchange rate.

Keywords: central banks, foreign exchange intervention, Philippines

JEL classification: E58, F31, G15

[1] Deputy Governor, Monetary Stability Sector, Bangko Sentral ng Pilipinas.

I. Introduction: aspects of foreign exchange intervention/operations

Emerging market economies, the Philippines included, have experienced a surge in capital inflows on the back of renewed risk appetite fuelled by their continued strong growth prospects and higher returns on domestic assets. The massive build-up in capital inflows started in 2002.[2]

The surge in foreign exchange (FX) inflows into the Philippines has allowed Bangko Sentral ng Pilipinas (BSP) to build up its international reserves, which help to insulate the economy against external shocks. Notwithstanding that, structural flows continue to be the dominant source of foreign exchange. The largest share comes from the export sector. Remittances from overseas Filipinos and receipts from business process outsourcing services constitute the second major source of inflows. Direct investments and portfolio flows of non-residents represent relatively smaller shares of nominal GDP.[3]

In the aftermath of the Asian currency crisis of 1997, many emerging market economies have adopted a policy configuration involving exchange rate flexibility that is greater, though still managed to varying degrees, together with ongoing financial integration and some measure of domestic monetary independence. However, these countries have continued to engage in exchange rate management to a great degree (Aizenman and Glick 2008). Hence, in the face of pressures on their currencies to appreciate, they have been accumulating reserves and sterilising the liquidity impact. The accumulation of international reserves has become a key element in enhancing the sustainability of this approach. Nevertheless, concerns about the cost of maintaining monetary stability with this new policy mix suggest a need for higher levels of intervention and sterilisation in order to support such a build-up of international reserves.

The effectiveness of central bank intervention is dependent on the channel through which it influences the exchange rate. In this paper, we focus on two channels: the portfolio channel and the signalling channel.

The *portfolio channel* operates even when intervention by the monetary authority is sterilised, as long as assets denominated in different currencies are imperfect substitutes. Essentially, purchases of foreign currency by the central bank change the supply of domestic vis-à-vis foreign assets. This will result in a change in the relative value of the domestic currency, which will be reflected in the exchange rate, as asset holders will require a higher risk premium to hold the rebalanced portfolio. Consequently, interventions must be significant relative to market turnover to trigger rebalancing or shifts in the behaviour of holders of domestic and foreign assets. In trading environments marked by secret central bank intervention through conduit banks, this channel may be another factor bolstering the effect – through asymmetric information. Conduit banks would have first mover advantages over the other banks, generating higher payoffs through trading behaviour that is

[2] International Monetary Fund (2007), World Economic Outlook (WEO), October.

[3] The reason for the generally meagre share of foreign direct investment, for instance, could be structural, i.e., the persistence of constraints on business competitiveness.

consistent with the central bank. This may trigger a form of herding behaviour,[4] as there is an information cascade in which other market participants sense the formation of a trend based on seemingly private information and follow suit.

As most emerging market economies hold sizable foreign exchange reserves relative to market turnover in the currency market or the domestic stock of government bonds, the portfolio channel is expected to have greater effect.[5]

A separate, though not mutually exclusive, means by which a central bank influences the exchange rate is the *signalling channel*, also known as the "expectations channel". Here, central bank intervention works by conveying information on future values of the exchange rate or of variables that are believed to influence the exchange rate (e.g., monetary policy settings, money supply, etc.). If intervention efforts in the market are clear and credible (i.e., informative), the central bank can anchor expectations. That is, persistent effects on the level or volatility of the exchange rate can be induced by credible central bank action in the foreign exchange market. However, if market participants fail to correctly read the central bank's intentions, the intervention may contribute to volatility in the exchange rate.

A variant of the signalling channel is the *coordination channel*. In periods of great volatility, when the exchange rate can deviate significantly from its equilibrium value, central bank intervention can coordinate the expectations of market participants and infuse the market with the idea that the misalignment of the exchange rate is extreme. Credible intervention changes the expectations of agents and increases the number of market traders who monitor fundamentals, as opposed to those who merely follow trends (e.g., chartists and technical analysts).[6]

This note primarily examines the extent of daily foreign exchange intervention by the BSP between 2005 and 2010, and its effectiveness in controlling the daily volatility of the exchange rate. Volatility often reflects, among other things, uncertainty surrounding economic policies and other fundamental determinants of exchange rates, which the market may be struggling to price accurately. As indicated by Kamil (2008) and Domínguez (1998), central bank intervention is expected to reduce volatility as long as intervention is both credible and unambiguous. Meanwhile, a key advantage of the daily intervention data used in this paper is that they reflect discretionary purchases of dollars made with the explicit intention of reducing the volatility of the domestic currency vis-à-vis the US dollar.

It should be emphasised that our estimation is limited to the 2005-2010 period of BSP intervention in the foreign exchange rate market. A more elaborate model and longer data series can help address broader issues and concepts relating to the effectiveness of intervention strategies. For instance, while we focus on a daily measure of exchange rate volatility, an important issue is whether central bank success in reducing such volatility itself creates an environment (for example,

[4] For details, see Evans, Martin and Richard Lyons (2001), "Portfolio balance, price impact and secret intervention", National Bureau of Economic Research Working Paper Number 8356, Cambridge, Massachusetts.

[5] See Galati, Gabriele and Will Meilick (2002), "Central bank intervention and market expectations", BIS Paper No. 10, Basel, Switzerland.

[6] See Sarno, Lucio and Mark Taylor (2001), "Official intervention in the foreign exchange market: Is it effective and, if so, how does it work?" *Journal of Economic Literature*, vol. 39, no. 3, pp. 839-868.

through a one-way bet) that reduces the effectiveness of intervention in the longer term. In this paper, we measure the effectiveness of intervention by BSP's ability to influence daily volatility. The short-term horizon of this paper constitutes an important caveat.

The remainder of the paper is organised as follows: Section II presents a brief background on the Philippine foreign exchange market and its interface with other asset markets, and a discussion of the effectiveness of intervention, based on the Philippine case. The section highlights the motives and tactics behind BSP's intervention, and presents a model for the institution's daily intervention in the foreign exchange market and its results. The impacts of BSP's intervention in the foreign exchange market on the BSP's own balance sheet and on the government securities market are also discussed. Section III concludes, with some insights on intervention and monetary policy.

II. The effectiveness of intervention: some empirical insights based on the Philippine case

A. The Philippine foreign exchange (FX) market

The BSP has adopted a floating exchange rate system. Exchange rates are determined by the interplay of supply and demand factors in the FX market. The role of the BSP in the FX market is principally to ensure orderly conditions in the market.

Foreign exchange trading is conducted through the Philippine Dealing System (PDS). The direct market participants include the member banks[7] of the Bankers Association of the Philippines (BAP) and the BSP. Electronic trading[8] is conducted through the Philippine Dealing and Exchange Corporation (PDEx), which was designated by the BAP as the official service provider for USD/PHP spot trading (which involves the purchase or sale of US dollars for immediate delivery, i.e., within one day for US dollars), while Reuters serves as the exclusive distributor of all PDEx data. Trading through the PDEx allows nearly instantaneous transmission of price information and trade confirmations. Banks which do not subscribe to the PDEx can continue to conduct peso-dollar spot transactions via their Reuters Dealing screens. Dealing can also be conducted through brokers.[9] Third currency trading is usually transacted through Reuters Dealing or Bloomberg Financial Services.

[7] These commercial banks are authorised to engage in spot, outright forward, and swap transactions in peso-dollar as well as third currency transactions. They can trade for their clients or for their own accounts. Relevant BSP circulars regulate banks' long (overbought) and short (oversold) positions when trading for their own account. These positions must not exceed 20 per cent of their unimpaired capital or $50 million, whichever is lower.

[8] Banks are enjoined to give two-way quotes with the normal interbank bid-offer spread of 0.005 pesos. Trading is conducted such that banks offering quotes remain anonymous until a transaction is joined.

[9] Currently, there are two foreign exchange brokers in the Philippines, Tullett Prebon (Philippines), Inc. and ICAP Philippines, Inc.

Since the exchange rate determines the valuation/pricing of peso-denominated assets for non-residents, it serves as a barometer of foreign investors' confidence in the Philippine economy. Market expectations regarding the exchange rate affect domestic markets for bonds, equities, credit and bank deposits. The process involves a feedback loop wherein portfolio flows create appreciation pressure on the exchange rate. This further enhances the attractiveness of Philippine assets. Consequently, BSP participation in the foreign exchange market not only helps to temper the volatility of the exchange rate, but also influences market expectations so that they are more in line with policy objectives. Staff research has shown policy rates to have been effective in containing the formation of asset price bubbles even when portfolio flows are strong. This has not been without cost in terms of policy setting. Recently updated staff estimates have shown that the influence of policy interest rates on domestic interest rates, while still significant, has been diminished by strong FX flows.

B. Intervention motives and tactics

For the Philippines, the motives driving intervention are: (1) to maintain monetary stability; (2) to curb excessive exchange market speculation; and (3) to discourage sharp capital inflows and outflows (BSP Primer on Exchange Rate, 2012).

BSP never pre-announces its foreign exchange interventions. Its decisions to intervene may be based on current developments or may call for pre-emptive action before the markets react to developing situations. It intervenes in both the spot and forward FX markets, and it also occasionally uses derivatives. Our analysis for the 2005-2012 period indicates that interventions have been successful at limiting exchange rate volatility. Table 1, below, shows that the coefficient of variation and the standard deviation of the peso-dollar exchange rate have declined significantly since the onset of the global financial crisis.

Peso-dollar exchange rate: descriptive statistics — Table 1

in PHP/USD	Mean	Standard Deviation	Coefficient of Variation	Skewness
2012	42.25	0.81	1.93%	0.19
2011	43.31	0.52	1.21%	–0.23
2010	45.13	1.11	2.46%	–0.33
2009	47.65	0.71	1.49%	–0.27
2008	44.45	2.91	6.56%	0.24
2007	46.22	2.10	4.54%	–0.59
2006	51.35	1.15	2.25%	–0.05
2005	55.10	0.84	1.52%	–0.23

Source: Bangko Sentral ng Pilipinas for basic data; author for calculations.

Meanwhile, non-market measures have not been resorted to so far by the BSP to address the increasing volatility of the exchange rate. The BSP is of the view that imposing strict capital controls creates more costs than benefits. First, there are administrative hurdles that must be overcome to effectively implement these restrictions. The tax on international transactions would have to be implemented universally to prevent the creation of tax arbitrage opportunities, and some

difficulties in implementing it could arise due to advances in technology and increasingly sophisticated financial instruments, which allow investors to circumvent controls and/or taxation. Secondly, the imposition of controls hampers the efficient allocation of capital across countries. Finally, the imposition of controls would send negative signals to investors and adversely affect our access to international capital markets and our ability to attract foreign investment.

C. BSP participation in the foreign exchange market

GARCH-type models were estimated to empirically test several observations about BSP intervention in the foreign exchange market. The following exponential GARCH(1,1) specification, taken from Kim, Kortian and Green (2000), was adopted for estimating central bank reaction functions for interventions employing derivatives.

$$Intervention = \sum_{i=0}^{n} \alpha_i S_{t-i} + \beta f(S) + \sum_{j=0}^{m} \delta_j Other\_intervention_{t-j}$$

$$Log(GARCH) = \alpha_1 + \alpha_2 \frac{|\varepsilon_{t-1}|}{\sqrt{GARCH_{t-1}}} + \alpha_3 \frac{\varepsilon_{t-1}}{\sqrt{GARCH_{t-1}}} + \alpha_4 Log(GARCH_{t-1}) + \gamma_3 Z$$

where *Intervention* represents intervention variables (spot market or derivatives transactions), S_{t-i} accounts for contemporaneous and lagged values of the exchange rate, and *f(S)* are other variables that influence the exchange rate, while *Other_intervention* is the other form of intervention employed by the BSP. A simpler GARCH specification is used to estimate the reaction function for spot market intervention by the BSP.[10]

$$\frac{S_t}{S_{t-i}} = \boldsymbol{\alpha D} + \boldsymbol{\beta Spot} + \boldsymbol{\gamma Forwards} + \boldsymbol{\delta Z}$$

$$Log(GARCH) = \alpha_1 + \alpha_2 \frac{|\varepsilon_{t-1}|}{\sqrt{GARCH_{t-1}}} + \alpha_3 \frac{\varepsilon_{t-1}}{\sqrt{GARCH_{t-1}}} + \alpha_4 Log(GARCH_{t-1}) + \gamma_3 Z$$

where $\frac{S_t}{S_{t-i}}$ is the daily return on the exchange rate; ***D*** is a vector of dummies for calendar effects and post-holiday effects; ***Spot*** represents a vector of spot intervention variables; ***Forwards*** accounts for a vector of variables for BSP intervention using derivatives and ***Z*** is a vector of other variables that may affect the exchange rate.

The main focus of this exercise is to estimate the contemporaneous impact of daily intervention (β in *Spot* and γ *in Forwards*) on the daily return on the exchange rate, $\frac{S_t}{S_{t-i}}$. If the central bank intervention is effective in reducing the volatility of the exchange rate, then β and γ ,the parameters of interest, will be both negative and statistically significant.

Based on our estimation of daily intervention by the BSP in the foreign exchange market from 1 December 2005 to 31 December 2010, we find that

[10] The original model was based on the exponential GARCH modelling framework used in Kim, Kortian and Sheen (2000). However, modifications were included to correct for bias arising from omitted variables and simultaneity. For details, see Kim, Suk-Joong, Tro Kortian and Jeffrey Sheen (2000), "Central bank intervention and exchange rate volatility – Australian evidence", *Journal of International Financial Markets*, vol. 10, pp. 381-405.

participation in the spot market remains the main method used by the BSP to influence the volatility of the exchange rate.[11]

Meanwhile, intervention through derivatives (forwards and FX swaps) serves a secondary role. Derivatives transactions entered into by local banks mostly took the form of forward and swap transactions. In the first three quarters of 2012, derivatives transactions registered a net gain of US$39 million, significantly lower than the US$914 million net gain posted during the same period in 2011.

Moreover, the results show that the BSP is sensitive to large swings in the exchange rate. Quite apart from that, there is no evidence that the BSP targets a particular exchange rate level over thirty-day or hundred-day trading horizons. There is also insufficient evidence to support some market assumptions that the BSP leverages its intervention activity in relation to the magnitude and direction of movements in regional currencies.

With respect to effectiveness, our estimates show that BSP intervention in the spot market has been effective in containing same-day volatility. Should volatility persist, the model indicates that higher-volume interventions or sustained central bank activities over consecutive trading days are significant in managing large fluctuations in the exchange rate. However, there is econometric evidence, albeit preliminary, that the covert nature of BSP spot market intervention appears to induce additional volatility in the exchange rate.[12]

D. Has sterilisation increased in magnitude?

The results of this study show that, in the case of the Philippines, the policies of accumulating international reserves and of sterilising the associated potential inflationary impact have complemented each other in recent years. The overnight reverse repurchase agreement has been an important tool for sterilisation since 1986, along with FX swaps and government bonds.[13] Other instruments for sterilisation include reserve requirements, government deposits with the BSP and the Special Deposit Account (SDA) facility. Beginning in 2006, the SDA facility assumed greater importance as a tool to complement BSP open market operations, though it was established in 1998. Banks can place funds with the BSP under the SDA facility, which is obligated to interest rates that depend on the term of the placements. Data from 1998 onwards show that the SDA was hardly used until 2006. In September 2006, the outstanding SDA balance rose to ₱49.7 billion, and then to ₱1.2 trillion in December 2010. As of 29 January 2013, it is at ₱1.8 trillion.

The effectiveness of each instrument, however, may not be isolated, as the BSP employs a mixture/combination of the instruments in sterilising FX purchases. Also, the relative costs of each instrument vary depending on market and economic conditions. For example, given a benign inflation forecast to the policy horizon, the cost of sterilisation using open market operations or special deposit accounts falls

[11] Further details of the estimation are available from the author.

[12] Market participants may fail to perceive small volumes of BSP intervention. There are also instances of the market's feeling that the BSP has intervened when it actually has not. The uncertainty generated by the way in which spot market intervention is conducted may result in differential information sets among market participants. Such circumstances can generate volatility.

[13] CBP/BSP bills were an important instrument from 1988 to 1999.

as the BSP cuts rates. The remuneration on reserve requirements may also vary. Effective April 2012, the BSP rationalised the reserve requirements imposed on banks, which include the non-remuneration of reserves, effectively eliminating financial costs to the BSP on this front.

In a recent move by the BSP, the interest rate for the SDA facility was reduced to 2.5 per cent regardless of tenor. Previously, the SDA rate was priced at a premium over the policy rate. This recent decision by the BSP was designed to rationalise the BSP's SDA facility so that it would be consistent with international central banking practice. Amidst manageable liquidity growth and a benign inflation outlook, the operational refinement of the SDA facility is expected to enhance BSP's ability to ensure that liquidity remains adequate to the requirements of the growing economy.

According to our assessments, which use 1986-2010 data for the Philippines and its Asian neighbours (Indonesia, Malaysia, South Korea, Singapore, Thailand, Mainland China and India), increases in foreign reserve inflows tend to be sterilised.[14, 15] In the case of the Philippines, the results showed that there has been a significant increase in the degree of sterilisation since 1986. If one compares the magnitude of sterilisation in different Asian countries, the Philippines appears to be in the middle of the pack. These findings indicate that the policies of accumulating international reserves and sterilising the potential inflationary impact have complemented each other in recent years. Moreover, the findings point to the BSP's having sterilised less than other Asian countries, possibly due to less pressure in the foreign exchange market.

An important observation is that there was a decline in the extent of sterilisation between the 1994-2001 period and the 2002-2010 period. This may indicate that the policy shift from monetary aggregate targeting to inflation targeting has given the BSP greater flexibility for achieving its price stability objective without depending so much on sterilising excessive foreign exchange inflows, and has allowed the flow of excess money to be absorbed by the economy's productive sectors. Mindful of the costs and operational considerations involved in sterilisation, the BSP in recent years has also implemented a package of policy measures to moderate the inflow of foreign exchange. These include exchange rate flexibility, liberalisation of the FX regulatory framework, prepayment of foreign exchange liabilities and support for changes in the fiscal borrowing mix.

E. Impact on the BSP Balance Sheet

While there are benefits to reserve accumulation, the BSP incurs financial losses from holding more foreign currency assets than foreign currency liabilities when the

[14] This is evidenced by the negative relationship between the net foreign assets (NFA) held by the monetary authorities and their net domestic assets. The inference is that any increase in NFA tends to be sterilised through a reduction in NDA. Positive values of NFA accumulation by the central bank correspond to foreign reserve inflows. Negative values of NDA correspond to reductions in domestic assets held by the monetary authorities, typically due to increases in open market operations.

[15] Also providing evidence for this conclusion is the unpublished paper "Has sterilization increased in magnitude over time?" presented by V. Bayangos at the Advisory Committee Meeting on 29 April 2011.

peso strengthens.[16] In addition, costs are incurred by the BSP since it has to sterilise its intervention in the FX market to mop up the liquidity associated with any operations that it conducts with a view to safeguarding price stability.

Income position of the BSP

For the periods indicated, in billions of pesos — Table 2

	2007	2010	2011	Jan-Sep 2012
Revenue	93.81	113.57	118.74	50.35
Less: Expense	67.05	82.48	115.97	83.14
Equals: Net Operating Income/Loss (–)	26.77	31.08	2.77	–32.79
Plus/Less: Gains/losses on FX Rate Fluctuations	–113.71	–90.12	–36.22	–35.56
Equals: Net Income/Loss (–)	–86.94	–59.04	–33.69	–68.36

Source: Bangko Sentral ng Pilipinas

The surge in capital flows took its toll on the BSP's finances as the central bank posted a net loss of ₱86.9 billion in 2007. During that year, the BSP's net operating income stood at ₱26.8 billion, which was not enough to cover losses from FX rate fluctuations totalling ₱113.7 billion. Similarly, the BSP registered net operating income of ₱31.1 billion in 2010. However, this was not enough to cover the losses from FX fluctuations, which amounted to ₱90.1 billion in that year, resulting in a net loss of ₱59.0 billion for 2010. In 2011, the BSP incurred a net loss of ₱33.7 billion due mainly to FX fluctuations amounting to ₱36.2 billion. For the period of January-September 2012, losses from FX fluctuations stood at ₱35.6 billion. Interest income totalled ₱30.8 billion, but interest expense reached ₱69.3 billion, resulting in a net loss of ₱68.4 billion.[17]

Moreover, the scale of the costs assumed by the BSP as a result of its participation in the FX market has been significant. Based on the latest available data, the BSP was mainly a net buyer of foreign exchange from late 2005 to the end of 2007. When the peso depreciated from early to mid-2008, the BSP was a net seller of dollars, thereby generating marked-to-market gains and trading profits. However, when the peso started to appreciate again in late 2009, the BSP became a net buyer of US dollars, generating greater costs to its balance sheet as the peso rose in value against the dollar.

F. Impact on the profile of government securities

A closer look at the nature of government securities shows that the increase in the holdings of government securities and the move to longer-dated bonds may have been caused by the strategy that government and private issuers adopted to take advantage of excess liquidity in the financial system and the relatively low interest rate environment. Table 3 shows the maturity of government securities as a percentage of the total outstanding from 2000 to 2011. Outstanding government bonds in domestic currency with maturities of more than three years rose from

[16] Under Section 71 of the New Central Bank Act, the BSP is required to maintain a net positive foreign asset position at all times.

[17] The BSP income statement for 2012 is based on preliminary, unaudited, data.

34.5 per cent in 2000 to 67.3 per cent in 2011. On the other hand, outstanding government bonds with maturities of less than one year dropped from 53.0 per cent in 2000 to 17.1 per cent in 2011. Meanwhile, the average maturity of the remaining outstanding domestic government securities increased by around 5 years – from 3.3 years in 2000 to 8.7 years in 2011.

Maturity of government securities at end of year

Table 3

	Government Securities (Percentage of total outstanding)				Central Bank Securities			
	Under 1 year	1 to 3 years	Over 3 years	Other maturities: average (years)	Under 1 year	1 to 3 years	Over 3 years	Other maturities: average (years)
Domestic								
2000	53.02%	12.44%	34.54%	3.31				
2005	41.67%	25.17%	33.16%	3.00				
2010	27.49%	17.78%	54.74%	6.09				
2011	17.14%	15.55%	67.31%	8.69				
Foreign					**BSP does not issue its own debt securities.**			
2000	–	13.00%	87.00%	12.18				
2005	8.00%	6.00%	86.00%	10.34				
2010	7.00%	3.00%	90.00%	12.21				
2011	–	7.00%	93.00%	12.80				

Source: Bureau of the Treasury

The maturity profile of foreign currency government securities is relatively stable except for maturities between one and three years which declined from 13 per cent of the mix in 2000 to 7 per cent in 2011. Moreover, the maturities of foreign currency government bonds are considerably higher than those of domestic currency government bonds.

Holders of domestic government securities*

(In billions of national currency units)

Table 4

	2005	2006	2007	2008	2009	2010	2011
Total	**2,118.17**	**2,121.14**	**2,167.95**	**2,387.97**	**2,452.70**	**2,709.10**	**2,864.26**
Banks	1,065.72	872.84	967.94	958.56	950.79	1,002.11	914.94
Private corporations	48.20	30.70	23.38	21.28	19.26	26.11	17.95
Custodians	0.00	158.74	143.54	140.54	146.02	219.99	355.69
GOCCs	118.36	118.51	138.20	145.72	140.16	149.66	132.21
Insurance companies	74.87	86.04	98.66	116.54	167.81	199.31	228.98
Investment houses	42.63	23.21	15.51	10.67	21.53	18.94	8.15
Local government units	1.40	0.76	0.35	0.00	0.00	0.35	0.15
Tax-exempt institutions	257.14	271.16	265.87	356.84	391.99	438.40	566.68
Others	509.85	559.17	514.51	637.82	615.14	654.24	639.52

* Excludes debt securities issued offshore, i.e. Global Peso Notes (GPN) and US$/Yen/Euro Bonds.

Source: Bureau of the Treasury

As to the holders of government securities, banks constitute the largest segment, holding about 32 per cent of domestic government securities as of end-December 2011 (Table 4). Following closely are custodians and tax-exempt institutions, which accounted for 32.2 per cent of total holdings of government securities at that time.

III. Conclusion: intervention and monetary policy

A market-based exchange rate policy is a necessary component of inflation targeting. Exchange rate flexibility can also serve as an automatic stabiliser and bear part of the burden of adjustment to capital flow surges. The BSP is aware that the exchange rate must not bear the entire burden of adjustments, particularly if the nature of the flows is perceived to be transitory. There is therefore a need to distinguish between more permanent flows, such as exports and remittances, and those driven by cyclical trends (e.g., higher cross-border flows) resulting from such factors as diversification by central banks and sovereign wealth funds (SWFs) in Asia and the Middle East, and structural portfolio adjustments in the private sector as home bias declines worldwide. Exchange rate overshooting can have significant repercussions on the economy – on its competitiveness in particular – that can be difficult to reverse.

In line with the discussions in Section II, it should be noted that while price stability is the primary goal of monetary policy, wide swings in the exchange rate may have destabilising effects on the economy, and hence they too must be managed.[18] To reduce the volatility of exchange rate movements, monetary authorities may opt to intervene in the foreign exchange market and undertake sterilisation to reduce liquidity and inflationary risks. Indeed, given the considerable capital flows to emerging market economies in recent months, monetary authorities have been grappling with two major concerns – price stability and stability of exchange rate movements. Accordingly, authorities have two policy instruments to deal with these concerns: policy interest rates and FX market intervention. Sterilised FX intervention would mitigate inflationary pressures that may result from the excess liquidity arising from the accumulation of FX reserves. On the other hand, accumulation of reserves may have a prudential value as a support in the event of a flow reversal.[19]

As noted previously, our estimation covers a limited period of daily BSP intervention in the foreign exchange rate market: 1 December 2005 to 31 December 2010. A more elaborate model and longer data series to capture broader issues on

[18] See Ostry, Jonathan D., A. Ghosh, K. Habermeier, L. Laeven, M. Chamon, M. Qureshi and A. Kokenyne (2011), Managing Capital Inflows: What Tools to Use? International Monetary Fund, Washington, D.C.

[19] For details, see:
(1) International Monetary Fund (2011), "Macroprudential Policy: An Organizing Framework", http://www.imf.org/external/np/pp/eng/2011/031411.pdf
(2) Ostry, Jonathan D., A. Ghosh, K. Habermeier, L. Laeven, M. Chamon, M. Qureshi, and A. Kokenyne (2011), "Managing Capital Inflows: What Tools to Use?" International Monetary Fund, Washington, D.C.
(3) Ostry, J., Ghosh, A., Habermeier, K., Chamon, M., Qureshi, M. and D. Reinhardt (2010), "Capital inflows: the role of controls", IMF Staff Position Note, International Monetary Fund, Washington, D.C.

the impact of central bank intervention on the volatility of exchange rate could help provide more insights on the effectiveness of intervention strategies.

Nevertheless, the paper's findings offer valuable insights. For the period covered by the study, we found that participation in the spot market remains the main method used by the BSP to influence the volatility of the exchange rate, with intervention in the foreign exchange market through derivatives serving a secondary role. Moreover, our results show that the BSP is sensitive to large swings in the exchange rate. However, we found no evidence that the BSP targets a particular level for the exchange rate over thirty-day or hundred-day trading horizons.

As to effectiveness, our estimates indicate that the BSP's intervention in the spot market has been effective in containing intra-day volatility. The effectiveness of intervention in the foreign exchange market is measured by how significantly spot market intervention and forward transactions influence the daily return on the exchange rate. Over longer trading days, our findings indicate that intervention at larger volumes or sustained central bank actions are significant in managing large fluctuations in the exchange rate.

Sterilised intervention is possible at any moment in time, but its sustainability is an important policy issue. Empirical policy studies suggest that the sustainability of the policy depends on the interest rate earned by the foreign reserves, the domestic interest rate, the exchange rate trend, and the evolution of the variables that determine the demand and supply of the monetary base and the impact of sustained sterilisation on the central bank balance sheet. The common thread in these studies is that there is a maximum level for the domestic interest rate at which sterilisation policy is sustainable. When there is an excess supply of foreign currency at the equilibrium exchange rate level, the central bank can determine the exchange rate and has the freedom to establish a domestic interest rate equal to or lower than that maximum level (Frenkel, 2007; Bofinger and Wollmershauser, 2003).

The terms of implementation for policies to check the negative effects of surges in flows require responsive monitoring and penetrating research. In conducting market surveillance, the BSP uses a set of macroprudential indicators to determine the status of financial markets, and also to get a feel of how exogenous shocks are transmitted to the domestic economy and the financial system.

What are some of these macroprudential indicators?

The macroprudential indicators that BSP regularly tracks may be broadly classified according to the two traditional aspects of systemic risk: procyclicality (time-dimension of risk) and interconnectedness (cross-sectional dimension of risk). The procyclicality seen in financial systems bespeaks herd-like market behaviour (see Annex A for a list of macroprudential measures currently in place in the Philippines).

Macroprudential indicators that BSP uses to track the time dimension of risk include the following:

- Philippine Financial Stress Index – This measure takes into consideration flight to liquidity and quality, and uncertainty about the fundamental value of assets, using Treasury bond yields, the interbank lending rate, overnight RRP rate, LIBOR, JP Morgan Philippine sovereign spread, Philippine credit default swap spread, Philippine Stock Exchange Index, Chicago Board Options Exchange

Volatility Index, and Corporate Ba3-rated bond spread vis-à-vis the 10-year Treasury bond rate.

- Bank Distress Index (BDI) – The BDI dates banking crisis episodes in the Philippines and defines a banking crisis as a period during which the BDI is above its mean by more than 1.5 standard deviations.
- Asset Price Bubbles Model – This measures asset price bubbles as the difference between price overvaluation and the portion attributable to short-term frictions.
- Philippine Business Cycle Model – This model warns policymakers of turning points in economic activity from expansion to contraction and vice versa. Insights generated by the model are important in designing appropriate economic policies.
- Early Warning System for Currency Crisis – This measures the probability of a currency crisis, using indicators from the external, monetary, financial, real, and fiscal sectors, and from the global economy.
- Financial market indicators that reveal abnormal price levels and changes that may indicate susceptibility to market disruptions (e.g., data from the foreign exchange market, interest rate market, commodities market and equities market, as well as volatility indices).
- Traditional aggregate banking system indicators, which show stages of the banking system cycle based on historical data – These include reports on consolidated consumer loans, real estate loans, non-performing loans, and capital adequacy. Likewise, stress testing is done on a semi-annual basis to measure the vulnerability of the banking system's capital adequacy ratio to changes in credit and market risks. Furthermore, changes in the liquidity, profitability and asset quality of the banks are monitored on a quarterly basis.

As to the cross-sectional dimension of systemic risk, BSP looks at the linkages between the financial sector and the real sector using the Financial Social Accounting Matrix. This model relates economic variables in the real sectors to variables in the financial sector and presents transactions and transfers between all economic agents. Other tools are currently being developed to strengthen our ability to monitor the interconnectedness of risk.

The insights in this paper raise the broader issue of whether or not intervention is effective under an inflation targeting regime – an issue that can be extended to an economy-wide framework. In the present context, the more relevant question is whether the exchange rate can be included in the monetary authorities' reaction function. The BSP is mindful that while there are benefits to reserve accumulation, there are costs from holding more foreign currency assets than foreign currency liabilities, especially when the peso strengthens and sterilising the intervention in the foreign exchange market to mop up the liquidity bears a price. These measures are conducted with a view to safeguarding price stability.

Annex A:
Macroprudential measures currently in place in the Philippines

For the Philippines, the following macroprudential measures are currently in place:

a. Measures to directly influence the credit cycle

- Direct controls on lending to specific sectors such as limits on different forms of credit exposures (by borrowing sector and by instrument). For example, for purposes of determining the 20 per cent limit on real estate exposure by banks, the definition of real estate exposure has been recently expanded to include investments in securities (both debt and equity securities) issued for purposes of financing real estate activities.[20]
- Regulation of foreign currency lending by requiring prior approval of the central bank for borrowings denominated in foreign currency if borrower is public sector and/or debt is to be serviced using foreign currency purchased from the banking system.
- Loan-to-value (LTV) caps/ratios such as a maximum LTV of 70% for loans secured by real estate.

b. Measures to limit the build-up of system-wide financial risk

- Restrictions on distribution of bank profits; distribution is subject to permission by regulators.
- Liquidity requirements such as a requirement that banks maintain 100% asset cover for their FX liabilities, with 30% in the form of liquid assets.
- Limits on open FX net positions and foreign assets.

Measures to reduce interconnectedness, such as leverage ratio and liquidity ratio, are being considered for future implementation by the BSP. Special attention is also being devoted to NDFs that are viewed as being used for speculative purposes.

[20] Excluding loans and investments in securities to finance the construction of highways, streets, bridges, tunnels, railways, and other infrastructure for public use.

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To what extent can central banks influence exchange rates with foreign exchange interventions? The case of Poland

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Abstract

The significant depreciation of the Polish zloty in the second half of 2011, difficult to explain by fundamentals, was accompanied by a large increase in exchange rate volatility. The foreign exchange interventions carried out by the National Bank of Poland at that time were aimed at reducing the volatility of the Polish currency and the risk of its disorderly depreciation. In this regard, the two event studies presented in this paper argue that the central bank's policy was effective. On the date of the intervention, the zloty typically appreciated against the euro while the implied volatility of the currency tended to decline.

Keywords: foreign exchange intervention, exchange rate volatility, central banks and their policies

JEL classification: E58, F31, O23

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Introduction

In this paper we discuss the role and effectiveness of foreign exchange (FX) interventions in Poland during the intervention period of late 2011. By putting aside interventions conducted before 2011, we are able to focus on the recent external conditions, as well as monetary policy considerations, which are largely determined by the inflation targeting (IT) regime under which the National Bank of Poland (NBP) operates. Interventions are not considered to be the main monetary policy instrument in Poland. Indeed, since the introduction of IT they have been used only occasionally. The 2011 interventions were exercised when the zloty faced periods of heightened exchange rate volatility. The NBP's experience is that not only the level of the exchange rate, but also its volatility may be of great importance during times of crisis. Hence, we pay special attention to both characteristics of the EUR/PLN exchange rate.

When deciding whether to intervene, a central bank is interested in assessing not only the preconditions for interventions, but also their effectiveness. We deal with this question by presenting possible techniques for assessing the effectiveness of interventions in two event study frameworks. Applied to actions undertaken by the NBP, the methods confirm that the 2011 interventions were generally successful.

The paper is organised as follows: Section I describes the evolution of the exchange rate regime in Poland. Section II presents the economic background that was present during the recent intervention period. Section III summarises the zloty's behaviour before the interventions started and explains the main motives behind the interventions. Section IV analyses the effectiveness of the interventions, using the event study methodology.

I. Characteristics of the exchange rate regime in Poland within the IT framework

The free float exchange rate regime was introduced in Poland in April 2000, soon after adoption of the inflation targeting (IT) strategy. The decision to shift from an eclectic monetary policy towards a more coherent IT framework was announced by the newly established Monetary Policy Council (MPC) in September 1998 and implemented in 1999. In the IT framework, a central bank's objective of price stability is expressed as a numeric target for inflation in the medium term. It is worth noting that the MPC recognised from the beginning that the free float exchange rate regime was a necessary condition for effective implementation of a new inflation targeting regime (Szpunar, Pruski 2004).

There are several theoretical arguments justifying this approach. Firstly, one of the conclusions of the "impossible trinity" paradigm is that in the long run a central bank operating under full financial integration cannot target both inflation and the exchange rate. Otherwise, monetary policy authorities run the risk that economic agents will begin to doubt whether the central bank truly pursues its inflation target. Secondly, the free float regime contributes to the overall flexibility of the domestic economy, as it constitutes a self-adjusting mechanism which corrects imbalances in the economy by acting as a shock absorber during rapid changes in the external environment (Brzoza-Brzezina, Makarski and Wesołowski, 2012).

The Polish experience with the new monetary policy framework is in line with the theory-based assumption that IT under a free float system is beneficial for price stability. The disinflation process in Poland was successfully completed at the end of the 90s, with inflation falling into single-digit territory in 1998 for the first time since the beginning of the transition, with low and stable inflation achieved subsequently. Indeed, since the introduction of the inflation target of 2.5% ± 1pp in 2004, inflation has averaged 3%. The high level of monetary policy credibility is reflected in the fact that long-term expected inflation, as measured by the difference between yields on 10-year conventional and index-linked government bonds, is now close to the official NBP medium-term inflation target, which is set at 2.5% in year-on-year terms. Overall, the new monetary policy framework has proved to be adequate in terms of controlling inflation and anchoring inflation expectations at low levels.

On the exchange rate front, it must be underlined that the free float regime has proved effective in reducing economic volatility by acting as a shock absorber cushioning real economic shocks. There is evidence from the latest financial crisis that part of the reason why Poland did not experience recession in 2008–2009 was owing to the steep fall in the zloty's value, which helped to sustain Polish exports at a rising rate. Yet, even though the free float regime appears to reduce economic uncertainty, excessive exchange rate volatility may constitute one of its major costs. The empirical data on the volatility of the Polish zloty partially validates this opinion. While it is true that in the first years of pursuing IT, exchange rate volatility increased and the zloty's ranked among the most volatile exchange rates in the emerging markets, the developments of the last four years point to a more positive picture. As shown in Table 1, before the Lehman Bank's collapse the zloty's volatility was way above the median emerging market currencies' volatility. When the latest four years are taken into consideration, however, the zloty's volatility falls back to the group's median.

In line with IT, the National Bank of Poland does not target any particular exchange rate level. At the same time, FX interventions are not excluded from the monetary policy toolbox as long as they are subordinated to ensuring domestic macroeconomic and financial stability. This is confirmed in the NBP's Monetary Policy Guidelines for 2013, which state that FX interventions are not ruled out under the floating exchange rate regime pursued. Quite the opposite, for under specific circumstances they may be necessary to ensure economic stability, which in the medium term is conducive to meeting the inflation target. From April 2000 to 23 September 2011 Poland's exchange rate regime was classified by the IMF as a free float regime, as there had been only one FX intervention by the NBP in the period preceding September 2011. During the NBP interventions in the second half of 2011, the exchange rate regime was classified as "floating". In 2012 the NBP ceased to intervene, so the *de facto* exchange rate arrangement was reclassified again as "free floating". Sporadic FX interventions in Poland are consistent with its priority on targeting over other goals. The same conclusion could be drawn from empirical studies on the monetary policy reaction function, which find that interest rates in Poland do not respond to exchange rate fluctuations (e.g., Frömmel and Schobert, 2006, and Vasicek, 2009).

Bańbuła, Koziński and Rubaszek (2011) analyse the preconditions for considering FX interventions in Poland, and examine motives for intervention other than monetary stability. They conclude that in Poland the central bank has the necessary tools at its disposal for identifying substantial deviations of the exchange rate from the equilibrium level. They also highlight the fact that the zloty was the most volatile currency in Central Europe in the 2000–2010 period. Excessive and

long-lasting exchange rate volatility can potentially be very disruptive to the stability of the financial system.

Volatility of major Emerging Market floating currencies — Table 1

Currency	12/2000 – 10/2012	12/2000 – 9/12/2008	9/12/2008 – 10/2012
Turkish lira	20.1%	22.0%	15.6%
South African rand	18.3%	17.3%	20.1%
Brazilian real	17.3%	15.5%	20.5%
Korean won	11.9%	7.5%	17.8%
Indonesian rupiah	11.7%	11.6%	11.9%
Polish zloty	11.6%	10.4%	13.7%
Mexican peso	10.4%	7.3%	14.9%
Hungarian forint	10.3%	8.1%	13.7%
Czech koruna	7.2%	6.1%	9.1%
Philippine peso	7.2%	7.4%	6.7%
Indian rupee	6.1%	3.9%	9.1%
Thai baht	5.2%	5.5%	4.5%
Median	11.0%	7.8%	13.7%
Mean	11.4%	10.2%	13.1%

Note: Exchange rates are **nominal exchange rate natural crosses** (CZK, HUF, PLN quoted vs. EUR; remaining currencies quoted vs. USD). Volatility is measured as the annualised standard deviation of daily log rates of return. The most liquid exchange rates were identified using the BIS Triennial Central Bank Survey 2010.

Source: National Bank of Poland, data; Bloomberg.

II. Economic background of FX intervention in 2011

Poland has weathered the recent global financial crisis relatively well. It has avoided recession, with its slowest growth being 0.4% in Q1 2009, while other European countries have seen a sharp decline in economic activity. It has not experienced a crisis in its banking system due to the sector's sound financial condition. Nor has it fallen into deep fiscal problems, since the debt to GDP ratio has stabilised below 55% over the last years.

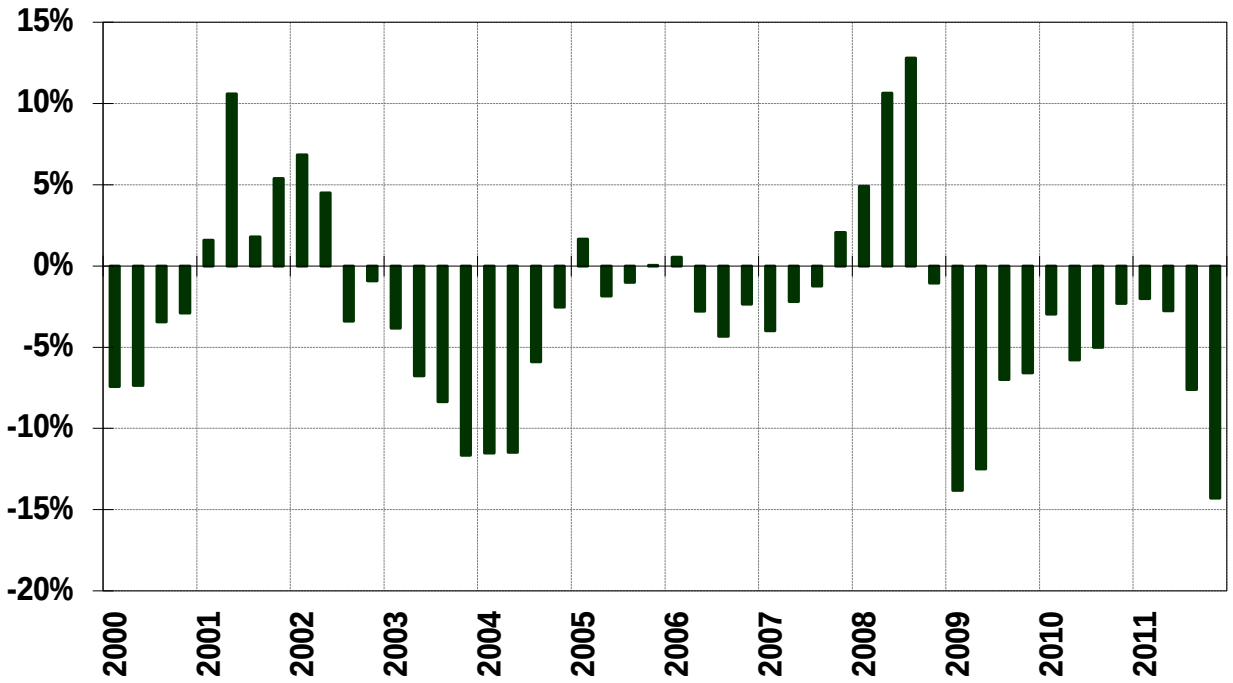
As a result, the Polish economy grew by an average of 3.7% in 2008–2011, while average growth in 2004–2007 was 5.5%. The reduced growth rate in the crisis period in comparison with the pre-crisis years seems to be moderate in comparison with other countries. In 2011, a year marked by the NBP's FX interventions, the country's economy enjoyed robust and well-balanced growth. Real GDP expanded by a solid 4.3% in 2011, driven by a strong rebound in fixed investment and net exports.

With strong economic performance and net exports contributing solidly to Poland's GDP, macroeconomic fundamentals should be an important factor in the stable behaviour of the Polish currency in 2011. In a more formal way, various equilibrium exchange rate models used at the National Bank of Poland come to the same conclusion. For example, the extended version of the fundamental equilibrium exchange rate model (Rubaszek, 2009) points to undervaluation of the Polish zloty at times of crisis. In the fourth quarter of 2011 the misalignment was as high as

14.3% based on the FEER model. Such a deviation from the equilibrium does not come as a surprise, given wide consensus in the literature that the fundamentals-based models explain exchange rate developments reasonably well only in the long run.

Fundamental equilibrium exchange rate misalignment

Figure 1



Note: Positive values stand for overvaluation. Misalignment is measured as the difference between the estimated FEER and the actual real effective exchange rate.

Source: National Bank of Poland.

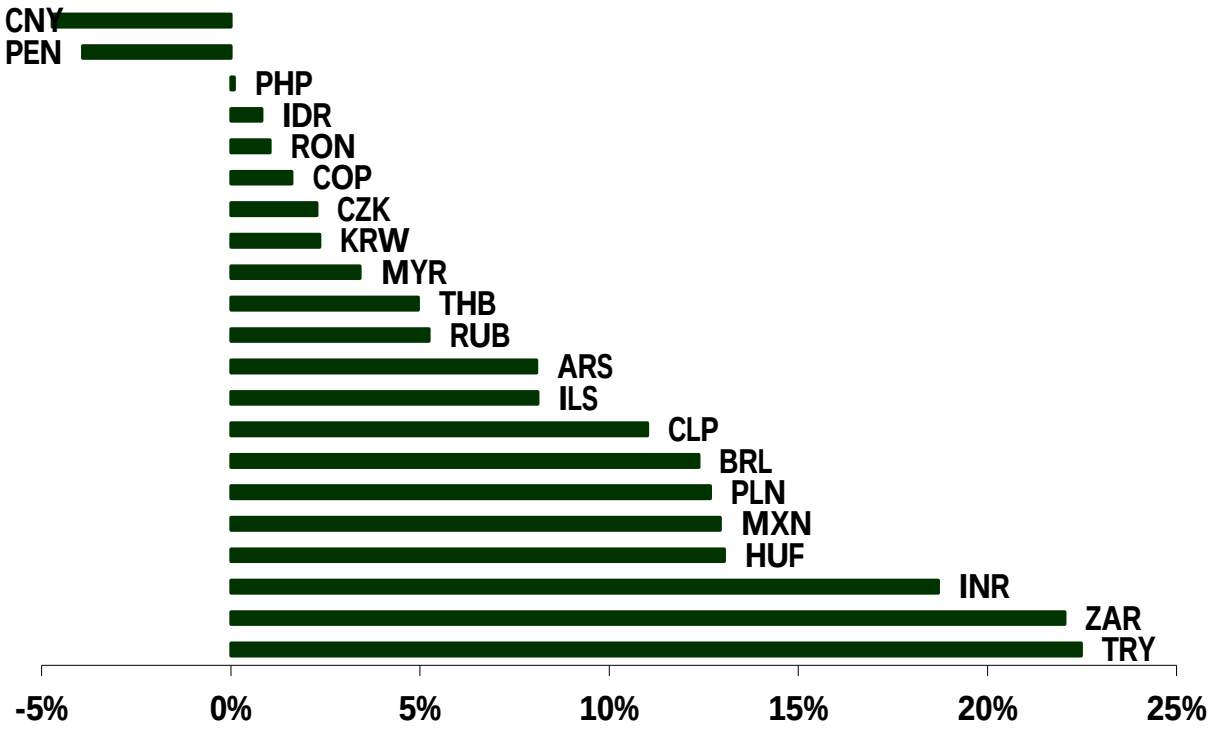
III. Exchange rate developments and motives behind FX interventions

While Poland managed relatively well during the global recession of 2008–2009 and avoided a domestic financial crisis, its financial market was to some extent affected by external shocks originating in major economies. The Polish economy was vulnerable to these shocks due to its close economic links with the rest of Europe and because of large external financing needs (Belka 2012). The second half of 2011 brought a sharp depreciation of the Polish zloty on the back of twin sovereign and banking crises in the euro area. Spillover effects led to currency market turbulence in Poland. However, it was a much broader phenomenon, as is evident from the sharp currency movements observed in many other emerging market countries. The National Bank of Poland responded to the exogenous shocks by starting FX interventions on 23 September 2011, and this decision coincided with other central

banks' activities in their domestic FX markets.[4] Between 23 September and 30 December 2011, the NBP stepped into the FX market several times.

One of the features of the Polish zloty movements before 23 September 2011 was its rapid depreciation compared to other emerging markets currencies. The zloty's high sensitivity to global risk factors could be partly attributable to its trading characteristics. The zloty's unusual weakness in 2011 despite Poland's solid macroeconomic fundamentals resulted from its relatively good liquidity and proxy hedge characteristic. During times of crisis, high liquidity can negatively impact currency stability, as investors are more inclined to close their positions in liquid currencies at the start of a crisis. Proxy hedge status refers to the idea that the most liquid market can often serve as a proxy hedge against adverse movements in illiquid markets. In the case of Poland, the zloty was used as a proxy hedge against other, less liquid regional currencies.

Emerging market currencies' performance in 2011 Figure 2



Note: Performance calculated as rate of return on nominal spot exchange rate natural cross.

Source: National Bank of Poland, data; Bloomberg.

The sharp depreciation of the zloty in the second half of 2011, difficult to explain by fundamentals, was associated with a large increase in exchange rate volatility. On 22 September 2011, one day before the first NBP FX intervention, the one-week implied EUR/PLN volatility reached a high of 18.6%. It remained at elevated levels until the end of the year. However, it stopped growing during the intervention period.

[4] At that time FX interventions were conducted by central banks in Brazil, South Korea, Russia and Turkey, inter alia.

The interventions were conducted at a time of increased exchange rate volatility and depreciation pressures on many emerging market currencies. The Polish monetary authorities made the decision to intervene in order to reduce the volatility of the Polish currency and the risk of further depreciation. This decision should be also viewed in the broader context of maintaining monetary stability. Owing to their positive impact on exchange rate volatility, the interventions should also contribute to lowering the risk of higher future inflation. Interventions were conducted at a time when inflation was markedly above the target of 2.5% (inflation in 2011 and in the first half of 2012 averaged 4.2% in annual terms). To curb inflation pressure, the NBP in early 2011 embarked on a monetary policy tightening cycle, which concluded in May 2012. For these reasons there was hardly any conflict between the objectives of the FX interventions and the monetary policy stance at the time.

IV. Assessment of the effectiveness of FX interventions

To complete the picture of the interventions conducted by the NBP in the second half of 2011, we must analyse their effectiveness. However, due to the complicated nature of such interventions this task is anything but trivial. The characteristics of the interventions include their sporadic and irregular nature, which results in unusual distribution, and the possibility of changes to intervention policy over longer periods. Fatum and Hutchison (2003) suggest that standard time-series studies are not particularly well suited for application in such a context. Therefore, it is common practice to rely on two advances in the field, namely, event study methodology and the possibility of using both daily and high-frequency (intraday) data.

There is a large body of work concerning the effectiveness of FX interventions in the event study framework. Neely (2005) surveys methodological differences in that body of work, pointing to several reasons which may find interventions successful in some studies but not in others. To minimise the impact of the choice of a particular method, we decided to use simple parametric and non-parametric methods. Both describe the behaviour of the exchange rate and/or its volatility around periods of intervention, and hence may be described as event studies. We leave aside the discussion of possible channels through which exchange rates may be influenced, and limit ourselves to studying the price impact of interventions in the short term only, as most studies do. It needs to be stressed, however, that the medium- to long-term effectiveness of interventions is of significant importance as well, and has also been tested in the literature (e.g., Fratzscher, 2008). To begin with, we describe the results of a parametric study using daily data. Then we proceed to the second study, which uses intraday data in a non-parametric framework. The event set consists of six interventions: those of 23 September, 30 September, 3 October, 23 November, 29 December and 30 December 2011.[5] Each was limited to a single day.

[5] In general, the NBP announced the interventions on its website by stating that it had bought a certain amount of foreign currency for zlotys.

Event study using daily data

In the first study we look at the 5-day windows following the interventions. For the purpose of calculating normal returns we use a market model in which we regress log returns of the EUR/PLN exchange rate on a constant, as well as log returns of EUR/USD, EUR/CZK and EUR/HUF. The latter two variables serve as proxies for the regional factors influencing the zloty, while the EUR/USD exchange rate approximates the global factor. We use standard ordinary least squares (OLS) technique. Under fairly general assumptions, the OLS is a consistent and efficient estimation procedure for the market model parameters. The estimation sample spans the period from 6 June 2011 to 22 September 2011, providing the same number of observations as the sample containing all the intervention periods. The exchange rate data are Bloomberg close of business day quotes. From Table 2 we conclude that the model for EUR/PLN log returns is reasonably well-specified, and that it passes standard autocorrelation of the error term (Breusch-Godfrey) and heteroskedasticity (ARCH) tests with a conventional number of lags.

Market model for EUR/PLN exchange rate (OLS) Table 2

Variable	Coefficient	Std. Err.	p-value
Const.	0.000	0.000	0.12
EUR/USD	–0.179	0.087	0.04
EUR/CZK	0.337	0.159	0.04
EUR/HUF	0.629	0.090	0.00
R-squared	0.63		
ARCH (1 lag)			0.11
ARCH (3 lags)			0.24
BG (1 lag)			0.18
BG (3 lags)			0.50

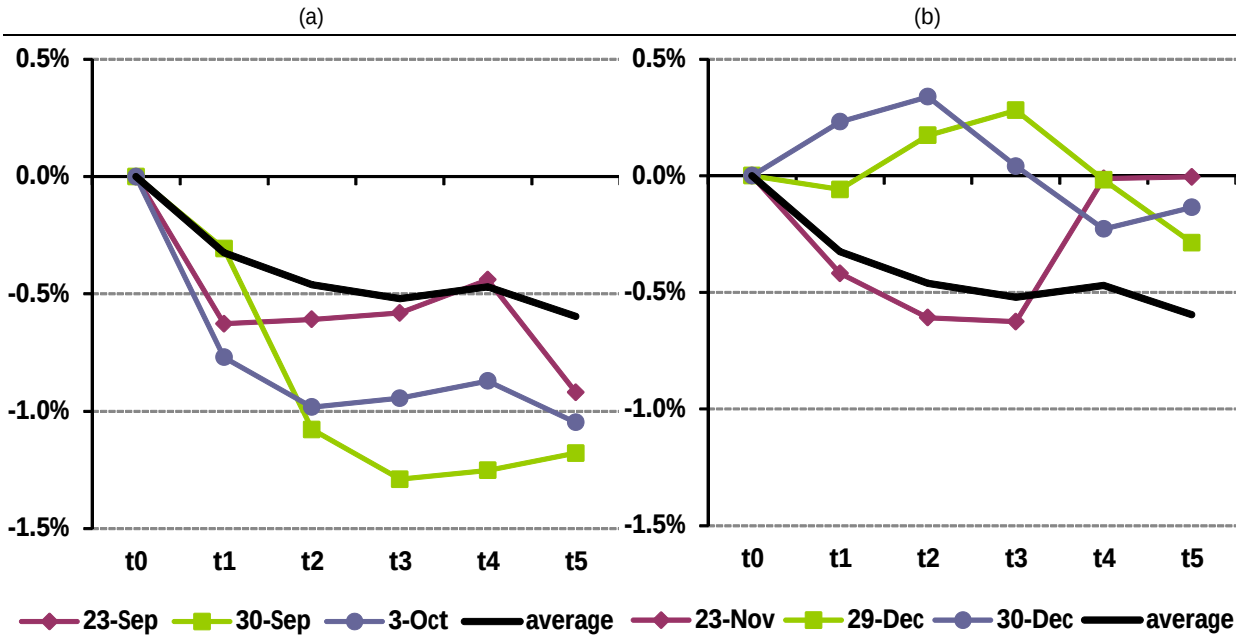
Notes: The dependent and explanatory variables are log rates of return. ARCH and BG denote ARCH heteroskedasticity and Breusch-Godfrey serial correlation tests respectively. Sample: 6/16/2011 – 9/22/2011.

Source: National Bank of Poland.

Next, we calculate abnormal returns by subtracting expected returns from actual (observed) returns and analyse their performance (Figure 3). The results indicate that in the five-day window following each intervention the zloty strengthened vs. the euro by 0.6% on average. Moreover, in period t1 (intervention day) the zloty appreciated in five out of six interventions, with the strongest reaction on 3 October 2011. The stabilising effect of central bank intervention was most visible during the September-October interventions, as the zloty appreciated further or remained at stronger levels for at least five days after the initial (t1) reaction.

Cumulative abnormal returns of EUR/PLN exchange rate

Figure 3



Notes: Abnormal returns are the returns obtained by subtracting expected EUR/PLN log returns (implied by the market model) from observed log returns. t0 is the day before intervention, t1 up to t5 are the days after the intervention.

Source: National Bank of Poland.

We recognise that the GARCH framework would be an appropriate way of testing together the effects of interventions on both the mean and volatility of the zloty. Our sample of interest, however, is not large enough to obtain reasonable estimates. Therefore, we decided to analyse the volatility of the EUR/PLN exchange rate via a simple linear regression model. To this end we use a market model, similar to the previous one, in which we relate the difference of the 1-month implied volatility of EUR/PLN to their global (EUR/USD) and regional (EUR/CZK, EUR/HUF) equivalents. The estimation sample is from 6 June 2011 to 22 September 2011, and the data are Bloomberg close of business day quotes. Table 3 provides the results of the estimation.

Market model for 1-month implied volatility of EUR/PLN exchange rate (OLS)

Table 3

Variable	Coefficient	Std. Err.	p-value
C	0.001	0.035	0.99
EUR/USD_1M	0.047	0.062	0.45
EUR/CZK_1M	0.148	0.166	0.38
EUR/HUF_1M	1.008	0.101	0.00
R-squared	0.80		
ARCH (1 lag)			0.36
ARCH (3 lags)			0.78
BG (1 lag)			0.71
BG (3 lags)			0.68

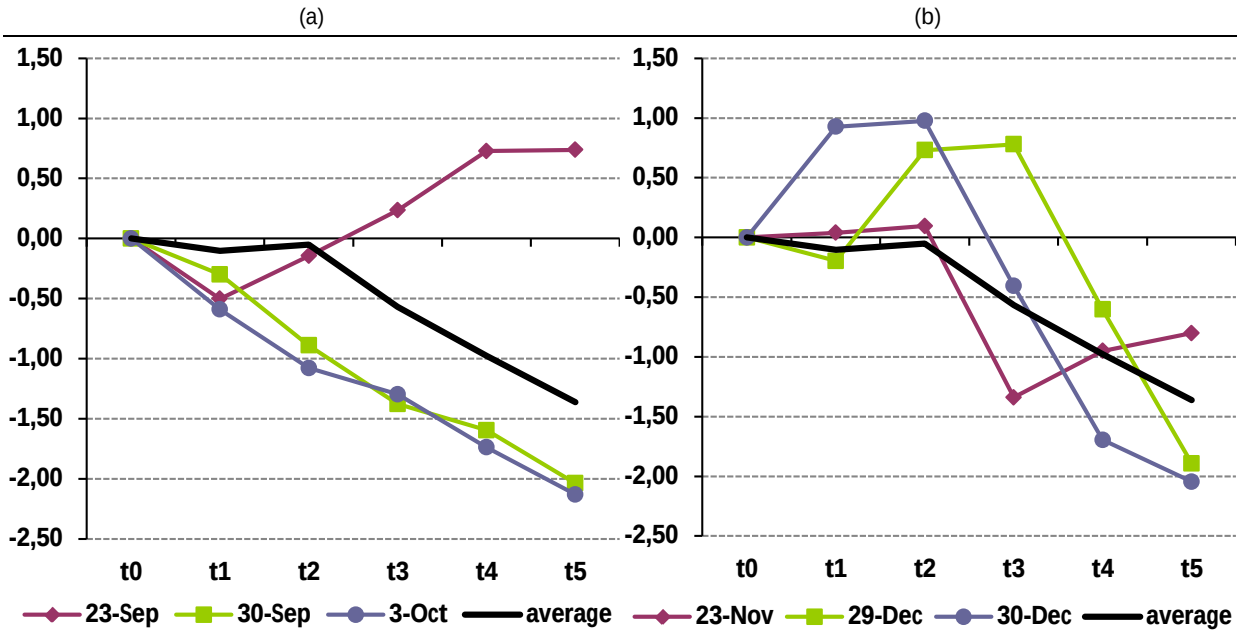
Note: The dependent and explanatory variables are in first differences. ARCH and BG refer to the ARCH heteroskedasticity and the Breusch-Godfrey serial correlation tests respectively. Sample: 6/16/2011–9/22/2011.

Source: National Bank of Poland.

In a similar manner we calculate abnormal changes by subtracting expected changes from actual (observed) changes in volatility and analyse their behaviour (Figure 4). The average abnormal change in the five-day window is negative (–1.4 pp.), which means that following the NBP interventions the zloty's implied volatility decreased, particularly in the t3–t5 period. In four out of six cases the volatility dropped on the intervention day, while in all but one it turned out to be lower after five days. The largest one-period effects are visible for the September-October interventions. The volatility argument may also be considered in terms of one of the criteria of successful interventions, the smoothing criterion (Humpage, 2000). In general, lower expected volatility of the currency means lower expected risk of excessive currency movements, including depreciation. To conclude, interventions decreased the volatility of the EUR/PLN expected by currency options traders, which was one of the objectives of the central bank in late 2011.

Cumulative abnormal changes of 1-month implied volatility of EUR/PLN exchange rate

Figure 4



Notes: Abnormal changes are the changes obtained by subtracting expected EUR/PLN volatility changes (implied by the market model) from observed volatility changes. t0 is the day before intervention, t1 up to t5 are the days after the intervention.

Source: National Bank of Poland.

Event study using intraday data

In the second event study we analyse the reaction of the zloty-vs.-euro to the interventions conducted by the NBP, using high-frequency data. By giving up the market model approach we lose the possibility of controlling for global or regional forces influencing the zloty contemporaneously with interventions. On the other hand, shorter event windows allow us to escape the problem of overlapping intervention periods. Here, the event windows are of various lengths, and we define them as lasting 15, 30 and 60 minutes from the beginning of the intervention, as well as 15, 30 and 60 minutes from the last transaction. We complement these results by reporting the change in the EUR/PLN rate up to 5 pm CET, approximately

close of business on the intervention day. Table 5 and Figure 5 contain the results. The data on exchange rate levels comes from the Reuters service. The average reaction of the exchange rate is negative regardless of the event window definition. The most pronounced average effect occurs 30 minutes after the beginning of the intervention or in 15 minutes if measured from the end of the intervention. From Figure 5 we also conclude that the interventions either reversed the zloty's depreciation trend, or supported its appreciation trend, on a given day.

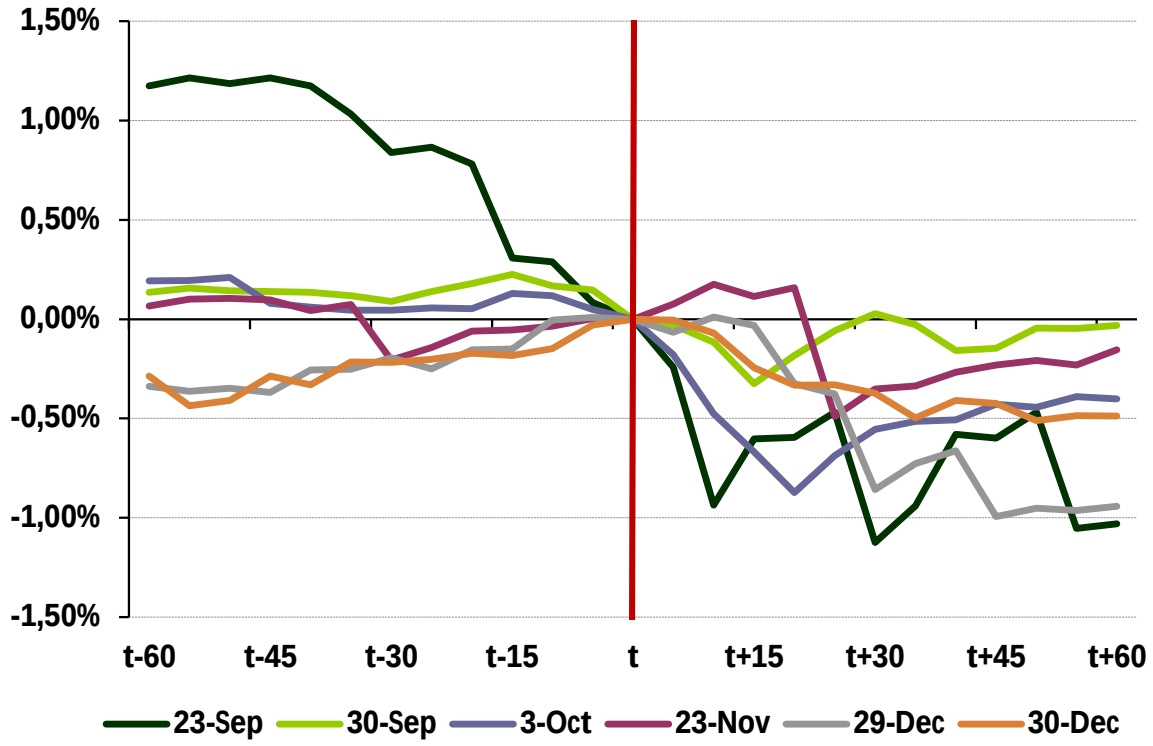
Intraday reaction of EUR/PLN exchange rate — Table 5

Intervention date	Change since beginning of intervention			Change since end of intervention			Change up to 5 pm CET
	15 minutes	30 minutes	60 minutes	15 minutes	30 minutes	60 minutes	
23-09-2011	–0.60%	–1.12%	–1.03%	–1.10%	–1.01%	–	–1.01%
30-09-2011	–0.32%	0.03%	–0.03%	–0.06%	–0.16%	0.04%	0.18%
03-10-2011	–0.67%	–0.56%	–0.40%	–0.51%	–0.39%	–0.28%	–0.56%
23-11-2011	0.11%	–0.35%	–0.15%	–0.23%	–0.15%	–0.15%	0.52%
29-12-2011	–0.03%	–0.86%	–0.94%	–1.09%	–1.11%	–1.13%	–0.94%
30-12-2011	–0.24%	–0.37%	–0.49%	–0.34%	–0.35%	–0.36%	–0.36%
Average	–0.29%	–0.54%	–0.51%	–0.55%	–0.53%	–0.38%	–0.36%

Note: Changes calculated as rates of return.

Source: National Bank of Poland.

EUR/PLN exchange rate movements around the events — Figure 5



Notes: Movements calculated as rates of return. t denotes the time closest to the beginning of a given intervention.

Source: National Bank of Poland.

Although both of these studies can be classified as event studies, a straightforward comparison of their results is not feasible for several reasons. They use different data sets, not only provided by different services, but quoted in different frequencies. As a consequence, the definitions of event and post-event windows do not match. Additionally, the first study is based on a regression model to control for external conditions while the second is not. However, both studies suggest that the interventions were largely effective in influencing the EUR/PLN exchange rate level. Depending on the definition of the event window, there is a minimum 66% success rate in influencing the exchange rate to move in the desired direction. Importantly, no NBP intervention could be identified as being a failure in majority of the event windows.

Conclusions

Strong economic fundamentals should have been an important driving force of stable behaviour of the Polish currency in 2011. However, the rate of the zloty's depreciation in Q4 2011 in comparison to other EM currencies threatened, inter alia, the stability of the currency and the achievement of the inflation target pursued by the NBP. Having FX interventions in its monetary policy toolbox, the central bank stepped into the market several times between September and December 2011, buying foreign currency for zlotys.

To evaluate whether the intervention policy of late 2011 was effective, we rely on an event study framework, looking at both daily and high-frequency data in various settings to minimise the impact of a given method. Even though the event set is rather limited, the results prove to be consistent and confirm that the interventions of the NBP were successful in that they tended to move the EUR/PLN exchange rate in the desired direction. As a result, the Polish zloty on a given day was slowing its depreciation path against the euro or strengthening its appreciation trend. The stabilising effect of intervention was most visible during the September-October period, as confirmed by the declining implied volatility of the EUR/PLN currency pair. More importantly, no NBP intervention could be identified as unsuccessful in all the event windows. Although not straightforwardly comparable, the results vary somewhat between settings, which highlights the complex nature of interventions and the difficulties involved in assessing their true effects.

Quite aside from methodological aspects of the event studies, we admit that more in-depth analysis is needed to get the complete picture of the FX interventions. One of the issues that must be explored is the medium- and long-term influence on the exchange rate. In this paper we studied only the short-term impact. What is more important for the inflation outlook is the ability of central bank interventions to contain the non-desired exchange rate pass-through, which obviously exceeds our event study horizon.

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The history of the Bank of Russia's exchange rate policy

Central Bank of the Russian Federation

Abstract

During the post-Soviet period of 1992–98, the monetary policy of the Bank of Russia was essentially exchange rate-oriented due to overall economic and financial instability combined with hyperinflation (1992–94) and high inflation (1995–98). An exchange rate corridor system was introduced in 1995. The government debt crisis of 1998 triggered a shift to a managed floating exchange rate. After that crisis, exchange rate dynamics were largely market-driven. The exchange rate continued to be tightly managed through 2002–05. In 2004, less restrictive capital control regulations were adopted, marking a move from an authorization-based system to flow controls. The rouble experienced steady upward pressure and the Bank of Russia intervened repeatedly in the foreign exchange market to contain the rouble's appreciation.

In 2005, the Bank of Russia introduced a dual-currency basket as the operational indicator for it exchange rate policy, again to smooth the volatility of the rouble's exchange rate vis-à-vis other major currencies. Following the global financial crisis, the Bank of Russia changed its policy focus towards moderating the rouble's depreciation. Interest rates were steadily raised, and a range of control measures was implemented. During 2009–12, the Bank of Russia further increased the flexibility of its exchange rate policy. Intervention volumes have steadily decreased. The overall scale of the exchange rate pass-through in the Russian economy has diminished in recent years. Greater flexibility on exchange rates has also let the Bank of Russia put increased emphasis on its interest rate policy.

In 2013–14, the Bank of Russia plans to further increase the flexibility of the rouble exchange rate regime with a view to creating the conditions for a transition to a fully floating exchange rate regime by 2015.

Keywords: Bank of Russia, rouble, foreign exchange market, exchange rate policy, exchange rate regime

JEL classification: E58

The post-Soviet period of 1992–98 was characterised by overall economic and financial instability combined with hyperinflation (1992–94) and high inflation (1995–98). Waning confidence in the domestic currency due to persistent inflation led to the dollarisation of the economy. During this period, monetary policy was essentially exchange rate-oriented. An exchange rate corridor system was introduced in 1995, strengthening the role of the rouble exchange rate as the nominal policy anchor.

The government debt crisis of 1998 triggered a shift to a managed floating exchange rate. After that crisis, exchange rate dynamics were largely market-driven and allowed official reserves to be rebuilt after oil prices revived. But the emphasis continued to rest on exchange rate policy in view of continued weaknesses in the transmission mechanism and the financial sector as a whole. The policy was intended to prevent excessive movement in the rouble exchange rate that might threaten macroeconomic and financial stability, thus compensating for a relative lack of experience and tools among economic participants and in the household sector for managing exchange rate risks. The exchange rate policy also helped to restore confidence in the country's financial system after the crisis and to dampen the effect of volatile commodity prices on the economy.

The exchange rate continued to be tightly managed through 2002–05. At the same time, the Bank of Russia started to gradually relax capital controls. In 2004, less restrictive capital control regulations were adopted, marking a move from an authorisation-based system to flow controls. The Bank of Russia lifted its last capital controls in July 2006.

After the capital account was liberalised, the rouble experienced steady upward pressure as rising oil prices swelled the current account surplus and capital flowed in at ever-faster rates. The Bank of Russia intervened in the foreign exchange market to contain the rouble's appreciation with its associated threats to the competitiveness of Russian exporters and to economic and financial stability. These operations were the main reason for a corresponding increase in the money supply; indeed, the country's monetary aggregates consistently outgrew the Bank of Russia's targets during this period. Inflation, however, slowed gradually, as economic agents de-dollarised their balance sheets. At the same time, strong economic growth also contributed to a steady increase in demand for money.

In 2005, the Bank of Russia introduced a dual-currency basket as the operational indicator for its exchange rate policy. Again, the aim was to smooth the volatility of the rouble's exchange rate vis-à-vis other major currencies. The dual-currency basket consisted of the US dollar and the euro in unequal shares that were designed to keep the dynamics of the basket's value in line with changes in the rouble's nominal effective exchange rate. The basket's value remained more or less stable during the 2005–08 period, thanks to the growing weight of euro within it (in the first quarter of 2007, the composition of the dual-currency basket was fixed at 55% for the US dollar and 45% for the euro).

In May 2008, the Bank of Russia introduced a mechanism for regular purchase of foreign exchange with a view to countering the persistent mismatch of supply and demand in the domestic foreign exchange market, which was caused by the transfer to the sovereign funds of tax revenues from the export of mineral resources.

The global financial crisis led to a sharp decline in oil prices. This sharply eroded Russia's current account balance and triggered massive capital outflows, thus

putting the rouble under significant downward pressure. In response, the Bank of Russia changed its policy focus towards moderating the rouble's depreciation, a trend that threatened to put a heavy strain on the balance sheets of banks, firms and households via the significant level of foreign currency-denominated debt that these agents had taken on.

Between November 2008 and January 2009, the Bank of Russia allowed the rouble to depreciate gradually by widening the dual-currency band. At the same time, the Bank conducted large-scale interventions in the domestic foreign exchange market in order to slow the pace of the rouble's depreciation with the aim of allowing the economy time to adjust to these ongoing changes. From November 2008 to January 2009, the level of Russia's international reserves fell by one third.

In order to curb capital outflows, slow the rouble's depreciation and prevent instability in domestic financial markets, the Bank of Russia raised interest rates steadily and implemented a range of additional measures. Banks were advised to maintain stable levels of net foreign assets and currency positions, and their observance of these recommendations was taken into account when credit limits were set for individual banks' access to Bank of Russia unsecured loans (the main anti-crisis refinancing tool during that period). Limits were substantially reduced for banks that did not adequately respect the recommendations.

In January 2009, the Bank of Russia announced a wide fixed band for the rouble value of the dual-currency basket (allowing fluctuations from 26 to 41 roubles) and it also introduced a floating operational band. The gradual move to a more flexible exchange rate regime was intended to create favourable conditions for market participants to adjust to a fully floating exchange rate environment.

Starting from the first quarter of 2009 the exchange rate policy mechanism permitted foreign exchange interventions both within the floating operational band for the rouble value of the dual-currency basket and at its borders. The operational band included a "neutral" range where no interventions were conducted. When the value of the dual-currency basket moved outside the "neutral" range, the Bank of Russia started buying or selling foreign currency. The closer the value of the dual-currency basket approached the borders of the operational band, the more heavily the Bank of Russia intervened. The borders of the operational band were adjusted automatically as soon as the cumulative volume of foreign exchange interventions reached a set level. In order to neutralise the systematic imbalance between demand and supply in the domestic foreign exchange market, only the excess of the total volume of foreign exchange purchases and sales over a set level (ie target interventions) was taken into account when calculating the aforementioned cumulative volume. The Bank of Russia calibrated the volume of its target interventions according to balance of payment factors, the budget policy and domestic and foreign financial market conditions.

During 2009–12 the Bank of Russia further increased the flexibility of its exchange rate policy: the floating operational band was widened from 2 to 7 roubles, the cumulative interventions volume triggering a 5 kopecks shift in the operational band was reduced from $700 million to $450 million and the parameters of the target intervention mechanism were modified.

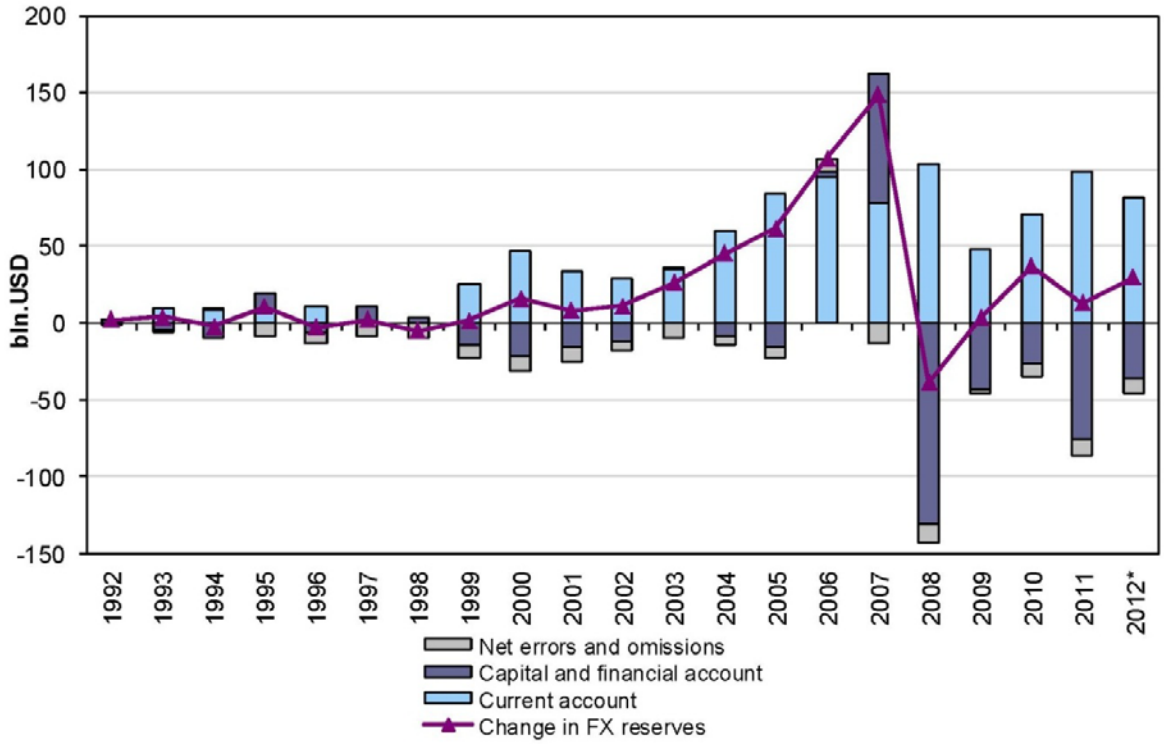
Following these changes, intervention volumes have steadily decreased. Yet the foreign exchange market has remained stable, and the rouble's moderate volatility and exchange rate trends have stayed in line with the dynamics of other emerging markets currencies, including those of the BRICS.

The gradual shift to more flexible rouble exchange rate helped economic agents adjust to the growing level of rouble volatility promoting continued de-dollarisation and making households' foreign exchange deposits and foreign exchange cash purchases dynamics less vulnerable to rouble exchange rate changes. According to Bank of Russia estimates, the overall scale of the exchange rate pass-through in the Russian economy has diminished in recent years. The move towards a fully floating exchange rate has also promoted the further development of Russia's hitherto nascent derivative markets for managing exchange rate risks

Greater flexibility on exchange rates has also let the Bank of Russia put increased emphasis on its interest rate policy. This has helped to reduce volatility in money market rates, thus strengthening the interest rate channel of the monetary policy transmission mechanism.

In 2013–14, the Bank of Russia plans to further increase the flexibility of the rouble exchange rate regime with a view to creating the conditions for a transition to a fully floating exchange rate regime by 2015 – an important prerequisite for the introduction of inflation targeting. After moving to a floating exchange rate regime, the Bank of Russia will abandon exchange rate-based operational indicators for its exchange rate policy. Even then, however, the Bank will retain the right to make interventions in the domestic foreign exchange market, especially for the purpose of managing liquidity in the banking sector.

Fig.1. Balance of Payments of the Russian Federation



*2012 estimate according to revised methodology

Fig.2. Ruble's Effective Exchange Rate Dynamics

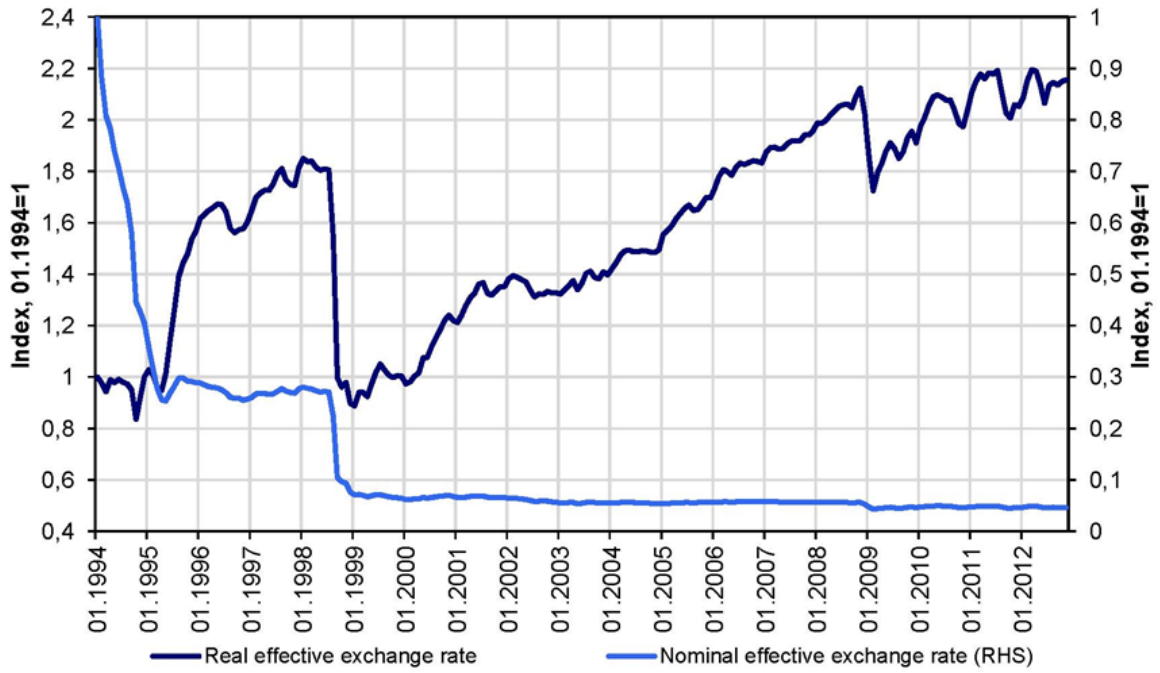


Fig.3. The Bank of Russia Net Foreign Assets and Monetary Aggregates

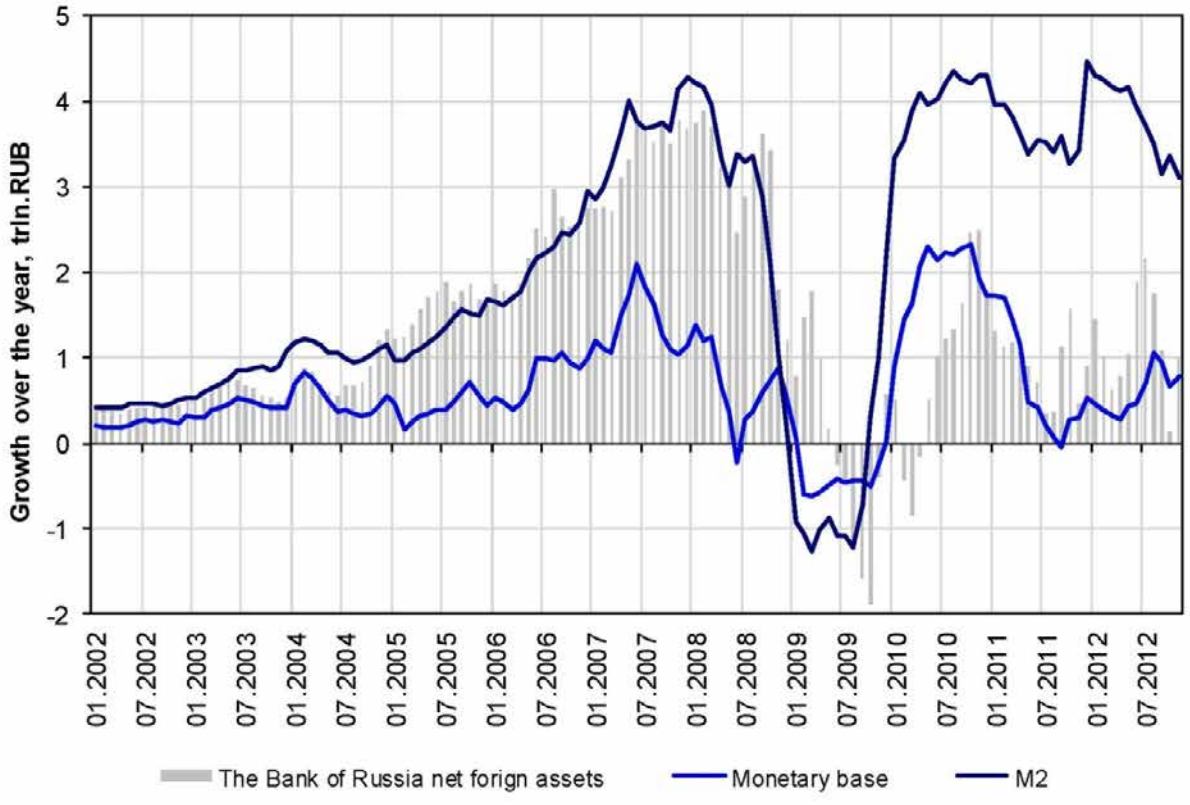


Fig.4. GDP Growth and Inflation in Russia

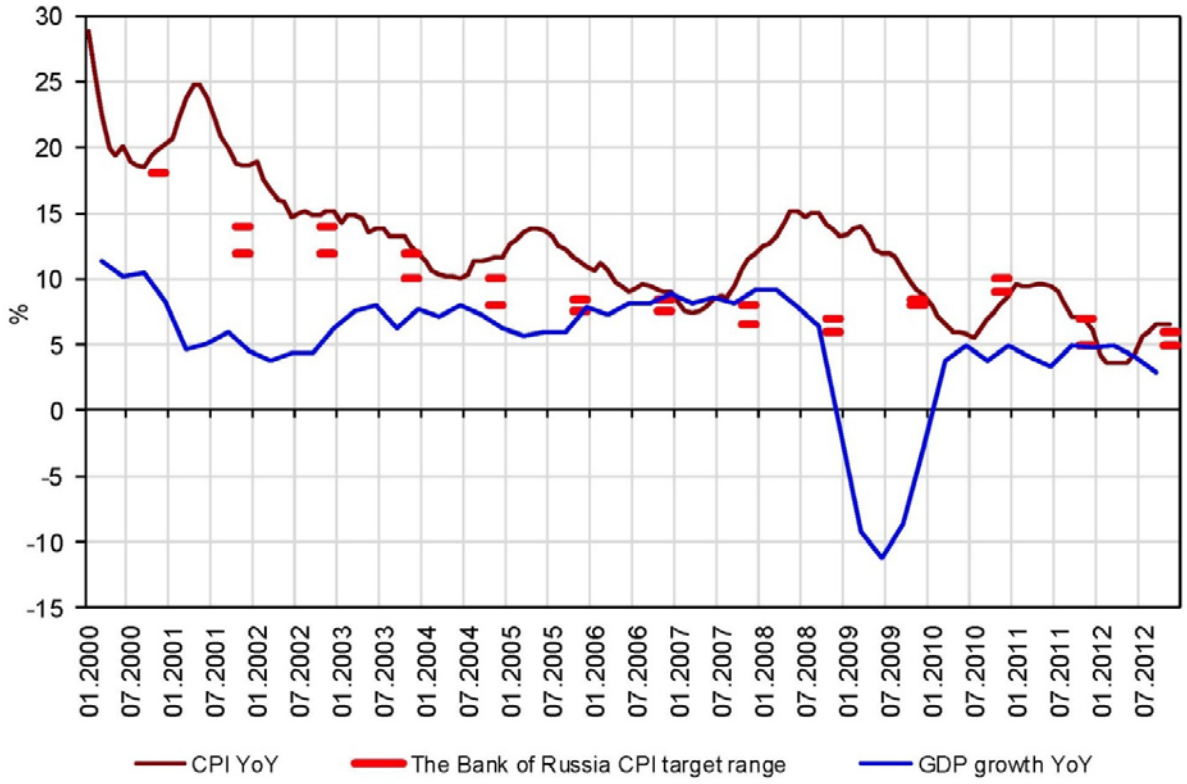


Fig.5. Rouble Exchange Rate and Inflation in 1992-1997

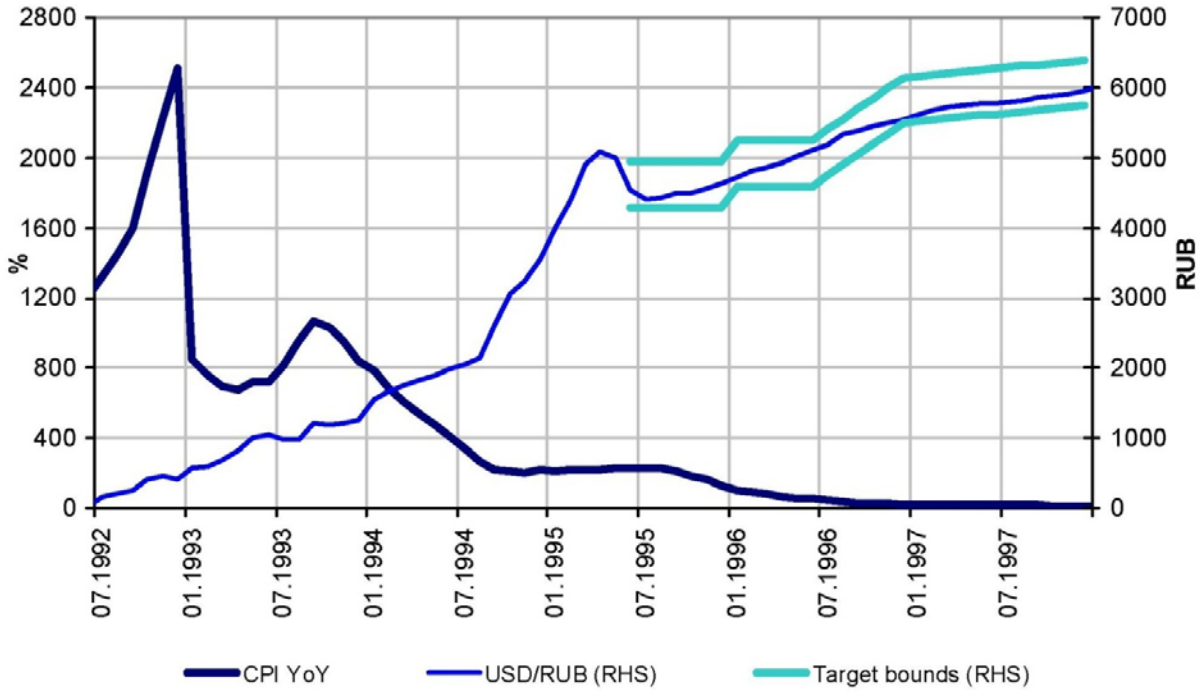


Fig.6. Rouble Exchange rate and the Bank of Russia FX Interventions in 1997-2004

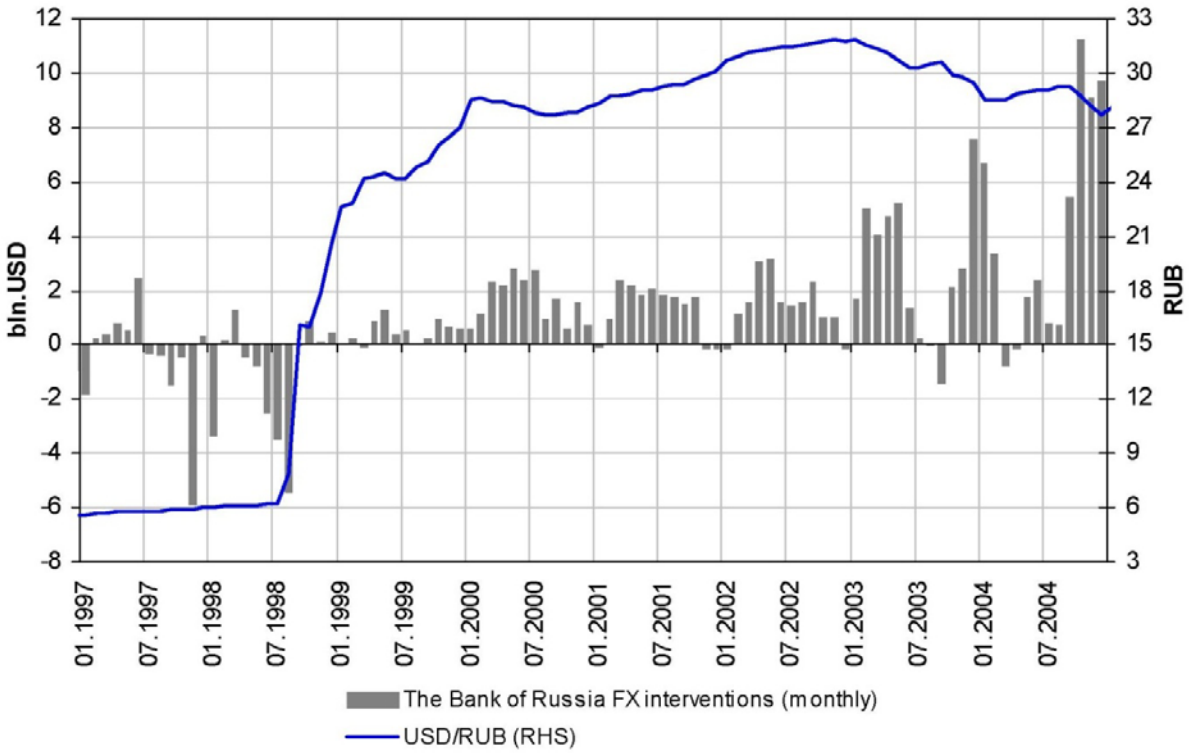
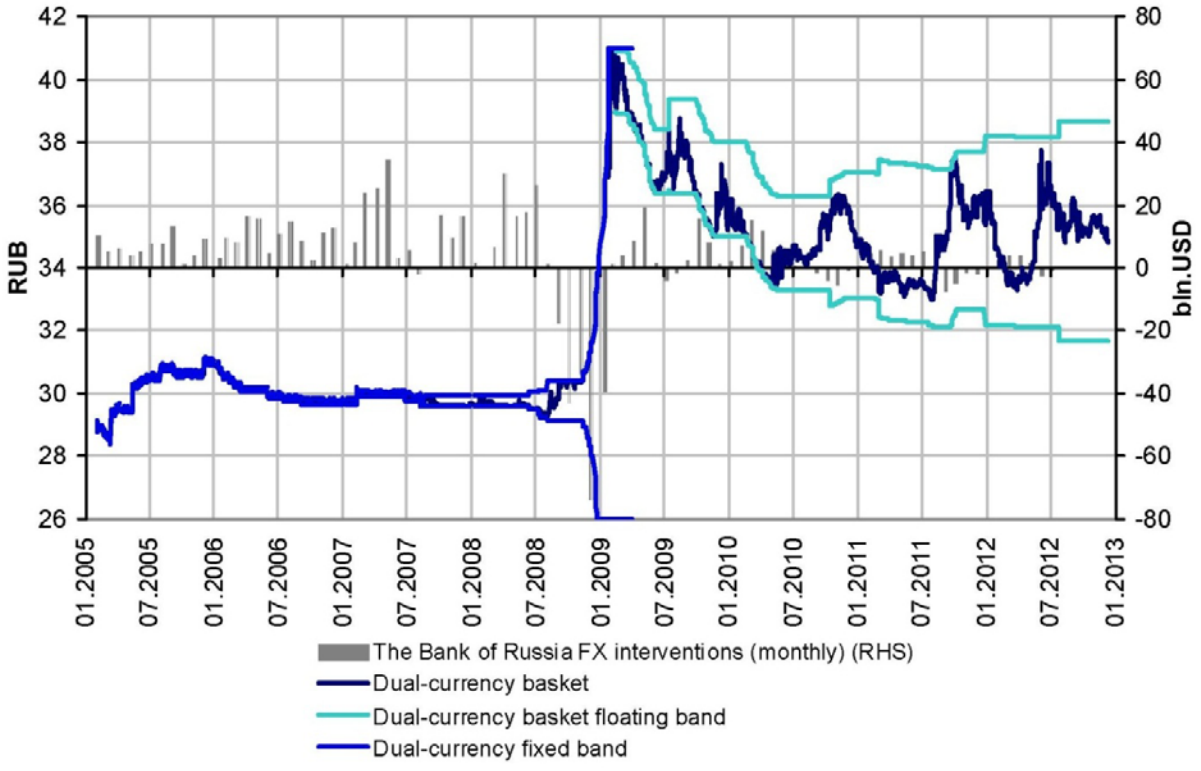


Fig.7. Rouble Exchange rate and the Bank of Russia FX Interventions in 2005-2012



Foreign exchange intervention in Saudi Arabia

Abdulrahman Al-Hamidy[1] and Ahmed Banafe[2]

Abstract

Saudi Arabia has a fixed exchange rate regime, with a dollar peg. The spot USD/SAR exchange rate has remained unchanged at 3.7500 since June 1986, as SAMA provides dollars to the domestic banks to meet the commercial and financial demand of the private sector. SAMA FX intervention has been discretionary and infrequent, mainly in the forward market, to stem speculative activity linked to external or domestic factors. It has not been SAMA policy to intervene for broader economic objectives, such as controlling inflation, maintaining competitiveness or regulating the amount of FX reserves, as these are amply addressed by fiscal measures rather than FX intervention in a pegged exchange rate regime, which is the economy's nominal anchor.

Keywords: FX intervention, Al-Hamidy, Banafe

JEL classification: F31

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1. Introduction

The Saudi riyal has been at a fixed rate to the US dollar since June 1986 (SAR 3.7500 per USD). Foreign exchange earnings come predominantly from oil exports, which are deposited with the Saudi Arabian Monetary Agency (SAMA). In turn, SAMA credits the government's account with the equivalent riyals. Therefore, SAMA is responsible for meeting the foreign exchange needs of the public and private sectors by selling dollars against riyals to the domestic banks.

SAMA last intervened in the foreign exchange market in 1998. This took place in the forward market, because speculation tends to be in the forward market since banks can treat it as an off-balance-sheet item. Speculation against the riyal occurred in the 1990s at times when the oil market was weak and foreign exchange reserves were falling. More recently, in 2007/08, there was an episode of speculation in favour of the riyal due to Saudi Arabia's strong balance of payments and fiscal position, a weaker dollar, and rising domestic inflation. SAMA handled this more recent episode by reiterating its long-standing position to uphold the exchange rate regime without actual intervention.

2. Macroeconomic background

Saudi Arabia is an oil-based economy and relies on oil revenue for the bulk of its budgetary spending. Oil revenue averaged 87% of total revenue during 2003–2011. The non-oil private sector represents about 49% of real GDP (or 25.5% of nominal GDP – which is because since 2003 the oil market has been strong, driving the share of nominal oil GDP noticeably). Saudi Arabia's real GDP growth has averaged 4.5%, and the domestic cost of living index rose at an annual average of 3.7% between 2003 and 2011. During this period the average budget surplus has been 12.5% of GDP. Saudi Arabia's debt/GDP ratio has fallen significantly – from the peak of 103.5% in 1999 to under 4% currently – due to cumulative budget surpluses over the recent years. BoP surplus/GDP averaged 20.6% in the 2003–2011 period.

The fixed exchange rate regime reflects the reality that adjusting the exchange rate has no effect on the competitiveness of oil exports in the global economy, which are priced in dollars. The fixed exchange rate has allowed riyal interest rates to track US dollar rates within a permissible deviation that reflects domestic market conditions. There is 100% currency backing by foreign exchange reserves, so that currency issued cannot exceed foreign exchange assets (Article 6 of Saudi Arabia's Currency Law).

Forward intervention in the foreign exchange market could be problematic if a country had high short-term foreign currency liabilities and a weak banking system. Saudi Arabia has a net creditor position externally and a strong and conservatively supervised banking system. This means that it has not been difficult to tackle the occasional speculation in the forward market either by intervention or by prudential measures. SAMA could insist on gross actual settlement of forward transactions (as opposed to net settlement), thus forcing counterparties speculating against the riyal to make payments in riyals to take delivery of their forward dollar purchases. Because SAMA has full control over the supply and availability of riyals, it can in effect prevent the development of an offshore riyal market.

3. Governance

The foreign exchange regime is selected by SAMA in consultation with the government. FX intervention is at the discretion of SAMA, acting within the confines of the exchange rate regime. Intervention is occasional and aimed at preserving exchange rate and financial stability. Intervention is not used to accumulate foreign exchange reserves or to strategically change the portfolio decisions of domestic and external operators (e.g. SAMA has not to date signalled any indication that it is considering adjusting the exchange rate regime to attract foreign capital).

4. Causes of speculation

In the two intervention episodes of the 1990s (1993 and 1998), speculation was linked to external events. SAMA follows trends in the forward foreign exchange market closely to pick up on the movement in forward prices. In 2007/08, there was speculation on a possible revaluation of the riyal, given Saudi Arabia's strong macroeconomic condition against the background of a weak dollar. Episodes are signalled by media comment and generally come from outside via a contagion effect, with the focus being primarily on the oil price and revenue outlook.

Saudi Arabia's external and domestic budgetary situation varies with developments in the global oil market. When the oil market is weak, Saudi Arabia runs external and budgetary deficits. The external deficit is met by running down foreign exchange reserves, and the budgetary deficit by issuing government bonds. When the oil market is strong, the cycle moves so that Saudi Arabia is in surplus externally and domestically. Foreign exchange reserves are replenished and the budget surplus results in a pay-down of government debt. Through these mechanisms the volatility of the resource-based economic cycle is dampened. Ultimately, the success of this approach depends on keeping enough foreign exchange reserves in hand at the bottom of the cycle.

Speculators misunderstand the use of countercyclical fiscal policy and project the current situation forward, treating the oil market as a trigger for speculation. There is a perception that devaluing the riyal would translate into higher budgetary revenue. But this is an accounting rather than a real phenomenon, as oil production is not stimulated by a change in the USD/SAR exchange rate (unlike more diversified economies, where devaluation tends to stimulate exports). Likewise, the effect on foreign exchange reserves is purely an accounting event. Since the propensity to import is relatively high, even purely domestic government spending (e.g. payrolls) results in a foreign exchange outflow.

Similarly, revaluing the riyal when oil revenues were strong would not have a marked effect on the domestic economy. While import prices might drop to some extent, this would be offset by higher imports due to the wealth effect of a revalued riyal in the hands of domestic consumers.

5. Intervention tactics and their effectiveness

In episodes of speculation against the riyal (as were seen in 1993 and 1998), SAMA's tactics were effective, and they are still available for use. In the forward market, foreign exchange swap points rise as speculators buy dollars forward against the riyal. The domestic banks, acting as market-makers, adjust their forward quotations, and aim to cover their short forward dollar positions by buying dollars from SAMA. There is a drain on system liquidity, and riyal rates tend to rise. Longer-dated forwards can be targeted specifically with the aim of destabilising the market and feeding more speculative activity.

SAMA responds both passively and actively. Passively, SAMA keeps providing spot dollars to the domestic banks to meet the commercial and financial demand of the private sector so that speculators find it difficult to distort the spot riyal rate. Actively, SAMA's policy has been to intervene on a discretionary basis in the forward market, given speculators' preference to target the forward market. SAMA's approach of gathering relevant information from the domestic banks (i.e. learning about the size of open positions, trading volumes and the origins of transactions) has proven to be helpful and successful without a need for large scale intervention. Supportive actions have included liquidity injection through deposit placements with the domestic banks, and use of foreign exchange swaps in order to achieve the maximum possible effect on lowering swap points (i.e. buying USD/SAR spot and selling forward).

When the speculation is in favour of the riyal, a wider range of tactics is available. In theory, riyal interest rates could be cut to make holding riyals less attractive and reduce the positive carry for speculators. But this would have consequences for the economy as a whole. Prudential steps have proved effective. In 2007/08, SAMA raised the minimum reserve requirements for domestic banks. This curbed excessive money supply growth, drained liquidity from the system and made it more difficult for speculators to acquire the riyals they wanted. During 2007 and 2008, the reserve requirement was raised in aggregate from 7% to 13% for demand deposits and from 2% to 4% for time and savings deposits. At the same time, the government took action to cut import tariffs and subsidise basic imported foodstuffs, thus dampening media comment that rising food prices might force a revaluation of the currency. Consumer price inflation peaked in July 2008 at 11.1%, and SAMA gradually brought the reserve requirement down by November 2008 to 7% for demand deposits, leaving it unchanged at 4% for time and savings deposits.

6. Cost of speculation, and domestic implications

Given the stability of the peg, riyal interest rates track dollar rates closely. Higher interest rates are often viewed as an important weapon in the fight against speculators, but this would have cost implications for business investment and economic growth. In the 1990s episodes, intervention was small-scale and ultimately profitable when forward contracts were liquidated.

In the 2007/08 episode, co-ordinated prudential measures were taken rather than cutting interest rates. Fiscal costs were incurred to reduce prices of basic foodstuffs. SAMA incurred no direct costs, and raising reserve requirements curbed

excessive money supply growth without raising rates. In summary, prudential measures were successful.

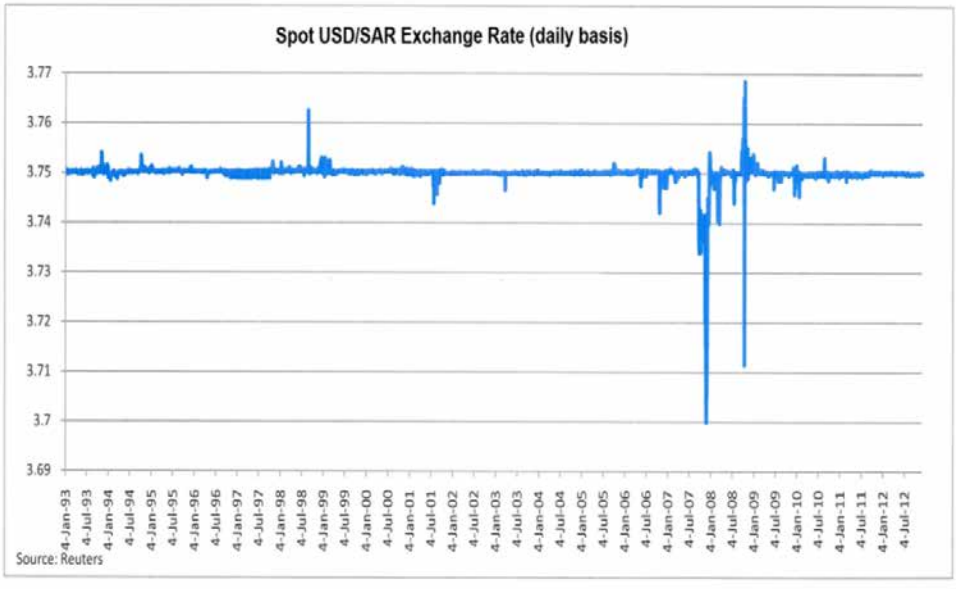
Since the government is the sole recipient of oil revenue, SAMA is the major source of dollars to the banks. Routine sales meet the financial and commercial demands. Given this steady supply, speculation against the riyal has been in the forward market. There has been no need to sterilise the small-scale interventions.

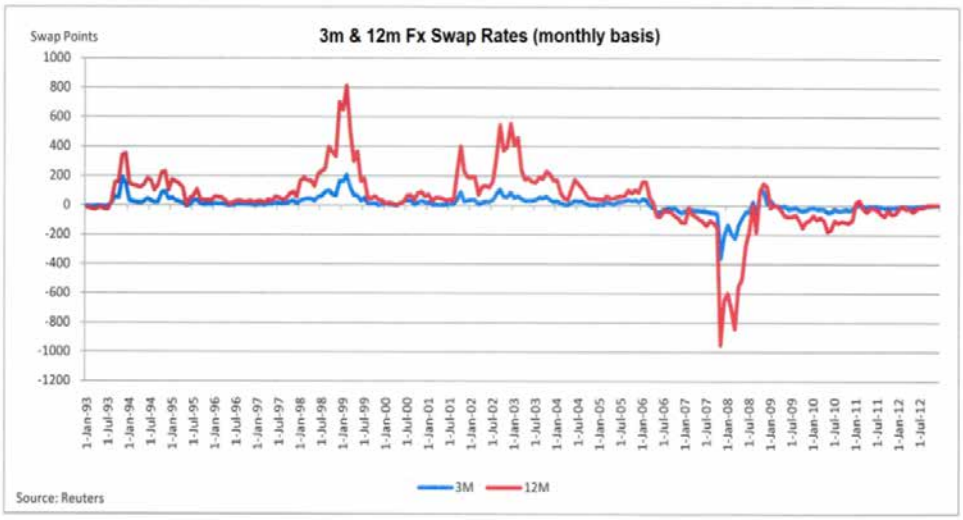
7. Conclusions

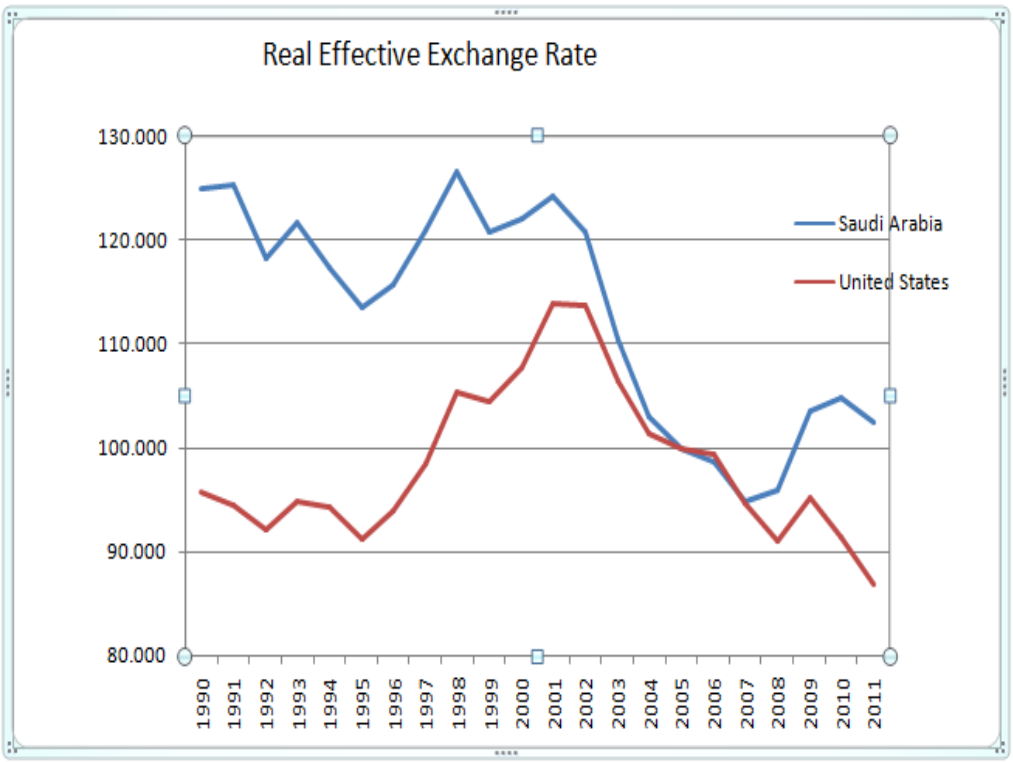
Speculation can take place for and against the riyal as speculators extrapolate the state of the oil market and underestimate authorities' resolve to defend the peg, which is the lynchpin of the strategy to reduce the volatility of economic growth. In particular:

- SAMA kept itself closely informed about market developments and was able to break the 1990s speculation against the riyal through small-scale forward FX interventions. In the 2007/08 episode (i.e. speculation on the riyal), active intervention was not needed, since prudential measures to curb system liquidity were adequate. SAMA accommodated the banks by buying spot USD against SAR from the market, while at the same time tightening monetary conditions for domestic reasons by raising reserve requirements, since interest rate hikes would have exacerbated the demand for riyals.
- Given SAMA's discretion on controlling the supply and availability of riyals, gross settlement of forward transactions can be required, and this implies that even longer interventions may not lead to a noticeable drain of reserves.
- Interest rates continued to be set for domestic reasons, so that the episodes had a relatively limited effect on business investment and growth.

To date, SAMA has not intervened for broader economic objectives such as controlling inflation, maintaining competitiveness or regulating the amount of FX reserves, as these are amply addressed by fiscal measures rather than FX intervention in a pegged exchange rate regime, which is the economy's nominal anchor.







Source: IMF/IFS

rf/BISFx-intervention 2013/ab*

An exchange-rate-centred monetary policy system: Singapore's experience

Ong Chong Tee[1]

Abstract

Unlike most other countries, Singapore has adopted the use of the exchange rate rather than the interest rate as the instrument of monetary policy. The choice of the exchange rate is predicated on the Singapore economy's small size and its high degree of openness to trade and capital flows. The basket, band and crawl features of the exchange rate system have served as an effective anchor of price stability, keeping inflation low and stable over the past 30 years. In addition, Singapore has complemented monetary policy with micro- and macroprudential measures to ensure overall price and financial stability in the economy.

Keywords: Singapore, monetary policy, exchange rate, macroprudential policies

JEL classification: F31, E52, E58

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1. Introduction

The issue of foreign exchange intervention is directly pertinent in the context of the conduct of monetary policy by the Monetary Authority of Singapore (MAS). Since 1981, monetary policy in Singapore has centred on the management of the exchange rate.

This paper first describes the mechanics of our operations, and then focuses on the broader challenges associated with managing the exchange rate since the onset of the crisis in 2008. The outline of the paper is as follows. Section 2 briefly explains the rationale for the choice of the exchange rate as a key macroeconomic lever, and sets out the framework of the exchange rate policy. Section 3 delves into the details of the implementation of monetary policy, including the tools used to sterilise the liquidity impact of our interventions. Section 4 follows with a review of Singapore's monetary responses since 2008. The challenges of an exchange-rate-centred monetary policy framework and MAS's assessment are then discussed in Section 5. Section 6 is the conclusion.

2. The exchange rate as the instrument of monetary policy

The exchange rate represents an ideal intermediate target of monetary policy for several reasons.

- First, it makes sense in the context of the small and open Singapore economy. Singapore has no natural resources, and is almost completely dependent on imports for necessities such as food and energy. The import content of domestic consumption is correspondingly high, with nearly 40 cents out of every $1 spent going to imports. Singapore has to export to pay for these imports. The economy is thus extremely open to trade, which totalled more than 300% of GDP in 2011.
- Second, the economy's openness means that the exchange rate bears a stable and predictable relationship to price stability as the final target of policy over the medium-term.
- Third, the exchange rate is relatively controllable through direct intervention in the foreign exchange markets. An exchange-rate-based monetary policy thus allows the government to retain greater control over macroeconomic outcomes such as GDP and CPI inflation, and thus over the ultimate target of price stability.

Conversely, the structure of the Singapore economy reduces the scope for using interest rates as a monetary policy tool. First, the corporate sector is dominated by multinational corporations (MNCs), which rely on funding from their head offices (typically in developed economies) rather than on local banking systems or debt markets. Second, Singapore's role as an international financial centre has led to a large offshore banking centre that deals primarily in the G3 currencies, and it is one where assets denominated in those currencies far exceed those of the domestic banking system. As there is no control on capital flows between the offshore (foreign currency) and domestic (Singapore dollars) banking system, small changes in interest rate differentials can lead to large and rapid movements of capital. As a result, it is difficult to target interest rates in Singapore,

as any attempt by MAS to raise or lower domestic interest rates would be foiled by a shift of funds into or out of the domestic financial system.

Changes in the exchange rate are transmitted to the economy in the following ways.

- First, the exchange rate acts *directly* to dampen imported inflationary pressures. Given that Singapore imports most of what it consumes, domestic prices are very sensitive to world prices. The exchange rate thus provides an important buffer against external price pressures at the borders, especially in periods of escalating global commodity prices, thereby contributing significantly to the objective of medium-term price stability.
- Second, the exchange rate acts *indirectly* to tackle domestic sources of inflation. A stronger currency moderates the external demand for our goods and services, and as the demand for domestic factor inputs eases, factor incomes rise more modestly. This in turn reduces the domestic demand for non-tradable goods and services, and puts downward pressure on prices.

Features of the basket, band and crawl system

There are three main features of the exchange rate system in Singapore, which can be summarised as the basket, band and crawl (BBC) system.

- First, the Singapore dollar is managed against a basket of currencies of our major trading partners (also known as the Singapore dollar nominal effective exchange rate or S$NEER). Hence, its movements are less volatile than if it were pegged to an individual currency. This feature also reflects Singapore's diverse trading pattern, with both the G3 and regional markets representing important partners in our merchandise and services trade.
- Second, MAS operates a *managed float regime* for the Singapore dollar. The trade-weighted exchange rate is allowed to fluctuate within a policy band, which provides a mechanism to accommodate short-term fluctuations in the foreign exchange markets and permits flexibility in managing the exchange rate. From an operational perspective, the band also minimises the need for constant foreign exchange interventions, in contrast to a system based on a hard currency peg.
- Third, the slope of the exchange rate policy band is reviewed regularly to ensure that it remains consistent with the economy's underlying fundamentals. This is the crawl feature which is incorporated in the band. It allows the exchange rate to adjust and avoid misalignment. The slope of the policy band, as well as the level at which it is centred, is not disclosed.

Together, these features have provided an anchor of stability for Singapore's highly open economy, and the effectiveness of the framework has underpinned confidence in the Singapore dollar.

The choice of the exchange rate as the main instrument of monetary policy necessarily implies that MAS cedes control over domestic interest rates and money supply. MAS does not attempt to control the level of domestic interest rates, limiting itself to dampening excessive interest rate volatility. Singapore dollar interest rates are therefore largely determined by foreign interest rates and investor expectations of the future movement of the Singapore dollar. MAS monitors interest rates and the money supply closely for economic surveillance, as well as to

ensure sufficient liquidity in the system for regulatory and settlement purposes, rather than for use as a monetary policy tool.

3. Implementation of monetary policy

The implementation of monetary policy is kept separate from the formulation of monetary policy, so as to keep monetary policy decisions unencumbered by short-term implementation considerations. Throughout the day, MAS monitors movements in the S$NEER closely to ensure that it moves in an orderly fashion broadly within the policy band. When the S$NEER reaches the edge of the policy band on either side, or when there is undue volatility or speculation in the Singapore dollar, MAS will intervene in the foreign exchange market using spot or forward transactions through our primary dealers (PDs). It may also intervene before the band is reached, or allow the S$NEER to breach the band before intervening. Insofar as possible, it refrains from intervening and allows market forces to determine the level of the Singapore dollar exchange rate within the policy band.

The timing, magnitude and frequency of its intervention operations are not disclosed to the market. Together with the non-disclosure of the policy parameters, the practice of not commenting on MAS operations allows some constructive ambiguity in the management of the exchange rate. In the rare event where MAS's explicit presence is required to calm the market, or to deter excessive speculation, MAS may reveal its operations. For accountability, the details of foreign exchange intervention operations are reported fortnightly to the Monetary and Investment Policy Meeting, the equivalent of other central banks' Monetary Policy Committees.

Nevertheless, the market participants have a fairly good grasp of MAS's monetary policy, given the institution's continued efforts to increase the transparency of the framework. Since July 2001, the movement of the S$NEER has been included in the semi-annual Monetary Policy Statement (MPS). Historical S$NEER data has been published on a six-month lag since April 2006. In October 2012, MAS reduced the time lag and began releasing weekly average S$NEER data on the first Monday of each month, giving market participants more frequent reference points to calibrate their S$NEER models. In conjunction with the release of the MPS, MAS publishes the Macroeconomic Review (MR), which documents the analysis and assessment of macroeconomic developments in the Singapore economy, and shares with market participants, analysts and the wider public the basis for the policy decisions conveyed in the MPS.

These initiatives have enabled bank analysts to arrive at relatively similar estimates of the S$NEER. They can also infer MAS's presence from the price action when their S$NEER models detect that the exchange rate is close to the estimated bounds of the band. The credibility of MAS in (i) maintaining the integrity of policy band and (ii) ensuring that the policy settings are appropriate for the fundamentals of the economy also helps to increase the effectiveness of our intervention.

Sterilisation of intervention operations

MAS's foreign exchange interventions have an impact on liquidity conditions in the banking system. Taking account of the other market factors as well,[2] MAS decides on the level of Singapore dollar liquidity that is sufficient to meet the banks' demand for reserve and settlement balances.

The instruments for the money market operations are:

- direct borrowing;
- foreign exchange swaps;
- repurchase agreements (repos) of Singapore Government Securities (SGS); and
- MAS Bills.

The MAS Bills are the latest instrument, introduced in 2011. They provide the growing banking system with an additional source of liquid regulatory assets, allowing commercial banks to practise better liquidity management. The greater utility and negotiability of the MAS Bills also lower the costs of MAS's sterilisation operations, as compared to clean borrowings from the banks. In the current environment of exceptionally low interest rates in advanced economies, domestic interest rates have followed suit, also easing significantly. Accordingly, the cut-off yield of the 12-week MAS Bill, as a proxy of sterilisation cost, is currently below 0.30%.

4. Effectiveness of monetary policy

The effectiveness of the exchange-rate-centred monetary policy as an anti-inflation tool for the Singapore economy is shown by the fact that domestic inflation has been relatively low for the last 30 years, averaging 2.1% per annum from 1981 to 2012. Expectations of price stability have also become more entrenched as a result of the long record of low inflation. More recently, headline inflation has remained elevated, reflecting transitional cost adjustments associated with supply-side constraints in land and labour, as well as the economy's broader restructuring to productivity-driven growth. Core inflation, however, has remained stable, typically in the range of 2.0–3.5% in each month since January 2009.

Recent historical experience: global financial crisis

In the most recent financial crisis, MAS adopted a gradualist approach in its monetary policy decisions, taking into account the nature of the external shock and the crucial role that the exchange rate plays as an anchor of stability, especially in times of uncertainty (Figure 1). In October 2008, MAS eased its policy, adopting a zero per cent appreciation of S$NEER policy band, amidst expectations of moderating inflationary pressures and the risk of further deterioration in the external environment. The policy band was subsequently re-centred downwards in

[2] These other market factors include currency issuance, fund flows from the Central Provident Fund, and government fund transfers.

April 2009, in line with the lower level of economic activity that would prevail over the crisis horizon.

Budgetary measures played a relatively larger role in countercyclical stabilisation in 2009. A $20.5b (8.2% of GDP) Resilience Package was announced, targeting specific segments of society where quick support was most warranted. The key features of the package included the Jobs Credit Scheme, which incentivised employers to retain their existing workers, the Special Risk-Sharing Initiative to stimulate bank lending, and a corporate income tax cut. The Singapore economy recovered swiftly towards late 2009 and early 2010, expanding 5.3% y-o-y in Q4 2009, 16.5% y-o-y in Q1 2010 and 19.8% y-o-y in Q2 2010.

As a broad-based recovery appeared to take root in the economy, MAS pre-emptively tightened monetary policy in April 2010 by re-centring the S$NEER policy band upwards and restoring its modest and gradual appreciation path. This marked the end of the accommodative monetary policy stance. Fiscal policy shifted away from the recession relief measures to more medium-term-oriented and productivity-enhancing initiatives. The band was subsequently widened to accommodate volatility in the international financial markets.

5. Post-Crisis: intervention, financial markets and monetary policy

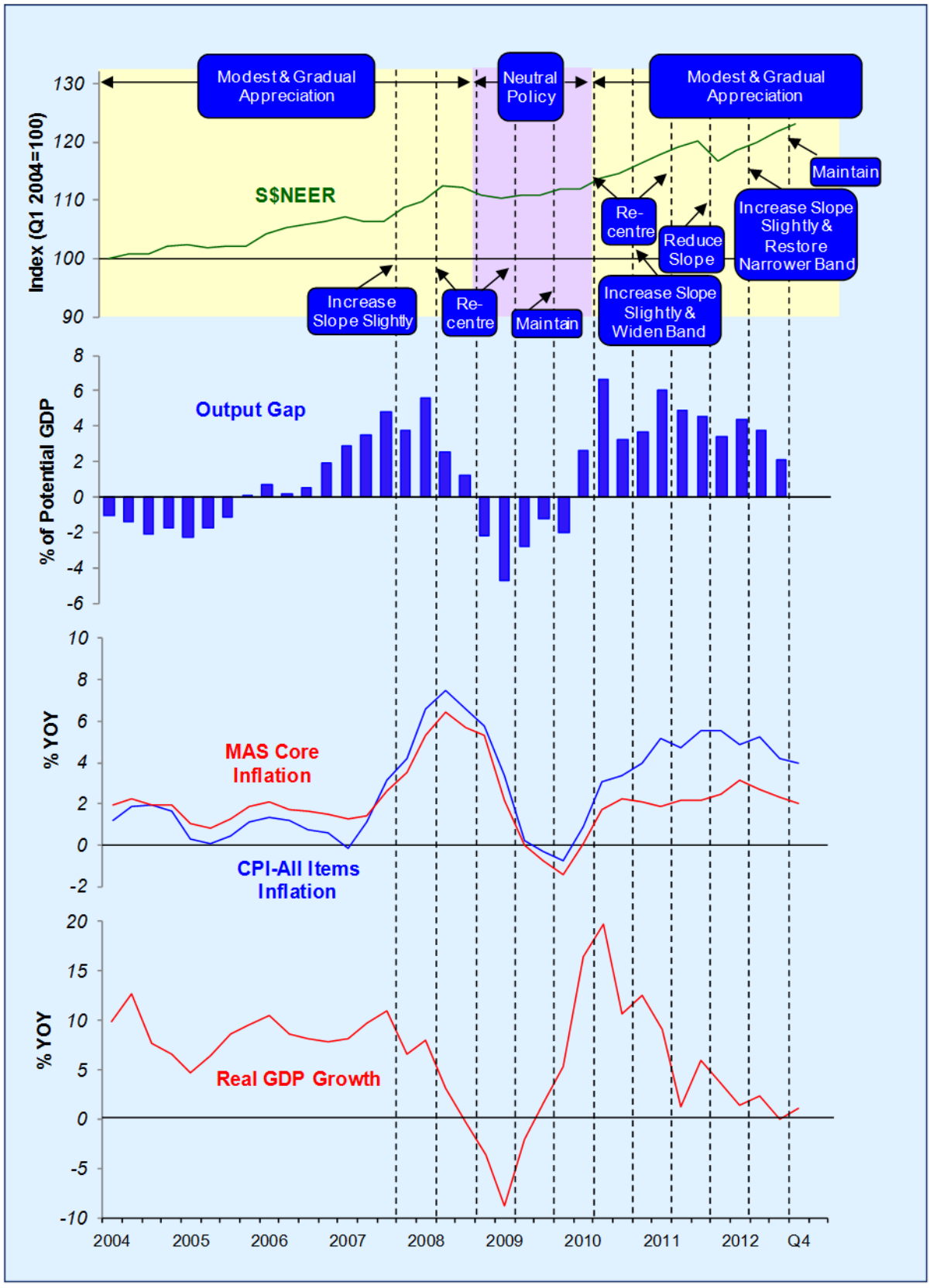
Singapore, like other emerging Asian economies, has to tackle the consequences of sustained capital inflows following the adoption of unusual monetary policies in developed economies. Since 2010 (according to balance of payments data) Singapore has seen strong capital inflows accompanying the broad-based weakness of the US dollar and relatively positive outlook of the Asian economies, including Singapore. Gross capital inflows turned positive, rising from an average of –9.2% of GDP in the Q1 2008 to Q4 2009 period to reach 55% of GDP in each quarter between Q1 2010 and Q3 2011. These inflows peaked in Q3 2011 at 131% of GDP.

Despite the “monetary tsunami”, MAS has not had to undertake any capital flow management measures in its conduct of monetary policy. The implementation of exchange rate policy continues to be directed at keeping the exchange rate on a path congruent with medium-term price stability. From an operational perspective, MAS has always had to face large and volatile capital inflows, given our small and open economy and the choice of the exchange rate as the intermediate target of monetary policy. Our deep and liquid financial markets, coupled with the efficient banking system, have helped to intermediate the capital flows effectively. In the event of sustained large capital inflows, the impact on the MAS balance sheet is also mitigated by relatively low sterilisation costs, as the interest rates are determined by external liquidity conditions. MAS also expanded our sterilisation capacity by issuing MAS Bills in 2011.

To be sure, capital flows could generate asset bubbles and threaten financial and macroeconomic stability. However, monetary policy is an extremely blunt instrument for addressing capital flows and asset price inflation. While a tighter monetary policy could dampen asset prices, it would come at the expense of significantly lower GDP growth, as the monetary policy action would have to be sufficiently aggressive to have a discernible impact on specific asset markets. This would also inject unwarranted volatility into the exchange rate, and jeopardise its role as an anchor of stability.

Key macroeconomic variables, and changes in the monetary policy stance

Figure 1



Monetary policy in Singapore has thus continued to be formulated on the basis of growth and inflation considerations, although MAS is cognisant of the impact that monetary policy may have on financial stability. Thus, MAS has chosen to deal with the destabilising effects of capital inflows through targeted macroprudential and administrative measures.

MAS has termed this approach "Monetary Policy Plus". While monetary policy is focused on price stability, it couples with micro- and macro-prudential supervision to ensure financial stability. Effectively, under the overarching target of "macroeconomic stability", we monitor consumer price stability, asset price developments, credit growth and financial stability. These multiple targets demand multiple policy instruments.

Consequently, the Singapore government introduced seven rounds of cooling measures between 2009 and 2013 in response to rising property prices. The latest set of measures was introduced in January 2013. Broadly, these measures sought to ensure a stable and sustainable property market and encourage financial prudence among property purchasers. The latest measures included higher stamp duty rates, tighter loan-to-value ratios, limits on mortgage tenures, and caps on mortgage servicing ratios. The government has also stated that it would continue to monitor market conditions closely and take further measures if necessary.

6. Conclusion

Singapore's choice of the exchange rate (rather than interest rates) as the principal tool of monetary policy is predicated on its small size and high degree of openness to trade and capital flows. A basic philosophy underlying Singapore's exchange rate policy is to preserve the purchasing power of the Singapore dollar in order to maintain confidence in the currency and preserve the value of workers' savings. While the recent financial crisis has made the conduct of monetary policy more challenging, MAS has not had to take extraordinary monetary policy measures.

Just as some of Singapore's particular characteristics necessitate a unique monetary policy framework, there are several structural factors which have allowed the exchange rate to function effectively as an intermediate target of monetary policy. First, the country's high savings rates in the public sector due to the government's budgetary surpluses, along with the contribution of companies and households to the mandatory CPF, have led to the continual withdrawal of liquidity from the banking system. MAS accordingly injects liquidity into the market by selling Singapore dollars and buying US dollars to offset government and CPF flows.

Secondly, MAS has gained credibility through its pre-emptive and effective policy decisions. Its single-mindedness and discipline in focusing on medium-term inflation trends, coupled with its robust reserves, have earned the trust of the market and public. It adopts a medium- to long-term orientation in formulating monetary policy, anticipating a six- to nine-month lag between implementation and impact. This medium-term orientation has helped to reduce the volatility of the exchange rate, anchoring the economy and providing certainty for businesses and households.

Finally, the effectiveness of Singapore's exchange rate policy is due to the broader framework that its monetary policy is part of. Monetary policy does not work in a vacuum. Instead, it is situated within a wider framework of sound and

consistent policies, including flexible prices and wages, a deep and efficient financial market, a robust corporate sector and prudent fiscal policy. In Singapore, the close coordination between fiscal policy and monetary policy has successfully ensured macroeconomic stability in the past three decades, including the recent financial crisis.

Note on the foreign exchange market operations of the South African Reserve Bank

Daniel Mminele[1]

Abstract

Capital inflows to emerging market economies increased substantially following the global financial crisis and subsequent implementation of unconventional accommodative monetary policies in advanced economies. Strong portfolio inflows put significant appreciation pressure on emerging market currencies, raising concerns about export competitiveness and growth prospects. A number of emerging market economies intervened in the foreign exchange markets to limit currency appreciation pressure, including intervening in the spot market and taxing purchases of domestic securities. The South African Reserve Bank did not intervene, instead allowing the rand exchange rate to be determined by forces of demand and supply. The Bank did, however, take the opportunity to increase the level of the country's official foreign exchange reserves. The Bank had intervened in the foreign exchange market during previous episodes of *currency weakness*, but found the success thereof to be limited and the exercise costly. Despite this, the Bank recognizes that there are also costs associated with inaction in the foreign exchange market, which can be much higher than the costs related to intervention. Therefore, the Bank does not rule out the possibility of intervening in the foreign exchange market to dampen excessive exchange rate volatility and ensure both economic and financial stability.

Keywords: South African Reserve Bank, foreign exchange intervention, capital flows, foreign reserve accumulation, oversold forward book, net open foreign currency position

JEL classification: G15, F31, E44

[1] Deputy Governor, South African Reserve Bank.

1. Introduction

The rationale for and extent of the South African Reserve Bank (Bank) involvement in the foreign exchange market have always been a topic of serious debate. This was the case in the 1990s when the Bank provided forward cover to state-owned enterprises (SOEs) and also intervened in the market with the objective of influencing the level of the exchange rate. During 2010 the strength of the rand against other currencies came under the spotlight, with calls for the monetary authorities to "weaken the currency" in order to "achieve a competitive and stable real exchange rate". However, with the depreciation of the rand seen since the second half of 2011, there was renewed focus on the factors driving the rand.

The purpose of this note is to elaborate on the South African experiences regarding foreign exchange intervention. The note deals with a historic perspective on the Bank's foreign exchange operations, the objectives of the Bank's current intervention in the foreign exchange market, and the Bank's tactics in foreign exchange operations – also during the global financial crisis. The institutional arrangements pertaining to foreign exchange reserves accumulation will also be discussed.

2. Historic perspective on the Bank's foreign exchange operations

The history of the Bank's operations in the foreign exchange market can be classified into the following phases: extensive use of the forward market for purposes of providing forward cover; intervention to support the depreciating currency and to support market functioning; and finally, reserve accumulation. When the Bank's official reserves were extremely low, and this was seen as adversely contributing to the country's external vulnerability, the Bank also utilised foreign currency loans to prop up its gross reserves. The last outstanding foreign loans were repaid in June 2010.

After the announcement of the foreign debt standstill in September 1985, and the introduction of economic and financial sanctions against South Africa, the country had no access to international capital markets, which included no access to borrowing from the International Monetary Fund (IMF) or other official agencies. Consequently, the forward market was used to encourage and facilitate the use of foreign trade credits by domestic corporates as a mechanism for the Bank, inter alia, to accumulate foreign exchange reserves. During the 1990s, the Bank also provided forward cover at preferential rates, mainly to SOEs. The hedging of the foreign obligations of the SOEs was mainly via outright forward contracts. At this time, the country's foreign debt amounted to US$24 billion and the Bank had a net open foreign currency position (NOFP) of US$12 billion. The NOFP increased to over US$25 billion in 1995.

After the dual exchange rate was abolished in March 1995, the Bank managed to reduce the NOFP significantly from US$25.8 billion to US$8.5 billion in March 1996, mainly by purchasing foreign exchange from the market as well as purchasing the proceeds of government bond issues abroad.

The Bank also has a history of intervention for the purpose of "leaning against the wind", and in some instances and for short periods, to impact the level of the rand. The exchange rate of the rand depreciated sharply in 1996, owing partly to speculative activity, and the Bank intervened in the foreign exchange market by increasing the forward book to US$22 billion. In 1997, the Bank was again successful in reducing the NOFP, by almost US$10 billion, but the 1998 emerging markets crisis occurred, and again the Bank intervened, with the NOFP returning to the levels recorded ten years before.

The Bank's intervention to influence the spot exchange rate comprised a combination of spot and forward transactions conducted in the foreign exchange market. These interventions entailed the Bank selling US dollar spot and then entering into a swap transaction with another authorised dealer bank. In the swap transactions, the Bank bought dollars spot and sold dollars forward. In this way the Bank did not lose any spot dollars through its intervention, but instead built up commitments to deliver dollars on a forward basis (the oversold forward book). Such intervention, however, was not that common in other countries, although it was at times used quite extensively by the Bank during the first half of 1996 and during 1998.

Both these interventions (paragraphs 2.2 and 2.4) occurred during extremely challenging circumstances in the financial history of the country, and it took several years to address the economic and financial consequences of these interventions – for example, the NOFP due to the huge oversold forward book, and the losses on the Gold and Foreign Exchange Contingency Reserve Account (GFECRA). The latter account reflects the local currency valuations of the gold and foreign exchange reserves, which is normally settled by the National Treasury (NT).

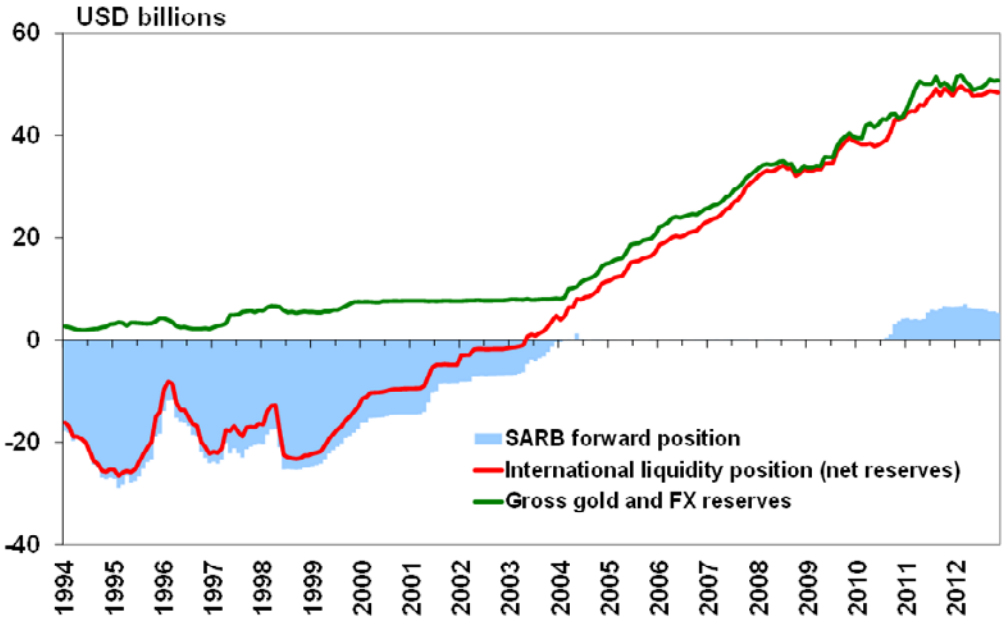
Subsequent to the 1998 crisis, a decision was taken to reduce the NOFP to zero. The NOFP was reduced from USD22 billion in December 1998 to USD13 billion in December 1999 and to USD9.5 billion at the end of 2000. However, because of regional events at that time, the rand depreciated on a trade-weighted basis by 12.4 per cent during 2000. In 1998 the Bank publicly announced the suspension of the selling of foreign exchange to the market for the purpose of influencing the exchange rate, and confirmed its commitment to a floating exchange rate, with the level of the currency determined by the demand and supply of foreign exchange in the market.

During late 2001, the rand depreciated by almost 40 per cent against the USD despite South Africa's sound economic fundamentals. The Bank, however, maintained its commitment of non-intervention in the foreign exchange market and the rand reached a level of R13.84 to the USD. Many arguments were put forward to explain the depreciation of the rand, including negative perceptions associated with regional instability, lack of foreign direct investment in the country, low economic growth and high unemployment, exchange controls, and the existence of the oversold forward book.

In 2003, after the NOFP was eliminated, the Bank started accumulating reserves by buying foreign exchange reserves on a spot basis. However, some of the foreign exchange purchased spot was swapped forward to match some of the oversold forward maturities. This led to the gradual reduction of oversold positions and ultimately the squaring-off of the forward book in February 2004. Effectively, spot purchases were swapped to dates of forward sales to match the sale of dollars forward in the books of the Bank.

The process of accumulating foreign exchange reserves has been successful over the past decade. Since March 2003, the official reserves improved from a negative NOFP of US$1.4 billion to an international liquidity position of US$47.9 billion as at the end of December 2012. During the same period, the forward book improved from an oversold position of US$6.8 billion to an overbought position of US$5.2 billion, while the official gross gold and foreign reserves amounted to US$50.7 billion at the end of December 2012 (Graph 1). The current overbought forward position reflects the commitment by the Bank to buy foreign currency against the rand at a future date. The oversold forward position, however, reflected a future commitment which had to be covered by purchasing foreign exchange.

Official gross gold and foreign exchange reserves plus forward position — Graph 1



3. The objective of the Bank's intervention in the foreign exchange market

Many countries react to exchange rate movements through some type of intervention, which is broadly defined as those activities undertaken by monetary authorities designed to influence the level of the exchange rate or to impact on unusual fluctuations in the value of the currency relative to others. Central banks will typically intervene if currencies are under extreme stress, or if they believe that they are misaligned to, or dislocated from, fundamentals, as well as if the spot market is overreacting, causing extreme volatility. However, countries also intervene for purposes of foreign exchange reserve accumulation.

The foreign exchange operations of the Bank are not aimed at managing the rand exchange rate, but directed towards gradually building up the official foreign exchange reserves, managing domestic liquidity and meeting clients' foreign exchange needs. The Bank, therefore, does not target a level for the exchange rate of the rand, or seek to counter forces of demand and supply. This is consistent with

the Bank's overall monetary policy framework, which is based on inflation targeting and a flexible exchange rate. The current exchange rate policy of the Bank is alluded to quite often in public speeches by the Executive of the Bank, and as such is well known to the public.

The Bank is not indifferent to challenges posed by volatility of the exchange rate and takes these into consideration in its Monetary Policy Committee (MPC) deliberations. It is generally acceptable for central banks operating within a flexible exchange rate system to maintain orderly market conditions, and thus they may also have to add liquidity in certain circumstances. The Bank, therefore, stands ready to become involved in the foreign exchange market to smooth out abrupt adjustments so as to facilitate an orderly functioning of the foreign exchange market, as well as for financial stability reasons.

Regarding the level of the exchange rate and competitiveness, while it is acknowledged that certain sectors of the South African economy have been affected by what may be perceived to be a relatively strong exchange rate of the rand, it is crucial to highlight the importance of inflation management in this regard. If the nominal exchange rate were to depreciate without inflation being controlled at the same time, there would be no improvement in the level of competitiveness. The real exchange rate is therefore important.

4. Bank's tactics in foreign exchange operations

South Africa has highly developed and liquid foreign exchange markets, including a well-established bond market and a sophisticated equity market. The main foreign exchange derivatives instruments comprise outright forwards, foreign exchange swaps, forward-forwards, currency futures and currency options, as well as currency swaps and basis trading. In its current foreign exchange transactions aimed at reserves accumulation, the Bank mainly conducts spot purchases from the market, funded by both the Bank and the National Treasury (NT). In addition to conducting spot purchases, the Bank utilises foreign exchange swaps with maturities of up to 12 months to fund purchases and for purposes of general domestic money-market liquidity management.

The Bank's participation in the foreign exchange market is informed by volatility conditions, the liquidity situation in the market and cost considerations. However, in certain exceptional circumstances where South Africa experienced considerable foreign direct investment inflows, the Bank directly purchased these flows as off-market transactions to accelerate the process of accumulating foreign exchange reserves, and to ensure the smooth execution of transactions which were exceptionally large relative to the size of the market. As at the end of November 2012, the average daily turnover in the spot rand market amounted to approximately US$4.0 billion, while the total net average daily turnover amounted to approximately US$22.0 billion.

The Bank does not conduct pre-announced foreign exchange interventions, but communicates its foreign exchange operations through a regular monthly publication of reserves figures, which includes a brief explanation of the main changes, and it publishes information about foreign exchange activities in its Annual Reports. This has helped the market to understand and accept that the Bank is

consistent in its foreign exchange operations and that the policy being pursued is in line with the Bank's inflation-targeting framework.

The South African monetary authorities do not have a target level for foreign exchange reserves, but use generally accepted measures such as import cover, an augmented Guidotti Ratio, and the Jeanne-Rancière model as guidelines for reserves adequacy.

5. Foreign exchange operations during the global financial crisis

Strong capital inflows into emerging-market economies, including South Africa in the past few years have presented policy-makers with the challenge of appreciating exchange rates, which raised concerns about the competitiveness of the export industries. Some emerging-market countries have implemented measures such as taxes on the purchase of domestic fixed-income securities and equities, and pre-announced currency market intervention programmes, in order to limit currency appreciation and build foreign exchange reserve balances.

South Africa studied all these measures and found that they would not be appropriate for its economy, given that South Africa's savings and investment imbalances make the country dependent on portfolio flows to finance the current-account deficit. In addition, the efficacy of some of these measures has been doubtful in terms of achieving the desired results. Therefore, South Africa has not deemed it necessary to adjust its approach to official involvement in the foreign exchange markets in any material way.

6. Institutional arrangement pertaining to foreign reserve accumulation

Although the Bank also carries the cost of foreign reserves accumulation in various ways, the National Treasury (NT) has funded the major portion of foreign exchange purchases since 2005. This funding is reflected on the Bank's balance sheet as a rand- as well as foreign-currency-denominated deposit.

The accumulation of foreign exchange reserves by the Bank has resulted in an increase in official reserves on its balance sheet. However, because of the Bank's policy of sterilised interventions, the Bank's domestic liabilities increased with the issuance of the securities (SARB debentures) that it had to issue for sterilisation purposes. Some of the Bank's foreign exchange purchases were sterilised through government deposits and by using foreign exchange swaps. The utilisation of foreign exchange swaps has the advantage of temporarily postponing the domestic money-market liquidity impact, but costs are still incurred in the process. The rand costs are transferred to the government's account via the GFECRA, while the US dollar cost is reflected in a decline in the foreign exchange reserves. The other instruments that the Bank uses for sterilisation purposes are reverse repos of part of its holding of government bonds, and government deposits with the Bank.

The costs of sterilisation increased substantially as the Bank accelerated its accumulation of foreign exchange reserves. Given the interest rate differentials

between South Africa and the major advanced economies, the Bank incurred losses, since it pays high interest rates on its domestic liabilities but earns low returns on the foreign exchange assets held on the balance sheet. In addition, the Bank is exposed to significant valuation effects stemming from both currency and interest-rate risk on its foreign assets.

Valuation gains/losses on gold and foreign exchange holdings in domestic currency terms are, however, for the account of the government and the resulting net balance of gains/losses is settled from time to time as and when agreed between the Bank and Government. However, the portion of the net balance with a cash flow or money-market liquidity impact is settled annually. Because the Bank's interventions are sterilised, there is no impact on the commercial banks' credit extension stemming from the Bank's foreign reserves accumulation.

The Bank has not experienced problems with monetary policy implementation due to its foreign exchange operations. However, from time to time the Bank does encounter challenges, specifically with its open-market operations. But these are addressed by continuous evaluation and relevant adjustments to its operational procedures.

7. Concluding remarks

The Bank's involvement in the foreign exchange market is mainly for the purpose of accumulating foreign exchange reserves. The Bank does not intervene to try and manage the level of the exchange rate, and it adheres to a policy of a flexible or floating exchange rate. However, this does not mean that the Bank is indifferent to challenges posed by volatility of the exchange rate. The Bank therefore stands ready to become involved in the foreign exchange market to smooth out abrupt adjustments, to facilitate an orderly functioning of the foreign exchange market, and for financial stability reasons.

Given the micro-structure of the domestic foreign exchange markets and the complex dynamics associated with it, it will be a challenge for the Bank to have an impact on the level of the exchange rate. The high volatility could be ascribed to the fact that the market is deep and liquid for an emerging market economy, and should not be confused with inefficiencies and structural deficiencies in the foreign exchange market.

At the macro level, a flexible exchange rate regime allows the central bank to follow an independent monetary policy framework of flexible inflation targeting, which is deemed suitable and appropriate for the economic conditions of the country. As a result, monetary policy in South Africa aims to achieve price stability, while the nominal exchange rate adjusts to balance the external accounts.

Foreign exchange policy and intervention under inflation targeting in Thailand

Bank of Thailand

Abstract

Amid the evolving global financial landscape, different speeds of economic adjustments and spillovers of unconventional monetary policy, central banks in emerging economies, including Thailand, have encountered volatile capital flows and greater difficulties in maintaining economic stability. The conduct of exchange rate policy has been particularly challenging in these economies. Given the changing economic and financial structures, a comprehensive review of the policy framework, the use of tools and the design of policy operations is needed to justify their appropriateness. This paper describes Thailand's current exchange rate policy framework and its objectives, which have shifted in recent years. It also discusses the central bank's experiences with undertaking foreign exchange operations under an inflation targeting regime, as well as considerations on capital flow management measures with regard to their effectiveness. In addition, the paper addresses the implications of the FX intervention and sterilization on the economy, the financial system and the Bank of Thailand's balance sheet.

Keywords: Bank of Thailand, exchange rate policy, foreign exchange market, intervention, sterilization, instruments

JEL classification: O24, G23

1. The recent evolution of the exchange rate policy framework in Thailand

Economic context

After the Asian financial crisis, the Thai economy recovered and rebuilt its productive capacity, while proving resilient to numerous shocks. Thailand's prevailing growth model had relied on labour-intensive export-led growth dependent on small and medium-sized businesses with limited understanding of how to protect against exchange rate fluctuations. Against this backdrop, the Bank of Thailand (BOT) has maintained a managed-float exchange rate regime. The intervention framework is focused on curbing short-term volatility and maintaining regional competitiveness, while keeping the exchange rate aligned with economic fundamentals in the medium and long term. However, there are signs that this previous export-driven growth model is in decline.

Rising global competition has forced Thailand to move on to a new growth model based upon competitive value-added production. It is widely accepted that exchange rate flexibility can potentially facilitate the transition to this new reconfiguration, for while it is no panacea, it is one factor, among many, that supports long-term growth and stability. A flexible exchange rate is crucial for other determinants of long term growth: abundant factors of production, strong industrial policy, political stability, private sector efficiency, financial development and macroeconomic stability. For example, the exchange rate's role as a major price signal can support private sector efficiency by strengthening market incentives for adaptability and productivity. In addition, exchange rate flexibility is a key step for deepening and broadening foreign exchange (FX) markets, as greater incentives for market agents to form views and manage exchange rate risks promote market activity.

In this changing economic context, the exchange rate management framework in Thailand since 2011 has moved towards allowing more flexibility in exchange rate movements determined by market fundamentals—an approach that supports the desired structural transformation of the economy.

Policy consistency under inflation targeting

As the exchange rate is allowed to move more flexibly under the precondition of greater financial openness and monetary policy autonomy, policy will become more consistent under the trilemma principle. It should be noted that policy consistency under the trilemma does not imply policy optimality for a particular country. Where the inflation targeting framework has been chosen for its own merits, it is clear that monetary policy independence is called for to preserve its effectiveness.

Increasing financial openness would require the exchange rate to be flexible for the following reasons. First, where domestic prices have been explicitly targeted, the presence of nominal rigidities would prevail: thus the flexibility of the exchange rate would be needed as a price variable to absorb shocks. On the other hand, where the exchange rate is kept rigid, external adjustments may instead affect the real economy. Second, under the interest parity condition, the exchange rate is one of the channels of monetary policy transmission. Allowing it to move freely could help strengthen this channel, enhancing policy effectiveness. Thus, with a flexible

exchange rate acting as an absorber of external shocks, the policy rate under the inflation targeting framework can be more focused and can more effectively accommodate domestic shocks. A research study at the BOT[1] indeed found that financially open countries with inflation targeting regimes tend to benefit more with exchange rate flexibility, resulting in long-term sustainable growth.

2. Motivation for FX intervention

Despite the benefits of a flexible exchange rate regime for long-term economic growth and stability, as discussed above, in certain circumstances FX intervention to avoid excessive exchange volatility may be effective and beneficial. During episodes of excessive capital inflows, exchange rate interventions have some capacity to trim extreme movements in the currency and reduce the duration and extent of the exchange rate's deviation from the equilibrium.

The main objectives of FX intervention by the BOT have shifted in recent years. Initially, the aim was to curb excessive exchange rate speculation. The objectives have recently focused more on discouraging sharp capital inflows from core economies during periods of unconventional measures, and on maintaining external competitiveness. In certain periods where the country was faced with massive capital inflows, other measures were implemented as well, such as the Unremunerated Reserve Requirement (URR).

From late 2006 until early 2008, the BOT imposed the URR on short-term capital inflows. Financial institutions were required to withhold 30% of foreign currency bought or exchanged for the Thai Baht (THB), though transactions related to trades in goods and services, or to repatriation of investments abroad by residents, were exempt. After one year, customers whose foreign currencies have been withheld can request refunds by submitting evidence proving that the funds have been in Thailand for at least one year. The intention of the measure was to discourage short-term capital inflows and reduce speculation on appreciation of the THB, since the currency's volatility and appreciation had been increasing markedly.

However, the effectiveness of the measure was short-lived. The URR's effect diminished as short-term capital inflows were replaced by an accelerated flow of FX selling by residents, which provoked further appreciation of the THB. Thus, capital flow management cannot completely replace direct FX intervention.

Instead of introducing measures to halt inflows, the BOT has since 2010 started relaxing regulations in order to encourage capital outflows. The objective is to restore the balance between capital inflows and outflows in the market, creating natural counterflows while helping to promote outward direct investment (ODI) and encouraging Thai investment abroad.

[1] Ananchotikul, et al., "The Future of Monetary Policy: The Role of Financial Stability and Exchange Rate," BOT Discussion Paper 2010.

3. BOT practices in FX intervention: methods and tactics

Like other central banks, the BOT normally uses both verbal and actual intervention when THB movement is not in line with BOT FX policy as determined by the Monetary Policy Committee (MPC).

The actual interventions are outright spot or outright forward USD/THB transactions executed by selling or buying USD against THB.

The BOT intervenes in the interbank FX market, both onshore and offshore, using designated agent banks in order to maintain anonymity. In practice, the BOT generally intervenes during the Asian time zone of high market liquidity.

So far, the BOT has never employed FX derivatives in conducting FX intervention. However, the use of FX derivatives for intervention has provoked increasing interest for its cost effectiveness under some market conditions.

The BOT FX intervention strategy focuses on keeping USD/THB volatility at an acceptable level, which allows economic agents more time to adjust smoothly to upcoming volatility. Also, the BOT monitors FX misalignment vis-à-vis economic fundamentals; i.e. whether the exchange rate deviates markedly from an equilibrium level determined by economic fundamentals.

Thailand, like most Asian countries, is the recipient of capital inflows resulting from unconventional measures in core countries. Since 2009, the BOT has intervened in the FX market from time to time. In some cases, where the capital inflows were huge but underlying Thai economic fundamentals were still sound, the BOT has adjusted its intervention strategy accordingly, allowing the THB to strengthen gradually.

4. Effectiveness of intervention

During periods of active intervention, the BOT's Enterprise Risk Management Department conducted empirical studies on the effectiveness of intervention. A recent study in 2009 indicated that FX intervention had a positive impact in smoothing the USD/THB path. However, it remains inconclusive as to whether FX intervention could, with a high degree of statistical confidence, be expected to reverse a general USD/THB trend.

In general, persistent or occasional intervention has neutral impact on the market's expectations regarding the future trend of the exchange rate, given the condition that FX flows are normal flows and not speculative ones. However, in some cases FX intervention may be capable of influencing the perceptions of market participants – speculators' perceptions in particular – where FX intervention has been designed to surprise the market.

Both persistent and occasional FX intervention can impact exchange rate expectations to some degree, generally when the underlying economic fundamentals are in line with the FX movement. In the current climate of excessive global liquidity seeking higher yields in the EM environment, persistent FX intervention would be less effective in shaping exchange rate expectations.

The BOT has never announced any FX operations beforehand. The effectiveness of such pre-announcement in shaping exchange rate expectations would very much

depend on underlying economic fundamentals. If the country's current and expected fundamentals are in line with suspected intervention, expectations could be shaped easily. Otherwise, such a tack might pose risks or create doubt in the market. However, following a "walk the talk" strategy may involve a trade-off between credibility and costly intervention, especially when market conditions are inappropriate.

Domestic consequences of FX intervention

Macro implications: implications for growth and macroeconomic conditions

For emerging markets that rely on export-led growth, foreign exchange intervention to smooth currency movements and maintain export competitiveness – especially in the face of strong capital inflows – may help mitigate short-term impacts on growth. However, intervention to stabilize the exchange rate has often incurred the expense of greater volatility in other macroeconomic variables such as domestic interest rates, international reserves, and other price variables. Nonetheless, excessive macroeconomic volatility resulting from exchange rate management has not been much of an issue in Thailand's case during the past decade. According to an independent evaluation,[2] under the inflation targeting and managed-float exchange rate regime during the 2000–2010 period, Thailand's price stability performance was favourable in comparison with past records and with other countries in the region. More importantly, the study noted that price stability has not been achieved at the expense of economic growth.

However, taking into account both longer-term economic considerations and the large expansion in international reserves during the past years, it must be noted that further intervention would be increasingly costly for the economy as a whole, as it would delay structural adjustments that are needed to enhance the economy's long-term economic potential.

Financial impacts: foreign exchange market development

A regime based on greater exchange rate flexibility creates higher FX volatility for market participants than did the previous system, which was based on a basket of currencies. To manage FX risk, banks in Thailand offer a wide range of competitively-priced FX hedging products such as forwards, options, FX swaps and cross-currency swaps. The FX hedging ratio, on average, increased from 19% in 2005 to 35% in 2012, reflecting the width and depth of the FX hedging market in Thailand. Thai corporations have learned that their current profit margin cannot fully absorb higher FX volatility; hence, there is an increased demand for hedging FX exposure. The BOT has also collaborated with commercial banks in promoting the use of FX hedging products, by arranging seminars and providing related documents to educate the corporate sector, especially the small and medium enterprises (SMEs). Recently, in June 2012, the BOT coordinated with the Thailand Futures Exchange (TFEX) to launch the country's first currency futures as a new alternative for FX hedging.

[2] Stephen Grenville and Takatoshi Ito (2011), "An Independent Evaluation of the Bank of Thailand's Monetary Policy under the Inflation Targeting Framework, 2000–2010". http://www.bot.or.th/English/MonetaryPolicy/Pages/Assessment.aspx

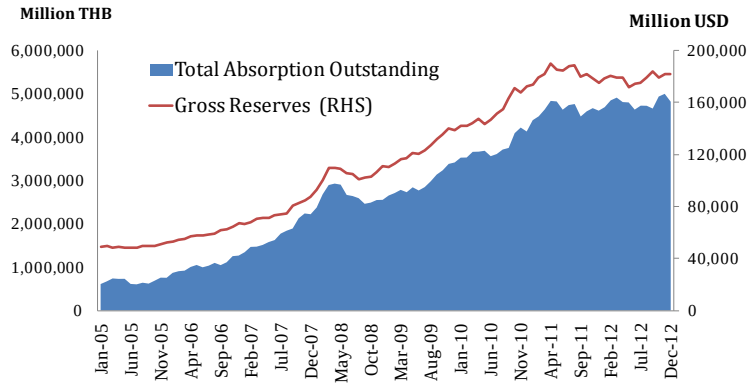
The market for FX hedging in Thailand is deep and liquid, with high transaction volume and competitive prices, and with products up to 1- to 3-year tenors being quoted. The BOT plays a major role in the FX swap market, absorbing THB liquidity while injecting USD liquidity to the market up to tenors of 1 year. The BOT's FX swaps book is roughly 23–24 billion USD as of end-January 2013. The presence of the BOT in the FX swap market significantly helps banks to efficiently manage their USD liquidity positions, which are driven by customers' FX hedging demand.

5. Sterilization: choice of instruments and implications

The choice of instruments

Over the past decade or so, continued purchase of foreign exchange to moderate the speed of currency appreciation has increased the obligation to sterilize excess liquidity. Under the inflation targeting regime, excess THB liquidity created by the purchase of USD needs to be fully sterilized to ensure that short-term money market rates move in line with the policy rate set by the Monetary Policy Committee (MPC). Sterilization obligations grew rapidly, especially in 2009–2010 following the Lehman crisis, increasing by over 50 per cent between end-2008 and end-2010. Nevertheless, the obligation has stabilized since the second half of 2011, and is in line with a more balanced capital flow. (Chart 1)

Total absorption instruments outstanding — Chart 1

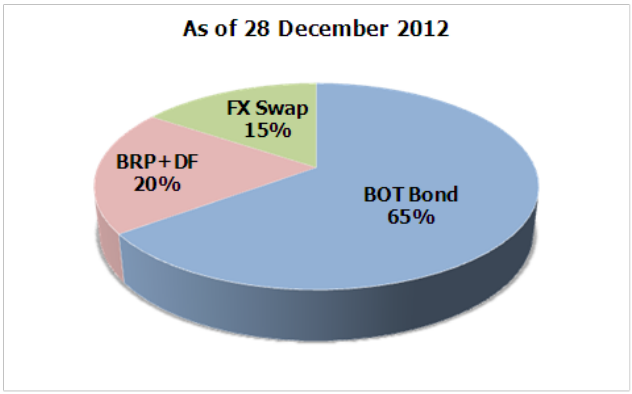


Source: Bank of Thailand

The BOT has employed several instruments to sterilize excess liquidity. The main instruments used are bilateral repurchase operations, issuance of BOT bills and bonds, and FX swaps. BOT bills and bonds represented the largest share of this mix – comprising over 60 per cent of the total instruments outstanding (Chart 2).

The allocation of absorption instruments is designed to take the effectiveness of monetary policy transmission and financial market developments into account. The fact that the largest allocation was to BOT bills and bonds was deliberate. As the obligation level increases, BOT bills and bonds have become an increasingly important sterilization instrument.

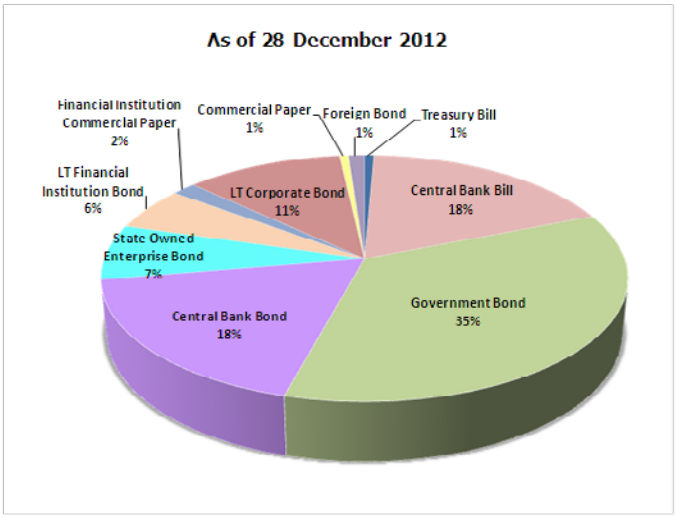
Proportion of total instruments outstanding — Chart 2



Source: Bank of Thailand

While other absorption instruments have limited and shorter tenors, and too much concentration could affect short-term market rates and hinder monetary policy transmission, the issuance of BOT bills and bonds is more flexible. This is because the BOT can issue a variety of bonds and bills at varying tenors, bearing in mind that it also intends to foster bond market development by providing a regular supply of bonds (see Table 1). The BOT and the Ministry of Finance are major issuers of domestic bonds, accounting for over 70 per cent of the total outstanding (Chart 3). Hence, close collaboration between these two main issuers is essential.

Domestic bonds, by issuer — Chart 3



Source: Thai BMA

BOT bond issuance plan — Table 1

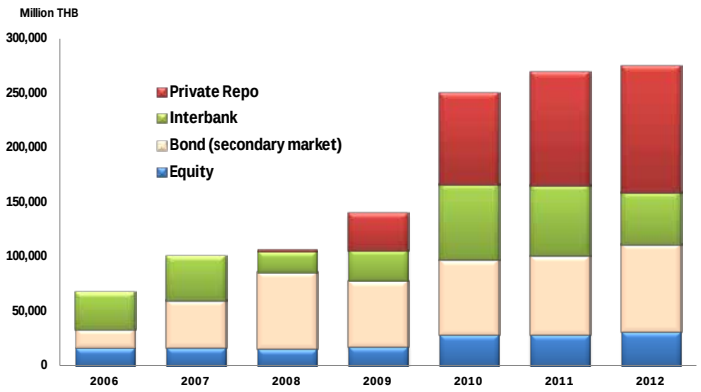
	Type of bond	Issue size per auction (Millions of bahts)	Outstanding per issue (Millions of bahts)	Number of issues per year
1.	Discount Bonds			
	Cash management bills	30,000 – 70,000	30,000 – 70,000	50 – 52
	1-, 3- and 6- month	25,000 – 35,000	25,000 – 35,000	50 – 52
	1-year	30,000 – 50,000	90,000 – 150,000	4
2.	Fixed-coupon bonds			
	2- and 3-year	20,000 – 40,000	60,000 – 120,000	2
3.	Floating-rate bonds			
	3-year	10,000 – 15,000	60,000 – 90,000	1

Implications

Implications for financial market developments

The increasing obligation to sterilize helps facilitate overall financial market developments in both money and bond markets. An increasing volume of bilateral repurchase (BRP) transactions has contributed to rapid development in the private repo market. With this in view, the BOT has designed the BRP to conform to international market practices – for example, it employs initial haircuts, margin calls and marking to market of collaterals. The private repo market has grown rapidly, with trading volume in 2011 more than three times the 2009 volume (Chart 4).

Average daily trading volume by market — Chart 4



Source: Bank of Thailand, SET and Thai BMA

The issuance of BOT bonds has contributed to a more complete range of securities. The BOT carefully plans the types of bonds it issues to fill in the tenor gaps, i.e. by issuing only shorter-term bonds with tenors that do not replicate the government's. With a wider range of products to choose from, the domestic bond market has increasingly attracted investors of all types – both local investors and

non-residents. Participation by foreign investors has increased from around 5 per cent in 2010 to 11 per cent as of end-2012.

Implications for the BOT's balance sheet

In the aftermath of the Lehman crisis, the continued weakness of the USD and interest rate differentials have adversely affected the BOT's financial position. Differences in the speed of recovery between advanced countries and emerging Asia led to widening interest rate differentials. While the US and European economies require prolonged accommodative monetary policy with extremely low interest rates, East Asian economies have put the crisis behind them and need to raise interest rates to combat growing inflationary pressure.

Given that foreign exchange intervention leads to an accumulation of international reserves, held primarily in G4 currencies with low interest rates, while interest rates on sterilization obligations are consistently higher, this combination results in a negative carry. On top of this, continued appreciation in East Asian currencies also leads to a loss of valuation. Both negative carry and valuation loss have contributed adversely to the BOT's financial position.

Alternative tools to manage capital flow volatility[1]

Koray Alper, Hakan Kara and Mehmet Yörükoğlu[2]

Abstract

Heightened volatility in cross-border capital flows has increased exchange rate volatility across emerging markets as well as in advanced economies, setting the stage for more active management of currencies. Traditionally, foreign exchange rate intervention has been the primary tool to address these types of challenges. However, given the limitations of foreign exchange rate intervention, it may be well worthwhile to explore alternative mechanisms for dealing with capital flow volatility. This paper explains how the new policy framework adopted by the Central Bank of the Republic of Turkey (CBRT) in the past two years has eased the need to conduct FX interventions. We first describe the rationale for the new policy framework, which is an augmented version of inflation targeting, with more emphasis on macro financial risks. Next, we explain the new instruments developed by the CBRT and their contribution to coping with capital flow volatility. In particular, we focus on the Reserve Option Mechanism, which is designed as a shock absorber for volatile capital flows, and thus reduces the need for FX intervention. We argue that although Turkey has not been engaged in direct FX interventions since the beginning of 2012, the volatility of the Turkish lira has been remarkably low in comparison with the currencies of peer economies.

Keywords: monetary policy, capital flows, exchange rate interventions, financial stability

JEL classification: E52, E58, F31, F32

[1] Opinions stated in this paper are the authors' and do not necessarily represent the official views of the Central Bank of the Republic of Turkey. We are indebted to Erdem Başçı, Salih Fendoğlu, Doruk Küçüksaraç, Pınar Özlü, Deren Ünalmış, Tolga Tiryaki, Canan Yüksel, Hande Küçük and other colleagues at the Central Bank of the Republic of Turkey for useful contributions.

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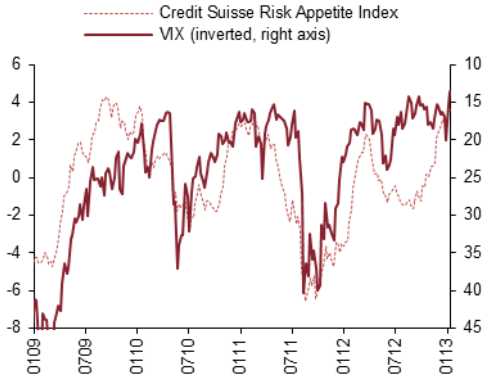
Introduction

During the past few years, heightened volatility in cross-border capital flows and sharp swings in risk appetite (Figures 1 and 2) has increased the focus on macro financial risks across emerging markets. Increased volatility in short-term capital flows has led the central banks of these countries to seek alternative policies. One particular variable of interest during this period has been the exchange rate. Excessive volatility in exchange rates has prompted central banks – even those that have traditionally operated under pure-float regimes – to take explicit policy measures.

Risk appetite

Figure 1

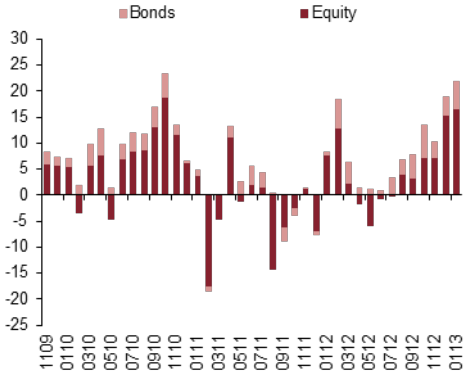


Source: Credit Suisse, Bloomberg.

Equity and bond flows to emerging markets

(USD Billions)

Figure 2



Source: EPFR.

Many central banks under inflation targeting (IT) regimes responded to capital flow volatility through direct interventions in the form of outright sales and purchases of FX. However, empirical evidence has been unable to provide robust support for the effectiveness of intervention and the issue is still open to debate. Moreover, there are non-negligible costs associated with FX interventions. Against this backdrop, Turkey has opted for an alternative strategy. Since year-end 2010, the Central Bank of the Republic of Turkey (CBRT) has implemented a new policy strategy to address the challenges posed by volatile capital flows. To this end, the conventional inflation targeting regime was modified by incorporating financial stability as a supplementary objective. The use of alternative monetary policy instruments in this new regime has reduced the need for direct FX intervention. This note explains the motivation and implementation of the new set of tools, and provides some evidence on the effectiveness of these tools in containing exchange rate volatility. We start by describing the main ingredients of the new framework.

A new policy framework

The new strategy adopted by the CBRT reflects the need to respond to the post-crisis dynamics governing the global financial environment. Table 1 compares the new and former policies. The current framework differs from the standard IT

framework in terms of both objectives and instruments. The new regime preserves the main objective of price stability, while risks to financial stability are also taken into consideration in the conduct of monetary policy. Financial stability as an objective calls for the use of multiple instruments in monetary policy. Consequently, the CBRT has developed a rich set of tools in order to be capable of addressing macro financial risks without jeopardizing the price stability objective.

Monetary policy framework — Table 1

	Former approach	New approach
Objectives	**Price Stability**	**Price Stability** **Financial Stability**
Instruments	Policy rate	Structural Instruments Cyclical Instruments (Policy Rate, Liquidity Management, Interest Rate Corridor)

The CBRT's approach to financial stability reflects a macro perspective. While aiming to achieve price stability, this approach does not ignore macroeconomic instabilities and risks accumulating in the financial system. Although macro financial risks can arise from many different factors, it is fair to say that the main source of vulnerability in the post-crisis period has been the global economic outlook and related policy uncertainty. Ongoing accommodative monetary policies due to the fragile global economic outlook, abrupt changes in risk perceptions and excessively volatile capital flows have been the main factors driving macro financial risks. In this context, the CBRT's approach to macroeconomic and financial stability in the last two years can be characterized as minimizing the effects of capital flow volatility on domestic markets.

Key variables: credit and exchange rates

The new policy framework attaches special importance to the credit and exchange rate channels as operating targets. Global liquidity cycles typically lead to excessive fluctuations in domestic credit and exchange rates in small, open, emerging economies. These two variables interact in a way that creates financial accelerator mechanisms that amplify business cycles. For example, capital inflows lead to currency appreciation and easy access to credit. A rapid appreciation of the local currency improves the balance sheets of firms, which are typically net borrowers of foreign currency. This, in turn, may lead to excessive lending appetite by banks and thus feed into rapid credit growth and systemic risk (see Bruno and Shin 2012). Rapid credit growth may lead to a relative rise in non-tradable prices, further increasing the appreciation pressures on the domestic currency. The feedback between exchange rates and credit growth may become a spiral, which can be a source of vulnerability and eventually end in a sudden reversal of capital flows. Needless to say, the possibility of an abrupt contraction in credit or an excessive depreciation of the local currency is undesirable from a macroeconomic and financial stability perspective.

In sum, capital flows create excess volatility in output and may threaten macroeconomic stability through the interaction of the exchange rate and credit. Rapid credit growth and excessive appreciation of the exchange rate lead to imbalances through over-borrowing and excess spending by domestic agents,

which in turn distort the economy's resource allocation. The policy framework developed by the CBRT in the last couple of years reflects the need to avoid the build-up of macro financial risks resulting from these cycles. To this end, the policy has focused on smoothing out the adverse effects of capital flow volatility. In order to implement this goal, the CBRT has stated that credit should grow at reasonable rates and that developments in the foreign exchange rate should be consistent with economic fundamentals. Of course, this is easier said than implemented. It is almost impossible to pin down the "equilibrium" or "fair value" of the exchange rate. Likewise, finding the appropriate pace of credit growth is far from being a trivial challenge, as there is no clear guidance provided by either theory or practice.

Exchange rates, intervention and monetary policy

Under conventional IT framework, which was in place between 2006 and 2010, the CBRT was almost completely silent about exchange rate movements. Occasional intervention was conducted through direct FX purchases/sales or regular auctions, yet the interventions were motivated by the usual "volatility" argument. Regular purchase auctions were also conducted with the classic motive of reserve build-up. There were no explicit references to exchange rate misalignments and/or macro financial risks.

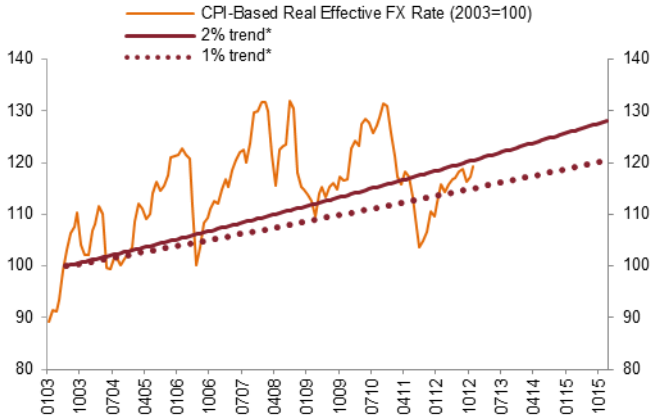
The new policy setup has changed both the motivation and implementation of the foreign exchange management policy. In the new framework, exchange rate movements are explicitly linked to the newly established financial stability objective. Monetary policy explicitly aims to avoid excessive misalignment of the exchange rate. Although it is impossible to be precise about the equilibrium exchange rate, it is often possible to use judgment or model-based analysis to detect an excessively misaligned exchange rate. For example, when economic fundamentals do not justify the level of the real exchange rate, indicators such as current account balance and relative prices provide important signals. When we have a strong feeling that the exchange rate is misaligned, we go public with our opinion and/or respond actively by using alternative policy tools.

In sum, compared to the previous framework, the new policy setup brings two major differences to exchange rate policy: (i) the CBRT is now more vocal and reactive regarding exchange rate misalignments, and (ii) direct FX intervention is no longer the main policy tool to smooth exchange rate fluctuations. As described below, the introduction of new instruments such as an asymmetric interest rate corridor and the Reserve Option Mechanism have reduced the need for FX intervention in the form of outright selling and purchasing of foreign currency.

Against this backdrop, the CBRT conducts exchange rate policy in a more rule-based fashion, aiming to prevent significant and persistent deviations of the exchange rate from what the economic fundamentals justify. In implementing the new policy, one needs some guidance on what a reasonable (or tolerable) path of the exchange rate is. Recently the Governor of the CBRT has announced that an annual 1.5–2% appreciation in the (CPI-based) real effective exchange rate is consistent with Balassa-Samuelson effects and measurement bias due to quality improvements. Excessive deviation from this trend will not be disregarded by the CBRT (Figure 3). Accordingly, the monetary authority will use its policy instruments to contain excessive appreciation or depreciation pressures. This approach implies an automatic mechanism to react against capital flow volatility.

Real effective exchange rate index

(2003 average=100) Figure 3



* Red trend lines show the real exchange rate appreciation that may attributed to Balassa-Samuelson effects and quality improvement.

Source: CBRT.

Credit growth rule

Many empirical studies show that excessive credit growth is highly detrimental to macroeconomic and financial stability. Mendoza and Terrones (2008), for instance, find that rapid credit growth is associated with booms in output, rising asset prices, widening external deficits, and sharp real appreciation. When booms phase out, recessions and financial crisis are likely to follow. Accordingly, excessive credit growth calls for corrective policy action. Using 140 years of data for advanced economies, Schularick and Taylor (2012) find that rapid credit growth is historically a leading indicator for financial crises. On the other hand, Jorda et al. (2011), using the same database, show that the relationship between credit growth and external imbalances has strengthened in recent years. They also emphasize the importance of the interaction between these two variables for financial stability.

As a reflection of the recent empirical evidence and lessons from the global crisis, the second pillar of the new policy strategy of the CBRT is to preserve a healthy and sustainable level for the path of credit that will ensure the stability of the financial system. The literature usually focuses on credit growth rates or credit-to-GDP (credit deepening) ratios in assessing credit paths. The CBRT instead highlights *the change in credit stock/GDP* (ΔCredit/GDP). This variable, which also can be called the "net borrowing-to-income ratio", incorporates the information embedded in the credit growth and credit deepening variables. It is a measure of the change in the net indebtedness of domestic agents in a given year relative to their income. Given that an economy's savings ratio does not tend to display major changes in the short-to-medium term, a higher ΔCredit/GDP ratio would imply an increasing share of external resources in total borrowing, rendering the economy vulnerable to sudden reversal. In addition to macro financial risks, above-normal

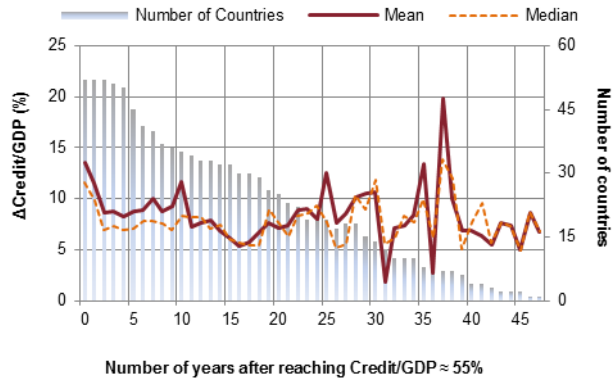
credit growth would be very likely to imply significant deterioration in credit quality, which would only become apparent in downturns, with a formidable cost.[3]

Thus, wishing to reflect financial stability concerns in the new policy framework, the CBRT decided to focus on the net borrowing-to-income ratio and become more responsive to excessive deviations of credit from "normal" levels. For practical implementation of a credit rule, one needs to have a benchmark for the reasonable (or normal) path for credit. Kara, Küçük, Tiryaki and Yüksel (2013) analyze historical data in order to provide some reference values for Turkey's credit path. In particular, they take Turkey's current credit-to-GDP ratio (55 percent) as a starting point, and aggregate the information embedded in the credit paths of other countries following similar credit deepening phases. Interestingly, the authors find that countries exhibit roughly stable net borrowing-to-income ratios after this point (Figure 4).

Evolution of net borrowing-to-income ratio (ΔCredit/GDP) after countries reach credit/GDP ratio of 55%*

Net Borrowing / GDP

Figure 4



*Horizontal axis indicates the number of years since a country reached a Credit/GDP ratio of 55%. Left vertical axis shows the evolution of ΔCredit/GDP, while the right vertical axis shows the number of countries.

Source: World Bank.

When averaged across time for each country, the 25 and 75 percent quartiles for ΔCredit/GDP correspond to a range of 6.7–10.6 percent. Considering the lessons learned from the global crisis, and considering Turkey's high current account deficit, the CBRT has judged that a ratio in the neighborhood of 7.5 percent would constitute a reasonable and prudent benchmark for Turkey. This ratio corresponds to annual credit growth of 15 percent in the short term, assuming nominal income growth of around 10 percent. As credit deepening increases through time, each percentage unit of credit growth means more borrowing relative to income. This means that in order to stabilize the ΔCredit/GDP ratio, the benchmark credit growth must follow a gradual downward path.

Accordingly, the CBRT announced a "credit targeting rule" for monetary and macro prudential policy. For the year 2013, significant deviations from 15 percent annual credit growth would prompt tightening through macro prudential tools such

[3] See, for example, Dell'Ariccia et al. (2012), and Jiménez and Saurina (2006).

as reserve requirements. Liquidity policy would also support this goal, provided that it does not conflict with exchange rate smoothing and inflation targeting goals.

The idea behind establishing some sort of a credit rule is twofold: First, the CBRT wishes to consolidate the lessons from the crisis in order to ensure the stability of the financial system. Second, the CBRT aims to break the vicious circle of exchange rate appreciation and rapid credit growth driven by capital flows and global liquidity cycles. By inhibiting banks' demand for external resources, the adoption of a credit rule dampens the amplitude of capital flow cycles, which implicitly help to smooth out exchange rate fluctuations. In that sense, dampening credit fluctuations also reduces the need for FX interventions.

New policy instruments

As explained above, besides the conventional price stability objective, the new policy strategy aims to reduce the credit and foreign exchange volatility associated with cross-border capital flows. This multiple-objective approach necessitates the use of a variety of policy instruments. Accordingly, the CBRT developed new instruments like the "asymmetric interest rate corridor" and the "Reserve Option Mechanism" in recent years.[4] In the next sections we describe these instruments and provide some evidence on how these new mechanisms have alleviated the need to conduct direct FX interventions.

Asymmetric interest rate corridor

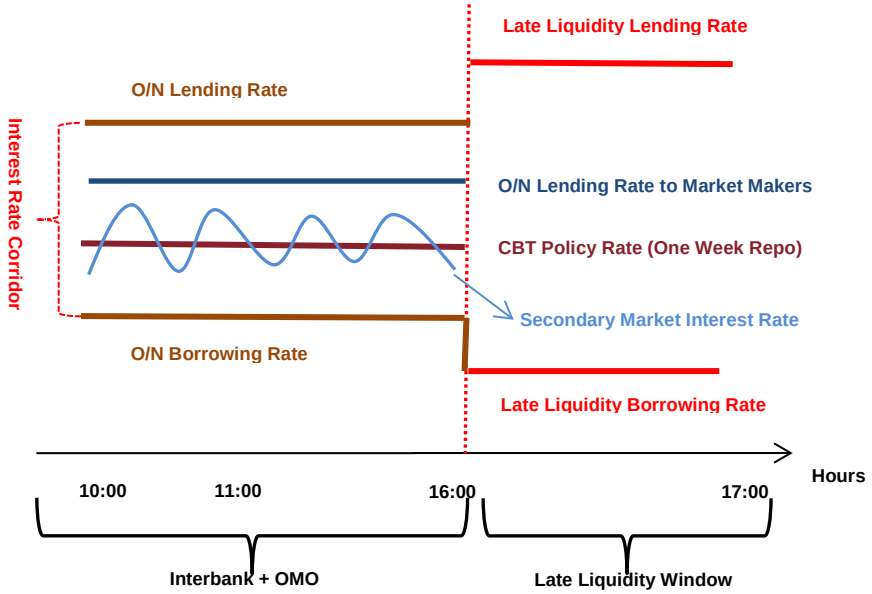
The asymmetric interest rate corridor is a new tool developed by the CBRT to increase the flexibility of monetary policy. It provides the ability to make timely responses to external finance or risk sentiment shocks through active management of daily open market operations. In order to understand how the mechanism works, it will be useful to briefly review the operational framework of monetary policy.

The CBRT, like many other central banks, has various instruments at its disposal to affect the amount of liquidity and interest rates in the interbank money market. Since funding is provided mainly through weekly repo transactions, the one-week repo funding rate is called the "policy rate". However, in principle, the CBRT can also provide daily, weekly, or monthly funding to banks that are short of liquidity, and borrow at the O/N borrowing rate from those that have an excess of it. The area between the O/N borrowing and lending rates is called the "interest rate corridor" (Figure 5). As a requirement of the operational structure, market rates are formed within the interest rate corridor.

[4] For details of the design and implementation of the new policy framework, see Başçı and Kara (2011) and Kara (2012).

Operational framework of CBRT's monetary policy

Figure 5



Up to here, there is nothing special in the operational framework. In fact, having an interest corridor for operational purposes is fairly common among central banks. What makes the Turkish case unique is the use of the width of the corridor as a policy instrument. In the conventional structure, the interest rate corridor is used as a two-sided buffer to prevent market rates from deviating significantly from the policy rate. The interest rate corridor is defined as a symmetrical (generally unchanged) narrow band around the policy rate. In other words, the interest rate corridor assumes a passive role. On the other hand, the CBRT's current system uses the interest rate corridor as an active instrument: The CBRT can adjust the width of the interest rate corridor (possibly in an asymmetric way) when necessary. In this structure, the interest rate corridor not only facilitates a faster and more flexible reaction to volatility in short-term capital movements, but also can be used as an effective instrument against credit growth.

The main contribution of the asymmetric interest rate corridor system is the flexibility it provides for reacting to capital flows. In the traditional inflation targeting framework, interest rates are fixed for a predetermined period (typically for one month). In other words, the central bank short-term interest rates depicted in Figure 5 stay unchanged between the periodic monetary policy meetings. Once the rates are announced, short-term money market rates stay close to the policy rate, reflecting the central bank's implicit commitment to keep the money market rates constant until the next meeting. However, under the new system implemented by the CBRT, there is no rigid commitment to keep the level of market rates constant at a predetermined rate. Market interest rates can be changed, if needed, on a daily basis, by adjusting the quantity of funds provided through one-week repo auctions. Accordingly, the overnight rate can be targeted anywhere inside the corridor.

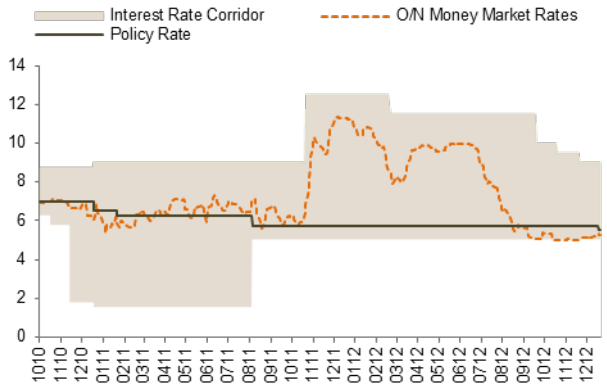
In this setup, the width of the interest rate corridor represents the range within which interest rates can fluctuate. In other words, it signals the maximum possible change that can be engineered in short-term market rates via daily liquidity operations. As a consequence, both the width of the corridor and upper/lower bounds matter for expectations and monetary policy. When the inflows are strong

(weak), the interest rate corridor may be widened downwards (upwards). The CBRT can "fine tune" the amount of liquidity in the money market via daily liquidity operations, letting the market O/N rate fluctuate within the corridor, depending on the intensity and direction of capital flows. The monetary stance can be adjusted, as needed, in response to rapid changes in the global risk appetite. This framework allows the liquidity policy to smooth out the impact of sharp changes in capital flows on exchange rates, thereby reducing the need for direct FX intervention.

The interest rate corridor may be also used to change the composition of inflows during "capital flood" episodes. This can be achieved by creating short-term interest rate uncertainty in money markets via liquidity management facilities. The short-term interest volatility created using the interest rate corridor should discourage short-term capital flows, yet remain less relevant for long-term investors.

Asymmetric corridor system and O/N money market rates

(percent) Figure 6



Source: ISE, CBRT.

Figure 6 shows the implementation of the corridor policy. Since year-end 2010, the CBRT has been using the interest rate corridor as an active policy tool. There have been three main phases during this period:

i) *QE2 and surging capital inflows at the end of 2010.* During this period, the lower bound of the interest rate corridor (O/N borrowing rate) was cut significantly, and interest rate volatility was increased, to discourage short-term capital inflows.

ii) *Intensification of the Euro Area debt crisis.* Global markets witnessed a sudden reversal in risk sentiment during the last quarter of 2011. In order to avoid a sudden stop, and to contain the depreciation of the exchange rate, the interest rate corridor was widened by increasing the upper bound (O/N lending rate).

iii) *Removal of tail risks associated with a break-up in the Euro Area.* There has been a resurgence of capital inflows to emerging markets since mid-2012. The CBRT responded by increasing the liquidity injected to the money market and thus lowering short-term market rates. The upper bound of the interest rate was cut gradually in response to persisting capital inflows.

In sum, the interest rate corridor was actively used to counterbalance the impact of capital flows in the past two years.[5] Although direct interventions (outright sales of FX) were used to complement the corridor system in the last quarter of 2011, more active use of the asymmetric corridor, coupled with the adoption of the Reserve Option Mechanism (described below), has gradually eased the need to intervene in FX markets. As a consequence, the CBRT has not resorted to direct interventions since January 2012.

Reserve option mechanism

Another recent instrument introduced by the CBRT to smooth exchange rate volatility is the Reserve Option Mechanism (ROM). This is a novel tool designed to act as a sort of an automatic FX intervention mechanism (but a more market-friendly one), reducing the adverse impact of excessively volatile capital flows on macroeconomic and financial stability. Below, we describe the main features of the ROM and evaluate its main transmission channels.[6]

The ROM is a mechanism that allows banks to voluntarily hold a certain proportion of their Turkish lira (TL) reserve requirements in foreign exchange (FX) and/or gold. The amount of FX or gold that can be held per unit of Turkish lira is called the reserve option coefficient (ROC). For example, if the ROC is 2, banks must hold 2 liras worth of FX or gold per 1 TL reserve requirement if they wish to utilize the ROM facility.

A simple example may help to understand the mechanism. Suppose that banks have to hold 100 TL reserve requirements in total for their TL liabilities. Let us assume that the ROM allows the banks to hold up to 90 percent of their TL reserve requirements in FX and that the ROC is equal to 1. Let us further assume that the USD/TL exchange rate is 1.8. In this case, if the bank prefers to use the facility fully in USD, it has to hold the 90-TL equivalent of USD, which is 90/1.8 = 50 USD. If this is the case, banks will hold 50 USD (90 TL) plus 10 TL, to fulfill their 100 TL of total reserve requirements. If the ROC is set at 2 instead of 1, the banks will have to hold the 2-TL equivalent of FX per 1 TL. In this case, if the banks wish to utilize the facility fully, they will hold the 90*2, i.e. 180-TL, equivalent of FX for their 90 TL reserve requirements, which will be 180/1.8=100 USD.

In the example above, for purposes of simplicity, the ROC is assumed to be uniformly distributed across the whole reserve option facility (up to 90 percent in our example). However, the ROC does not have to be constant across all tranches. For example, in the above example, it is possible to set the ROC, say, at 1 through the first-40-percent tranche, and at 2 for the remaining 50 percent. In fact, as we will explain below, increasing the ROC across tranches may lead to a more efficient system under certain conditions.

Figure 7 presents some examples of the alternative ways of setting the ROC. The first panel depicts the case of a constant ROC. In the second panel, the ROC increases linearly across reserve option ratios. In this case, banks have to hold higher amounts of FX per unit of TL if they wish to use the facility more intensively. The last panel corresponds to the current practice of the CBRT: The ROC is an

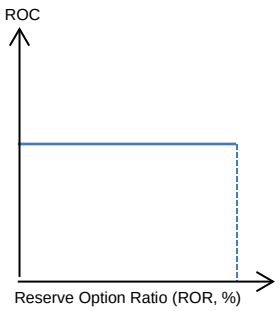
[5] See Kara (2012) for details.

[6] This section is partly based on Alper, Kara and Yörükoğlu (2012).

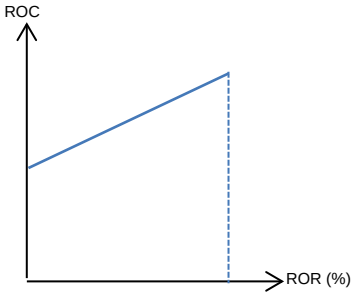
increasing function of reserves; however, for practical implementation purposes, the use of the whole facility is discretized by 5 percent tranches.

Some examples for the setting of the ROC — Figure 7

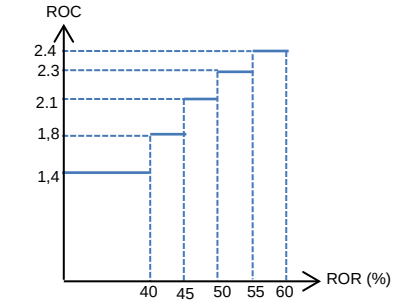
a) Constant ROC



b) Linear Increasing ROC



c) Current Practice* (for FX)



*As of February 2013

As explained above, banks may not always opt to utilize the ROM facility in full. Up to what fraction banks will use the ROM depends on the relative cost of FX funding to TL funding. For example, in the case of a ROC equal to 1, the banks will use the ROM facility fully if FX borrowing is less costly than TL borrowing, provided that there is no quantity constraint for FX-denominated borrowing. On the other hand, in the case of an increasing ROC across reserve option ratios, the banks will prefer not to use the facility fully if the ROC is "sufficiently high" at the highest tranches. The "threshold ROC", the level of ROC that makes banks indifferent about using or not using the facility, will depend on the relative cost of FX and TL funding. For example, if the cost of Turkish lira funding is 6 percent and the cost of FX funding is 3 percent (including the expected depreciation), the threshold ROC will be 2. In other words, banks will be expected to use the ROM up to a point where the ROC is equal to 2. Technically, the threshold ROC can be expressed as follows:

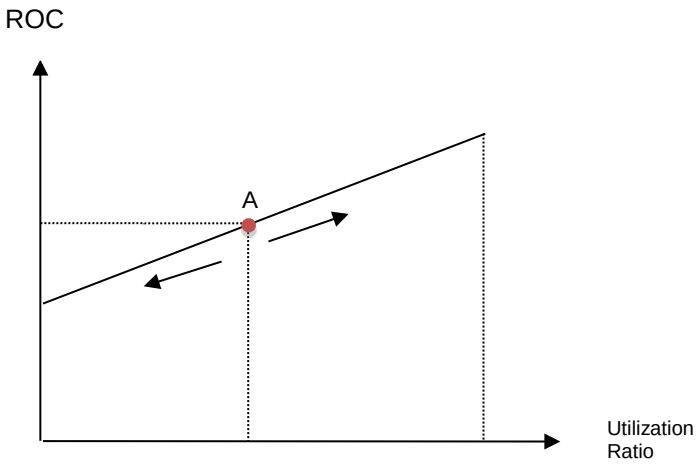
$$ROC^{tr} = \frac{r_t^{TL}}{r_t^{FX} * \frac{E(e_{t+1})}{e_t}} \qquad (1)$$

In the equation, ROC^{tr} denotes threshold ROC, r_t^{TL} denotes the cost of TL funding, r_t^{FX} is the cost of FX funding, e_t is the spot exchange rate at the beginning of the maintenance period, and $E(e_{t+1})$ is the expected exchange rate for the end of the maintenance period. In this formula, r_t^{TL} is the cost the bank incurs if it prefers to maintain the Turkish lira reserve requirements by borrowing in TL. The denominator ($r_t^{FX} * E(e_{t+1})/e_t$) denotes the bank's expected cost at the end of the maintenance period (denominated in TL), should it choose to use the ROM and fulfill the Turkish lira reserve requirement through FX borrowing.

Each bank's threshold ROC will depend on the relative funding cost shown in equation (1). The fact that each bank can solve its own maximization problem (depending on the relative costs and availability of credit) is critical, as it facilitates the system's working as an automatic stabilizer in the face of external funding shocks.

Impact of the change in relative funding costs on the threshold ROC

Figure 8



Now, in order to understand the automatic intervention mechanism, let us use a simple figure to analyze the interaction of cross-border capital flows with ROM. Assume that the ROC is linearly increasing in reserve option ratios as in Figure 8, and that the point "A" represents the threshold ROC at a certain period. The automatic stabilizer mechanism in the face of capital flows is expected to work as follows.

During an acceleration of capital inflows: These periods are typically characterized by a decline in FX funding costs relative to TL funding costs and/or a relaxation of quantity constraints. In the case of a relative decline in FX borrowing costs, the threshold ROC will increase, inducing banks to hold a higher ratio of their TL reserve requirement liabilities in FX. In other words, profit maximization behavior will lead the banks to use the ROM facility more intensively, increasing the "ROM utilization ratio". Accordingly, point A will shift to the right along the line, increasing both the threshold ROC and, consequently, the utilization ratio. In this case, a fraction of the foreign exchange inflows will be withdrawn, since they will be placed at the CBRT accounts of the banks as reserve requirements. This will not only contain the appreciation pressure on the TL but also limit the conversion of the FX inflows into bank lending, weakening the linkage of capital flows, credit, and exchange rate. On the other hand, if there are quantity constraints on bank borrowing, accelerating capital inflows will lead to a relaxation of these constraints, and once again shift point "A" to the right. This means that the utilization ratio will increase again and thus some of the inflows will voluntarily park at the CBRT. In both cases, some TL liquidity will be injected into the system. Yet the amount will be less – and thus sterilization costs will be lower – than in the case of direct FX purchasing by the CBRT, as long as the ROC is greater than 1 (see the balance sheet example below).

During a deceleration of capital inflows: These periods are typically characterized by an increase in FX funding costs relative to TL funding costs, and/or a tightening of external borrowing constraints, which will shift point "A" in Figure 2 to the left. This will lead to a fall in the utilization of the ROM and release some of the FX liquidity held by the banks at the CBRT, limiting depreciation pressures and reducing the possibility of a credit squeeze. Once again, the ROM will act as an automatic stabilizer.

Thus, by providing the banks with the flexibility to adjust their foreign exchange reserves depending on changes in external financing conditions, the ROM alleviates the impact of volatile capital flows on the exchange rate and credit volumes. As a by-product, there is less need for direct FX intervention.

Is the ROM more efficient than direct FX interventions?

In order to contrast the ROM with conventional sterilized intervention in the face of capital inflows, Table 2 conducts a simple balance sheet analysis of the aggregate balance sheet of the banking system. For all cases in the table, banks borrow 100 units of foreign currency from abroad (for the sake of simplicity, we assume that the exchange rate is 1 and there are no reserve requirements for FX liabilities).[7]

Effects of capital flows on the balance sheet of the banking system — Table 2

a) Base Scenario		b) Sterilized Intervention	
Assets	Liabilities	Assets	Liabilities
Loans +100	Due to foreign banks +100	Loans +50	Due to foreign banks +100 Due to CB (Repo) –50
c) ROC=1		**d) ROC=2**	
Assets	Liabilities	Assets	Liabilities
Loans +50 TL RR (ROM) +50 Due from CB –50	Due to Foreign Banks +100 Due to CB (Repo) –50	Loans +0 TL RR (ROM) +100 Due from CB –50	Due to Foreign Banks +100 Due to CB (Repo) –50

The first panel of the table describes the case of no policy response. Under this scenario, 100 units of capital inflows are fully converted into FX-denominated credit by banks. Moreover, the rise in the domestic supply of foreign currency would exert appreciation pressure on the domestic currency. This means that, c*eteris paribus*, both the exchange rate and credit would deviate from the desirable path. The typical response of central banks to such a situation has traditionally been to conduct sterilized FX intervention, which is shown in the second panel of the table. Here the central bank purchases 50 units of FX and simultaneously sterilizes the liquidity injected to the market. With this policy, the central bank contains some of the appreciation pressure on the domestic currency. Moreover, domestic interest rates stay intact because of the sterilization. However, this does not necessarily mean that the impact of capital inflows on credit growth is fully sterilized in practice. Since the banks' need for domestic currency liquidity decreases as their liquidity

[7] It should be noted that the results would remain the same if one considered the portfolio flows. In that case capital flows would end up as FX deposits on the banks' balance sheets.

positions improve, the situation may encourage them to expand their loan portfolio.[8]

The ROM, if calibrated properly, may be more effective than sterilized intervention in containing the impact of capital inflows on credit and exchange rates. To demonstrate this, the last two panels of the table analyze the scenarios where capital inflows are absorbed by using the ROM facility. In panel (c), ROC=1, whereas in the final panel ROC=2. To compare the results with the sterilized FX example, we assume that under both scenarios the central bank withdraws the amount of FX needed to fulfill 50 TL of reserve requirements. As shown in the aggregate balance sheet of the banks, the consequences of sterilized intervention and the consequences of the ROM are quite similar when the ROC is set at 1.

The merits of using the ROM become clearer when the ROC is greater than 1, i.e. when banks have to hold more FX for each unit of TL reserve requirements. When ROC>1, the central bank can withdraw more FX from the market (than in the previous case) for each unit of TL reserve requirements. The balance sheet in panel (d) shows the case ROC=2. In this case, banks deposit 100 units of FX to the central bank in exchange for 50 units of TL reserve requirements. Therefore, all 100 units of FX inflows are absorbed by the ROM facility and there is no additional credit expansion by the banks. This is absolute sterilization.

In sum, the ROM has the potential to be more effective than sterilized intervention in neutralizing the effects of fluctuations in the supply of foreign currency on domestic markets.

Another advantage of the ROM over sterilized FX intervention is its potential to be a more efficient tool economically. Direct intervention decisions are mostly discretionary by nature and impose the same restrictions on all relevant agents. The results of the ROM, on the other hand, derive from the optimization policies of the individual banks, which may lead to a more efficient outcome in terms of resource utilization.

The ROM is also easier to communicate and implement than discretionary tools such as FX intervention. Thus, unlike direct intervention procedures, the ROM runs less risk of provoking speculative FX demand. An FX intervention aiming to smooth exchange rate volatility may be (mis)perceived as an attempt to defend some exchange rate level or as a change in monetary policy stance, leaving the currency prone to speculative attacks. Indeed, the likelihood of interventions' attracting speculative attacks is one of the reasons that central banks opt for covert intervention (see, for example, Archer, 2005). In contrast, withdrawal or injection of FX liquidity through the ROM (assuming that it operates as an automatic stabilizer) does not pose such a problem, since it is largely an outcome of optimization decisions by the banks.

In addition to the possible negative side effects of intervention, its effectiveness in influencing the exchange rate is debatable. Disyatat and Galati (2004) argue that existing empirical evidence indicates that intervention may be a useful tool only to

[8] Garcia (2011), with a simple IS-LM type model, shows that contrary to conventional wisdom, sterilization may be expansionary. He argues that when capital flows take the form of foreign borrowing by domestic banks, the central bank's sterilization should induce an increase in banks' bond holdings. However, with increased liabilities, banks are drawn to diversify their assets, leading them to enlarge their loan portfolio. In other words, in his model a portfolio balance effect is generated inside the bank.

cope with short-run exchange rate fluctuations arising from temporary shocks. Turkish experience does also yield mixed results so far. Domaç and Mendoza (2002), studying the experiences of Mexico and Turkey, conclude that while sale operations are effective in reducing volatility, purchase operations are not. Another empirical study on experience in Turkey, by Akıncı et al. (2004), concludes that only large and isolated purchase interventions were effective in curbing exchange rate volatility, while appreciation/depreciation trends seem to remain impervious to intervention. Özlü (2006), investigating the effects of intervention on the risk premium under two different exchange rate regimes for Turkey, concludes that neither sale nor purchases of US dollars had any effect on the size of the risk premium for the TL/USD exchange rate under either managed or free-float regimes.

It is important to note that the ROM is not intended as a full replacement for FX intervention. The adoption of the ROM reduces, but does not completely remove, the need for discretionary intervention. Although it has the potential to be a more efficient tool than just selling and purchasing FX in a discretionary fashion, its power as a signaling and coordination device at times of extreme stress may not be as strong as that of discretionary interventions. Moreover, the liquidity-managing capacity of the ROM may not adjust quickly enough. Abrupt swings in capital flows and/or unhealthy price formation in the FX market may still necessitate the use of intervention as a supplementary instrument. Therefore, there may be circumstances where discretionary intervention tools[9] are needed.

Finally, it is worth mentioning that the corridor and the ROM can also work as complementary tools on certain occasions. For example, the presence of the corridor provides flexibility for sterilizing the liquidity effects of the ROM. In the standard inflation targeting framework, the TL liquidity injected into the system through FX withdrawals has to be almost fully sterilized, since the central bank commits to keep short-term interest rates close to a pre-announced policy rate. On the other hand, the existing corridor system allows short-term interest to fluctuate freely within the corridor, providing ample flexibility in terms of sterilization. For example, during a surge of capital inflows, the central bank will have the option of not fully sterilizing the domestic currency liquidity injected through the ROM, by letting short-term interest rates decline. A fall in short-term rates may further discourage short-term capital inflows in such a case, strengthening the ROM's role in smoothing the exchange rate and credit fluctuations.

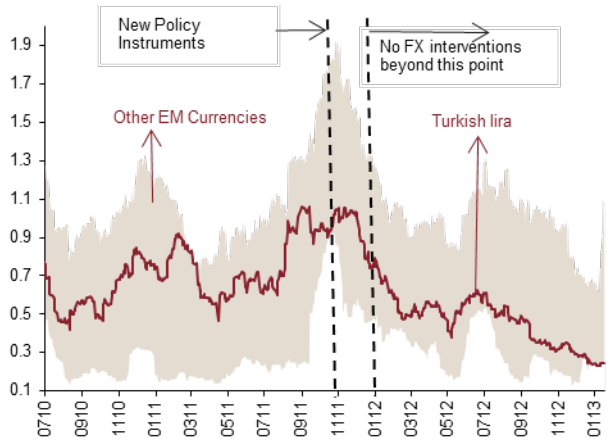
New Instruments and Exchange Rate Volatility: Empirical Evidence

Throughout this paper, we have argued that the adoption of policy instruments such as the ROM and the interest rate corridor have reduced the need for direct intervention. In fact, several recent studies conducted by the CBRT staff provide evidence on the role of the new instruments in reducing FX volatility. Using a GARCH framework, Akçelik et al. (2012) find that the active interest rate corridor and liquidity policy (adjusting liquidity conditions frequently to counterbalance exchange rate movements) have been associated with lower FX volatility. In a companion paper, Oduncu et al. (2013) show that the ROM has had a significant role in reducing the excess volatility of nominal exchange rates.

[9] Spot foreign exchange transactions, swaps, options and verbal operations are examples of such discretionary intervention instruments.

Volatility of the Turkish lira and other EM currencies* against USD

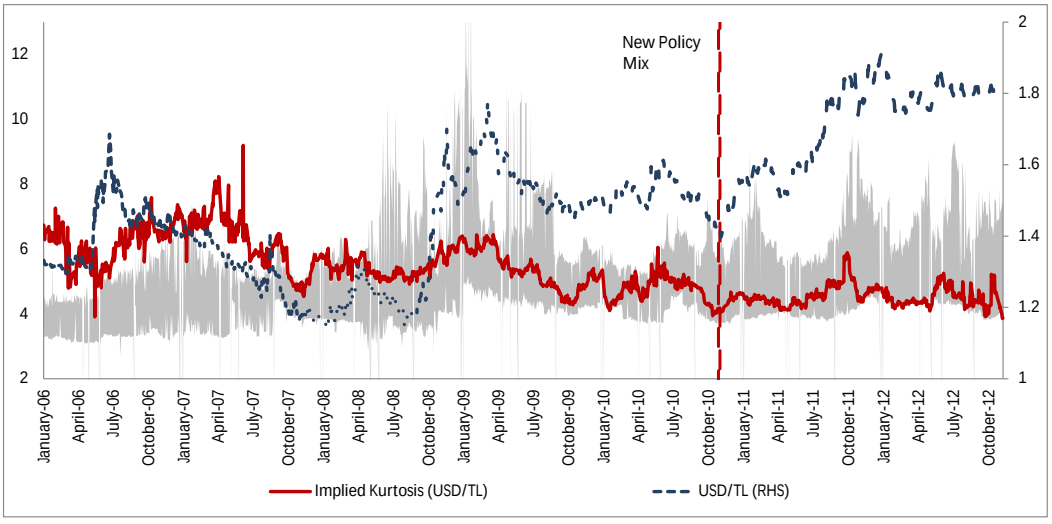
(30-day moving average) Figure 9



* The sample contains countries with current account deficits: Brazil, Chile, Columbia, Czech Republic, Hungary, Indonesia, Mexico, Poland, Romania, South Africa, and Turkey.

Another way to test the effectiveness of the new instruments is to compare the Turkish lira with peer currencies, and see whether relative volatility of the TL has declined after the introduction of new instruments. Figure 9 shows that the answer is affirmative. The first broken line marks the beginning of the adoption of the ROM mechanism and the active use of the upper bound of the interest rate corridor (November 2011). The second shows the date of the last FX intervention. It is evident at first sight that the relative volatility of the Turkish lira has declined considerably compared to peer emerging-market currencies, despite the fact that the CBRT did not resort direct FX interventions after the beginning of 2012.

Implied kurtosis of the USD/TL exchange rate expectations* Figure 10



* The shaded area denotes the maximum and minimum kurtosis of FX expectations for 10 emerging economies with current account deficits.

Source: Değerli and Fendoğlu (2013)

Using distributions extracted from options prices, Değerli and Fendoğlu (2013) find that the implied volatility of the Turkish lira vis-à-vis the US dollar has declined considerably since the introduction of new policy instruments, compared to peer emerging-market currencies. More importantly, the relative kurtosis of the distribution has declined markedly since the implementation of the new policy mix in late 2010 (Figure 10). This result is important because the kurtosis of the distribution is somewhat related to the probability of a sudden stop. These observations suggests that the adoption of the new policy mix and the introduction of new instruments such as the asymmetric interest rate corridor and the ROM have considerably reduced the tail risks associated with sharp movements in exchange rates.

Summary and conclusions

Persisting volatility in cross-border financial flows and the increased emphasis on financial stability have once again shifted the focus to exchange rate movements across the globe. Historically, in this environment, direct FX interventions emerge as a natural policy tool. However, the evidence on the effectiveness of intervention is, at best, mixed. Interventions are costly and may entail undesired signaling effects. In this study, we have argued that new alternatives to FX interventions are worth exploring, as demonstrated by the Turkish experience. Recent evidence suggests that the new toolkit developed by the CBRT has so far been effective in reducing exchange rate volatility and tail risks without using FX interventions. As a consequence, the Turkish lira has been one of the least volatile currencies among emerging markets. These observations lend support to the view that new instruments such as an asymmetric interest rate corridor and the Reserve Option Mechanism have largely eased the need for direct intervention. Moreover, these instruments, by nature, have the potential to be more efficient and market-friendly than conventional interventions. All in all, we conclude that Turkish approach may offer an alternative way to deal with the post-crisis exchange rate volatility.

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Foreign exchange intervention by emerging market economies: issues and implications

Saif Hadef Al Shamsi[1]

Abstract

The UAE's Union Law 10 of 1980 stresses that one of the major tasks of the Central Bank of the United Arab Emirates is to "support the currency, maintain its stability and ensure its free convertibility into foreign currencies". In practice, this has translated into the adoption of a fixed dollar/dirham exchange rate, which essentially implies a passive approach to foreign exchange intervention. Liquidity is balanced through the use of tools such as Certificates of Deposit (CDs), both conventional and Islamic, as well as dollar/dirham swaps. These tools help to sterilise excess liquidity and to provide liquidity during times of market stress. Recent experiences and challenges suggest that these tools have served the UAE well, but as debt and trade flows enlarge, a more proactive approach may be required in regulating liquidity within the UAE financial system.

Keywords: monetary policy, central banking, the supply of money and credit

JEL classification: E5

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The topic for discussion for this meeting is "FX intervention by Emerging Market Economies: Issues and Implications". At the Central Bank of the UAE, we do not intervene in FX markets in a direct and active manner. Therefore, we thought that it would not be advisable for us to fill in the tables that were sent to us by the BIS, as the data we fill in could give the readers an incorrect impression that we intervene in markets in a conventional way, whereas we have a different approach to the subject. This short paper is an effort to present that approach in a short and concise way.

The UAE's Union Law 10 of 1980, which established the Central Bank of the UAE (CBUAE), stresses that one of the major tasks of the CBUAE, is "to support the currency, maintain its stability internally and externally, and ensure its free convertibility into foreign currencies".

The UAE dirham was launched in 1973 and has been pegged to the US dollar since 1980. The resultant stability of the dirham that has followed from the fixed exchange rate has served the UAE economy well – a fact which has been noted by the International Monetary Fund.

Indeed, reducing currency risk has benefited the UAE's open economy, which has gained from its geo-strategic location between the East and the West. This locational advantage has been further enhanced by the modern infrastructure that has been built in the country, making the UAE an important travel and logistics hub.

The commitment that the country and its monetary authority have shown to the fixed peg regime has enhanced business continuity and stability. Meanwhile, the Central Bank of the UAE has followed a passive but highly effective policy in preserving the peg. We fully recognize that in a pegged regime the market cannot have an iota of doubt over the central bank's commitment to the exchange rate policy.

It is to back this commitment that we are always on either side of the market during our working hours. Therefore, any bank licensed by the CBUAE and operating in the country can approach the CBUAE to buy/sell the dirham, without any limit, at the exchange rate of 3.6720 to 3.6730 dirhams per US dollar. This is our bid/offer spread, and we are committed to it during our business hours.

The narrowness of the peg has had its consequences in the form of limiting FX market activity, ***but it has been highly effective in maintaining FX stability and balancing market liquidity***. It is not the policy of the CBUAE to actively intervene in markets, but given our policy stance, we are available for market players to access the dollar/dirham window throughout the day.

The government in the UAE is the major supplier of dollars, since the UAE is an oil producing country and oil exports are denominated in US dollars. It has also been noticed that at times of market stress, as has been the case with recent bouts of the European debt crisis, the appetite for dollars goes up when dollar supply from the global interbank market dries up.

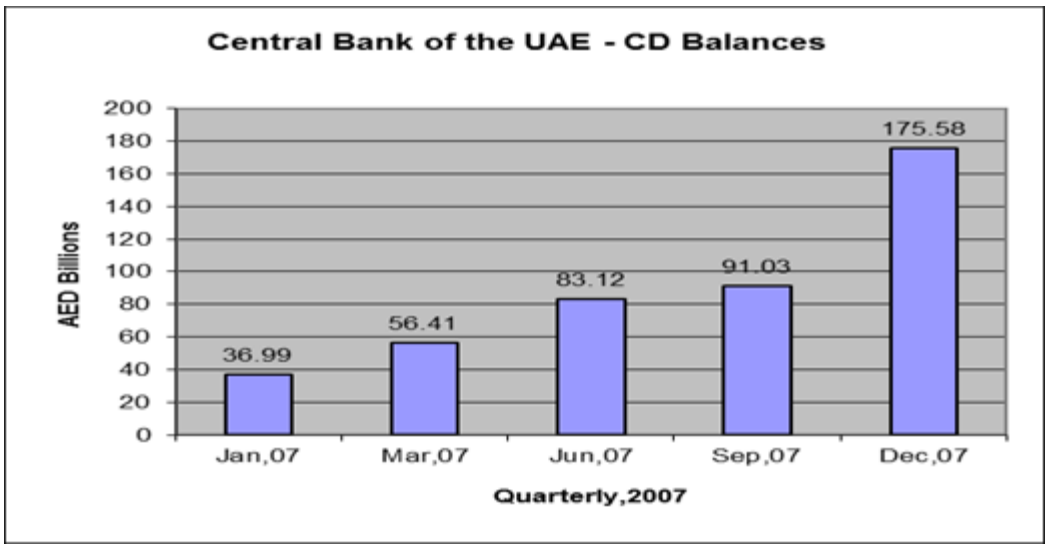
The need to provide an almost unlimited amount of US dollars to back up any demand against the UAE dirham is therefore a major monetary policy goal. Hence, the focus of our reserves management strategy is on liquidity and capital preservation.

Apart from the dollar/dirham window, we offer banks the ability to manage their dirham liquidity via two other programs – the dollar/dirham swaps and the Certificate of Deposit (CD) program. Both these programs have been in place for a

long period, although they have undergone significant changes in their scope and execution over time.

The dollar/dirham swap was a limited program till December 2008, but since then it has been expanded in terms of eligibility, tenor and amounts.

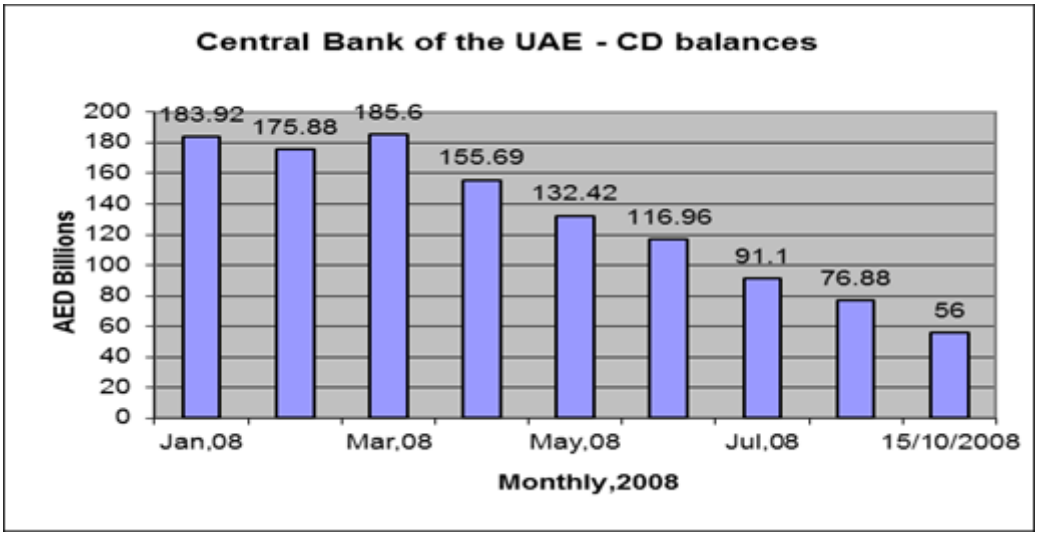
Outstanding CDs at the CBUAE – 2007 Figure 1.1



Source: Central Bank of the UAE

Similarly, our CDs program was reviewed in 2007 as a result of the speculation on dirham revaluation during the years 2007–2008. This was a time when fiscal policy was very expansionary in the UAE, and high GDP growth, with rising inflation, led the market to speculate on a dirham revaluation against the dollar. These flows were, to a great extent, sterilized via the CDs program (see Figures 1.1 and 1.2).

Outstanding CDs at the CBUAE – 2008 Figure 1.2



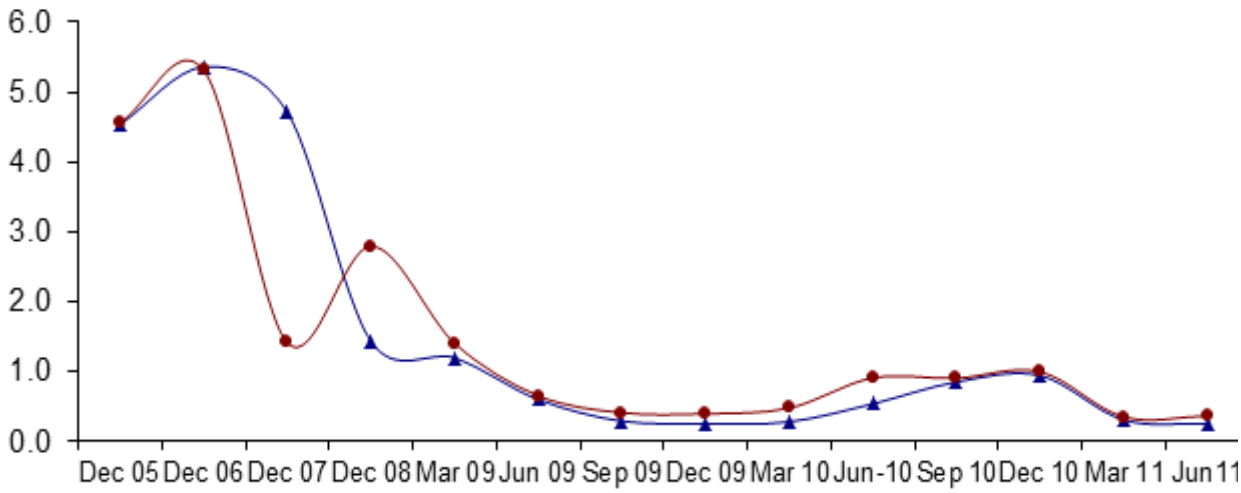
Source: Central Bank of the UAE

These large flows led us to readjust the CDs program from a passive program, where issuance was up to the banks, to an auction-based program where the cut-off rates would be decided by the CBUAE. Previously, CDs were issued at fixed rates closely aligned to the US Libor rates. Consequent on the adjustment, the new rates were gradually aligned with rates prevailing in the domestic interbank dirham market and those derived from the dollar/dirham swap curve. As a result, the coupons paid on CDs collapsed from around 4.5% to close to 1%, in line with the prevailing market rates, both in the deposit market and forward markets, at that time.

The changes had their impact on the inflows, which peaked in early 2008 and gradually reversed over time, till the CD rates, dirham swap implied rates and dollar Libor all came in line over the course of time (Figure 2).

The CDs program has been a very useful tool for sterilizing market liquidity. The outstanding amount of CDs has always risen or fallen in line with market liquidity. The CDs program has also been able to add to market liquidity at times of shortages, as banks can borrow both dirhams and dollars via CD repos at very reasonable rates for periods varying from overnight to 3 months.

AED swap implied rates and Libor rates — Figure 2



Source: Bloomberg and Central Bank of the UAE

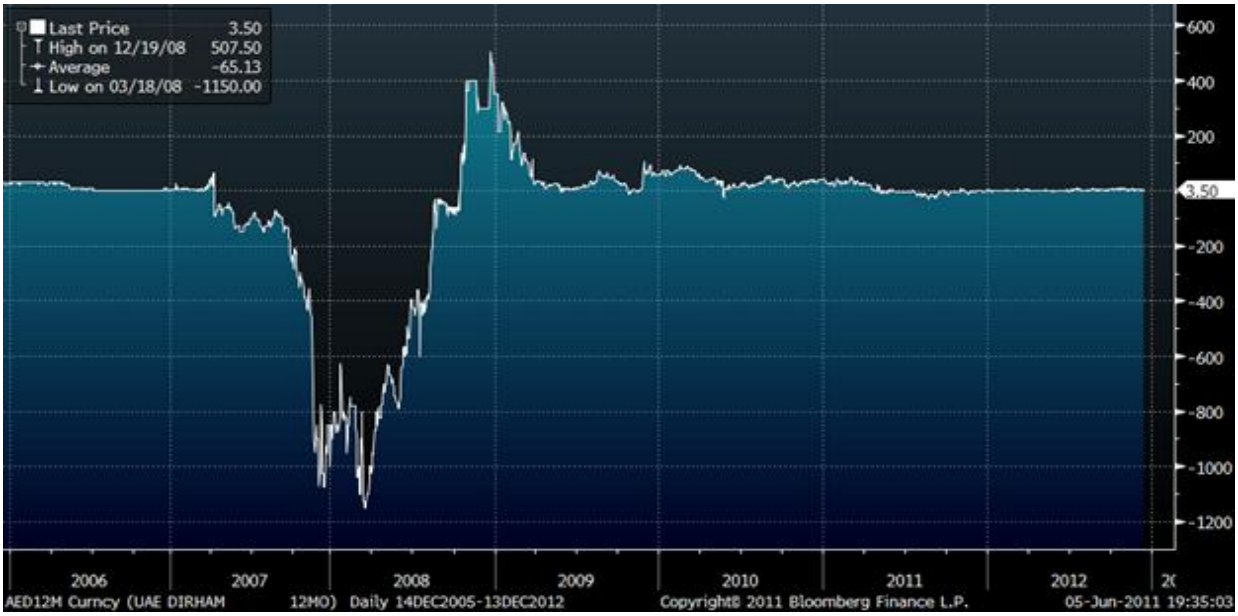
The narrow band of FX volatility in both spot and 12-month forward markets (Figure 3 below) has largely resulted from the commitment of the CBUAE to buy and sell unlimited amounts of USD, spot as well as forward, at the pegged rate during the official working hours of the Central Bank.

Figure 3 shows large variations in the 12-month USD/AED forward rates during the 2007/2008 period – this was the time when there was speculation on dirham revaluation and during this period money market rates diverged from the Central Bank's CDs rates. From March 2008, forward rates surged higher as the global crisis began and local banks, trying to fund their dollar assets, now pushed the rates in the opposite direction. This is when we introduced dollar funding (against CD

collateral) and expanded the dollar swap program, which normalized the forward curve to its natural levels.

USD/AED 12-month forwards

Figure 3



Source: Bloomberg

But inevitably, as markets grow and debt and trade flows enlarge, we will need to be more proactive in regulating liquidity within the financial system. To provide an enabling environment to encourage banks to buy UAE government securities, the CBUAE will be launching a discount window facility called the Marginal Lending Facility (MLF) in the next 18–24 months.

Through the MLF, banks will be able to borrow intra-day and overnight funds to tide them over sudden short term liquidity shortfalls. Currently, there is a lack of eligible government securities, but it is to be hoped that over time we will be able to redress this situation.

It is our understanding that the pegged exchange rate regime guarantees the stability of the UAE economy and has served our interests well in the past. Hence, we intend to continue with the pegged regime, but are moving towards creating an infrastructure which further strengthens our monetary policy environment. This will involve closer monitoring of liquidity within the banking system and provide support in events of excesses or shortages of liquidity. Naturally, events of shortages are more devastating than periods of excess. With the benefit of hindsight, however, one can say that both shortages and excesses have negative fallout and central banks should guard against them by closely regulating liquidity within the banking system.

Foreign exchange intervention in emerging market economies: lessons, issues and implications for central banks*

Miguel Pesce[1]

Abstract

In the wake of the Lehman crisis, intervention in the foreign exchange market has been a topic of increasing relevance in central banking, particularly for small and medium open economies like Argentina. This has implied a change in focus to deal with some problems arising from the combination of the international financial crisis and the monetary policies implemented by developed countries. Therefore, the policies implemented by EMEs to cope with the crisis have included direct central bank intervention in the foreign exchange market, either in the spot or in the forward market, the build-up of international reserves, the adoption of administered floating exchange rate regimes and the regulation of capital inflows and outflows. Argentina followed those policy guidelines well before the crisis erupted, allowing it to reduce nominal exchange rate volatility and maintaining monetary stability.

Keywords: central banks and their policies, foreign exchange, current account adjustment, short-term capital movements

JEL classification: E58, F31, F32

* Note added in January 2014.

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1. In recent decades, intervention in the foreign exchange market has been a topic of increasing relevance in central banking. The economic and monetary authorities, in particular that of many small and medium open economies, have pointed out that the combination of the international financial crisis and the monetary policies implemented by developed countries sparks negative spillovers to their economies. In order to cope with this situation, they have had to implement different policies. Considering the financial and economic structure of the economy, those policies included direct central bank intervention in the foreign exchange market, either in the spot or in the forward market, the building-up of international reserves and the regulation of capital inflows and outflows. It is worth noting that central banks of some industrialized countries have been implementing aggressive policies of FX intervention, for example the Swiss National Bank and the Bank of Japan. I will address some of these issues, referring specifically to the Argentine case.

2. During the convertibility plan, Argentina followed a passive monetary policy in which the central bank had to convert foreign currencies into pesos – or the other way round – at a fixed rate. In that situation, the Central Bank of Argentina (BCRA) played the role of the currency board and its foreign exchange policy was totally reoriented towards that goal. When convertibility collapsed in 2001–02, the monetary authority had to establish a new regime: an administered floating exchange rate. Bearing in mind the setbacks of the previous regime, the main goals of the policy were to set up an environment of sustainable growth while trying to avoid the recurrent balance of payments crisis. Since then, the main reasons and motivations behind forex market intervention in Argentina have been the same, according to the following order of importance: (1) to reduce nominal exchange rate volatility, (2) to build up foreign exchange reserves as self-insurance against either external or domestic shocks, (3) to maintain monetary stability, and (4) to avoid domestic asset appreciation. We will see these motivations in more detail below.

3. First, there are some structural and economic reasons why to control the volatility of the foreign exchange market. In economies like Argentina, controlling the volatility of the nominal exchange rate is important because short-term exchange rate changes tend to affect consumption and investment decisions and, for this reason, the central bank's interventions are geared towards both preventing and reducing nominal volatility that goes beyond economic fundamentals. In addition, in dollarized countries, like many emerging market economies (EMEs), controlling the volatility of the exchange rate is also important given the repeated experiences of financial sector crises triggered by balance of payments collapses (usual stop-and-go cycles).

Second, the policy of reserve accumulation followed by many emerging countries is better understood in the context of an international financial framework that has been characterized by the lack of an international lender of last resort with unconditional credit lines which can be quickly disbursed when they are most needed. Sudden short-term capital reversals that occurred especially after the Lehman crisis have proven the appropriateness of this policy. Argentina and other EMEs were able to face the worst of the crisis, among other things, in terms of economic activity by reducing the volatility of the exchange rate using "precautionary" international reserves.

Third, in countries such as Argentina, with strong links between nominal exchange rate movements and domestic inflation, high levels of exchange rate volatility tend also to be an amplifier of domestic inflation. This feature has higher

importance in developing countries than in industrialized ones. This has been seen during the last cycle of increasing commodity prices –particularly agricultural ones.

Fourth, it has been seen that the tendency of domestic assets' real appreciation has been a factor with negative consequences for the level of domestic activity and employment, especially in export- oriented production sectors. High levels of unemployment combined with unequal wealth distribution are worsened by appreciation phenomena.

4. As I mentioned, for different reasons some EMEs show a certain degree of dollarization of their economies. For example, economic agents prefer to keep their savings in foreign currency, and commercial banks are being allowed to raise deposits in foreign currency and furnish loans in a currency other than the domestic legal tender. As shown in different financial crises, such a preference for foreign currency represents a point of vulnerability of the financial system in case of capital outflows, and a challenge to central bank policies. In fact, under those conditions a negative shock can increase the liquidity and solvency risks when banks have currency mismatches affecting their profitability and, therefore, their levels of solvency. Because of this, policy makers have to incorporate the restrictions that arise from this feature when implementing monetary and exchange rate policies. For this reason, reducing exchange rate volatility and encouraging financial stability should be key goals of central bank policies.

5. The central bank and economic authorities introduced several measures and policies to regulate the FX market. Regarding currency mismatch, after the collapse in 2001 of the currency board regime, the BCRA implemented a number of policies in order to sharply reduce the likelihood of the problem. These measures included ones promoting a reduction in currency risk, e.g. capital requirements for currency mismatches, together with a regulatory framework establishing that deposits in dollars in local banks should only be used for loans in dollars, and dollar-denominated credit should only be granted when payment capacity of the debtor is linked to the dollar (e.g. tradable sector activities). This new framework reduces currency mismatch risk and has given the BCRA more freedom to intervene and buffer exchange rate volatility (see below).

The BCRA did not usually resort to forex derivatives for intervening in the FX market. One of the reasons preventing more frequent use of forex derivatives is the low level of traded volume which, in part, is a consequence of the small size of the Argentine capital market. However, the central bank had used it when the stress in the FX market reached an extremely high level.

6. Another way of regulating foreign exchange markets in EMEs has been the introduction of measures to discourage short-term capital inflows and mitigate sudden outflows. In order to diminish the negative effects of short-term capital flows, Argentina has successfully taken a series of measures to directly or indirectly deal with this problem. Since mid-2005, the economic authorities have implemented measures oriented towards regulating and discouraging short-term capital flows. New financial borrowing traded in the domestic foreign exchange market and rollovers of nonfinancial private sector and financial sector residents' external liabilities must be made and kept within the system for at least 365 consecutive days (in the first regulation, the term was 180 days). These loans cannot be paid before the maturity date, regardless of the settlement modality and whether or not that modality involves access to the domestic foreign exchange market. In addition, later when the economy was receiving an increasing amount of capital inflows, Executive Order 616/2005 and BCRA Communication A 4359 established a one-year

interest-free deposit equivalent to 30% of certain capital inflows (financial sector and nonfinancial private sector financial liabilities). This deposit basically applies to portfolio investments in secondary securities markets and foreign loans for investment in financial assets, and was aimed at reducing part of the yield of local assets acting as a dissuasion of short-term financial investments. There have been no other restrictions on FDI inflows and foreign financing of external trade operations (imports or exports).

Regarding capital outflows, currently there are practically no restrictions for residents to meet their commercial and financial obligations abroad. Amortizations and interests of foreign debts can be paid without any restriction at their maturity.

Non-residents can repatriate FDI. In the case of banking institutions, they require prior BCRA approval. For investments that took place after October 28th 2011, the funds that originated the investment must have been previously sold in the local FX market. Non-residents can also repatriate portfolio investments with a monthly limit of US$500,000 and must prove that the funds that originated the investment have been sold in the local FX market (the Single Free Exchange Market, MULC). There is no limit, for non-residents, to repatriate National Government debt services.

In the second part of 2012, considering the volatility and restrictions of the international situation and its probable effects on the domestic market, the Argentine government modified its system of foreign resource administration in order to ensure the availability of necessary foreign exchange so as not affect the imports required to maintain local production and to meet foreign obligations (including public and private financial debts). It was established that residents require prior central bank approval to access the MULC to buy foreign assets (foreign currency, portfolio investments and FDI).

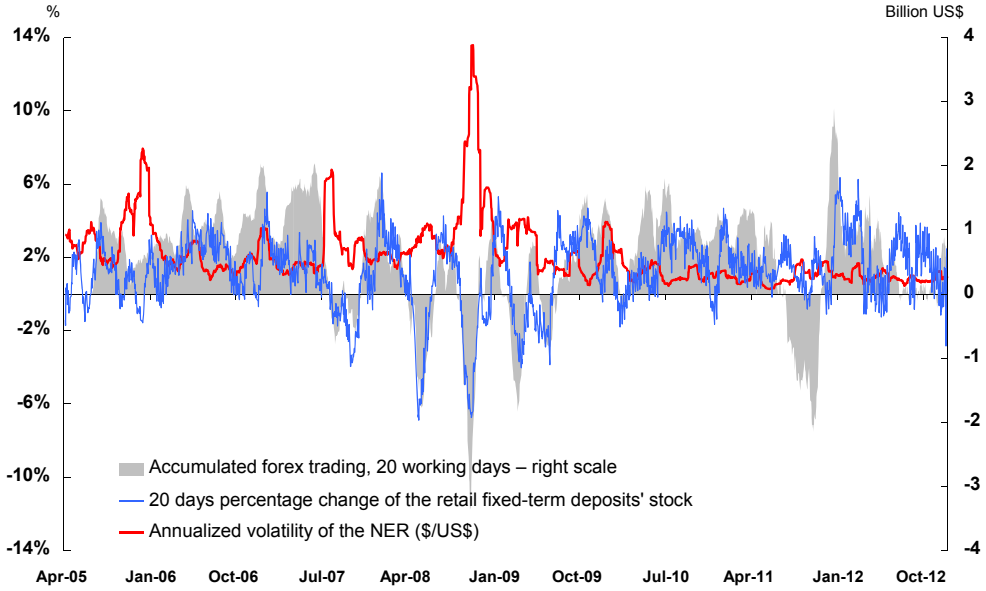
7. In relation to the previous policy measures implemented to regulate the FX market, it is important to stress two points. (1) Recently, the change of views about the rationality of capital regulation has been remarkable. Indeed, the IMF released an institutional paper ("The liberalization and management of capital flows: an institutional view", by Olivier Blanchard and Jonathan Ostry, November 2012) recognizing the important benefits that capital flows may bring, but at the same time cautioning about the risks. The paper also identifies conditions and situations where capital and prudential measures and regulations may be needed and appropriate to safeguard macroeconomic and financial stability in the face of sudden inflows, stops and reversals. In the paper, the authors acknowledge that full liberalization of the capital account may not be the right goal for all countries at all times. (2) All the measures implemented are in full accordance with the Articles of Agreement of the IMF, Article VI Capital Transfers, 3 Controls of Capital Transfers, which states that "Members may exercise such controls as are necessary to regulate international capital movements, but no member may exercise these controls in a manner which will restrict payments for current transactions or which will unduly delay transfers of funds in settlement of commitments, except as provided in Article VII, Section 3(b) and in Article XIV, Section 2."

8. Concerning particularly to central bank FX intervention, over the past decade, it has had positive results in terms of one of the main goals mentioned above, reducing exchange rate volatility. Since the end of the currency board regime and after the initial overshooting, the nominal exchange rate showed a fairly smooth trend that was reflected in a relatively stable level of intervention (central bank intervention in the MULC as a percentage of total trade averaged around 8%

in 2003–12). When the international financial crisis began, central banks of the developed countries implemented expansive monetary policies that have constantly affected capital flows across countries, especially from advanced economies to EMEs, and therefore their exchange rates (the adverse spillovers already mentioned). In the case of Argentina and due to its administered floating regime, the evolution and volatility of the exchange rate was not much altered by the international crisis, though the exchange rate has started a new steeper trend.

The fact that Argentina has intervened persistently in the FX market helped to anchor the exchange rate and to prevent temporary shocks that would have distorted relative prices. The reduction in the exchange rate volatility also helps to transfer certain stability to other monetary and financial variables, as can be seen in the relationship between retail fixed-term deposits and the exchange rate (Graph 1).

Exchange rate and retail fixed-term deposits' volatility — Graph 1



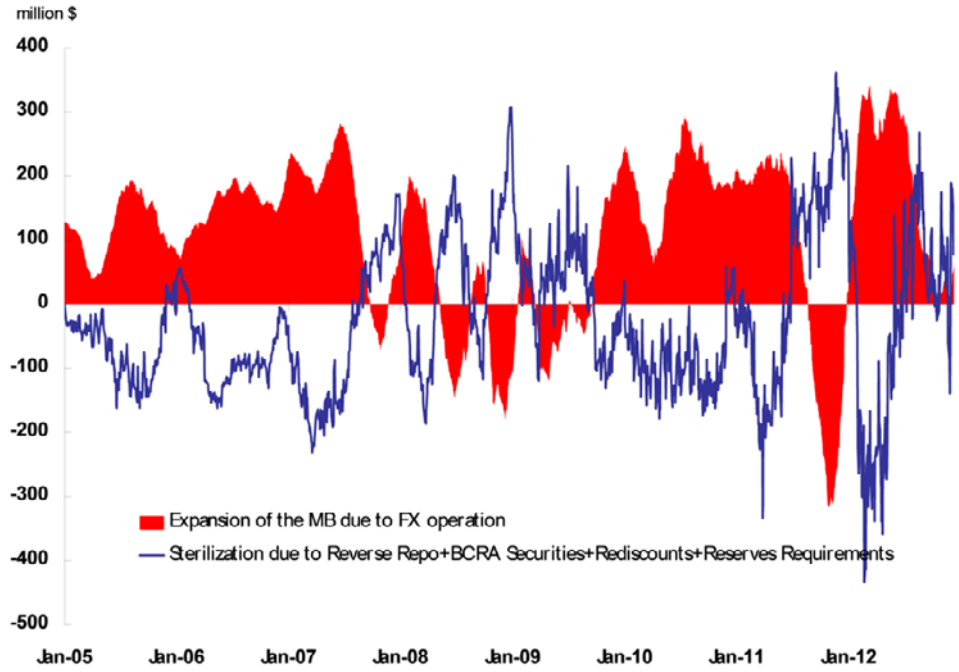
Source: BCRA.

9. The BCRA has combined the policies of international reserve accumulation and FX intervention with a control over monetary aggregate growth, so that the sustained growth recorded by external assets did not undermine the monetary market equilibrium. Thus, in order to control the endogenous expansion of monetary aggregates produced by the precautionary reserve accumulation policy, the BCRA used the sterilization instruments available and developed new ones: reverse repos, reserve requirements, redemptions of rediscounts, together with issuing BCRA bills and notes. In addition to pursuing monetary equilibrium, the sterilization of pesos issued to buy the reserves implied a policy to restrain the growth in domestic demand that would have been triggered by the higher monetary aggregates and lower interest rates (Graph 2). We can also say that obtaining continuous trade surpluses implies that domestic absorption by definition has always been below the national income.

It is important to mention that the reserve accumulation strategy was a significant counter-cyclical policy tool that cushioned the effects of shifts in short-term financial flows over the economic cycle, bringing down volatility in FX and domestic financial markets. It is also necessary to stress international reserves' positive qualities of automatic and immediate availability to stabilize monetary and financial markets. In spite of some supposed financial costs of that policy, given the fall in aggregate demand in industrialized countries, including their imports from EMEs, having had sufficient reserves, among other factors like a sound fiscal stance, allowed these countries to actively support their domestic economies.

Sterilization of FX Operations

3 month moving average — Graph 2



According to the BIS, "previous research showed that intervention can have a greater influence on exchange rates in EMEs than in advanced economies partly because of the relatively low substitutability of EM assets". Regarding the Argentine economy, the low level of financial integration and high risk premia has revealed the lack of substitutability of its assets. In this context, FX market microstructure is a key factor to determine the effectiveness of intervention. Whether the market presents some imperfections, such as asymmetrical information, clustering or the existence of black markets, the equilibrium of this market is bound to these factors of uncontrollable nature (in principle) of the monetary authority. However, despite these imperfections the intervention has been successful, precisely due to the low substitutability of EME assets.

10. Reasons for adopting an exchange rate managed float regime: Considering the experience of the currency board in Argentina during the convertibility regime, when the peso was pegged one to one to the US dollar, the adoption of a regime of greater exchange rate flexibility, with less FX market intervention by the central bank, has been controversial. We believe that kind of regime would have few positive effects and many possible disruptive ones on the development of local

financial markets, on the ability of domestic firms to manage forex risks, and on growth rates and macroeconomic volatility. This is so because, as already mentioned, greater exchange rate flexibility in a partially dollarized economy might give rise to more inflation, together with disruptive effects on the whole economy that would lessen economic growth. Furthermore, it is considered that if central banks do not intervene to soften FX volatility, this could entail expensive movements in the allocation of productive factors resulting from temporary distortions in relative prices between tradable and non-tradable goods.[2]

As regards the main challenges of pursuing monetary and exchange rate objectives at the same time, some inconsistencies might arise, especially in EMEs if their economic authorities try to achieve both goals with only one tool, usually the interest rate. This is the case because the interest rate is the usual instrument of monetary policy for dealing with adverse effects from capital inflows related to excessive domestic demand growth. However, it may not be a useful instrument in countries with weak monetary transmission mechanisms given that an increase in the interest rate in these countries would promote growing capital inflows, worsening the problems that need to be prevented. In the latter case and to achieve both objectives, it is adequate to follow policies based on a managed floating regime and the accumulation of international reserves together with the sterilization of the impact on the monetary base of those transactions in the foreign exchange market. This need to be combined with the use of macroprudential tools, as the BCRA has been doing during the last decade.

[2] As mentioned by the US Secretary of State in 1971, "The dollar is our currency but your problem", meaning that the side effects of dollar volatility are a problem that the rest of the world has to deal with (blogs.ft.com/maverecon/2007/11/our-currency-anhtml/#axzz2BZ3sn5CQ).

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