BANK FOR INTERNATIONAL SETTLEMENTS

BIS Papers

No 78

The transmission of unconventional monetary policy to the emerging markets

Monetary and Economic Department

August 2014

JEL classification: E52, F31, F42, G12, G15

Papers in this volume were prepared for a meeting of senior officials from central banks held at the Bank for International Settlements on 6–7 March 2014. The views expressed are those of the authors and do not necessarily reflect the views of the BIS or the central banks represented at the meeting. Individual papers (or excerpts thereof) may be reproduced or translated with the authorisation of the authors concerned.

This publication is available on the BIS website (www.bis.org).

ISSN 1609-0381 (print)
ISBN 92-9131-566-6 (print)

ISSN 1682-7651 (online)
ISBN 92-9197-567-3 (online)

Contents

BIS background papers

Contributed papers

The transmission of unconventional monetary policy to the emerging markets

An overview

M S Mohanty[1]

Highly accommodative monetary policies in the major advanced economies and the questions about the exit from such policies have created major challenges for policymakers in emerging market economies (EMEs). Quite a few of EMEs that experienced rapid capital inflows and strong currency appreciation pressures during 2010-12 saw a sharp reversal in episodes of market volatility from May 2013 to February 2014.

This meeting of Deputy Governors focussed on three main questions: (i) How can external monetary conditions become a source of risks to monetary and financial stability in EMEs? (ii) How should central banks respond to such shocks? (iii) And, can there be a greater international role of emerging market currencies? A key conclusion from the discussion is that asset prices and interest rates have become more correlated globally during the period of unprecedented monetary easing by advanced economies. The risk of abrupt reversal of capital inflows to EMEs was a major worry. Central banks face difficult policy dilemmas in preserving financial stability while achieving their monetary policy goals. It is hard for EME monetary authorities to counter a prolonged period of very low long-term interest rates and increased risk-taking in global financial markets.

Keywords: Monetary policy, international spillover, emerging market economies, capital flows, exchange rate, long term interest rates.

JEL classification: E52, F31, F42, G12, G15

1 This overview draws on the response of central banks to a BIS survey questionnaire conducted for this meeting as well as their notes and many valuable suggestions and feedback. I am thankful to Claudio Borio, Blaise Gadanecz, Guonan Ma, Ken Miyajima, Előd Takáts, Philip Turner, Agustin Villar and Abraham Vela for comments and contributions.

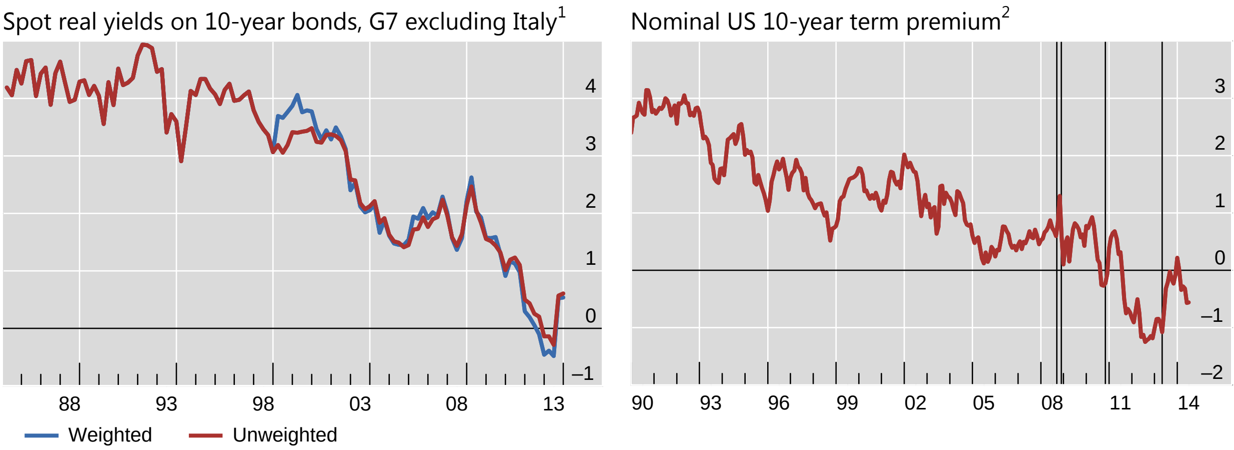
Highly accommodative monetary policies in the major advanced economies and questions about the exit from such policies have created major challenges for policymakers in emerging market economies (EMEs). Quite a few of EMEs that experienced rapid capital inflows and strong currency appreciation pressures during 2010–12 saw sharp reversals in a new phase of market volatility that started in May 2013.

This topic was discussed by the Deputy Governors from major EMEs when they convened in Basel on 6–7 March 2014. The meeting focussed on three major issues:

- First, how do external monetary conditions influence the economy? Could they become a source of risk for monetary and financial stability in EMEs?[2]
- Second, how should central banks respond to such shocks?
- Third, can there be a greater international role of emerging market currencies? Foreign investors' holdings of EME equities and bonds have risen rapidly over the past decade.

World real long term interest rates

In per cent | Graph 1



Vertical lines indicate bankruptcy of Lehman Brothers on 15 September 2008, Federal Reserve announcements of quantitative easing on 25 November 2008 and 3 November 2010 and FOMC hint on tapering on 1 May 2013.

[1] Quarterly data calculated by M King and D Low in "Measuring the "World" Real Interest Rate", *NBER Working Paper*, no 19887. [2] Sum of inflation and real yield risk premia. These are calculated using the BIS term structure model ((see Hordahl and Tristani (2012).

Sources: BIS calculations and King and Low (2013).

Current monetary policy dilemmas have been accentuated by developments in global long-term interest rates. After trending down for much of the past two decades, the world real long-term interest rates became negative in 2013 – a development associated with sharp declines in the US term premium (Graph 1). The decline in the US term premium in the early 2000s has promoted a debate on how various policies influence the long-term rate *given expectations of future short-term rates*. The discussion was much dominated by the reverse spillover effects of large-scale accumulation of dollar bonds by EMEs on US Treasury yields, as part of the

[2] For recent reviews on international financial spillovers, see Gagnon et al (2011), Caruana (2012), Chen et al (2012), IMF (2013a, 2013b), and He and McCauley (2013).

strategy to intervene in the foreign exchange market. Since 2009, however, the US term premium has come to be influenced considerably by the Federal Reserve's bond purchase programmes. Questions therefore arise as to whether greater exchange rate flexibility would by itself be enough to insulate domestic monetary conditions. It is hard for EME monetary authorities to counter very low long term interest rates in global markets and increased risk-taking encouraged by G3 monetary policy.[3]

One main conclusion emerging from the discussion is that interest rates and asset prices have become increasingly correlated globally during the period of unprecedented monetary easing by the major advanced economies. Both the short- and long-term interest rates of EMEs have been highly influenced by those in the advanced economies, particularly the United States. Allowing the currencies to adjust can reduce speculative capital inflows to EMEs, but is unlikely to deter risk-taking by investors. There was a concern that many foreign investors preferred to take unhedged foreign exchange exposures while investing in EM local currency bonds. When sentiment changes, there is a sudden and simultaneous fall in the exchange rate and the bond market. At the same time, EME non-financial corporations have sharply increased their foreign currency borrowing in the international bond markets, magnifying financial stability risks in some countries.

The discussion on policy responses revealed the difficult dilemmas EME central banks face in preserving financial stability while achieving their monetary policy goals. One view was that anchoring inflation expectations require a credible floating exchange rate regime. Another view pointed to the limits to exchange rate and interest rate flexibility in the face of swings in capital flows. Rather, central banks need several instruments to reduce the risk of monetary and financial instability.

Some participants argued in favour of restricting excessive exchange rate volatility through foreign exchange intervention. There was also some support for efforts to manage long-term interest rates. Some argued that central banks may be required to act as market-maker of last resort in times of extreme stress in debt and foreign exchange markets. But such intervention would also expose central banks to new risks, which could adversely affect their credibility when seeking to control inflation. There was a general view that macroprudential instruments are useful in addressing financial stability risks arising from international spillovers. But they are unlikely to replace interest rate policy as the principal tool for managing aggregate demand.

Finally, the Deputy Governors agreed that greater foreign holdings of EME local currency assets are a positive development, enhancing the international status of EME currencies and reducing currency mismatches. Yet the recent trend needs to be seen with caution. If much of the increased foreign holdings of EME local currency debt and equity have been driven by low interest rates in the advanced economies, EMEs may face sudden reversals once expectations of higher interest rates take root.

Given the growing weight of EMEs in global output and trade and the increased depth of their financial markets, a number of EM currencies may become more actively traded in the global markets in future. But only a few (eg the renminbi) have the potential to become major international currencies. Not only do network effects

[3] See Bruno and Shin (2012), Rey (2013), Rajan (2014), Turner (2014a).

play a strong role in the international status of a currency, as in the case of the US dollar, but foreign investors must also be able and willing to lend and borrow in that currency. The volatility of returns from EME local currency portfolios is potentially lower when foreign investors are allowed to borrow in these currencies. In many EMEs (particularly China) restrictions that deter non-residents from borrowing in the domestic currency continue to hinder an international role for these currencies.

The rest of this overview attempts to provide a brief summary of the main points, drawing on the recent facts, central banks' response to a BIS survey questionnaire, the notes prepared for the meeting as well as the discussions at the meeting. The summary is organised along the three main themes identified in the agenda: (i) the channels of international monetary spillovers; (ii) policy responses to such spillovers; and (iii) the internationalisation of emerging market currencies.

1. Channels of international spillovers

The monetary policy of the advanced economies can affect EMEs through several channels, including capital flows, asset prices and the interest rate-setting behaviour of the central bank more broadly. The BIS background paper by Takáts and Vela ("International monetary policy transmission") distinguishes five stylised spillover effects, although these naturally interact closely: (i) the exchange rate; (ii) the policy rate; (iii) long-term interest rates; (iv)international bank lending; and (v) portfolio flows.[4]

In open economies, the most obvious channel of transmission for external monetary conditions is the **exchange rate**. When the exchange rate floats, all else equal, a fall in the foreign interest rate leads to an appreciation of the domestic currency. Asset purchases by major central banks, which drive down interest rates along the yield curve, have a similar effect.

The role of the exchange rate depends, of course, on how flexible it is in practice. Takáts and Vela show that, although the real exchange rates of most EMEs have appreciated over the past decade, such appreciations have been small and have tended to reverse in the absence of significant changes in interest rate differentials.

Nominal exchange rate developments – the main source of changes in their real counterpart – have naturally behaved in a similar way. To focus attention on recent years, Table 1 shows changes in the nominal effective exchange rates in major EMEs following the May 2013 Fed tapering announcement that it would at some future date reduce its asset purchases. This announcement was accompanied by strong indications for the Federal Reserve that policy rates would be kept very low. Even before the tapering news, the exchange rates of several EMEs actually depreciated during 2010-April 2013. Nominal appreciations have been relatively modest during capital inflow episodes. Exchange rate volatility was high (relative to that of advanced economies) in both periods and has increased in some cases since May 2013.

[4] See Caruana (2012) for a similar classification and framework for considering spillovers.

Nominal effective exchange rate of emerging markets

Table 1

	January 2010–April 2013		May 2013–August 2014[1]	
	% change	Standard deviation[2]	% change	Standard deviation[2]
China	13.0	1.00	0.3	1.01
India	–15.1	1.66	–9.8	2.26
Indonesia	–7.1	0.92	–15.8	2.74
Korea	0.8	1.56	9.1	1.36
Other emerging Asia[3]	10.6	0.95	–3.4	1.06
Brazil	–7.3	2.24	–5.6	2.86
Mexico	5.0	2.14	–6.5	1.54
Chile	7.6	1.83	–14.4	1.52
Other Latin America[4]	–11.0	3.02	–8.4	1.60
Poland	–5.3	2.09	1.7	0.90
Hungary	–13.2	2.32	–5.4	1.27
Czech Republic	–2.6	1.56	–5.1	1.41
Turkey	–14.3	1.96	–15.6	2.42
South Africa	–16.3	2.36	–12.9	2.33
Euro area	*–7.8*	*1.5*	*4.1*	*0.8*
United States	*–0.5*	*1.2*	*2.1*	*0.6*

[1] As of 7 August 2014. [2] Standard deviation over the specified period based on percentage change in monthly average exchange rate. [3] Simple average of Malaysia, Philippines, Singapore and Thailand. [4] Simple average of Argentina, Colombia, Peru and Venezuela.

Source: BIS calculations.

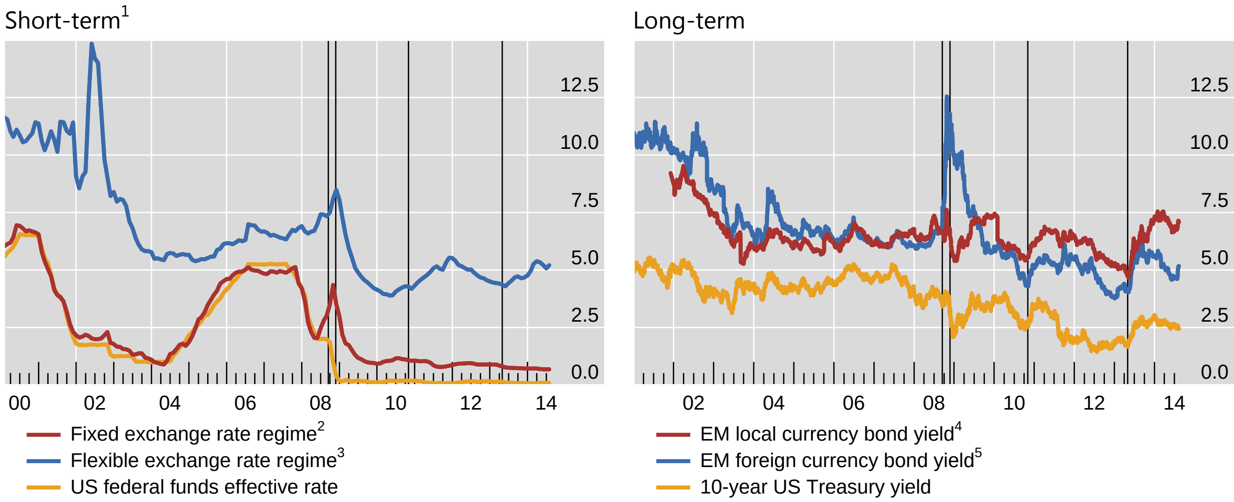
A second effect operates through the **policy interest rate**: EME central banks may directly respond to actual or imminent changes in advanced economy policy rates by changing their own policy rates. Taylor (2013) argues that EMEs may follow advanced economies in lowering rates because currency appreciation has an immediate negative effect on output, while the favourable trade effect from higher growth in advanced economies comes with a lag. Other considerations may also play a role. These include avoiding long-term damage to trade competitiveness from sustained currency appreciation, preventing perceived "overshooting" of the exchange rate, and reducing the incentive for firms to take on dollar debt during periods of low global interest rates.

Graph 2 illustrates this point. The left-hand panel shows that average policy rates in economies with fixed exchange rates have moved very closely with the federal funds rate, as one would expect. But notwithstanding their different monetary regimes, this tendency is also apparent in economies with a flexible exchange rate, particularly following the 2008 crisis. It was only in May 2013 that policy rates in this group of countries started to diverge from the federal funds rate, as many EME central banks tightened monetary policy in the wake of a sharp rise in market volatility.

Of course, part of this co-movement may reflect the high degree of convergence in business cycles across economies. But many recent studies find that short-term policy rates in EMEs have been lower than standard benchmarks such as the Taylor rule[5]. They have also been lower than output growth over a longer horizon. This tendency is confirmed in the BIS background paper by Takáts and Vela, who find that the US policy rate has been a statistically significant determinant of the policy rate in most, if not all, EMEs over the past decade.

Interest rates

In per cent — Graph 2



Vertical lines indicate bankruptcy of Lehman Brothers on 15 September 2008, Federal Reserve announcements of quantitative easing on 25 November 2008 and 3 November 2010 and FOMC hint on tapering on 1 May 2013.

[1] Three-month Treasury bill yield for Algeria, three-month interbank rates otherwise. [2] Simple average of Hong Kong SAR, Saudi Arabia and the United Arab Emirates. [3] Simple average of Algeria, Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Singapore, South Africa, Thailand and Turkey. [4] JPMorgan Government Bond Index – Emerging Markets (GBI-EM), 7–10 years. [5] JPMorgan Emerging Market Bond Index (EMBI), 7–10 years.

Sources: Bloomberg; Datastream; JPMorgan; national data.

A third spillover effect works through **long-term interest rates**. The US long-term rate affect both the global benchmark yield and risk appetite, which together determine the pricing of bonds issued by EMEs in local and international markets. Thus, given the growing presence of foreign investors in the EME local currency bond markets, the monetary policy of the advanced economies is likely to have a larger effect on EME yield curves than in the early 2000s.

The right-hand panel of Graph 2 shows a significant positive correlation between US and EME long-term yields. Between mid-June 2009 and end-April 2013, while the US 10-year Treasury yield fell by about 206 basis points, EM local currency bond yields declined by 236 basis points. The decline in the yield was more rapid for EME foreign currency bonds (341 basis points). However, between end-April 2013 and end January 2014 while the US long-term yield rose by about 97 basis points, EME local currency bond yields jumped by 268 basis points, exacerbating the tightening of financing conditions induced by the Federal Reserve's tapering announcement. By comparison, the rise in the EME foreign currency yields has been

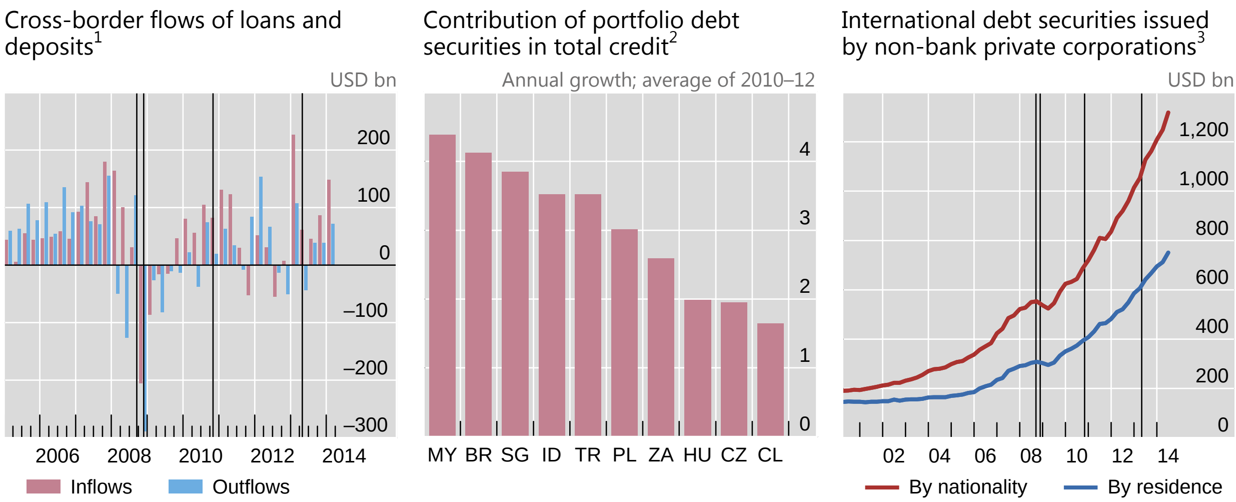
[5] See, for example, Hofmann and Bogdanova (2012).

modest (172 basis points). The yields on both types of bonds have since stabilised at a higher level.

The fourth and fifth spillover effects work through **cross-border bank lending** and portfolio flows (or **market risk-taking**), which can be grouped under a single "capital flows" effect. As the left-hand panel of Graph 3 shows, cross-border bank lending played a major role during 2000–07, accounting for a large part of gross capital flows to and from EMEs. Subsequently, with international banks cutting down their assets following the 2008 crisis, cross-border bank lending has not only become very volatile but has also lost substantial ground to other capital flows. In many cases, its role has been taken over by portfolio flows.

Indeed, the value of aggregate cross-border bond and equity investment in EMEs increased from \$3.29 trillion at the end of 2007 to \$4.46 trillion at the end of 2012, according to the IMF's Coordinated Portfolio Investment Survey. The increase of more than \$1.17 trillion reflected both large gross capital inflows and a substantial appreciation of the value of the existing stock of assets. About 85% of the increase was in the form of debt (or \$994 billion), with a much smaller part (\$170 billion) in equity. These numbers suggest that cross-border debt investment has been a significant driver of credit growth in many EMEs. For instance, non-resident debt investment contributed 2–5% of the growth in total credit (private and public sector) in a number of EMEs during 2010–12 (Graph 3, centre panel).

Cross border flows, portfolio investment and debt securities of EMEs — Graph 3



Vertical lines indicate bankruptcy of Lehman Brothers on 15 September 2008, Federal Reserve announcements of quantitative easing on 25 November 2008 and 3 November 2010 and FOMC hint on tapering on 1 May 2013.

[1] Inflows (outflows) of developing countries are represented by estimated exchange rate-adjusted changes in assets (liabilities) of loans and deposits of all BIS reporting banks vis-à-vis developing countries. [2] Portfolio debt securities are non-resident investment in debt securities taken from derived liabilities of IMF CPIS. Total credit is sum of total credit to private non-financial sector and total debt securities issued by the general government. [3] Amount outstanding of international debt securities issued by non-bank private corporations in all maturities. Aggregate of Algeria, Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand, Turkey, the United Arab Emirates and Venezuela.

Sources: IMF, *Coordinated Portfolio Investment Survey*; BIS debt securities statistics; BIS locational banking statistics by residence; national data.

A key development over the past five years is the massive expansion of debt issuance by EME corporations in the international markets. The outstanding international debt of EME corporations based on the residency of the borrower (consistent with the BOP classification) has tripled since 2009, to about $750 billion by the second quarter of 2014 (blue line in Graph 2, right-hand panel). Even so, this number actually understates these firms' international bond issuance, as a large part of such fund-raising was undertaken through offshore affiliates. This is captured by the red line in the right-hand panel of Graph 3, which shows debt issuance by the borrower's nationality. On this measure, the outstanding international debt securities of EME corporations more than doubled between 2009 and the second quarter of 2014, to $1.32 trillion.[6]

Recent shifts in the size and composition of capital flows may have changed international spillovers in ways that increase EMEs' vulnerabilities. First, such borrowing may be highly procyclical, driven by the behaviour of a few large asset management firms that are major investors in EME bonds. To the extent that these firms adopt similar investment strategies ("herding"), they can contribute to amplifying asset price dynamics. Second, it is true that the increase in foreign investors' holdings of EME local currency bonds has helped to develop domestic bond markets and reduce some of the traditional vulnerability of EMEs. It has also exposed these investors to the exchange rate risk. At times of stress, sharp exchange rate depreciations may result in further selling pressure on EME markets.

Central bank views about the relative importance of different spillover effects

Table 2 summarises the responses of central banks to a BIS questionnaire on the main international monetary spillover effects. There is a significant convergence of views among central banks. According to the majority view, advanced economy monetary policy is transmitted to EMEs mainly through the policy rate, long-term interest rate, the exchange rate and portfolio flows, representing induced risk-taking. In fixed exchange rate regimes, the policy rate is obviously the most important factor. By contrast, most countries with a flexible exchange rate consider the exchange rate to be the main mechanism. In addition, a number of central banks suggest that the monetary policy of the advanced economies can affect commodity prices, international credit conditions and inflation expectations.

There is also some evidence that the relative importance has changed since the 2008 crisis. This is most evident in central banks' opinions about portfolio flows, with 87% of respondents (20 out of 23) viewing this as an important spillover variable following the May 2013 Fed tapering announcement compared to 83% during 2009–12 and about 70% before the 2008 crisis. Likewise, more central banks now consider the monetary policy of the advanced economies as having an influence on their domestic long-term interest rate than did before the 2008 crisis.

6 For a detailed analysis, see Turner (2014).

Main international monetary spillover transmission

Number of central banks considering them relevant for their economy (total 23) — Table 2

Transmission	Pre-2008 crisis		Post-2008 crisis		Post-Fed tapering announcement in May 2013	
	Fixed[1]	Flexible[2]	Fixed[1]	Flexible[2]	Fixed[1]	Flexible[2]
Policy rate	3	13	3	12	2	12
Long-term interest rate (bond yield)	2	11	2	15	2	15
Exchange rate	1	17	1	19	1	18
International bank lending (credit)	2	9	2	9	2	9
Portfolio flows[3]	2	14	2	17	2	18
Other[4]	0	5	0	6	0	6

[1] Economies under fixed exchange rate regime: Hong Kong SAR, Saudi Arabia and United Arab Emirates. [2] Economies under flexible exchange rate regimes. [3] Changes in the advanced economy monetary policy stance affect investors risk appetite and thereby their demand for emerging market assets. [4] Argentina, Colombia and Peru suggested the commodity price channel; Argentina also suggested the foreign growth of major trading partners; Mexico suggested international credit conditions; Philippines suggested inflation expectations.

Source: BIS questionnaire, September 2013.

A number of factors seem to condition the relative influence of these spillovers. The first is the degree of exchange rate flexibility. In Hong Kong SAR, given the currency board arrangement, short-term interest rates have historically been highly synchronised with the federal funds rate. As pointed out by the paper from the Hong Kong Monetary Authority in this volume, such synchronisation ensures the stability of the currency board regime. This is also true to some degree in Singapore, where the exchange rate serves as an intermediate target for monetary policy. As a result, three-month Singapore dollar rates have closely tracked three-month US dollar Libor, particularly since 2008 (see the paper from the Singapore Monetary Authority in this volume).

On the other hand, it appears that countries with a floating exchange rate have been able to set short-term rates relatively independently from the monetary policy of the advanced economies. Chile is an important example. As discussed by Claro and Opazo, in Chile short-term interest rates were only weakly correlated with those of the advanced economies during 2008–13. And domestic monetary conditions have been broadly consistent with those implied by the Taylor rule.

That said, in several cases, global factors, rather than local policy rates, seem to have influenced long-term interest rates most strongly. In Malaysia, a surge of capital inflows into the domestic bond market has led to a persistent flattening of the yield curve (see the paper by Singh). Likewise, the yield curve has steepened considerably following the Fed's tapering announcement. In Korea, as pointed out by the paper by Kim, the correlation between domestic and US long-term yields has jumped since 2008. In Poland, foreign portfolio inflows have led to a compression of long-term rates, although bond market volatility has fallen because of a growing base of stable non-resident investors (see Adam, Kozinski and Markun in this volume). The paper from Colombia shows that the nature of shock to the US long-term rate also matters in determining the spillover effect, particularly whether the shock is due to the expected path of future short-term rates or changes in the US term premium (see Guarin, Moreno and Vargas in this volume).

Yet another factor is the structure of the financial system. The paper from the Central Bank of Brazil argues that Brazil's deep derivatives market, combined with a high degree of capital account openness and exchange rate flexibility, has contributed to amplifying the impact of global shocks on the economy (see Barroso, Kohlscheen and Lima). In Brazil, capital flows have the strongest influence on asset prices and credit growth.[7]

Finally, a number of central bank notes suggest that country-specific factors play a crucial role in the transmission of global shocks. For instance, South Africa's high exposure to external monetary factors has been related to its large current account deficits and high degree of dependence on portfolio flows – a vulnerability it shares with Brazil and India (see the paper from the South African Reserve Bank). Likewise, Argentina's vulnerability stems from the strong correlation of commodity prices with the sovereign credit spread, which tends to amplify the effects of large external monetary shocks (see the paper by Pesce in this volume).[8]

The discussion at the meeting also highlighted the key importance of investor psychology in driving capital flows (the so called "psychological channel"). There was a view that macroeconomic factors cannot fully explain the very quick changes in investor sentiment that occurred after the Fed's first "tapering" announcement. Although there were no apparent shifts in EMEs' macroeconomic and external fundamentals, some investors and analysts chose to brand selected EMEs as the "fragile five". These psychological shifts reflected the familiar agency problem of "herding" by investors, so widely evident in the past financial crises.

There was a consensus that, in the current environment, push factors (ie those related to the advanced economies) are much stronger drivers of capital flows to EMEs than pull (ie domestic) factors. Global monetary conditions seem to determine the total amount of capital flows, while pull factors play a role only in allocating these flows across EMEs. This market differentiation across EMEs seems to have strengthened recently, especially since January. Nevertheless, both factors can interact in ways that can aggravate the impact of an adverse external shock, as demonstrated in recent months by substantial weakening of EMEs' growth prospects following the Fed's "tapering" announcement.

In many countries the relevant risks stem not so much from the volume of capital flows but from the specific high-risk borrowing and lending strategies adopted by the residents and non-residents alike. One source of that risk related to the large unhedged forex exposures undertaken by foreign investors through carry trades on EME debt and currency products. A second was the vulnerability that EME corporations incur when they take on dollar debt in the international debt market to finance local currency-denominated investments.

Some participants felt that EME corporations have accepted risks that they do not fully understand. One element is their exposure to potential currency mismatches. Covenants issued by affiliates of EME corporations in the process of

7 The Central Bank of Brazil points out that estimating the impact of international spillovers accurately depends on the construction of proper counterfactual scenarios (Barroso et al (2013)). Assuming that the US term spread would be higher by 150 basis points without Fed quantitative easing measures, a shock of that size would generate additional capital inflows to Brazil in the order of $100 billion, leading to large effects on the exchange rate, equity prices and credit flows.

8 Such spillovers also stem from the increasing role of EMEs in global growth both as producers and consumers of commodities.

debt issuance in offshore centres can affect the health of the parent companies. International debt obligations of EME firms have therefore the potential to create systemic risks which might go undetected for a long time. Serving to heighten these risks are the lack of sufficient information on the balance sheets of non-financial corporations and the unregulated nature of these liabilities.

The impact of future spillovers seems to be even harder to judge. Many participants expressed concern about asset prices: as the monetary policy of the advanced economies has started to determine domestic bond and equity prices, traditional pricing tools have lost their anchoring role, and asset prices are becoming increasingly dependent on expectations for the future path of US monetary policy. Thus, even apparently marginal changes to policy may have the potential to create large-scale market volatility.

2. Policy responses to international spillovers

How should EME policymakers respond to international spillovers? There is no unique answer to this question, and whatever approach is chosen will involve trade-offs. Allowing the exchange rate to appreciate is an option when aggregate demand is strong and inflation rises. But a very significant appreciation also carries risks. It can shift output from the tradable to the non-tradable sector.

One gambit could be active countercyclical fiscal measures, as suggested by Eichengreen (2013). Tightening fiscal policy in the face of rising capital inflows will dampen spending, reduce upward pressure on asset prices and put downward pressure on domestic interest rates. By reducing currency appreciation pressures, it could also increase the flexibility of monetary policy in responding to inflation. However, the required scale of fiscal adjustment is likely to be very high if the economy is to be stabilised in the face of strong swings in capital flows – and adjustments on this scale may not be realistic.

A second approach, consistent with the conventional view, is for the central bank to focus on limiting specific risks to the financial system by using macroprudential tools. These tools can be directed at areas/sectors exposed to greatest risks.

A third approach is to address the problem at its origin, by putting some restrictions on capital flows. In 2009, a BIS working group agreed that capital account measures could, "at least in the short run, help monetary policy by moderating the size or the volatility of inflows and by modifying their composition in favour of more stable flows" (CGFS (2009)). However, views about the effectiveness of capital flow management measures vary widely. And, these measures are not without costs, particularly as they have the potential to increase financial intermediation costs as well as reduce efficiency.

Table 3 reports central bank responses to two specific questions: what foreign factors have had important implications for the economy and the financial system? What role did these factors play in monetary policy?

Foreign factors influencing domestic economy and monetary policy decisions

Number of affirmative responses (total 23) — Table 3

	Importance for domestic economy				Incorporation in monetary policy decisions			
	Output and inflation volatility		Financial stability and asset prices		Incorporate formally or informally		Incorporation increases policy effectiveness	
	Fixed[1]	Flexible[2]	Fixed[1]	Flexible[2]	Fixed[1]	Flexible[2]	Fixed[1]	Flexible[2]
Foreign policy rates	0	11	3	14	1	14	1	11
Global long-term interest rates	0	9	2	17	0	13	0	10
Exchange rates	0	17	1	17	0	18	0	13
International bank lending	0	7	2	10	0	6	0	5
Portfolio flows[3]	0	13	2	18	0	15	0	11

[1] Economies under fixed exchange rate regime: Hong Kong SAR, Saudi Arabia and United Arab Emirates. [2] Economies under flexible exchange rate regimes. [3] Changes in the advanced economy monetary policy stance affect investors' risk appetite and hence their demand for emerging market assets.

Source: BIS questionnaire, September 2013.

As regards the first question, for most central banks international spillovers appear to be a concern from the viewpoint of both macroeconomic and financial stability. But risks are perceived to be significantly higher for financial stability. Among the five factors listed in the table, risk-taking in global financial markets through portfolio flows poses the most difficult challenges for most central banks, together with the exchange rate, and global long-term and policy rates.

It is therefore not surprising that a majority of central banks take these factors into account in the formulation of monetary policy. For instance, 78% of the reporting central banks (18 out of 23) formally or informally incorporated exchange rate developments in their monetary policy decisions; 65% did so with respect to foreign policy rates and portfolio financial positions. Over 56% of the respondents took some account of global long-term interest rates in their monetary policy formulation. The success rates of these measures are shown in the last two columns of Table 3. Several central banks took the view that monetary policy effectiveness was enhanced when their decision-making also took account of foreign policy rates, global long-term interest rates, portfolio flows and the exchange rate. A lower percentage of central banks thought that this was true also for international bank lending.

That said, the survey results do not provide insight into whether central banks responded to these variables with a view to changing their direction or path, nor do they provide information about the precise methods used to respond to monetary spillovers.

What instrument to respond with?

Monetary policy measures

One possible instrument is the interest rate: the central bank moves its policy rate more aggressively to stabilise output and inflation following large changes to the exchange rate. Research has generally supported the conclusion that very high exchange rate volatility increases the volatility of both output and inflation, thus jeopardising financial stability.[9] Gourinchas and Obstfeld (2012) find that an overvalued exchange rate can lead to cyclical booms and a financial crisis.

Bond yields, however, tend to be more influenced by yields in the main centres, notably by those of the US Treasury market, than by changes in local policy rates. The BIS background paper by Gadanecz, Miyajima and Urban ("How might EME central banks respond to the influence of global monetary factors?") makes the case for a central bank response to the exchange rate and domestic long-term bond yields. Using a highly stylised macroeconomic model, the authors show that by expanding the interest rate rule with exchange rate and bond yields, central banks can improve macroeconomic performance.

These results are based on the assumption that the exchange rate and bond prices exert a large, independent influence on aggregate demand and inflation. This could be true if long-term interest rates and exchange rates are volatile, causing frequent deviations of inflation and aggregate demand from their targets. Yet, as the authors note, central banks are confronted with large parameter uncertainty, which could stem from the changing relationships between the exchange rate, long-term yields and the real economy. This may imply that the reliance placed on different instruments should vary over time according to circumstances.

Another instrument extensively used by central banks is foreign exchange intervention. Evidence from a previous survey conducted for the 2013 Deputy Governors' Meeting suggested that in a large number of EMEs, FX intervention was intended to dampen capital flow volatility and reduce risks to monetary and financial stability.[10] The paper from the Czech National Bank in this volume discusses the special role of FX intervention in the Czech Republic, where the short-term interest rate has remained at zero since 2012 (see Skorepa and Hampi).

Nevertheless, FX intervention also presents a number of challenges. First, the cost of intervention may be large when the interest rate differential is high and rising. The paper from South Africa mentions that the carry cost due to the positive interest rate differential is the main reason for South African Reserve Bank's losses on reserve holdings. Second, when an intervention is made in order to avoid raising policy rates, it may inadvertently promote a domestic credit boom. Finally, interventions to restrict exchange rate flexibility can lead to more risk-taking and increased speculation about the future value of the currency, encouraging investors to exploit interest rate differentials more aggressively (Claro and Soto (2013)).

A key issue is whether the accumulation of FX reserves resulting from such intervention is cyclical or structural. When FX intervention is used to dampen cyclical capital flow volatility around the trend in both directions, its balance sheet impact is likely to be limited. By contrast, when such interventions resist fundamental appreciation pressures, financial imbalances can increase.

Unsurprisingly, therefore, views differed significantly among participants about the role of the exchange rate. Some advocated a free-floating exchange rate as one of the main lines of defence against external shocks, as long as prudent macroeconomic – notably fiscal – policies are in place in place to support it.

9 See the summary of discussions and country papers in BIS (2013).

10 See Mohanty and Berger (2013).

Participants from countries with free-floating regimes believed that sterilised intervention has little sustainable effect on exchange rate movements.

By contrast, some Asian economies advocated foreign exchange intervention, notably when the exchange rate puts an excessive adjustment burden on the tradable sector. Although the costs of holding foreign exchange reserves are generally high these should be assessed against the benefits of holding reserves (eg preventing risks to financial stability). According to one participant, solid reserves should be built based on their permanent component, which is related to the current account surplus, rather than the transitory element related to the aim of stemming capital inflows.

Participants agreed that greater attention needs to be paid to long-term rates, which can no longer be viewed as an average of future short-term rates. Long term rates are key to government financing costs. In addition, long rates matter for the funding of large corporations with their increasing use of the capital markets. However, more needs to be known about the transmission of longer-term rates to bank lending rates.

Some took the view that greater management of long-term rates may be needed to gain adequate control over the economy. This is particularly relevant when policy rates are at the zero low bound or when there is a risk that bond yields will overshoot in reaction to capital flow volatility. One central bank said that it has had recourse to dual intervention in the forex and debt markets since 2010. Another central bank observed that it may become more involved in yield curve management: spillovers from the reversal of unconventional monetary policies in the United States could lead to a steeper, and perhaps more volatile, yield curve (Turner (2014b). However, any such intervention should be consistent with the central bank's inflation objectives and it must be coordinated with the national debt management office. In addition, it must take into account the costs of impairing the information role of the yield curve for monetary policy.

Non-monetary policy measures

The use of non-monetary instruments for stabilisation purposes has received much attention since 2008. One set of such instruments are macroprudential tools. Gadanecz, Miyajima and Urban discuss the rationale for their use in EMEs. Targeted macroprudential measures can reduce risks from currency mismatches or certain types of funding that are particularly susceptible to global liquidity conditions. In addition, macroprudential tools can help prevent domestic booms associated with capital inflows.

Table 4 summarises the survey responses of central banks on non-monetary policy measures along three dimensions: the types of measures used since 2008, the purpose for which they were used, and their effectiveness. The responses are shown as percentage of total respondents.

Focusing on macroprudential tools, a large number of EMEs have used measures targeted specifically at the banking sector. Caps on loan-to-value ratios and debt service ratios are the most common, followed by rules on currency mismatches. Among the measures focused specifically on limiting risks to bank balance sheets, reserve requirements on banks,[11] adjustment to risk weights on assets, caps on loan-to-deposit ratios and loan loss provisioning have been most popular. As regards measures related to collateral in wholesale funding, about 9% of EMEs have used margins or a haircut requirement to prevent procyclicality in funding. In addition, a number of EMEs have used other measures, such as regulation of foreign exchange derivatives (Korea), limits on the maximum tenure of loans (Malaysia) and limits on non-deliverable forward (NDF) exposures (the Philippines). Annex Table A1 lists some of these measures.

Use of non-monetary policy measures since 2008

Percentage of 23 respondents — Table 4

	Measure is used	Purpose		Measure is effective
		Financial stability	Monetary policy	
Capital account				
Capital inflows	26	13	13	26
Capital outflows	26	17	13	26
Bank loans				
Caps on loan-to-value for mortgages	52	48	0	43
Caps on ratio of debt service to household income	57	48	0	48
Rules on reference interest rate used for mortgage lending	22	9	0	4
Rules on currency mismatches of borrowers	30	30	0	26
Ceilings on credit growth (aggregate or by sector)	4	9	0	4
Bank balance sheets				
Countercyclical capital ratios	17	22[1]	0	9
Dynamic provisioning	22	17	0	17
Adjustment to asset risk weights	52	61[1,2]	0	48
Rules on loan loss provisioning	48	39	0	39
Caps on loan-to-deposit ratios, core funding ratios, other liquidity requirements	48	48	0	43
Bank reserves deposited with the central bank	65	39	26	61
Limits on interbank exposures (domestic or cross-border)	26	17	0	17
Capital surcharges for systemically important institutions	17	22	0	17
Other	4	0	0	4
Collateral used in wholesale funding				
Prevention of procyclical variation in minimum margins or haircuts (or making such variation countercyclical)	9	9	0	4
Other[4]	83	95[5]	5[5]	79[5]

[1] Mexico has not yet adopted this measure and is working on it for financial stability. [2] Argentina has not yet adopted this measure but regards it as serving a financial stability purpose. [3] Mexico has been considering this measure partially based on recommendations by the FSB and BCBS. [4] Nineteen other measures were cited by 11 central banks. See Annex Table A1 for details. [5] As a percentage of 19 measures.

Source: BIS questionnaire, September 2013.

The survey results also suggest that many EMEs have used multiple non-monetary measures – rather than a selected few – to tackle the spillover problem.

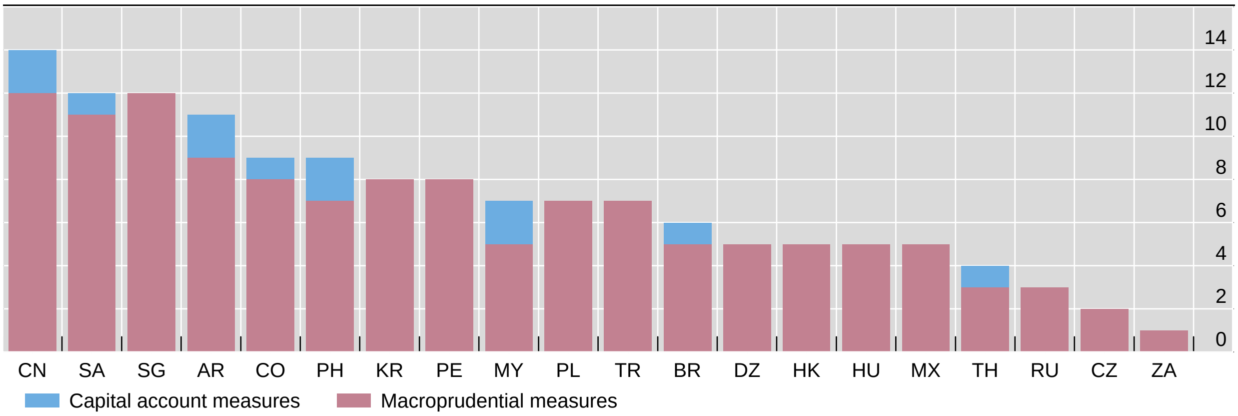
[11] Strictly speaking, these are probably best classified as traditional administrative monetary policy tools.

As shown in Graph 3, the number of measures introduced since 2008 has varied significantly across economies, with a typical median value of around seven.

Regarding the purpose of such instruments, a high percentage of central banks reported that macroprudential measures were used primarily to limit financial stability risks. None reported that bank-specific measures were exclusively directed at monetary policy objectives. The only exception is reserve requirements, which are viewed partly as a monetary instrument.

Number of non-monetary policy measures

Graph 3



[1] Sixteen measures are specified in the questionnaire. Replies from 11 central banks indicate measures in addition to the specified ones. See Annex Table A1 for details.

Source: BIS questionnaire, September 2013.

On the effectiveness of macroprudential measures, central bank views seem to converge on several points: first, according to a significant majority of central banks (61%), reserve requirements have a high degree of effectiveness as a stabilisation instrument. Second, rules regulating banks' exposure to real estate markets (eg loan-to-value, adjustment to risk weights, loan loss provisioning) and debt accumulation by borrowers (eg debt service ratio) appear to be more successful than other measures in limiting risks to the economy.

This view is also supported by country experiences as summarised in several central bank notes. First, macroprudential measures are more effective in influencing bank credit and leverage than in dampening property prices. In addition, their effectiveness can vary depending on the state of the economy: LTV ratios are more powerful in curbing excess credit demand than in limiting supply (Hong Kong SAR). Second, macroprudential policies work better when complemented by other policies, such as taxation. Both Hong Kong SAR and Singapore used taxes on property transactions alongside LTV ratios to stabilise their property markets. Third, the experience of Korea suggests that measures such as leverage caps on derivative transactions and a bank levy on non-core liabilities can be successful in limiting currency mismatches and increasing the maturity of borrowing.[12] Finally, in a

[12] The paper from Turkey presents empirical analysis on the interaction between macroprudential policies, VIX and portfolio flows. The results show that Turkey's modified monetary operating procedure with the option for banks to maintain reserves in local and foreign currency (Reserve Option Mechanism) has had a significant effect in terms of dampening capital inflows during periods of high investor risk appetite (a reduction of VIX).

number of cases, reserve requirements on banks – especially when imposed on foreign currency deposits, as in Peru – seem to be useful in resolving trade-offs facing monetary authorities due to capital flows.

Participants generally believed that macroprudential measures tend to complement traditional interest rate policy. The case for complementarity between the two sets of policies was seen as especially relevant if macroprudential policy shifted lending into the shadow banking system. The general view was that both monetary and macroprudential policies should be used to achieve the joint objectives of price and financial stability. In short, multiple targets demand multiple instruments.

The survey results also shed light on the use of capital account measures. As shown in the top rows of Table 4, slightly more than one quarter of central banks have used measures on capital inflows and outflows since 2008, as stabilisation tools. Only half of them viewed these measures as targeted towards preserving monetary stability. But all countries that used capital account measures considered them to have been relatively successful in achieving their intended objectives.

3. Internationalisation of EME currencies

Over the past decade, internationalisation of EME asset holdings has proceeded apace. For instance, as Annex Tables A2 and A3 show, at the end of 2012 the share of foreign holding of Asian and Latin American local government bonds has risen from very low or negligible to 10–50%. In the equity market, this share was 20–45% in many cases. At the same time, however, the EME official sector has invested much of its foreign assets in major advanced economies' currencies. This discrepancy between foreign investors' and EME official sector's asset preferences raises questions about the future role of EME currencies in international asset allocation.

Frankel (2011) notes that three fundamental factors determine the international status of a currency: (i) the size of the economy; (ii) confidence in the value of the currency, as influenced by its long-term strength and short-term variability as well as the country's net asset position; and (iii) the financial system's degree of development. In all these dimensions, the US dollar continues to be the world's dominant currency.

The BIS background paper by Ma and Villar in this volume ("Internationalisation of emerging market currencies") reviews most of these factors in its assessment of the international role of EME currencies. The authors observe that, compared with the previous decade, international investors' holding of EME financial assets have risen substantially. And this has been accompanied by rapid growth in the offshore foreign exchange turnover of EME currencies. The Chinese renminbi and Mexican peso were among the top 10 traded currencies of the world in 2013. In addition, the share of EMEs in world GDP and trade has doubled from 15% in early 1990s to 30% by 2013.

Yet EMEs lag far behind advanced economies in financial development and their governments are yet to attain the highest credit standing. Ma and Villar note that managing currency risk is costly for global investors, and together tighter with strong home bias, it restricts global asset allocation to EMEs. The internationalisation of EME currencies also depends crucially on EME authorities' willingness to liberalise cross-border capital movements and facilitate offshore currency trading.

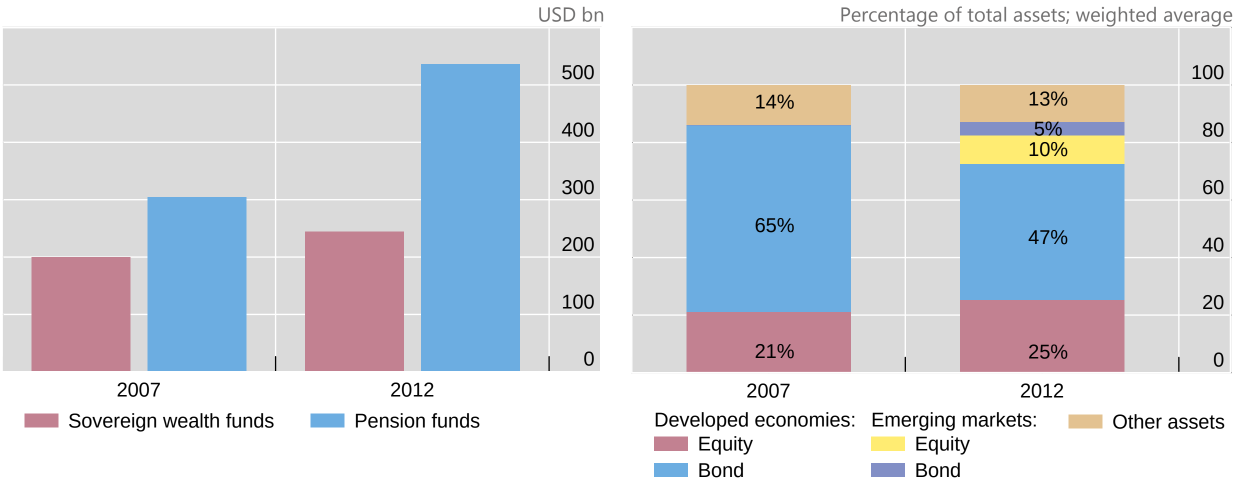
Looking forward, an international role for EME currencies raises at least three interrelated issues: (i) implications for EM financial markets; (ii) the role of sovereign wealth funds including central banks; (ii) and the importance of the Chinese renminbi.

As regards the first, the lack of financial depth will pose challenges to many EMEs in managing the risks from growing foreign ownership of their assets. Both the exchange rate and the interest rate could become more volatile, exposing EMEs to financial fragility. The potential costs of currency internationalisation could be particularly high for countries with weak balance sheets.

Second, the role of official investors is likely to be crucial. As noted by Ma and Villar, official investors such as sovereign wealth funds (SWFs), which have a longer investment horizon and greater risk appetite, can play a useful stabilising role in EME asset markets. They can be a catalyst for greater private investment in EME assets.

Assets of sovereign wealth funds (SWFs) and pension funds Graph 4

Amounts outstanding[1] | Composition of assets held by SWFs[2]



[1] Aggregate of data from five central banks for sovereign wealth funds and data from six central banks for pension funds. [2] Data are from Chile, Colombia and Korea only. Weighted averages based on total assets of these three countries are shown.

Source: BIS questionnaire, September 2013.

As one illustration of their importance, Graph 4 shows the size and composition of pension fund and SWF assets in a group of EMEs that responded to the survey. Total assets managed by both types of fund have risen over the past five years. Total assets of pension funds appear to be far larger than those of SWFs, notwithstanding differences in samples. Information about the composition of pension fund assets is not available, but it is possible that home regulations require a large chunk of their assets to be invested in local debt and equities. As regards SWFs, although the shares of assets invested in EME bonds and equities in total assets have increased from practically zero in 2007 to 5% and 10%, respectively, at the end of 2012, they are nowhere comparable to those invested in assets of advanced economies.

Another relatively unexplored question is what role the large foreign reserves held by EME central banks might potentially play in the development of EME asset markets. The note from the South African Reserve Bank (SARB) in this volume argues that the official reserve management strategy is changing. The traditional priorities of reserve managers – capital preservation, liquidity and returns – have been called into question by extremely low returns on traditional reserve assets, the growing interest rate risk exposure on these assets and the reduced availability of high-quality assets. While the SARB has not changed its objectives, it has started giving more weight to returns in the management of reserves, leading to more investment in EME currencies such as the renminbi and the Korean won. That said, the allocation to EME assets is still very small (renminbi assets constitute about 3% of the SARB's total reserves). The paper from the Bank Negara Malaysia makes a similar point. It argues that reserve managers can potentially boost risk-adjusted returns by increasing allocation of foreign reserves to EME currencies. But the actual decision to invest in EME currencies would depend on several other factors, including country fundamentals, accessibility, regulatory regimes, financial market valuation and liquidity.

A final issue concerns the potential for the renminbi to play a more international role. Over the past decade, renminbi internationalisation has been deepening through the Hong Kong markets. In addition, the Chinese authorities have initiated a number of steps such as promoting trade settlement in renminbi, partially liberalising capital account transactions and developing offshore markets in renminbi products which would further enhance the role of the renminbi as a future international currency.

Greater internationalisation of the currency could also serve Chinese interests by accelerating domestic financial liberalisation and creating better risk-sharing opportunities for residents. But there are also risks. First, greater renminbi internationalisation could lead to a more rapid appreciation of the currency and possibly unsustainable current account deficits, although the historical record is not conclusive on this. Second, the more open capital account associated with the renminbi's internationalisation could mean a greater vulnerability to spillovers from external shocks to the Chinese economy.

Appendix

List of non-monetary measures specified by central banks[1]

Table A1

	Measure 1	Measure 2	Measure 3
Argentina	Limits on application of foreign currency funding: it must be applied to credit recipients whose income is generated in foreign currency (exporters), or related to such activities.	Limits on financial institutions' global position in foreign currency, defined as total assets and liabilities related to financial intermediation denominated in foreign currency, plus foreign currency-denominated bonds	
Korea	Regulation on the ratio of banks' FX derivatives positions and macroprudential stability levy.		
Malaysia	July 2013: limit on maximum loan tenure (i) purchase of properties: 35 years, (ii) personal financing: 10 years.		
Mexico	A bank has to obtain authorisation from the central bank to transfer or sell assets between banks or related counterparties when those operations exceed 25% of its basic capital in a year.	The value-at-risk limits for pension funds were increased and their methodology was changed to avoid massive asset sales after the recent financial crisis.	
Peru	Additional reserve requirements conditional on foreign exchange mortgage and car loans growth.	Additional reserve requirements conditional on foreign exchange aggregate credit growth.	
Philippines	Limits on the amount of NDF exposures at 20% and 100% of unimpaired capital of domestic banks and foreign bank branches, respectively.	Non-residents prohibited from investing in trust departments/entities in the SDA facility, a BSP monetary tool used for managing excess domestic liquidity in the financial system.	Capital conservation buffer of 2.5% (the requirement of 2.5% capital conservation buffer took effect starting 1 January 2014).
Poland	Recommendation by the Polish Financial Supervision Authority on profit retention to strengthen banks' capital buffer.		
Singapore	Leverage ratio: to be introduced in line with Basel timeline – MAS has published and implemented requirements on the calculation of the leverage ratio and reporting to MAS in MAS Notice 637 based on the rules published in the Basel III text dated 16 Dec 2010 (revised 1 Jun 2011). The Basel rules on the Leverage Ratio were updated by end-2013 for implementation of disclosure requirement by 1 Jan 2015, and the final Basel rules on the Leverage Ratio are expected to be published in 2017. MAS will reference these revisions in the Basel rules and implement them in the regulations accordingly.	MAS imposes large exposure limits on banks' exposures to any one single counterparty group.	The rules on margins and haircuts are set out in the Securities and Futures Act (SFA). Under SFA, margining requirements are imposed on capital markets services licensees who carry out securities financing and dealing in contracts for differences. The SFA margin requirements prescribe the minimum margin rate, the acceptable collateral and the applicable haircuts for acceptable collateral. Securities financing transactions by capital markets services licensees are required to be fully secured at all times.

[1] Hong Kong SAR, Saudi Arabia and Thailand have measures other than those listed in Table B2 but have not specified these measures.
Source: BIS questionnaire, September 2013.

Foreign ownership in domestic bond markets

Percentage of market capitalisation — Table A2

	Local currency government bonds			Corporate bonds		
	2000	2007	2012	2000	2007	2012
Asia						
China	–	0.1	0.5	–	0.1	0.5
Korea	0.2	9.3	13.9	0.6	0.5	0.3
Malaysia	0.3	14.1	29.6	–	5.9	3.4
Philippines	–	–	10.3	–	–	–
Thailand	–	0.9	16.2	–	–	0.2
Latin America						
Brazil	–	5.1	13.7	–	0.1	0.8
Colombia	0.0	3.9	4.1	–		0.3
Mexico	1.4	8.7	30.8	–	1.1	0.6
Peru	–	22.6	53.2	–	14.1	30.6
Central Eastern Europe						
Czech Republic	7.4	27.5	14.2	–	–	–
Hungary	17.0	30.0	40.0	11.0	22.0	5.0
Poland	18.2	20.9	36.0	9.2	10.4	2.0
Russia	24.6	0.8	17.4	–	–	–
Turkey	9.0	13.4	23.3	–	–	5.2
Other						
Algeria	–	0.0	0.0	–	0.0	0.0
South Africa	22.0	18.0	31.0	2.0	6.0	4.0

Source: BIS questionnaire, September 2013.

Foreign ownership in domestic equity markets

Percentage of market capitalisation — Table A3

	2000	2007	2012
Asia			
China	–	1.7	1.6
Korea	27.0	31.0	32.4
Malaysia	19.5	26.6	24.5
Philippines	–	33.3	26.4
Thailand	–	–	34.7
Latin America			
Argentina	7.9	11.9	12.1
Brazil	–	26.0	29.0
Chile	–	6.8	9.0
Colombia	4.4	2.8	2.7
Mexico	–	39.3	31.9
Peru	–	47.6	45.9
Central Eastern Europe			
Hungary	71.0	80.0	66.0
Poland	45.5	47.6	44.4
Turkey	–	72.4	65.8
Other			
Saudi Arabia	–	2.5	6.3
South Africa	23.0	20.0	21.0

Source: BIS questionnaire, September 2013.

References

Bank for International Settlements (2013): "Market volatility and foreign exchange intervention in EMEs: what has changed?", *BIS Papers*, no 73.

Barroso, J, L Pereira da Silva and A Sales (2013): "Quantitative easing and related capital flows into Brazil: measuring its effects and transmission channels through a rigorous counterfactual evaluation", *Working Papers*, no 313, Central Bank of Brazil.

Borio, C and H Zhu (2012): "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism", *Journal of Financial Stability*, vol 8, no 4.

Bruno, V and H Shin (2012): "Capital flows and the risk-taking channel of monetary policy", *BIS Working Paper*s, no 400, December.

Caruana, J (2012): "International monetary policy interactions: challenges and prospects", speech to the CEMLA-SEACEN conference, 16 November.

Chen, Q, A Filardo, D He and F Zhu (2012): "International spillovers of central bank balance sheet policies", *BIS Papers*, no 66.

Claro, S and C Soto (2013): "Exchange rate policy and exchange rate interventions: the Chilean experience", *BIS Papers*, no 73, October.

Committee on the Global Financial System (2009): "Capital flows and emerging market economies", report by a CGFS Working Group chaired by Rakesh Mohan, *CGFS Papers*, no 33, January.

Eichengreen, B (2013): "Currency war or international policy coordination?", University of California, Berkeley, January.

Frankel, J (2011): "Historical precedents for internationalisation of the RMB", Council on Foreign Relations, November.

Gagnon, J, M Raskin, J Remache and B Sack (2011): "The financial market effects of the Federal Reserve's large scale asset purchases", *International Journal of Central Banking*, vol 7, no 1.

Gourinchas, P and M Obstfeld (2012): "Stories of the twentieth century for the twenty-first", *American Economic Journal: Macroeconomics*, vol 4, no 1.

He, D and R McCauley (2013): "Transmitting global liquidity to East Asia: policy rates, bond yields, currencies and dollar credit", *BIS Working Paper*s, no 431, October.

Hofmann, B and B Bogdanova (2012): "Taylor rules and monetary policy: a global Great Deviation?", *BIS Quarterly Review*, September.

Hordahl, P and O Tristani (2012): Inflation risk premia in the term structure of interest rates" *Journal of the European Economics Association* 10(3).

International Monetary Fund (2013a): "2013 spillover report", *IMF Policy Paper*, August.

——— (2013b): "Global impact and challenges of unconventional monetary policies", *IMF Policy Paper*, October.

King M and D Low (2013): "Measuring the "World" Real Interest Rate", *NBER Working Paper*, No 19887.

Mohanty, M and B Berger (2013): "Central views on foreign exchange intervention", *BIS Papers*, no 73, October.

Rey, H (2013): "The global financial cycle and monetary policy independence", paper presented at the Jackson Hole Symposium, 24 August.

Taylor, J (2013): "International monetary policy coordination: past, present and future", *BIS Working Papers*, no 437, December.

Turner, P (2014a):"The global long-term interest rate, financial risks and policy options in EMEs", *BIS Working Papers*, no 441, February.

Turner, P (2014b): "The exit from non-conventional monetary policy: what challenges?", *BIS Working Papers*, no 448, May.

How might EME central banks respond to the influence of global monetary factors?

Blaise Gadanecz, Ken Miyajima and Jörg Urban[1]

Abstract

Easy monetary conditions in advanced economies have played an important role in determining domestic monetary conditions in emerging market economies (EMEs), notably through the exchange rate and domestic bond yields. How can EME central banks best react to such external influences? Using a small, highly stylised and non-structural monetary policy model, we show that setting the policy interest rate in response to movements in the exchange rate and the yield on domestic long-term bonds – in addition to focusing on more traditional domestic variables such as the output gap and the inflation gap – can make monetary policy more effective. But there are important caveats and trade-offs, notably with respect to uncertainty about the structure of the economy and opposing effects of exchange rates and bond yields on domestic monetary conditions.

Keywords: Emerging market economies, monetary policy, exchange rate, bond yields

JEL classification: E43, E52, E58, F31, F36, F42

[1] Prepared with assistance from Tracy Chan, Sonja Fritz, Emese Kuruc and Lillie Lam. Comments from Claudio Borio, Andrew Filardo, Madhusudan Mohanty, Kostas Tsatsaronis, Philip Turner, James Yetman and BIS seminar and meeting participants are gratefully acknowledged.

1. Introduction

Easy monetary conditions in advanced economies (AEs) have played an important role in determining domestic monetary conditions in emerging market economies (EMEs). How can central banks best react to such external influences and what are the potential trade-offs? This paper focuses on two variables that influence macroeconomic and financial stability policy choices in addition to the traditional macroeconomic variables included in stylised policy rules (ie the output gap and the deviation of inflation from the target, the "inflation gap"):

- **The exchange rate**: Currency appreciation normally reduces aggregate demand. In addition, currency overvaluation creates financial stability risks. Gourinchas and Obstfeld (2011), for instance, argue that overvalued exchange rates during cyclical booms increase the risk of subsequent financial crises. Because of its implications for macroeconomic and financial stability, the exchange rate creates policy trade-offs.
- **The yields on long-term domestic bonds**: As EME domestic bond markets have grown and foreign participation has risen, domestic yields have become more closely linked to yields in the main financial centres. Low or even negative term premia in the dollar market tend to lower yields on EME bonds, thus loosening domestic monetary conditions. In such circumstances, monetary policy may have become less effective as raising policy rates does not necessarily increase interest rates at the long end.

To address such issues, EME policymakers during the past decade have resorted to a wider range of monetary and non-monetary policy tools. Foreign exchange market intervention has been used frequently. Central banks have also used a wide range of non-monetary policy tools such as macroprudential and capital flow management measures. Reserve requirements have also been important in some countries.

One key question is whether EME central banks need to place more weight on the exchange rate and domestic bond yields in the conduct of monetary policy. For the purposes of this paper, monetary policy effectiveness is measured by macroeconomic stability: a reduction in the volatility of the output gap and the inflation gap. We use a small, highly stylised and non-structural monetary policy model to address this question. We argue that setting the policy interest rate in response to movements in two key asset prices, the exchange rate and the yield on domestic long-term bonds, in addition to more traditional domestic variables such as the output gap and the inflation gap, can make monetary policy more effective. But policymakers need to be mindful of trade-offs. For instance, when the relationships among the key macroeconomic variables are not certain, monetary policy may become less effective if the central bank sets the policy interest rate in response to the exchange rate and the domestic bond yield.

A related question pertains to the role of non-monetary policy measures in this policy setting. Expanding interest rate-setting rules may not be sufficient to address the challenges posed by easy global monetary conditions and volatile capital flows. Probably for this reason, EME central banks have increasingly been relying on a range of non-monetary policy measures. But we do not yet fully understand how effective such measures are and how best to combine them with monetary policy.

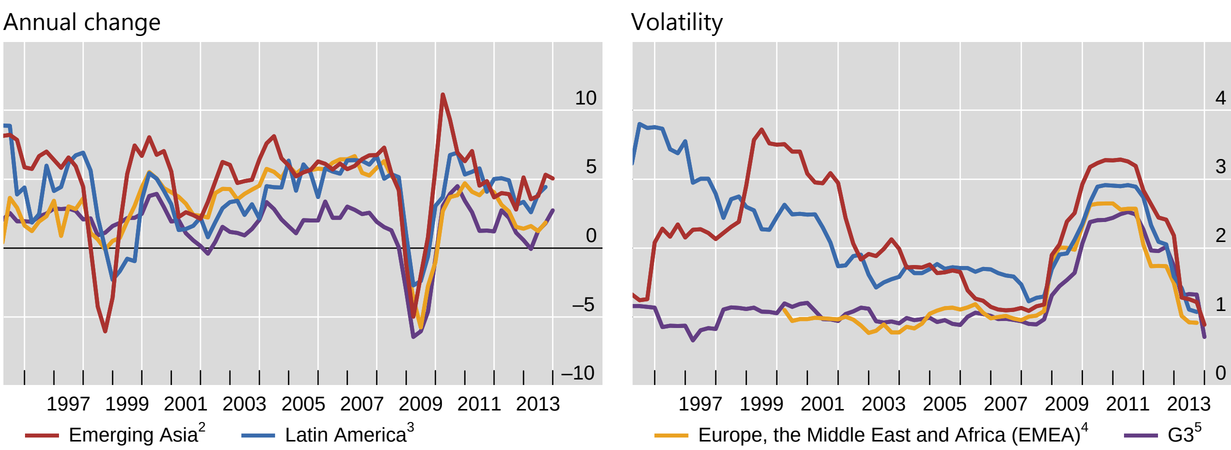
The rest of the paper is structured as follows. Section 2 presents some stylised facts about the macroeconomic performance of EMEs and possible risks. Section 3 discusses the role of the exchange rate and domestic long-term bond yields in EMEs. Section 4 discusses possible monetary policy responses to their movements. Section 5 discusses the role of non-monetary policy measures. Section 6 concludes.

2. Performance of output and inflation

Output growth and inflation are the most common variables that are used to assess monetary policy performance. A moderate level of inflation, as well as low output and inflation volatility, can generally be considered as good proxies for the objective functions of many central banks in EMEs and AEs alike. Of course, the ideal measures would rather be the deviation of actual output from its potential level, and that of actual inflation from the target. But those measures are not straightforward to estimate for certain EMEs.

Global output performance[1]

In per cent | Graph 1



[1] Measured by real GDP. Volatility represents the three-year moving standard deviation of quarterly percentage point changes of year-on-year growth rate. Average for G3; median otherwise. [2] China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [3] Brazil, Chile, Colombia, Mexico and Peru. [4] Czech Republic, Hungary, Israel, Poland, Russia, South Africa and Turkey. [5] Germany, Japan and the United States.

Sources: Datastream; national data; authors' calculations.

Starting with the performance of output, the left-hand panel of Graph 1 suggests that output growth has been correlated between EMEs and AEs since the 1990s. The correlation has become more pronounced since the early 2000s, especially during the financial crisis in 2008–09. Tighter trade and financial linkages[2] probably explain some of this. Common shocks, such as greater uncertainty and shifts in global investor sentiment, may also play a role.

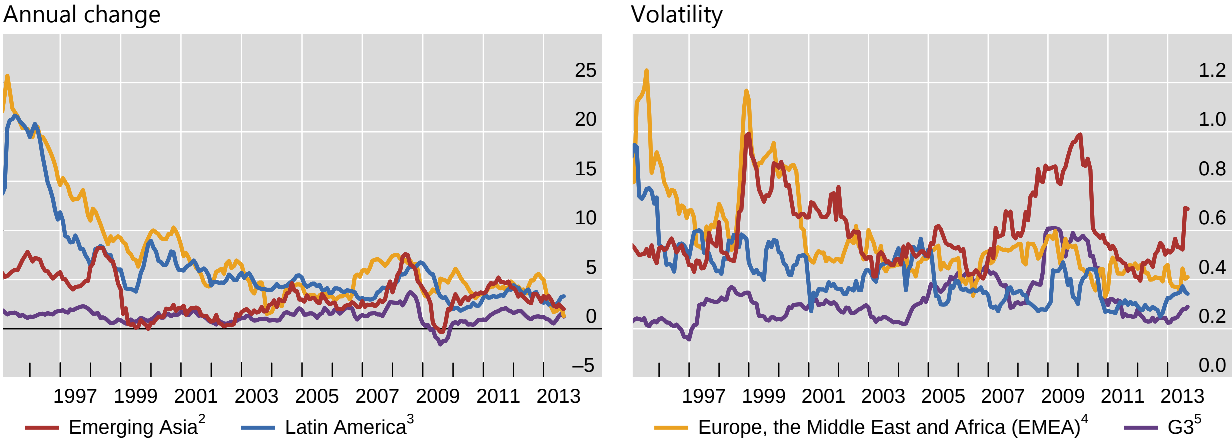
[2] Financial linkages may induce growth divergence between EMEs and AEs in normal times by allowing capital to move where it is most productive. However, these linkages may increase spillovers (via investor sentiment) in crisis times. See Kalemli-Özcan et al (2013).

The right-hand panel of Graph 1 shows that the volatility of output growth has fallen significantly in the decade prior to the 2008 crisis. This likely owes in part to the increased credibility of monetary policy frameworks thanks to a stronger focus on price stability.[3] EMEs and AEs experienced a simultaneous spike in output growth volatility after the 2008 financial crisis, but volatility has fallen since 2011. Some EMEs succeeded in implementing countercyclical monetary and fiscal policies.[4]

Global inflation performance[1]

In per cent

Graph 2



[1] Average for G3; median otherwise. Volatility represents the three-year moving standard deviation of quarterly percentage point changes of year-on-year growth of CPI. [2] China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [3] Brazil, Chile, Colombia, Mexico and Peru. [4] Czech Republic, Hungary, Israel, Poland, Russia, South Africa and Turkey. [5] Germany, Japan and the United States.

Sources: Bloomberg; authors' calculations.

Graph 2 shows that inflation (left-hand panel) and its volatility (right-hand panel) had fallen in EMEs to levels comparable with those observed in AEs through the middle of the 2000s. This is, again, due partly to greater focus on price stability in some EMEs. Since the early 2000s, inflation volatility has remained low in AEs, but has surged in EMEs, coinciding with the increased volatility of capital flows. It has been particularly high in Asia, probably as more heavily managed exchange rates have increased the pass-through of global nominal shocks into domestic monetary and financial conditions.

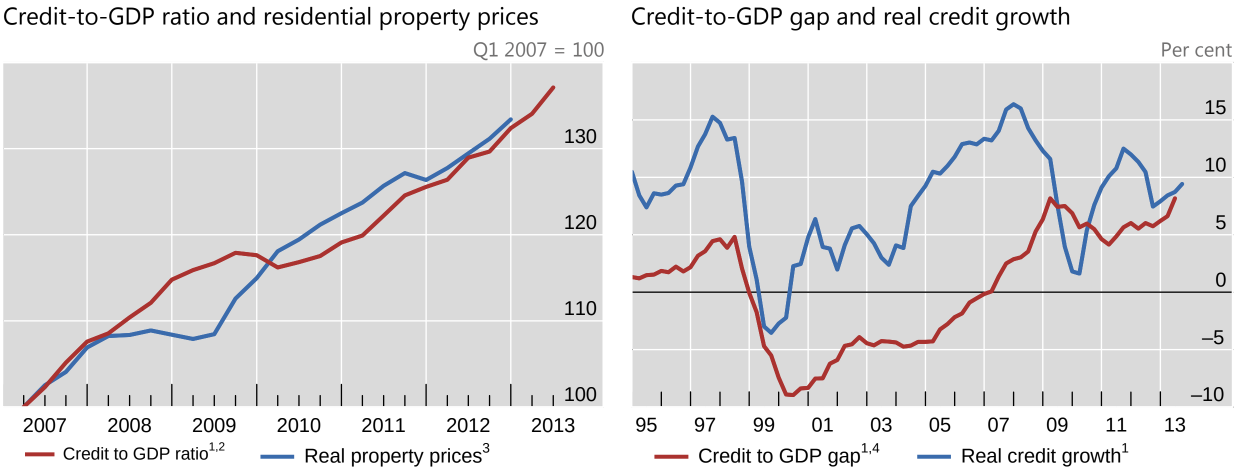
While inflation and its volatility have generally fallen, inflation risk may be on the rise in some EMEs. Policy rates and long-term bond yields in EMEs have shown a high degree of co-movement with those of AEs, as the output and inflation performance of the two groups of countries has been converging. As shown in the first two panels of Table A1 of the Appendix, in most EMEs both short- and long-term real interest rates have declined from 2007 and have since remained low.

[3] Whether the formal adoption of inflation targeting can be credited with this result may depend on the region. See Filardo and Genberg (2010) and Mehrotra and Yetman (forthcoming).

[4] Takáts (2012) argues that, for several reasons, EMEs are now better able to implement countercyclical measures than before. In addition to the adoption of inflation targeting, fiscal conditions and balance sheet structures have improved and exchange rates have become more flexible.

Taken at face value, this could point to stronger inflation pressures at some point in the future.

Private sector credit and residential property prices | Graph 3



[1] Simple average of Argentina, Brazil, Chile, China, Hong Kong SAR, Colombia, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand and Turkey. Saudi Arabia is excluded before Q1 2009. Bank credit for Chile, Colombia, Peru and the Philippines; total credit otherwise. [2] The index is based on the difference between quarter-on-quarter changes in nominal credit to the private sector and quarter-on-quarter changes in the four-quarter moving sum of nominal GDP. [3] Seasonally adjusted, quarterly averages; definitions may differ across economies. Simple averages of Brazil, China, Hong Kong SAR, Colombia, Indonesia, Korea, Malaysia, Mexico, Peru, Singapore, South Africa and Thailand; Thailand is excluded before Q2 2008. [4] The credit-to-GDP gap is the deviation of the credit-to-GDP ratio from a one-sided long-term trend. The smoothing parameter λ is 400,000.

Sources: IMF, *International Financial Statistics*; Datastream; national data; BIS calculations.

In addition, financial stability risks may have risen.[5] The ratio of credit to GDP has been shown to be useful as an indicator of the stage of the financial cycle, notably by Borio and Lowe (2002, 2004) and more recently by Shin (2013). The left-hand panel of Graph 3 shows that the average credit-to-GDP ratio (red line) and real residential property prices (blue line) have risen rapidly since 2007. The right-hand panel shows that the credit-to-GDP gap (red line) in EMEs as a whole has reached its highest level in more than a decade. However, real credit growth (blue line) has remained below its previous highs. The third panel of Table A1 shows that in many EMEs real credit growth in 2013 was 5–15 percentage points below its 2007 level.

3. Exchange rates and domestic long-term bond yields in the conduct of monetary policy

Monetary policy in EMEs seems to have been effective so far, but signs are emerging that financial stability risks, and possibly also inflation risks, may be building up. This owes partly to the strong influence of international monetary and financial factors on the exchange rate and domestic long-term yields. Against this

[5] For a recent discussion of central banks' monetary and financial stability objectives, see Borio (2014).

backdrop, we next review the implications of these two key factors for monetary policy and financial stability.

Exchange rates

EME central banks have faced policy challenges arising from both exchange rate appreciation and depreciation in the past two decades. During the decade preceding the 2008 crisis, and since 2009, interest rate and growth differentials have resulted in substantial capital inflows and exchange rate appreciation pressures.[6] By contrast, large capital outflows during May–September 2013 and early 2014 were accompanied by sharp exchange rate depreciations. Overall, in most EMEs nominal effective exchange rates depreciated significantly and were volatile between 2007 and 2013.[7] However, as shown in the fourth panel of Table A1, real effective exchange rates strengthened, with the exceptions of Argentina, India, Korea and South Africa.

As implied by the "impossible trinity" concept (ie the impossibility of reconciling free capital flows with both fixed exchange rates and an independent monetary policy), an independent monetary policy requires either flexible exchange rates or capital flow management measures. Conditional on the move towards fewer restrictions on capital flows, an independent monetary policy thus requires sufficiently flexible exchange rates (IMF (2005)).[8] Depending on the circumstances,[9] a flexible exchange rate can help central banks in responding to external monetary shocks, particularly when capital flows are attracted to EMEs by interest rate differentials.

In practice, however, central banks do respond to exchange rate movements due to concerns about macroeconomic and financial stability in the short run, or medium-term resource allocation considerations (Mihaljek (2011)). In the short term, currency depreciation can increase inflation if the exchange rate pass-through into domestic prices is large. Exchange rate volatility can affect asset prices and private sector balance sheets, leading to "fear of floating" (eg Calvo and Reinhart (2002)). Output volatility can also increase with exchange rate volatility, particularly if domestic financial markets are underdeveloped and risk-hedging is difficult. In the medium term, a strong exchange rate can reduce external competitiveness and tilt resources towards the non-tradables sector.

6 See CGFS (2009) for a discussion of capital flows and emerging markets, including the macroeconomic context of capital flows, their composition, policy responses and the implications for financial markets, banks and financial intermediation.

7 Notable exceptions are China and commodity exporters such as Chile and Peru.

8 For instance, Masson et al (1997) argue that the co-existence of an inflation objective and other policy goals such as an exchange rate target can create tensions for monetary policy. Taylor (2013) advocates that the policy rate should not be moved in reaction to the exchange rate. Such a move could have an adverse effect on the economy when the perceived deviation of the exchange rate from an equilibrium level reflects productivity changes. If exchange rate volatility represents random movements along the path of mean reversion, attempts to smooth them out would only increase interest rate volatility.

9 Gadanecz and Mehrotra (2013) report an intriguing result: the relationship between real exchange rate volatility and output volatility in a group of EMEs appears to be U-shaped. Up to a point, real exchange rate flexibility (proxied by its volatility) can help absorb shocks and limit output volatility, but very volatile real exchange rates are associated with high output volatility.

The question, then, is whether EME central banks respond appropriately to exchange rate movements to ensure price stability (together with financial and hence macroeconomic stability) or whether they respond too much or too little. One view is that EME central banks respond too much to exchange rates, not least owing to concerns about external competitiveness.

Long-term domestic bond yields

The long-term interest rate is important for the real economy for several reasons. Since the government is typically a large-scale net debtor in the bond markets, movements in the long-term interest rate have significant wealth effects for the private sector. A risk-free yield curve serves as a benchmark for the pricing of key long-term financial contracts such as mortgages. Banks are less willing to engage in maturity transformation if term spreads are too volatile, which can adversely affect the supply of long-term financing. Finally, financial stability risks can arise from the valuation effects of long-term interest rates on domestic balance sheets.

In traditional macroeconomic models for a closed economy, the monetary authority manages only the short-term interest rate, which then determines the yield curve in the economy. The path of expected future policy rates fully determines long-term rates. In these models, the assumption of a fixed, or non-existent, term premium is key (Turner (2013)).

However, when the term premium depends on policies and shocks, long-term interest rates can move differently to the path of expected future short-term interest rates. This argument is strengthened in an open economy because long-term interest rates are more highly correlated across countries than short-term interest rates. The greater integration of EMEs into global financial markets has strengthened this link (Turner (2013)). Turner (2014) argues that EMEs' domestic monetary conditions have been looser in the past two years than what the policy rates would imply, because domestic long-term bond yields have fallen substantially along with those in AEs.[10] In such cases, there could be reasons for the monetary authority to seek to influence the level and volatility of long-term interest rates. This may become more important when private borrowing rates (particularly mortgage rates) are linked to long-term government yields rather than short-term interest rates. Influencing the long-term bond yield has, indeed, been one aim of AE monetary authorities' asset purchases during the financial crisis.

Chadha, Turner and Zampolli (2013) provide two explanations as to why the monetary stance may not be fully transmitted along the yield curve. First, according to the so-called preferred habitat theory, originally developed by Modigliani and Sutch (1966), and recently revisited by Vayanos and Vila (2009) in the context of the financial crisis, certain investors are concerned about specific maturities.[11] Second, market participants are not always able to perform arbitrage between different

10 During 2005–12, EME domestic long yields were influenced more by US 10-year yields than by domestic policy rates (all measures in first difference). As much as one half of changes in US 10-year yields were seemingly passed through to changes in domestic long yields in EMEs. In Korea, Oh (2013) notes that long-term yields were declining since 2009 because of large capital inflows, despite the central bank raising the policy rate several times since 2010.

11 For instance, pension funds care mainly about the performance of long-term securities.

maturities along the entire yield curve. Especially at times of market stress, expectations become unanchored, banks face liquidity or capital constraints, and the substitutability between short- and long-term securities declines.

The transmission of the policy rate to long-term yields may be even weaker in EMEs, where bond markets are less developed, further reducing substitutability across maturities (Committee on the Global Financial System (2007)).[12] The term premium may be significantly volatile in small bond markets which lack depth (Filardo et al (2012)).

4. Monetary policy responses

One way for EME central banks to address concerns about exchange rates and long-term rates is to take them into account when setting policy. An obvious example is that of augmented Taylor-type rules (Mohanty and Klau (2004), Stone et al (2009), Aizenman et al (2011), Filardo et al (2011), Garcia et al (2011), Ostry et al (2012)). EME central banks can also set the policy rate in reaction to movements in domestic long-term bond yields.

Many central banks consider that foreign factors such as AE policy rates or foreign bond yields are important determinants of domestic macroeconomic and financial stability. Consequently, many of these central banks have formally or informally incorporated the major foreign factors into their monetary policy decisions, which they believe has often increased the policy's effectiveness.

Our model suggests that augmenting Taylor rules with exchange rates and domestic bond yields can improve economic performance. In the Appendix to this paper, we present a small-scale, admittedly non-structural, monetary policy model in which a stylised central bank accounts for the developments in the exchange rate and long-term domestic bond yields in its rate-setting rules, in addition to focusing on the more traditional factors such as the output gap and the inflation gap. We find that economic performance can be higher (ie the variability in the output gap, the inflation gap and the policy rate can be lower) when the Taylor-type rules are augmented to include the exchange rate and domestic long-term bond yields.

However, there are some important caveats. Such performance gains from augmenting Taylor-type rules could be smaller when the pass-through of an exchange rate appreciation (a proxy for capital inflows) into long yields is stronger. In such an economy, a policy rate rise aimed at lowering aggregate demand could, instead, stimulate it, as the capital flows attracted by higher policy rates compress long yields. In such a situation, a policy rate rise (and the ensuing exchange rate

[12] Despite considerable progress in developing them, the report by CGFS notes the following main signs of underdevelopment of local currency bond markets in EMEs: illiquidity, lack of foreign investor presence, predominance of banks among investors and of the public sector among issuers. As noted by Filardo et al (2011), given relatively underdeveloped EME bond markets and a shortage of high-quality EME assets, the term premium is likely to be more sensitive to changes in demand for various debt maturities than to anticipations of future monetary policy actions. Admittedly, then, long-term bond yields may play a smaller role in the transmission mechanism in EMEs to the extent that bond maturities tend to be short, a large share of financial contracts are indexed to short-term rates and in some cases, and dollarisation is high.

appreciation) tightens monetary conditions, while lower long yields ease them, potentially creating asymmetric effects on the tradables and non-tradables sectors.

There are at least two issues that EME central banks should consider when augmenting their Taylor rules. First, reliance on a more complex Taylor rule would create greater uncertainty about the performance gains. The linkage of the exchange rate and the domestic long-term interest rate with other macroeconomic variables is probably less well understood than the links behind the classic Taylor rule. Such a relationship may be less stable over time in dynamically evolving EMEs. Our small monetary policy model illustrates a well known general result: faced with uncertainty about the structure of the macroeconomy, a stylised EME central bank may be better off relying on a more parsimonious Taylor rule.

Second, augmenting their Taylor rules alone would not be enough for EME central banks to fully address challenges created by large and volatile capital flows. For instance, capital inflows would lead to currency appreciation, which is contractionary, but also reduce domestic bond yields, which is expansionary. A policy rate reaction aimed at stabilising aggregate demand could be overly tight for the tradables sector while overly easy for the non-tradables sector, facilitating resource allocation towards the non-tradables sector.

Another possible monetary policy response is foreign exchange intervention. The extent of foreign exchange market intervention varies substantially across EME central banks. Before the 2008–09 financial crisis, and more recently, large capital inflows prompted many EME central banks to resist currency appreciation by selling their domestic currencies. During the 2008–09 financial crisis, and more recent bouts of EME asset sell-offs, a number of EMEs intervened to resist the depreciation of their currencies and to provide liquidity to their domestic financial systems.[13]

Ostry et al (2012)) argue that foreign exchange intervention can be optimal even under an inflation targeting regime. The monetary authority should use the policy interest rate primarily for inflation targeting. When volatile capital flows create a large and temporary deviation of the exchange rate from its medium-term value, foreign exchange intervention can be used to influence the exchange rate. By using two distinct instruments to address two separate concerns, the central bank can avoid confusing the public and is able to safeguard its credibility. To the extent that capital inflows are driven by self-fulfilling expectations of exchange rate appreciation, foreign exchange intervention could also reduce carry trade incentives.

That said, depending on circumstances, foreign exchange intervention may not be that effective in influencing the exchange rate, and can be very costly. Its success in EMEs has been, at best, mixed. It appears that such interventions have been more successful in curbing exchange rate volatility than in influencing the level of the exchange rate.[14] In addition, intervention entails fiscal costs if the interest rate on domestic liabilities exceeds that earned on foreign assets.

[13] For an overview of recent intervention motives and tactics by EME central banks, see Mohanty (2013).

[14] Indeed, Miyajima and Montoro (2013) find that foreign exchange intervention can in some cases increase exchange rate volatility.

5. Non-monetary policy responses

Monetary policy responses may not be able to fully resolve the dilemmas resulting from globalisation. This has led the monetary authorities of EMEs to also rely on non-monetary policy tools. In this section, we discuss the effectiveness of these policies, focusing first on macroprudential policies, then on debt management measures and finally on capital flow management measures.

Macroprudential measures

What is the role of macroprudential tools in relation to the traditional policy interest rate? One view is that macroprudential tools might completely substitute for interest rates in stabilising the economy, because the transmission channels are similar[15] (Cecchetti and Kohler (2012)). The opposite view is that macroprudential tools cannot replace policy rate adjustments (Stein (2013)), because interest rates are the universal price of leverage which apply to all agents in the economy and present virtually no scope for regulatory arbitrage.

In general, it is probably best to consider macroprudential and monetary policies as complementary, for at least two reasons. First, the interest rate alone may be too blunt a tool to address financial stability risks, which often have a sectoral dimension. Targeted macroprudential measures can therefore help, especially if the transmission of policy rate changes to interest rates of different maturities and different parts of the economy is weak. Second, and more generally, financial booms are simply too powerful to be addressed with one type of policy. And treating macroprudential and monetary policies as complementary can make it easier to jointly pursue the objectives of price stability, output stability and financial stability (Caruana (2010), Borio (2012), Shin (2013)).

The right policy mix between monetary and macroprudential tools depends on the type of imbalances and shocks.[16] Some macroprudential tools can be used to remedy financial imbalances that are domestic in nature. Countercyclical capital buffers, limits on debt service and loan-to-value ratios, and other balance sheet policies would fall into this category. Other instruments can reduce vulnerabilities arising from the influence of global factors on EMEs monetary conditions, by specifically targeting currency mismatches, or types of funding that are particularly susceptible to global liquidity conditions. Bruno and Shin (2013) argue that in Korea macroprudential measures targeted at non-core deposits have reduced the sensitivity of capital inflows to global factors, relative to a group of comparator countries.

However, the literature provides mixed evidence on the effectiveness of macroprudential policies across a broader set of EMEs. Habermeier et al (2011) find that macroprudential measures introduced in 13 EMEs succeeded in mitigating the impact of capital inflows in some cases, reduced credit growth in others, but failed

15 Changes in policy rates or in capital requirements both alter banks' cost of doing business.

16 That puts a premium on an appropriate set of indicators to guide the deployment and release of macroprudential measures.

to restrain asset price inflation.[17] Such measures also do little to remedy maturity and currency mismatches on the liability side of balance sheets. Kuttner and Shim (2013) find that certain types of targeted credit and tax policies can affect the housing market, and could potentially be used as tools to promote financial and macroeconomic stability. However, not all policies are able to achieve this outcome. In particular, policies designed to affect either the supply of or the demand for credit have no discernible impact on house prices, and the authors also caution that their findings are sensitive to the choice of econometric approach.

A large number of central banks have deployed a range of macroprudential measures and consider these measures to have been effective. Loan-to-value and debt service to household income ratios have been used most.

Debt management policies

Long-term interest rates have been an important intermediate target for AE central banks using unconventional monetary policy measures (notably the US Federal Reserve, the Bank of England and the Bank of Japan) as policy rates had hit the zero lower bound in several instances. There is considerable evidence by now (eg Gagnon et al (2011), Baumeister and Benati (2013)) suggesting that unconventional monetary policy measures have had an impact on long-term yields. In addition, Chadha, Turner and Zampolli (2013) find that changes in the private sector's holdings of public debt can significantly influence the term premia on domestic sovereign bond yields even outside crisis times.

Central bank balance sheet policies to influence long yields have not been common in EMEs during the financial crisis, but there have been exceptions. The experience of India is a case in point. After the announcement in May 2013 that the Fed might start "tapering", the rupee started to depreciate sharply, prompting the Reserve Bank of India to raise the policy rates. An unintended consequence was a rise in long yields; the central bank responded by conducting open market purchases of long-term government securities while simultaneously auctioning cash management bills to keep money market conditions tight.

Under normal circumstances, in most EMEs, both governments and central banks are active in sovereign bond markets (Filardo et al (2012)). Governments issue debt of various maturities to finance fiscal deficits. Central banks issue their own securities to finance the acquisition of assets (particularly foreign exchange reserves). These actions influence the size and the maturity structure of public debt held by the private sector. Given the imperfect substitutability of assets along the maturity spectrum, this also has an impact on the shape of the yield curve.

That said, the objectives of debt management, such as reducing the cost of government debt, may conflict with those of monetary policy, notably when the central bank is seeking to stimulate aggregate demand (Borio and Disyatat (2009)). This highlights the importance of coordination[18] to ensure that the actions of the

[17] The objectives of capital flow management noted by the authors include stemming currency appreciation, reducing the volume of capital inflows, changing their composition, providing greater room for monetary policy manoeuver, slowing credit growth and dampening asset price inflation.

[18] Such coordination can, for instance, be realised through increased transparency or a central debt management office located inside the central bank (Filardo et al (2012)).

debt manager and the central bank should not influence the long end of the yield curve in opposite directions.

Capital flow management measures

Recently, some observers have argued that monetary policy can remain independent only if the capital account is managed. The influence of global factors on EMEs' domestic financial conditions, including domestic bond yields, de facto limits their monetary policy autonomy, regardless of the flexibility of the exchange rate regime in place. Rey (2013) posits that monetary policy in AEs has a powerful influence on the global financial cycle (proxied by the VIX) and thus the leverage of global banks.[19] Given the difficulties of coordinating monetary policy and regulatory frameworks across countries, governments may need to manage capital flows in addition to macroprudential policies to ensure both monetary and financial stability (CGFS (2012), IMF (2013), Agénor and Pereira da Silva (2014)).

Others are more concerned about the effectiveness of capital flow management measures. Even if such measures may provide short-term insulation from international monetary influence, they tend to lose effectiveness over time. In their review of the experiences of 13 EMEs in the 2000s, Habermeier et al (2011) find ambiguous support at best for the effectiveness of capital flow management. While these measures were occasionally effective in reducing capital inflows, the effect was usually short-lived and not sufficient to reduce currency appreciation pressures. Moreover, capital flow management entails costs and cannot replace macroeconomic policies (Fratzscher (2012)). Capital flow management measures can be counterproductive if they delay necessary policy adjustments (Caruana (2011)). And some control measures can reduce speculative capital inflows, but impair access to external finance.

Some central banks have used controls on capital inflows and outflows in recent years. Those measures were deployed, for instance, because of monetary policy and financial stability considerations. It appears that the measures had some intended effect, at least in the short term.

6. Conclusion

The influence of foreign monetary factors has posed challenges for monetary policy and financial stability in EMEs. Globalisation has increased the need to revisit policy frameworks, especially interest rate policy. Many central banks have paid particular attention to external factors in their monetary policy management.

A very stylised modelling exercise illustrates the general point that EME central banks can increase the effectiveness of their monetary policy by taking into account the exchange rate and domestic bond yields in their interest decision rules, besides output and inflation. Even so, there are trade-offs arising from the uncertainty about the way in which the exchange rate and long-term domestic yields interact with

[19] Bruno and Shin (2013) develop a model in which expected EM currency appreciation leads to an increase in the leverage of global banks (a driver of capital flows to EMEs) and vice versa.

each other and with other macroeconomic variables. And even in the absence of such uncertainty, interest rate policy alone may not be able to address challenges from large and volatile capital flows. It is therefore not surprising that many EME central banks have increasingly relied on non-monetary policy tools, such as capital flow management measures and macroprudential instruments with a view to gaining better control over the economy.

Appendix

Monetary conditions in emerging market economies

Table A1

	Real policy rate[1]		Real domestic five-year gov't bond yield[2]		Real credit year-on-year growth[3]		Real effective exchange rate[4]	
	2007	2013	2007	2013	2007	2013[5]	2007	2013
Emerging Asia[6]	**2.0**	**0.2**	**1.9**	**0.6**	**11.8**	**11.1**	**100.0**	**104.0**
China	2.7	3.4	–1.3	1.0	16.0	14.7	89.0	115.9
Hong Kong SAR	3.7	–3.8	2.2	–2.6	14.5	11.4	105.3	104.6
India	2.9	1.4	2.9	1.9	16.6	9.6	99.4	89.3
Indonesia	2.2	0.5	3.3	–0.6	15.6	17.6	94.2	93.7
Korea	2.5	1.2	2.8	1.7	10.1	3.1	129.2	104.5
Malaysia	1.5	0.9	1.5	1.3	4.5	7.1	98.3	100.1
Philippines	2.3	0.6	2.9	2.9	7.3	13.6	94.8	109.6
Singapore	–0.8	–2.3	0.5	–1.6	18.8	13.1	91.8	113.1
Thailand	1.0	0.1	1.9	1.2	2.7	9.4	97.5	105.3
Latin America[6]	**1.6**	**–3.6**	**4.3**	**2.6**	**25.9**	**13.5**	**97.5**	**104.1**
Argentina	–0.6	–1.1	…	…	30.0	15.9	113.6	90.5
Brazil	7.6	3.8	7.9	4.3	20.9	9.3	83.7	90.4
Chile	1.6	2.4	1.5	3.0	16.2	8.9	97.8	102.7
Colombia	4.0	1.2	4.5	3.6	18.6	12.1	87.8	99.4
Mexico	3.5	–0.3	3.7	0.9	18.8	5.0	108.5	102.1
Peru	3.2	1.2	4.1	1.1	30.9	14.6	91.0	105.6
Venezuela	–7.8	–32.3	…	…	46.2	28.8	100.3	137.9
Europe, the Middle East and Africa (EMEA)[6]	**2.6**	**–0.6**	**1.7**	**1.0**	**18.7**	**7.9**	**95.3**	**97.4**
Algeria	…	…	…	…	11.6	14.6	99.1	101.9
Czech Republic	0.6	–1.4	0.9	–0.3	12.3	2.3	90.6	96.1
Hungary	–0.5	1.3	–1.0	3.5	10.8	1.3	102.5	95.9
Israel	3.7	–0.5	…	…	…	…	87.6	102.5
Poland	2.6	1.3	3.0	2.3	21.4	2.7	102.9	96.1
Russia	1.0	–1.3	–2.9	–0.3	40.3	11.1	93.6	107.1
Saudi Arabia	1.4	–1.5	…	…	22.1	11.2	89.5	105.2
South Africa	4.9	–0.8	2.2	0.8	14.7	3.1	91.8	82.5
Turkey	7.0	–3.0	8.0	0.2	16.3	20.5	95.9	90.6
United Arab Emirates	…	0.1	…	…	…	4.0	99.3	96.4
Memo								
Germany	1.7	–1.3	1.8	–0.9	–0.5	–0.2	105.5	97.8
Japan	0.4	–0.3	1.2	–0.1	0.6	1.0	82.6	79.8
United States	1.4	–1.2	1.6	–0.3	6.7	2.6	105.1	97.7

[1] End of period. [2] Period average. [3] Bank credit for Chile, Colombia, Peru, the Philippines, the United Arab Emirates and Venezuela; total credit otherwise. [4] 2010=100; period average. [5] As of Q2 2013 for Algeria and the United Arab Emirates; as of Q4 2013 for China; as of Q3 2013 otherwise. [6] Simple average of the region.

Sources: IMF, *International Financial Statistics*; Bloomberg; national data; BIS.

Augmenting EME Taylor rules with exchange rates and domestic bond yields

What might EME monetary policymakers do to dampen the influence of international monetary and financial factors? To help shed some light on the trade-offs, we consider a small-scale monetary policy model. The model comprises a macroeconomic block of equations calibrated to EME data and a monetary policy block with a Taylor-type policy rule. We explore the potential benefits of including the exchange rate and the domestic bond yield in the monetary policy reaction function.

The macroeconomic block

The macroeconomic block includes four equations which are meant to capture the macroeconomic dynamics of output, inflation, the exchange rate and the long-term bond yield. The structure of the model is consistent with a standard IS-PC model commonly used in the literature (eg Batini and Haldane (1999) and Rudebusch and Svensson (1999)). Given the purpose of our paper, we introduce domestic benchmark bond yields instead of bond prices.[20] Our macroeconomy is characterised by four variables: the output gap, inflation, the exchange rate and the domestic bond yield.

- **Output equation:** The output gap is assumed to be a function of its own lag, the real exchange rate, the real bond yield and the real policy rate:

$$y_t = \alpha_{11} y_{t-1} + \alpha_{13}(e_{t-1} - \pi_{t-1}) + \alpha_{14}(b_{t-1} - \pi_{t-1}) + \alpha_{15}(i_{t-1} - \pi_{t-1}) + \varepsilon_{y,t} \qquad (1)$$

where y is the output gap, π is inflation, e is the year-on-year change in the nominal effective exchange rate (where a positive value represents depreciation), b is the nominal domestic bond yield, i is the nominal policy rate and ε is an i.i.d. random error.

- **Inflation equation:** The inflation rate is a function of the (lagged) output gap, inflation and the nominal exchange rate:

$$\pi_t = \alpha_{21} y_{t-1} + \alpha_{22}\pi_{t-1} + \alpha_{23} e_{t-1} + \varepsilon_{\pi,t} \qquad (2)$$

- **Nominal exchange rate equation:** The exchange rate is a function of the lagged exchange rate and policy rate:

$$e_t = \alpha_{33} e_{t-1} + \alpha_{35} i_{t-1} + \varepsilon_{e,t} \qquad (3)$$

[20] We adapt the approach of Filardo (2000) for asset prices, which in our case is the long-term bond yield.

This specification captures the notion that exchange rate dynamics are difficult to predict using macroeconomic variables such as output and inflation developments. It also represents our assumption that the exchange rate responds to signals created by policy rate actions about the future change in bond yields.[21]

- **Nominal domestic bond yield equation:** The domestic bond yield is allowed to vary with lags of most of the above variables:

$$b_t = \alpha_{41} y_{t-1} + \alpha_{43} e_{t-1} + \alpha_{44} b_{t-1} + \alpha_{45} i_{t-1} + \varepsilon_{b,t} \tag{4}$$

Table A5 presents empirical estimates of the parameter values of the model using a panel regression with fixed effects on a set of 14 major EMEs for the period 2000–07.[22] The size of the coefficients and the signs are mostly economically plausible.

The monetary policy block

The central bank chooses the parameters of its policy rule to optimally respond to the economic dynamics summarised in equations (1)–(4). We assume for pedagogical purposes a standard central bank loss function used in the literature. The economic losses, L, are assumed to be well represented by the variance of the output gap, the deviation of inflation from the target and changes in the policy rate. We set the preference parameters of the central bank to be equal to 1.0 for the variance of the output gap and the inflation gap and 0.2 for the variance of the change in the policy rate.

In other words, the central bank solves the following minimisation problem:

$$\min L = \underset{\beta}{\operatorname{argmin}} \ \{1 * var(y_t) + 1 * var(\pi_t - \pi^*) + 0.2 * var(i_t - i_{t-1})\} \tag{5}$$

subject to equations (1)–(4) above, where var stands for variance, π^* for the targeted year-on-year inflation rate, and β is the vector of Taylor-type policy rule coefficients defined below for each specification of the rule.

We consider three Taylor-type rules. The first, R1, is a conventional Taylor-type rule that includes the reaction to both the output gap and the inflation gap; the others include the exchange rate smoothing and the bond yield.[23]

[21] The exchange rate equation is motivated by Ball (1999) and Eichengreen (2002). We also experimented with versions where bond yields, rather than the policy rate, enter this equation on the right hand side. However, we decided to use the policy rate, as this representation best captures our assumption that the exchange rate responds to the signal created by policy rate actions. Indeed, if we used bond yields in the exchange rate equation, the effect of policy rate moves on the exchange rate would be transmitted only indirectly through bond yields.

[22] Brazil, Chile, Czech Republic, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Philippines, Poland, South Africa, Thailand and Turkey. Parameter values estimated for three regions (Asia; Latin America; Eastern Europe, Middle East and Africa) are broadly similar.

- **Rule 1 (R1):** The central bank reacts only to the lagged output gap and the lagged inflation gap:

$$i_t = \beta_{11} y_{t-1} + \beta_{12}(\pi_{t-1} - \pi^*) \tag{6}$$

- **Rule 2 (R2):** The central bank also takes into account exchange rate smoothing with one lag, which is the quarter-on-quarter difference in e:

$$i_t = \beta_{21} y_{t-1} + \beta_{22}(\pi_{t-1} - \pi^*) + \beta_{23} \Delta e_{t-1} \tag{7}$$

- **Rule 3 (R3):** The central bank also reacts to the lagged yield on long-term domestic government bonds:

$$i_t = \beta_{31} y_{t-1} + \beta_{32}(\pi_{t-1} - \pi^*) + \beta_{33} \Delta e_{t-1} + \beta_{34} b_{t-1} \tag{8}$$

Baseline results

Given the macroeconomy and monetary policy blocks and the parameters in Table A5, we solve the model using numerical methods, ie we simulate the macroeconomy summarised in equations (1)–(4) and search for the parameters of the Taylor-type rules that minimise the loss function (5).[24]

The simulation results highlight two key policy findings. First, by including the exchange rate and the domestic bond yield in the Taylor-type rules, the hypothetical monetary authority can improve macroeconomic performance. The last column of Table A2 shows that the loss associated with variability in the output gap,

[23] Our model assumes that when the central bank augments its reaction function, the parameters of the underlying economy remain unchanged. In practice, this is an empirical issue, as the change in policy may alter the behaviour of private agents. Our result should be interpreted with this Lucas critique in mind.

[24] In the model, the output gap, inflation, the exchange rate and the domestic bond yield move in accordance with the four macroeconomic relationships described in equations (1)–(4). In addition, each of the four variables is subjected to a shock in each period. We draw normally distributed i.i.d. random shocks with (i) a mean of zero, and (ii) a standard deviation that allows us to match the second moment of the simulated macroeconomy with that of the actual macroeconomic data. For modelling purposes, π^*, the targeted level of inflation is set to zero as the model is formulated in terms of deviations from the steady state. Specifically, we generate i.i.d. shocks $\varepsilon_{y,t}$, $\varepsilon_{\pi,t}$, $\varepsilon_{e,t}$, $\varepsilon_{b,t}$ for 5,000 periods to compute time series for the output gap, inflation, the exchange rate movement, the bond yield as well as the policy rate. Depending on the specific Taylor rule, at most four unknown β_i coefficients need to be determined, so as to minimise the loss function L specified in equation (5). We start at β_i=0 and parse its neighbourhood (defined by a certain predefined grid size) to search for the minimum of L until the desired level of precision is achieved. We repeat this exercise 1,000 times. We subsequently jump to the point which corresponds to that minimum, and parse again in that neighbourhood to search for a new minimum. If we do not find a minimum, we refine our grid and start again from the previous point. Our results are robust to a more general Monte Carlo setup comprising 100,000 iterations where the search array is not dependent on the starting values.

the inflation gap and the policy rate is lower with the augmented Taylor-type rules R2 and R3. When the rule is expanded from R1 with exchange rate smoothing to R2, the loss declines by 18%, and the decline is statistically significant at the 95% level.[25] When R2 is expanded with the domestic bond yield to R3, the loss declines by another 10%, although the difference in loss is only significant at the 90% level.

Second, given the calibration of the model, it is interesting to note that Taylor-type rule coefficients in Table A2 are consistent with those in the empirical literature for EMEs (eg Mohanty and Klau (2004), Filardo et al (2011)). In particular, the optimised rule coefficients on the output gap are between 0.7 and 1.4, and those on the inflation gap range from 1.0 to 4.0. The coefficients on the exchange rate are positive in rules R2 and R3, which indicates that the central bank would tighten policy as the nominal exchange depreciates; the coefficient on the domestic bond yield is negative, which indicates the central bank would lower policy interest rates when the domestic bond yield rises. It is also interesting to note that, when the hypothetical central bank directly includes exchange rate smoothing and the domestic bond yield in its policy rate setting, the coefficients on the inflation gap rise. In other words, the central bank reacts more vigorously to inflation outcomes when also reacting directly to these other variables.

Central bank reaction and loss: baseline economy

Table A2

	Central bank reaction				Loss
	y_t	$\pi_t - \pi^*$	Δe_t	b_t	
R1	1.42 [1.28, 1.56]	0.97 [0.88, 1.05]			3.08 [2.87, 3.30]
R2	1.28 [1.15, 1.41]	1.50 [1.39, 1.61]	0.31 [0.30, 0.33]		2.54 [2.37, 2.70]
R3	0.70 [0.61, 0.78]	4.05 [3.84, 4.25]	0.30 [0.29, 0.32]	–1.67 [–1.81, –1.54]	2.28 [2.14, 2.41]

95% confidence intervals around the point estimates in square brackets. *y* is the output gap, π *and* π^* are realised and targeted year-on-year inflation, Δe is the quarter-on-quarter difference in the year-on-year percent change of the exchange rate, *b* is the government bond yield. The loss is calculated as $1 * var(y_t) + 1 * var(\pi_t - \pi^*) + 0.2 * var(i_t - i_{t-1})$, where var stands for variance and *i* for the policy rate.

Source: Authors' calculations.

Increasing the pass-through of the exchange rate into bond yields

In this section, we illustrate the limitations of interest rate policy by showing that monetary policy actions alone cannot fully resolve certain policy dilemmas. To do this, we continue focusing on the dilemma faced by many EME central banks when higher domestic interest rates attract larger capital inflows, reduce domestic bond yields and undo some of the impact of a policy rate hike.

To illustrate the point, we consider, in addition to the baseline economy, an alternative economy where, in the bond yield equation (equation (4)) the coefficient

[25] (2.54–3.08)/3.08*100 = –17.5%.

α_{43} on exchange rate movements (which proxies capital flows) is raised from the baseline value of 0.1 to the alternative value of 0.3.

$$b_t = \alpha_{41}y_{t-1} + \boldsymbol{\alpha_{43}}e_{t-1} + \alpha_{44}b_{t-1} + \alpha_{45}i_{t-1} + \varepsilon_{b,t} \quad (4)$$

In Table A3, we report the Taylor rule coefficients and the central bank loss for the alternative economy. The right column shows that expanding the Taylor rule form R1 to R2 (paying attention to the exchange rate in addition to the output gap and inflation) still brings a significant welfare gain of 14%, even though it is smaller than the 18% gain obtained in the baseline economy. However, the additional gain from expanding the Taylor rule from R2 to R3 (incorporating the bond yield) is very small and statistically insignificant. In the baseline economy, the gain amounts to is 10%, but is only significant at the 90% level.

These results are not surprising, given that the policy dilemma referred to above is more pronounced in the alternative economy. That is, in the presence of capital inflows, concern about further exchange rate appreciation would call for an easier monetary stance. However, as capital inflows compress domestic long-term bond yields and ease domestic monetary conditions, incorporating the domestic bond yield in monetary policy decisions call for a tighter (or less easy) monetary stance.

Central bank reaction and loss: alternative economy

Table A3

	Central bank reaction				Loss
	y_t	$\pi_t - \pi^*$	Δe_t	b_t	
R1	1.12 [1.00, 1.24]	0.91 [0.82, 0.99]			2.80 [2.60, 3.01]
R2	1.10 [0.99, 1.22]	1.28 [1.18, 1.39]	0.27 [0.26, 0.29]		2.40 [2.25, 2.56]
R3	1.13 [1.02, 1.24]	0.86 [0.47, 1.24]	0.27 [0.26, 0.29]	0.13 [0.02, 0.24]	2.40 [2.24, 2.57]

95% confidence intervals around the point estimates in square brackets. y is the output gap, π *and* π^* are realised and targeted year-on-year inflation, Δe is the quarter-on-quarter difference in the year-on-year percent change of the exchange rate, b is the government bond yield. The loss is calculated as $1 * var(y_t) + 1 * var(\pi_t - \pi^*) + 0.2 * var(i_t - i_{t-1})$, where var stands for variance and i for the policy rate.

Source: Authors' calculations.

Considering parameter uncertainty

The baseline results assumed that the central bank knows with certainty the parameters in the macroeconomy captured in equations (1)–(4). In practice, these relationships are not precisely known, especially in dynamically evolving EMEs. In this section, we look at how parameter uncertainty can affect the conclusions drawn from the baseline results. We find that parameter uncertainty alters the policy trade-offs that central banks face and, in the case we address, perhaps argues for greater reliance on more parsimonious Taylor-type policy rules.[26]

We consider the following scenario: the coefficient on lagged exchange rate movements in the bond yield equation, α_{43}, takes on the value of 0.1. However, the central bank believes that it may have taken on a higher value, namely 0.3.[27] The potential for a larger coefficient could be interpreted as reflecting the inherent limitations in precisely estimating parameters that may be undergoing structural change. In the case of EMEs, for example, greater financial globalisation has meant larger capital inflow volatility, and the central bank may believe that these flows now play a bigger role in compressing domestic long-term bond yields than in the past.

This exercise differs from that discussed in the previous section where we compared two economies, in which the value of the pass-through from changes in the exchange rate to bond yields was known with certainty. In this exercise, uncertainty has been introduced about this value.

So, how can we assess the potential cost arising from this type of parameter uncertainty? In the context of our model, it would be to compare the losses associated with the Taylor-type rules R1, R2 and R3 using the following two scenarios:

- Baseline scenario: the central bank uses the "true" parameter α_{43} = 0.1 to optimise its Taylor rules and the loss is calculated using the same parameter value of 0.1.
- Downside scenario: the central bank optimises its Taylor rules assuming α_{43} = 0.3 but the loss is calculated using α_{43} = 0.1 (the true value).

Central bank losses evaluated using α_{43} = 0.1

Table A4

	Baseline scenario	Downside scenario	Difference
R1	3.08 [2.87, 3.30]	3.11 [2.87, 3.35]	0.03
R2	2.54 [2.37, 2.70]	2.57 [2.39, 2.74]	0.03
R3	2.28 [2.14, 2.41]	2.68 [2.48, 2.87]	0.40

95% confidence intervals around the point estimates in square brackets. Under both scenarios, the loss is calculated using α_{43} = 0.1, but the Taylor rules are optimised using α_{43} = 0.1 under the baseline scenario and α_{43} = 0.3 under the downside scenario.

Source: Authors' calculations.

26 This result is consistent with the conclusion drawn by Taylor (1999) that heavily augmented Taylor-type rules lack robustness, when compared to simpler ones, where there is uncertainty about the exact specification of the model of the economy.

27 The choice of the magnitude of the coefficient difference is guided by the fact that one side of the 95% confidence interval in our regressions used to set up the parameters in equations (1)–(4) was in the range of 0.1–0.2. Hence, the value of 0.3 would be seen as a surprise to a central bank relying on econometric methods alone to assess the relationship between exchange rate movements and domestic bond yields.

Several key messages come out of Table A4, in which the comparison is reported. First, for a given rule, the losses can be higher when the central bank makes a wrong assumption. This is especially the case for R3, the most complex rule, where the potential additional loss of 0.4 is large and statistically significant. Under the more parsimonious rules R1 and R2, the potential loss arising from parameter uncertainty is not significantly different from zero. Second, and most important, parameter uncertainty can alter the ranking of the preferred Taylor-type rules. Under parameter uncertainty, the point estimates of the losses associated with R3 (2.68) are greater than those associated with R2 (2.57) even though the confidence intervals overlap.

This result underscores the fact that parameter uncertainty is an important consideration to take into account in choosing from competing policy options. Parameter uncertainty alters the policy trade-offs that central banks face and, in the case we address, can argue for greater reliance on more parsimonious Taylor-type policy rules. Of course, the nature of parameter uncertainty in reality is more complex than in this particular example.

Baseline parameter calibration

Table A5

Equation	Variable	Parameters	Model	Regression[6]	Literature				Note
					Filardo (2000)	Rudebush & Svensson (1999)	Batini & Haldane (1999)	Ball (1999)	
y_t	y_{t-1}	α_{11}	0.60	0.58 ***	0.60	0.91 [1]	0.80	0.80	Following regression result. Similar to values in the literature.
	$e_{t-1} - \pi_{t-1}$	α_{13}	0.05	0.03 *			0.20	0.20	Following regression result. Lower than values in the literature.
	$b_{t-1} - \pi_{t-1}$	α_{14}	–0.10	–0.11 **	–0.20[4]				Following regression result. Similar to values in the literature.
	$i_{t-1} - \pi_{t-1}$	α_{15}	–0.20	0.20 ***	–0.20	–0.10	–0.50	–0.60	Similar to values in the literature. Regression result suggests opposite sign.
π_t	y_{t-1}	α_{21}	0.15	0.06	0.15	0.14		0.40	Taken from values in the literature.
	π_{t-1}	α_{22}	0.75	0.74 ***	1.00	1.00 [2]			Following regression result. Lower than values in the literature.
	e_{t-1}	α_{23}	0.10	0.06 *				0.20 [5]	Following regression result. Similar to values in the literature.
e_t	e_{t-1}	α_{33}	0.85	0.71 ***			1.00		Somewhat higher than regression result to match second moment in the data.
	i_{t-1}	α_{35}	–0.50	–0.50			1.00 [3]	–2.00 [5]	Lower than values in the literature.
b_t	y_{t-1}	α_{41}	0.10	0.03					Following regression result despite being insignificant.
	e_{t-1}	α_{43}	0.10	0.04					Following regression result despite being insignificant.
	b_{t-1}	α_{44}	0.70	0.54 ***					Somewhat higher than regression result to generate sufficiently high second moment
	i_{t-1}	α_{45}	0.20	0.15					Following regression result despite being insignificant.

[1] Sum of two lags [2] Sum of four lags [3] Differential to foreign interest rate; UIP [4] Original coefficient is +0.20 on real asset price inflation [5] Real exchange rate [6] 14 EMEs for 2000–07; BR, CL, CZ, HU, ID, IL, IN, MX, MY, PH, PL, TH, TR, ZA. The nominal and real policy rate and bond yields have been de-trended using a Hodrick-Prescott filter with a smoothing parameter of 1,600 for panel regression with fixed effects and robust standard errors. ***, ** and * denote significance at the 1, 5 and 10% levels, respectively.

Sources: IMF, *International Financial Statistics*; Bloomberg; Global Financial Data; JP Morgan, national data; authors' calculations.

References

Agénor, P-R and L Pereira de Silva (2014): *Inflation targeting and financial stability: a perspective from the developing world*, monograph published by the Inter-American Development Bank and CEMLA.

Aizenman, J, M Hutchison and I Noy (2011): "Inflation targeting and real exchange rates in emerging markets", *World Development*, vol 39, no 5, pp 712–24.

Ball, L (1999): "Monetary policy rules for open economies", in J Taylor (ed), *Monetary policy rules,* Chicago University Press, pp 127–56.

Batini, N and A Haldane (1999): "Forward-looking rules for monetary policy", *Monetary Policy Rules*, National Bureau of Economic Research, pp 157–202.

Baumeister, C and L Benati (2013): "Unconventional monetary policy and the great recession: estimating the macroeconomic effects of a spread compression at the zero lower bound", *International Journal of Central Banking*, vol 9, no 2, pp 165–212.

Borio, C (2012): "The financial cycle and macroeconomics: what have we learnt?", *BIS Working Papers,* no 395, December. Forthcoming in the *Journal of Banking and Finance*.

——— (2014): "Monetary policy and financial stability: what role in prevention and recovery?", *BIS Working Papers*, no 440, January.

Borio, C and P Disyatat (2009): "Unconventional monetary policies: an appraisal", *BIS Working Papers*, no 292, November.

Borio, C and P Lowe (2002): "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers*, no 114, July.

——— (2004): "Securing sustainable price stability: should credit come back from the wilderness?", *BIS Working Papers*, no 157, July.

Bruno, V and H-S Shin (2013): "Capital flows and the risk-taking channel of monetary policy", mimeo.

Caruana, J (2010): "Monetary policy in a world with macroprudential policy", speech delivered at the SAARCFINANCE Governors' Symposium 2011, Kerala, 11 June.

——— (2011): "Capital flows to the emerging market economies: a perspective on policy challenges", speech delivered at the 46th SEACEN Governors' Conference, Colombo, Sri Lanka, 24–26 February.

Cecchetti, S and M Kohler (2012): "When capital adequacy and interest rate policy are substitutes (and when they are not)", *BIS Working Papers*, no 379, May.

Chadha, J, P Turner and F Zampolli (2013): "The ties that bind: monetary policy and government debt management", *Oxford Review of Economic Policy*, vol 29, no 3, pp 548–81.

Committee on the Global Financial System (2007): "Financial stability and local currency bond markets", *CGFS Papers*, no 28, June.

——— (2009): "Capital flows and emerging market economies", *CGFS Papers*, no 33, January.

——— (2012): "Operationalising the selection and application of macroprudential instruments", *CGFS Papers*, no 48, December.

Eichengreen, B (2002): "Can emerging markets float? Should they inflation target?", *Central Bank of Brazil Working Paper Series,* no 36.

Filardo, A (2000): "Monetary policy and asset prices", *Federal Reserve Bank of Kansas City Economic Review,* Third Quarter.

Filardo, A and H Genberg (2010): "Targeting inflation in Asia and the Pacific: lessons from the recent past", *BIS Papers*, no 52, July.

Filardo A, G Ma and D Mihaljek (2011): "Exchange rates and monetary policy frameworks in EMEs", *BIS Papers*, no 57.

Filardo, A, M Mohanty and R Moreno (2012): "Central bank and government debt management: issues for monetary policy", *BIS Working Papers*, no 67, October.

Fratzscher, M (2012): "Capital controls and foreign exchange policy", *ECB Working Papers*, no 1415, February.

Gadanecz, B and A Mehrotra (2013): "The exchange rate, real economy and financial markets", *BIS Papers*, no 73, October.

Gagnon, J, M Raskin, J Remache and B Sack (2011): "The financial market effects of the Federal Reserve's large-scale asset purchases", *International Journal of Central Banking*, vol 7, no 1, pp 3–43.

Garcia, C, J Restrepo and S Roger (2011): "How much should inflation targeters care about the exchange rate?", *Journal of International Money and Finance* 30(7): 1590–1617.

Gourinchas, P and M Obstfeld (2011): "Stories of the twentieth century for the twenty-first", *NBER Working Paper*, no 17252.

Habermeier, K, A Kokenyne and C Baba (2011): "The effectiveness of capital controls and prudential policies in managing large inflows", *IMF Staff Discussion Note*, no 11/14, August.

International Monetary Fund (2005): "Inflation targeting in emerging market economies", *World Economic Outlook*, Chapter 4, October.

——— (2013): "Guidance for the liberalization and management of capital flows", April.

Kalemli-Özcan, Ş, E Papaioannou and F Perri (2013): "Global banks and crisis transmission", *Journal of International Economics*, vol 89, no 2, pp 495–510.

Kuttner, K and I Shim (2013): "Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies", *BIS Working Papers*, no 433, November.

Mehrotra, A and J Yetman (forthcoming): "How anchored are inflation expectations in Asia? Evidence from surveys of professional forecasters", *BIS Papers*.

Mihaljek, D (2011): "How have external factors affected monetary policy in the EMEs?", *BIS Papers*, no 57, October.

Miyajima, K and C Montoro (2013): "Impact of foreign exchange interventions on exchange rate expectations", *BIS Working Papers*, no 73, October.

Modigliani, F and R Sutch (1966): "Innovations in interest rate policy", *American Economic Review*, 56(1/2), pp 178–97.

Mohanty, M (2013): "Market volatility and foreign exchange intervention in EMEs: what has changed? – An overview", *BIS Papers*, no 73, October.

Mohanty, M and M Klau (2004): "Monetary policy rules in emerging market economies", in R Langhammer and L Vinhas de Souza (eds), *Monetary policy and macroeconomic stabilization in Latin America*, Springer, pp 205–45.

Oh, G (2012): "Public debt and monetary policy in Korea", *BIS Papers*, no 67, October.

Ostry, J, A Ghosh and M Chamon (2012): "Two targets, two instruments: monetary and exchange rate policies in emerging market economies", *IMF Staff Discussion Note*, no 12/01, February.

Rey, H (2013): "Dilemma not trilemma: the global financial cycle and monetary policy independence", mimeo.

Rudebusch, G and L Svensson (1999): "Policy rules for inflation targeting", in J Taylor (ed), *Monetary policy rules*, Chicago University Press, pp 203–62.

Shin, H-S (2013): "Adapting macroprudential approaches to emerging and developing economies", in *Dealing with the challenges of macrofinancial linkages in emerging markets*, World Bank Studies, October.

——— (2013): "Procyclicality and the search for early warning indicators", *IMF Working Paper*, no 13/258.

Stein, J (2013): "Overheating in credit markets: origins, measurement and policy responses", remarks at the Research Symposium "Restoring household financial stability after the great recession: why household balance sheets matter", sponsored by the Federal Reserve Bank of St Louis, 7 February.

Stone, M, S Roger, S Shimizu, A Nordstrom, T Kisinbay and J Restrepo (2009): "The role of the exchange rate in inflation targeting emerging economies", *IMF Occasional Paper*, no 267.

Takáts, E (2012): "Countercyclical policies in emerging markets", *BIS Quarterly Review*, June.

Taylor, J B (1999): "The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European central banking", *Journal of Monetary Economics*, vol 43, pp 655–79.

Taylor, J B (2013): "International monetary coordination and the great deviation" *Journal of Policy Modelling*, vol 35, no 3, pp 463–72.

Turner, P (2013): "Benign neglect of the long-term interest rate", *BIS Working Papers*, no 403, February.

——— (2014): "The global long-term interest rate, financial risks and policy choices in EMEs", *BIS Working Papers*, no 441.

Vayanos, D and J Vila (2009): "A preferred-habitat model of the term structure of interest rates", *NBER Working Paper*, no 15487.

Wynne, M and G Solomon (2007): "Obstacles to measuring global output gaps", *Economic Letter, Federal Reserve Bank of Dallas*, March, vol 2, no 3.

International monetary policy transmission[1]

Előd Takáts and Abraham Vela

Abstract

In this paper we investigate how monetary policy in advanced economies affects financial conditions in emerging market economies (EMEs). We find evidence for the working of several international transmission channels. In particular, advanced economy monetary policy, as proxied by US monetary conditions, seems to drive EME policy rates beyond what domestic factors would suggest. Furthermore, US long-term interest rates also affect EME long-term interest rates significantly. Finally, our results suggest that while the impact of US monetary policy has weakened, the co-movement of long-term rates became stronger after the financial crisis in 2008.

Keywords: Monetary policy, international spillovers, Taylor rule

JEL classification: E52, E58, F33

[1] Comments from BIS seminar participants and from Claudio Borio, Andrew Filardo, Blaise Gadanecz, Mikael Juselius, Marco Lombardi, Robert McCauley, Madhusudan Mohanty, Kostas Tsatsaronis, Philip Turner, Christian Upper and James Yetman are gratefully acknowledged. Emese Kuruc, Lillie Lam and Alan Villegas provided excellent research assistance. All remaining errors are our own.

1. Introduction

Emerging economy financial markets tumbled in January after the Federal Reserve announced its intention to cut the volume of the bond purchase programme. Even though US monetary policy remained quite accommodative following the announcement, the move signalled tighter future policies. In Alexandre Tombini's words, the prospect of tighter US policy acted as a "vacuum cleaner" and capital started to flow out of emerging market economies (EMEs). The event echoed what had happened after the first "tapering" announcement last May: the prospect of US monetary tightening sent EME financial markets tumbling.

These developments confirm that advanced economy monetary policy has large and significant effects on EMEs. EME capital markets have increasingly become open over time. This has led to large gross capital flows and the build-up of large international balance sheets (BIS, 2011). However, these international positions have not only helped to allocate capital efficiently: they have also provided the means for sudden shifts in international risk appetite to translate into macroeconomic volatility, especially after 2008. And monetary policy in advanced economies, particularly in the United States, seems to drive this risk-taking as shown in Borio and Zhu (2012) and Bruno and Shin (2013). Evidence is accumulating on the workings of such monetary spillovers: Aysan et al (2013) found monetary spillovers for Turkey and many other EMEs, Barroso et al (2013) for Brazil and Chua et al (2013) for Malaysia, for instance. However, many uncertainties remain: we do not know precisely how and through which channels international monetary transmission works.

To shed further light on this question, this paper explores how international monetary transmission works in EMEs participating in the Meeting of Deputy Governors in Basel.[2] We set out to investigate the influence of international monetary policy through five areas: (i) short-term policy rates, (ii) long-term interest rates, (iii) exchange rates, (iv) international bank lending and (v) market risk-taking. Importantly, when measuring the EME policy rate responses we think about the transmission from advanced economy monetary policy, ie including unconventional tools, to the policy rate of EMEs. This means that the short-term policy rate responses can work even after advanced economies' policy rates have reached the zero lower bound.

In our empirical analysis, we focus on the policy rate and long-term interest rates, because they are most likely to capture the shift in transmission implied by the shift from policy rates to unconventional monetary policies in advanced economies after the 2008 crisis. Using regression analysis based on estimated Taylor equations and bond pricing, we find consistent evidence that short- and long-term interest rates transmit US monetary conditions to most EMEs.

Furthermore, we find evidence that policy rate responses became less important after 2008, while long-term interest rates became more important – as one might expect given the shift from conventional to unconventional policies. These results are also consistent with the central bank responses to our

[2] Algeria, Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand, Turkey and the United Arab Emirates.

questionnaire reviewed in the accompanying paper by Mohanty (2014). Finally, we estimate a monthly VAR model and study the impulse responses of cross-border portfolio flows to EMEs following changes in the US long-term interest rate.

When we talk of spillovers, we mean that at least one of the following variables is affected as discussed in Caruana (2013): (i) quantities, (ii) prices and/or (iii) endogenous policy responses. Quantity effects include changes in gross capital flows such as portfolio investment and cross-border bank lending. However, asset prices can change without necessarily requiring a change in quantities. Finally, EME central banks may adjust their policy settings in response to advanced economy monetary conditions to limit quantity and price movements.

The rest of the paper is organised as follows. Section 2 discusses the policy rate responses. Section 3 investigates the long-term interest rate. Section 4 discusses the issues relating to exchange rates, international bank lending and portfolio flows. Section 5 concludes.

2. Response of EME policy rates to US monetary policy

EME central banks might react to the stance of US monetary policy when setting their policy interest rates. In fixed exchange rate regimes with free capital mobility, such as Hong Kong SAR, Saudi Arabia and the United Arab Emirates, the link between advanced and EME policy rates is largely direct and automatic. In China, notwithstanding capital controls and progressive liberalisation of the exchange rate regime over the past decade, the renminbi short-term interest rate has not deviated much from the US policy rate.

The impact of advanced economy monetary policies on EME policy rates is not automatic in floating exchange rate regimes. Many EMEs have formally adopted inflation targeting regimes over the past two decades. Under strict inflation targeting the exchange rate is allowed, in principle, to move freely. This would, in turn, help to insulate monetary policy from external effects, as implied by the Trilemma theory.[3] However, according to the IMF only Chile, the Czech Republic, Israel, Mexico and Poland are classified among the inflation targeting economies of the meeting as operating under fully free floating exchange rates. Thus, the resulting resistance to large exchange rate movements, a kind of "fear of floating" from Calvo and Reinhart (2002), could still link EME monetary policy to advanced economies beyond, for instance, what inflation targeting policy responses would imply.

Furthermore, even full exchange rate flexibility might be insufficient to insulate emerging economies from advanced economy monetary policy. Rey (2013) argues, for instance, that without capital controls EME monetary policies are necessarily linked to advanced economy monetary policies: there is no Trilemma, only the dilemma between free capital movements and independent monetary policy.

In the following, we investigate empirically how monetary policy in advanced economies, in particular in the United States, affects policy rate setting in EMEs.

[3] The Trilemma, or impossible trinity, originates from the work of Fleming (1962) and Mundell (1963) and states that countries can have two of the following three: free capital movement, fixed exchange rates and independent monetary policy.

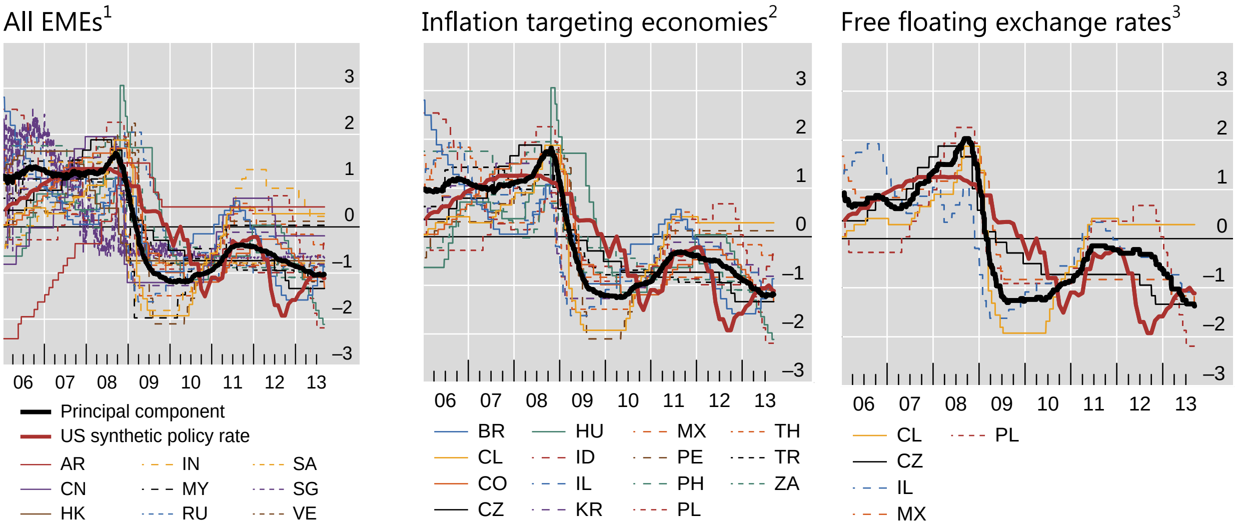
Co-movement of EME policy rates: principal component analysis

Principal component analysis provides straightforward evidence on the co-movement in EME policy rates (Graph 1). When considering all EMEs together (left-hand panel), one can see that in spite of the sizeable heterogeneity there is a strong co-movement of policy rates in EMEs: the first principal component explains around 60% of the total variation in rates.[4]

Furthermore, the first principal component of EME policy rates (thick black line on Graph 1) seems to follow a similar, though not fully identical path to that of the "shadow" US monetary policy rate (thick red line). In order to account for the impact of unconventional monetary policies, we measure the stance of US monetary policy by using the estimates from Lombardi and Zhu (2013). This estimate accounts for the impact of unconventional policies once the policy interest rate has reached the zero lower bound. Naturally, it can be negative.

Principal components for emerging economies: policy rates

Normalised variables (zero mean and unit standard deviation) Graph 1



AR = Argentina; BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; HK = Hong Kong SAR; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; RU = Russia; SA = Saudi Arabia; SG = Singapore; TH = Thailand; TR = Turkey; VE = Venezuela; ZA = South Africa.

[1] The first principal component accounts for 61% of total variations of time series for the 24 countries under consideration. [2] The first principal component accounts for 66% of total variations of time series for the 15 countries under consideration. [3] The first principal component accounts for 70% of total variations of time series for the five countries under consideration.

Sources: Bloomberg; Datastream; BIS calculations.

[4] The strength of the co-movement is difficult to compare with that of advanced economies. Though the first principal component would explain a larger share of total variation for advanced economies, the advanced economy figure is artificially inflated because there are fewer advanced economies with independent monetary policy and many of those reached the zero lower bound for some time.

Surprisingly, the correlation between US and EME policy rates is stronger for inflation targeting regimes than for all EMEs taken together (Graph 1, centre panel). Taken at face value, and without controlling for other factors, this suggests that inflation targeting might not be sufficient in itself to insulate the domestic monetary policy decision from external influence. Furthermore, the correlation is just as strong in the case of those economies which the IMF considers as having a fully free floating exchange rate (right-hand panel). Though other factors, such as co-movements in EME and US business cycles, might also be responsible for this result, the strong correlations in EME policy rates certainly suggest the possibility that advanced economy monetary policy drives this common factor.

Regression analysis

The strong co-movement calls for a closer investigation of key drivers of policy rates: how far does the co-movement reflect external monetary factors (such as US monetary policy) as opposed to domestic factors (such as the business cycle or inflation)? In order to achieve this identification, we investigate the impact of advanced economy monetary policy in two steps.

In the first step, we estimate a domestic Taylor equation for each EME:

$$r_{t,EME} = c + \alpha\pi_{t,EME} + \beta y_{t,EME} \tag{1}$$

where r denotes the monetary policy rate of the EME in question, π the inflation rate and y the output gap; t is the quarterly time index. In the regression analysis, we focus on the post-2000 period when most EMEs' monetary policy turned countercyclical as shown in Takáts (2012). The country sample covers 20 out of 24 economies participating in the meeting as data were not available for four countries.[5]

We then augment the Taylor equation with the US policy rate and separately also with the US shadow policy rate from Lombardi and Zhu (2013):

$$r_{t,EME} = c + \alpha\pi_{t,EME} + \beta y_{t,EME} + \gamma r_{t,US} \tag{2}$$

The results show that US monetary policy has a statistically and economically significant impact on EME policy rates (Table 1). The first and second columns show, respectively, the estimated impact of the US federal funds and shadow rates during the period 2000–13 and the third column shows the results for the US shadow rate for 2008–13. While there are important nuances and small differences, the basic message is clear: US monetary policy has a significant impact, both statistically and economically, on EME policy rate setting. Thus, the results suggest that more accommodative advanced economy monetary policies led to more accommodative EME policies than would have been warranted by Taylor rules consistently with the estimates of Hofmann and Bogdanova (2012).

Further analysis shows that economic crises originating from EMEs do lead to larger coefficient estimates as policy rates appear to be more sensitive to sudden changes in economic and financial conditions. In our sample period, Brazil and

[5] In the case of Singapore, we used the interbank overnight rate implied by its monetary policy centred on the management of the trade-weighted exchange rate.

Turkey experienced crises and the size of the coefficient estimates partly reflect this. However, re-estimating the coefficients for the post-2003 period still yields economically and statistically significant results. Our results are also robust to a number of changes in the specification as detailed in the Appendix. Adding exchange rates, lagging independent variables or adding the lagged dependent variable do not materially affect the main thrust of the findings.

Estimated EME policy rate response to US monetary policy Table 1

	US policy rate	US shadow rate	
	Q1 2000–Q3 2013		Q1 2008–Q3 2013
Brazil	1.08***	0.66***	0.35***
Chile	0.03	0.02	–0.10
China	0.07***	0.04**	0.03
Colombia	0.36***	0.16**	0.06
Czech Republic	0.48***	0.39***	0.21***
Hungary	0.07	0.30***	0.34***
India	0.38***	0.24***	0.05
Indonesia	0.50***	0.48***	0.17***
Israel	0.95***	0.41***	–0.15***
Korea	0.32***	0.19***	0.08
Malaysia	0.02	0.01	–0.03**
Mexico	0.78***	0.26***	0.22***
Peru	0.51***	0.19***	–0.09**
Philippines	0.89***	0.44***	0.05***
Poland	0.75***	0.50***	0.03
Russia	0.53**	–0.14	0.10
Singapore	0.49***	0.14***	0.05***
South Africa	0.73***	0.59***	0.36***
Thailand	0.16***	0.05	–0.02
Turkey	3.33***	1.52***	0.86***

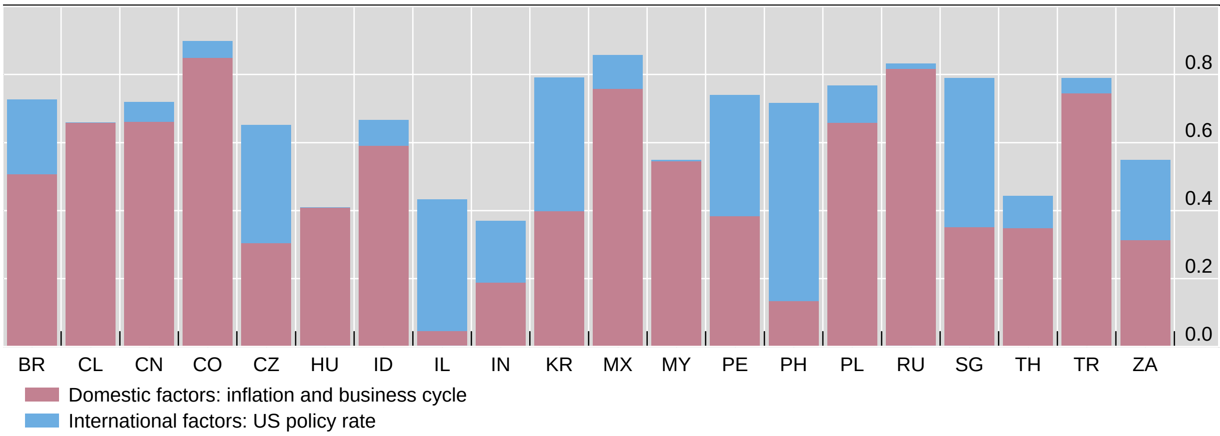
γ coefficient estimates for equation (2): *** denotes results significant at the 1% level, ** at the 5% level and * at the 10% level.

Source: Authors' calculations.

The results are also consistent with the questionnaire responses: the number of countries that report a response to advanced economy monetary policy falls after 2008. While for the full 2000–13 period the shadow policy rate coefficient is significantly positive at the 5% level for 16 economies, it is only significantly positive at the same level for nine economies during 2008–13. Furthermore, for three countries (Israel, Malaysia and Peru) the US shadow rate becomes negatively significant. While these negative effects are interesting they do not seem to be economically significant.

Furthermore, our regression framework describes the evolution of EME policy rates well. Graph 2 shows that the estimated policy rule explains between 40 and 90% of the variance of EME policy (red and blue bars together). Domestic factors (red bars) explain a large share of the total variation in most EMEs: over 60% in Chile, China, Colombia, Mexico, Poland, Russia and Turkey. However, the US policy rate (blue bars) also explains a substantial part: between 20 and 40% in Brazil, the Czech Republic, Israel, Peru, the Philippines, Singapore and South Africa.

Factors explaining EME monetary policy[1] Graph 2



BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; RU = Russia; SG = Singapore; TH = Thailand; TR = Turkey; ZA = South Africa.

[1] Red bars: R-squared from estimating equation (1). Red and blue bars: R-squared from estimating equation (2) with the US policy rate. Blue bars: partial R-squared for US monetary policy.

Source: Authors' calculations.

These significant regression results do not necessarily imply a loss of monetary policy independence in EMEs. In principle, EME central banks can choose their short-term policy rates. The question is *why* they seem to follow US monetary policy, an issue which is discussed in the accompanying paper by Gadanecz, Miyajima and Urban (2014). While this might happen due to monetary spillovers, there are other explanations too. For instance, US monetary policy might co-move with some common factors, such as the prospects for the global business cycle and risk sentiment, which affect EMEs and advanced economies alike. Furthermore, the significant results, even if true for EMEs as a group, do not apply to all EMEs. For example, in Chile and Malaysia we found consistent evidence that US monetary policy is not significant for domestic policy rate setting.

In sum, our results indicate that EME policy rates co-move together with the US rate. Furthermore, the impact of US monetary policy seems to have declined after 2008. These results are also consistent with central bank questionnaire responses.

3. The long-term interest rate

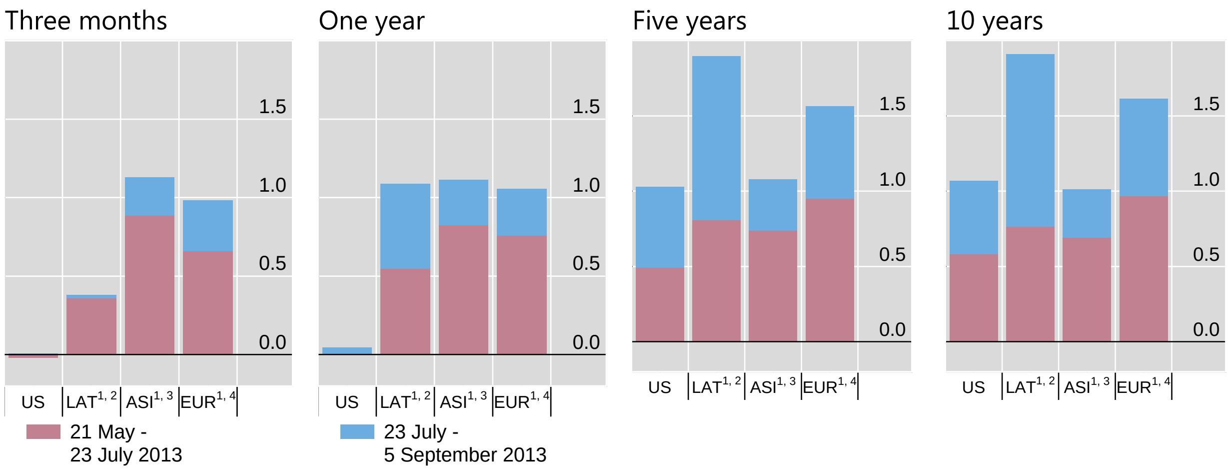
The long-term interest rate in advanced economies can influence financial conditions in EMEs through portfolio investment decisions. The freer capital markets are and the greater the substitutability between long-term bonds of advanced economies and those of EMEs, the stronger is the expected impact of advanced economy rates on EME yields as, for instance, suggested by Turner (2014). However, capital flows are not strictly necessary for this spillover: yields can and do adjust through price effects with little or no capital flows. This spillover is in sharp contrast with the short-term rate, where international factors might convince central banks to adjust their rates, but the choice is ultimately theirs.

The close co-movements of global long-term yields after the Federal Reserve's "tapering" announcement last summer demonstrated how rapidly changes in US bond yields can be transmitted to other countries (Graph 3). Yields started to rise after the announcement (red bars), and continued to rise until early September (blue bars) – that is, until the Federal Reserve clarified its policy response. The current turmoil provides similar anecdotal evidence on the impact of US long-term rates. And more systemic evidence is also accumulating; for instance, Moore et al (2013) show how US large-scale asset purchases have compressed EME long-term yields.

Yield curve evolution after the "tapering" announcement

Change, in percentage points

Graph 3



US = United States; LAT = Latin America; ASI = Asia; EUR = Emerging Europe.

[1] Change in weighted average based on 2005 GDP and PPP exchange rates of the economies listed. [2] Brazil, Chile, Colombia, Mexico and Peru. [3] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Singapore and Thailand. [4] The Czech Republic, Hungary, Poland, Russia and Turkey.

Source: Bloomberg.

A principal component analysis confirms the co-movement of long-term yields. The first principal component explains around 55% of the total variation across EMEs, which is higher than the corresponding figure for advanced economies. Furthermore, the first principal component of the EME bond yield co-moves very closely with the US long-term rate. This co-movement suggests that common factors could drive EME long-term yields.

Regression analysis

To shed further light on the issue we estimate a regression model incorporating both the domestic policy rate and US long-term yields following Turner (2014). Formally, we estimate the regression model below:

$$r^{long}_{t,EME} = c + \alpha r^{policy}_{t,EME} + \lambda r^{long}_{t,US} \qquad (3)$$

where r^{long} denotes the five-year interest rates in EMEs and in the US, respectively, r^{policy} denotes the EME policy rate, , and t denotes monthly frequency. We use fully modified OLS to account for the cointegrating relationship. As before, we use series dating back to 2000. However, to expand our sample size to 19 EMEs we allowed eight economies which have series starting later than 2000, but not later than 2004.

The results show that US long-term rates have a statistically and economically significant impact on EME long-term rates (Table 2). The first column shows the coefficient estimates for 2000–13: eight out of the 19 estimates are significantly positive at the 5% level and only two are significantly negative at that level. The coefficients are also economically significant: on average a 10 basis point change in the US long-term rate is associated with around a 2 to 7 basis point change in EME long rates. The second column shows the impact for 2008–13. Interestingly, in spite of the smaller sample size, the estimates tend to be larger and are significant for more countries: 14 out of 19 estimated coefficients are significantly positive at the 5% level and only one is significantly negative at that level. These results are again consistent with the questionnaire responses.

Estimated EME long-term rate response to the US long-term rate — Table 2

	M1 2000–M9 2013[1]	M1 2008–M9 2013
Brazil	0.11	1.45***
Chile	0.09**	0.09
China	–0.03	0.05
Colombia	0.30	1.40***
Czech Republic	0.05	0.84***
Hong Kong SAR	1.28***	0.88***
Hungary	–0.27***	–0.11
India	–0.11	–0.08
Indonesia	0.50	0.98***
Israel	0.19	0.66***
Korea	0.66***	1.02***
Malaysia	0.52***	1.03***
Mexico	0.22***	0.26***
Philippines	–0.19	0.94***
Poland	0.12	0.77***
Russia	–0.78***	–0.84***
Singapore	0.67***	0.58***
South Africa	0.37***	1.10***
Thailand	0.32***	0.35***

γ coefficient estimates for equation (3):*** denotes a coefficient significant at the 1% level, ** at the 5% level and * at the 10% level.

[1] India and Mexico, M4 2000-; Israel, M4 2001-; Chile, Q4 2002-; Colombia and Indonesia, M1 2003-; Brazil and China, M1 2004-.

Source: Authors' calculations.

The coefficient estimates are also robust to changes in the specification as discussed in detail in the Appendix. Removing the lagged dependent variable or adding additional controls does not change the main thrust of the results: US long-term rates drive EME long-term rates.

In sum, our results show that US long-term yields significantly drive long-term yields in EMEs. Furthermore, similarly to how central banks perceived the evolution of this impact in their questionnaire responses, our results suggest that the influence of US long-term rates became stronger after 2008.

4. Exchange rates, bank lending and portfolio flows

In the previous two sections we explored the influence of two variables – advanced economies' short-term and long-term interest rates – on the corresponding variables in EMEs. In this section, we broaden the analysis to consider spillovers operating through the exchange rate, international bank lending and portfolio flows.

These variables are interdependent, as Alper et al (2013) argued. Bruno and Shin (2013) showed that US monetary policy drives private sector risk-taking. In turn this risk-taking, measured for instance by the VIX index, drives exchange rates, bank lending and portfolio flows – and thereby transmits monetary policy internationally. First, to stimulate the discussion on these interactions, we briefly describe the mechanisms at work.

Exchange rates

Easier monetary policy in the United States leads to portfolio adjustments and generally an appreciation in EME exchange rates. This currency appreciation in turn reduces demand for domestic goods and hurts trade competitiveness. In addition, Borio and Lowe (2002) and more recently Gourinchas and Obstfeld (2012) show evidence that overvalued exchange rates contribute to the build-up of financial stability risks. Rapid depreciations then lead to stresses on financial stability, especially in heavily dollarised or euroised economies.

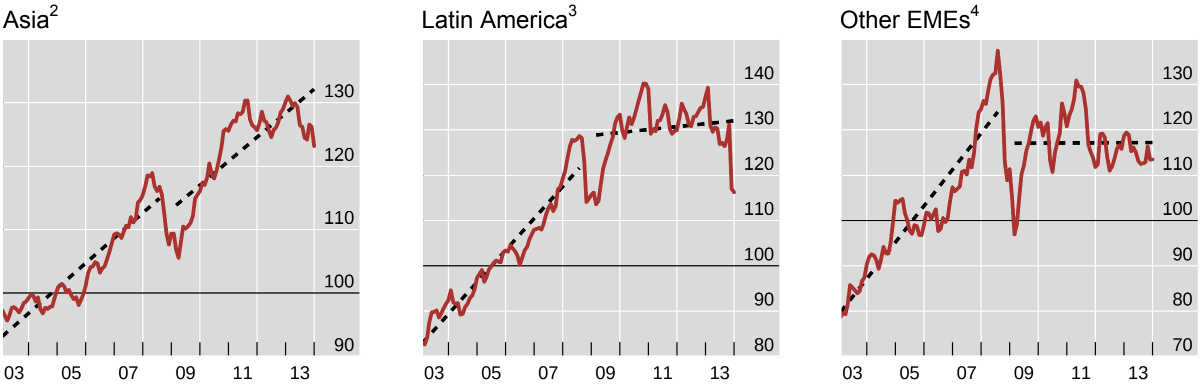
A currency appreciation, which may have a qualitatively similar impact on aggregate output to an increase in policy rates, affects the tradable sector disproportionately. Given that the effects of interest rate changes are more broadly felt, EMEs might have difficulties in offsetting the impact of exchange rate appreciation. Not surprisingly given these concerns, EMEs are often perceived as resisting exchange rate appreciation.

However, in spite of these concerns EME currencies did appreciate substantially in real terms in all regions prior to the 2008 financial crisis (Graph 4). Though during the global financial crisis EMEs' currencies weakened significantly, emerging Asian currencies resumed their real appreciation trend after the crisis (left-hand panel). By contrast, real exchange rate appreciation has virtually stopped in Latin America (centre panel) and in other EME regions in the post-crisis period (right-hand panel).

EME exchange rates also move together, pointing to a common driving factor. The first principal component explains around 50% of the total variation.

Real exchange rates in emerging markets[1]

Graph 4



Dashed black lines represent trends for the periods January 2003 to July 2008 and February 2009 to December 2013, respectively.

[1] Real exchange rate vis-à-vis the US dollar, deflated by CPI. Simple average of real exchange rate indices (2005 = 100) of the region. An increase denotes an appreciation. [2] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [3] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [4] The Czech Republic, Hungary, Poland, Russia, South Africa and Turkey.

Source: National data.

International bank lending

Monetary policy decisions in advanced economies affect global liquidity and hence the ability of both banks and other corporations to fund real and financial assets. This ability, however, does not depend directly on the level of monetary policy, but on how the conditions set by monetary policy are translated into the financing costs of market participants. We focus first on the role of international banks, and discuss the role of other corporations in the transmission of global shocks to EMEs separately later.

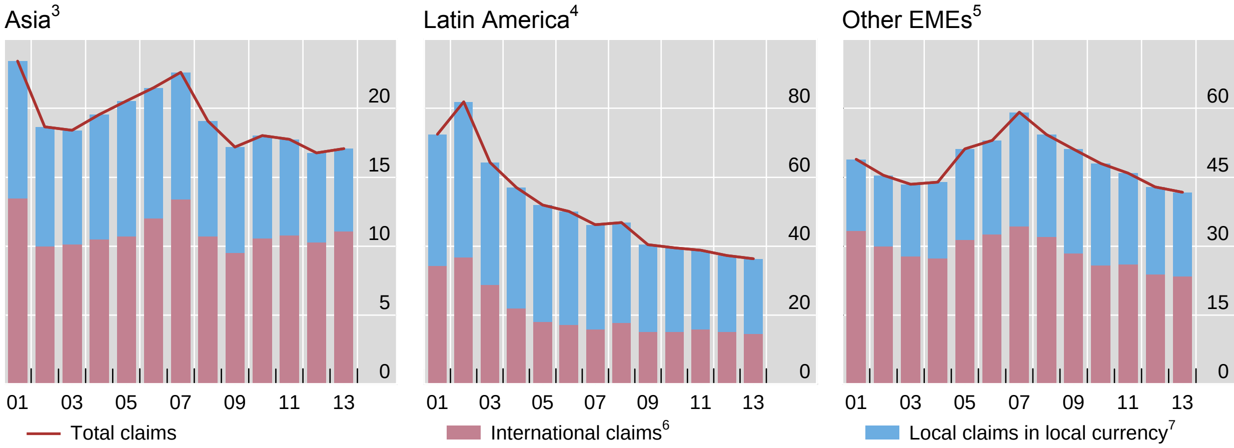
International banks have traditionally played a large role in transmitting global financial conditions, including the impact of advanced economy monetary policy, to EMEs as shown, for instance, by Cetorelli and Goldberg (2012). The relevance of advanced economy factors in cross-border bank lending has also been confirmed by studies using the BIS international banking statistics, for instance Takáts (2010) and Avdjiev et al (2012).

However, in spite of impressive growth figures when expressed in US dollars, international bank lending has tended to lose importance or to stagnate in comparison to domestic financing in most EME regions over the past decade (Graph 5). The main reason is the fast development of EME financial markets and local financial institutions. The BIS banking statistics, which include the local operations of international banks, illustrate this. In Latin America the share of international banks in financing the domestic economy was falling even before the financial crisis (red line on centre panel). In emerging Asia (left-hand panel) and in other EMEs (right-hand panel) the financial crisis eroded all the gains international banks had made before 2008.

There is also substantial geographical heterogeneity: international banks finance a larger share of the domestic credit in Latin America and other regions than they do in emerging Asia. These differences naturally affect how much international bank lending can affect these regions.

BIS reporting banks' lending to emerging market economies[1]

As a percentage of domestic credit[2] Graph 5



[1] Emerging market positions of BIS reporting banks. Data are not adjusted for exchange rate movements. For 2013, as of Q2. [2] Bank credit to the private and public sector. [3] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [4] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [5] Algeria, the Czech Republic, Hungary, Israel, Poland, Russia, Saudi Arabia, South Africa, Turkey and the United Arab Emirates. [6] International claims comprise consolidated cross-border claims in all currencies and local claims in foreign currencies. [7] Local claims in local currency comprise local currency claims of reporting banks' foreign offices with local residents.

Sources: IMF, *International Financial Statistics*; national data; BIS consolidated banking statistics on an immediate borrower basis.

Furthermore, one needs to consider not only the size of international banks, but also their funding and lending model. International claims, ie cross-border claims and local claims in foreign currency, are more likely to transmit foreign monetary impulses (red bars on Graph 5), whereas locally funded local currency-denominated claims (blue bars) are more sensitive to local monetary policies. Thus, looking forward, emerging Asia, where international claims became more important relative to local-in-local claims (left-hand panel), is likely to be more affected than total claims of international banks would suggest. And the historically high share of locally funded local currency claims in Latin America (centre panel) may suggest that foreign monetary policy might affect the regions less than the size of international banks would otherwise suggest. However, these local-in-local claims might not necessarily insulate EMEs from international bank lending: international banks may be less responsive to host country monetary policy than domestic banks, as Wu et al (2009) argue. In addition to international banks, domestic banks in EMEs also often lend in foreign currencies, which transmits further international shocks. He and McCauley (2013) document, for instance, the growing share of foreign currency loans in China.

Notwithstanding this heterogeneity, cross-border bank lending to EMEs has also co-moved strongly across countries over the past decade. The first principal component explains around 60% of the total variation. This is remarkably high compared to advanced economies, where the first principal component is able to account for less than 50%. This strong co-movement again suggests that common drivers are at work.

Portfolio flows

In recent years capital flows to EMEs and issuance of securities by EME corporations in international debt markets have taken an increasingly important role. Consequently, changes in investor sentiment and risk-taking, in part influenced by monetary policy in the jurisdictions of the main international currencies, represent another major avenue through which advanced economy monetary conditions can affect EMEs. The effect can manifest itself as changes in quantities (for instance, in gross capital flows) or prices. One example is the well-known risk-on/risk-off behaviour of international investors.

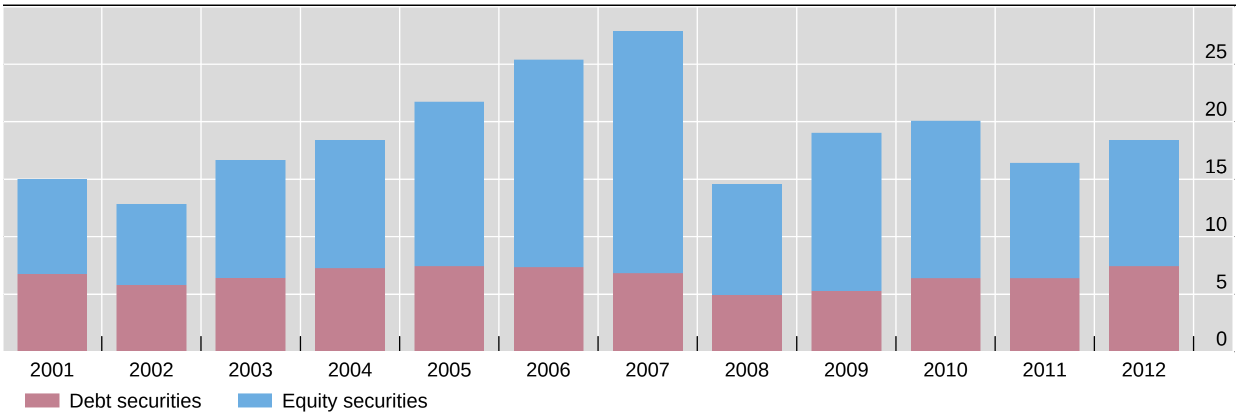
The value of portfolio investment in EMEs grew much faster than domestic credit in EMEs before the financial crisis in 2008 (Graph 6). Though capital outflows and falling valuations reduced these portfolios substantially in 2008, they recovered by more than US$ 2 trillion in the following five years. The recovery was particularly strong for debt securities (red bars), which reached around the same levels compared to domestic credit as before the financial crisis.

While some of these gross flows reflect the improved fundamentals and growth prospects of EMEs, a significant part is influenced by unconventional monetary conditions in advanced economies. There are thus concerns that the unwinding of easy monetary policy in advanced economies could lead to large reversals of these inflows from EMEs.

Portfolio investment in EMEs[1]

As a percentage of domestic credit[2]

Graph 6



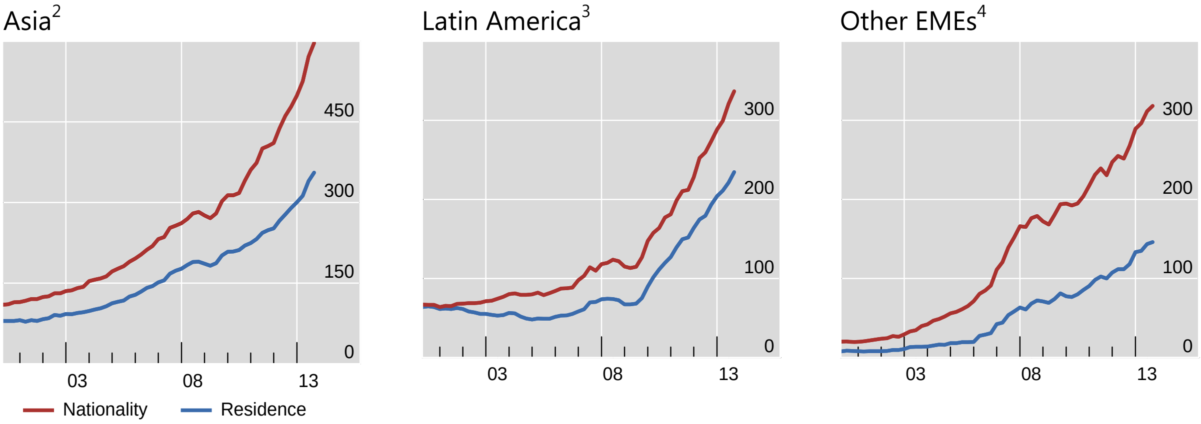
[1] Derived portfolio investment liabilities. Emerging market economies: Algeria, Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand, Turkey, the United Arab Emirates and Venezuela. [2] Bank credit to the private and public sector.

Sources: IMF, Coordinated Portfolio Investment Survey, International Financial Statistics; national data.

The international issuance of debt securities of EME non-bank corporations has increased rapidly since 2008 (Graph 7). Consequently, even those economies where external debt is considered low could be vulnerable to global monetary shocks, because corporations might issue securities via affiliates in offshore centres. This offshore issuance is captured by the difference between corporate international debt issuance by borrower nationality (red line) and by residence (blue line). The gap has increased rapidly to around US$ 250 billion for emerging Asia (left-hand panel), US$ 100 billion for Latin America (centre panel) and around US$ 150 billion for other emerging economies (right-hand panel).

International debt securities by residence and nationality[1]

Amount outstanding, in billions of US dollars — Graph 7



[1] International debt securities issued by non-banks (non-financial and financial corporations excluding central banks, private banks and public banks), in all maturities. [2] Aggregate of China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [3] Aggregate of Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [4] Aggregate of Algeria, the Czech Republic, Hungary, Israel, Poland, Russia, Saudi Arabia, South Africa, Turkey and the United Arab Emirates.

Sources: BIS securities statistics by nationality; BIS securities statistics by residence.

The strong co-movement in portfolio inflows to EMEs suggests the existence of common factors. The first principal component of cumulative capital inflows explains more than 92% of movements in individual EME capital inflows. This is much higher than the corresponding value of 66% for advanced economies.

Panel VAR analysis of portfolio inflows, exchange rates and reserves

In the rest of this section we carry out a more general econometric exercise that brings together some of the factors discussed so far. In particular, we explore the international transmission of changes in US sovereign yields through an unrestricted panel VAR model, which considers the interconnectedness of long-term interest rates, cross-border portfolio flows and exchange rates.

The estimation is based on monthly observations over 2005–13 for 13 EMEs for which information was readily available.[6] All of these countries have flexible exchange rates. The United States was used to represent advanced economies. The panel VAR includes the following variables: (i) 10-year US sovereign yields (representing global monetary conditions), (ii) the difference between 10-year US and EME government bond yields, (iii) cross-border portfolio flows to EMEs (proxied

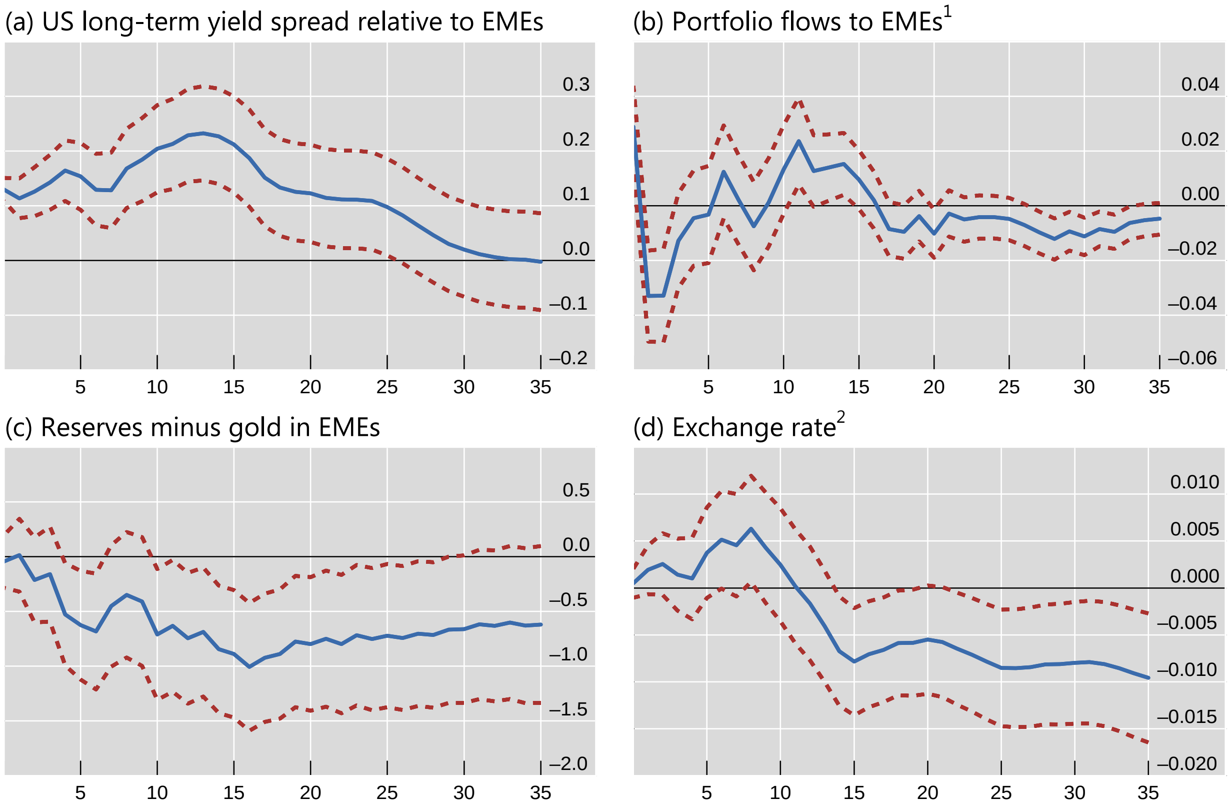
[6] The EMEs considered in the estimation were chosen on the basis of data availability for the 10-year sovereign yields: Brazil, Chile, Colombia, the Czech Republic, India, Indonesia, Israel, Korea, Mexico, Peru, the Philippines, Poland and Singapore.

by flows to dedicated EME mutual funds reported by EPFR) and (iv) nominal exchange rates of EMEs vis-à-vis the US dollar.[7]

Given space limitations, we report only the (generalised) impulse responses of long-term interest rate spreads, portfolio flows and exchange rates to a change in 10-year US sovereign yields. As Graph 8 shows, an increase in these yields results in a mild increase in the spread of US yields relative to EMEs' long-term yields. Therefore, despite the fact that long-term yields in both the United States and EMEs tend to co-move closely, the spread widens (panel (a)).

Impulse response function to a one standard deviation shock to US long-term yields

Response of each variable | Graph 8



[1] As measured by EPFR. [2] Domestic currency per US dollar.

Source: Authors' calculations.

The contractionary impact of a rise in US long-term yields on portfolio capital flows to EMEs appears to be relatively short-lived (panel (b)), despite the fact that the effect on long-term yield differentials is somewhat persistent. The gross flows decline sharply following the change but then return to previous levels in a fairly short time period.

[7] The panel VAR excludes fixed effects and analysis focuses on generalised impulse responses. Therefore, the shocks are not orthogonal and one cannot attach to them any structural interpretation.

An interesting outcome of the analysis is the response of international reserve assets (excluding gold) to the increase in US long-term yields (panel (c)). Not only do international reserves contract on impact but the effect also seems to show some persistence. One possible interpretation is that central banks in EMEs have relied on FX intervention as a shock absorber in response to developments in international financial markets.

However, our analysis does not indicate a clear-cut response of exchange rates to US long-term yields, perhaps as a result of the different ways in which EMEs have reacted to changes in US yields. In particular, our results indicate that higher US long-term yields have induced a statistically negligible depreciation pressure on exchange rates (panel (d)), which is followed by a significant appreciation. Clearly, this may also reflect several factors driving exchange rates (eg FX intervention or capital account measures).

5. Conclusion

In this note, we discuss a number of channels through which monetary policy in advanced economies can affect EMEs and we find evidence of tight linkages. In addition, consistent with the questionnaire responses from central banks, we find that EME policy rates reacted less to advanced economy monetary policy after the 2008 crisis, while their long-term interest rates have reacted more to changes in long-term rates in advanced economies. Our VAR analysis also suggests that changes in US long-term interest rates are associated with significant effects on portfolio flows to EMEs and international reserves.

However, many uncertainties remain about how exactly international monetary transmission works. The potential channels certainly need more discussion and research. The discussion at the meeting has identified two other potential channels. The first one is the commodity price channel. Several central banks have argued that advanced economy monetary policy has a direct impact on commodity prices, and therefore on macroeconomic conditions in EMEs. The precise channel, through which this might occur – investment in commodity related financial assets, commodity futures, remains uncertain. The second is the market psychology channel. The discussion revealed that market psychology can play an independent role in the transmission of advanced economy monetary policy to EMEs. This can manifest through rapid shifts in market sentiment, from excessive optimism to excessive pessimism, in response to actual or perceived changes in advanced economy monetary policy stance. Finally, the spillover effects are likely to depend on country-specific factors which have not been adequately studied.

Appendix

Robustness of the analysis of policy responses

In order to confirm robustness of our findings we repeated the analysis in four additional specifications. The main thrust remained unchanged: US monetary policy does matter for EME policy rate setting, but the impact weakens after 2008.

Equation (A.1) uses lagged independent variables to address endogeneity concerns. Equation (A.2) adds the exchange rate. In spite of the importance of the exchange rate in non-linear specification and higher-frequency data, it often turned out to be insignificant. At quarterly frequency the exchange rate is highly endogenous: we might not observe exchange rate movements precisely because of the EME policy reaction. Equation (A.3) adds the lagged dependent variable to address autocorrelation in policy rates. However, the relationship with the US policy rate remains strong. Finally, equation (A.4) combines lagged policy rates and exchange rates.

$$r_{t,EME} = c + \alpha\pi_{t-1,EME} + \beta y_{t-1,EME} + \gamma r_{t,US} \qquad \text{A.1}$$

$$r_{t,EME} = c + \alpha\pi_{t,EME} + \beta y_{t,EME} + \gamma r_{t,US} + \theta\Delta REER_{t,EME} \qquad \text{A.2}$$

$$r_{t,EME} = c + \varphi r_{t-1,EME} + \alpha\pi_{t,EME} + \beta y_{t,EME} + \gamma r_{t,US} \qquad \text{A.3}$$

$$r_{t,EME} = c + \varphi r_{t-1,EME} + \alpha\pi_{t,EME} + \beta y_{t,EME} + \gamma r_{t,US} + \theta\Delta REER_{t,EME} \qquad \text{A.4}$$

Finally, we also re-estimated the baseline regression for central and eastern European economies (the Czech Republic, Hungary and Poland) for the euro rate instead of the US dollar rate. Again, the results remained robust.

Robustness of the influence of long-term interest rates

We repeated the analysis in three additional specifications. The main thrust remained unchanged: US monetary policy does matter for EME policy rate setting and the impact is stronger after 2008.

$$r^{long}_{t,EME} = c + \varphi r^{long}_{t-1,EME} + \alpha r^{policy}_{t,EME} + \lambda r^{long}_{t,US} \qquad \text{A.5}$$

$$r^{long}_{t,EME} = c + \alpha r^{policy}_{t,EME} + \beta\pi_{t,EME} + \gamma E_t \pi_{t+long,EME} + \phi d_{t,EME} + \lambda r^{long}_{t,US} \qquad \text{A.6}$$

$$r^{long}_{t,EME} = c + \varphi r^{long}_{t-1,EME} + \alpha r^{policy}_{t,EME} + \beta\pi_{t,EME} + \gamma E_t \pi_{t+long,EME} + \phi d_{t,EME} + \lambda r^{long}_{t,US} \qquad \text{A.7}$$

Equation (A.5) repeats the analysis with the lagged dependent variable. Using quarterly data equation (A.6) controls for inflation, long-term inflation expectations and budget deficit following Miyajima et al (2012) and Montoro et al (2012). Finally, equation (A.7) adds the lagged dependent variable to equation (A.6). In addition, we also repeated the analysis with the 10-year bond yield. Though data was available for fewer countries, the main thrust of the results did not change.

References

Adam, M (2013): "Spillovers and contagion in the sovereign CDS market", *Bank i Kredyt*, vol 44, issue 6, pp 571–604.

Adam, T and S Benecka (2013): "Financial stress spillover and financial linkages between the euro area and the Czech Republic", *Czech Journal of Economics and Finance*, vol 63, issue 1, pp 46–64.

Alper, K, H Kara and M Yörükoğlu (2013): "Alternative tools to manage capital flow volatility", *BIS Papers*, no 73, pp 335–52, October.

Avdjiev, S, Z Kuti and E Takáts (2012): "The euro area crisis and cross-border bank lending to emerging markets", *BIS Quarterly Review*, December.

Aysan, A F, S Fendoğlu and M Kilinç (2013): "Macroprudential policies as buffer against volatile cross-border capital flows", mimeo.

Bank for International Settlements (2011): "The risks of international imbalances: beyond current accounts", *81st Annual Report*, Chapter 3, June.

Barroso, J, L A Pereira da Silva and A Soares Sales (2013): "Quantitative easing and related capital flows into Brazil: measuring its effects and transmission channels through a rigorous counterfactual evaluation", *Working Paper Series*, no 313, Central Bank of Brazil, Research Department, July.

Borio, C and P Lowe (2002): "Assessing the risk of banking crises", *BIS Quarterly Review*, December.

Borio, C and H Zhu (2012): "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?", *Journal of Financial Stability*, vol 8, issue 4, pp 236–51.

Bruno, V and H S Shin (2013): "Capital flows and the risk-taking channel of monetary policy", mimeo.

Bruno, V and H S Shin (2014): "Cross-border banking and global liquidity", mimeo, http://www.princeton.edu/~hsshin/www/capital_flows_global_liquidity.pdf.

Calvo, G A and C M Reinhart (2002): "Fear of floating", *Quarterly Journal of Economics*, vol 117, issue 2, pp 379–408.

Caruana, J (2013): "Ebbing global liquidity and monetary policy interactions", speech delivered at the Central Bank of Chile Fifth Summit Meeting of Central Banks on Inflation Targeting: "Global liquidity, capital flows and policy coordination", Santiago, Chile, 15 November.

Cetorelli, N and L S Goldberg (2012): "Banking globalization and monetary transmission", *Journal of Finance*, vol 67, issue 5, pp 1811–43.

Chen, Q, A Filardo, D He and F Zhu (2012): "International spillovers of central bank balance sheet policies", *BIS Papers*, no 66, pp 230–74, October.

Chua, W S, N Endut, N Khadri and W H Sim (2013): "Global monetary easing: spillovers and lines of defence", *Bank Negara Malaysia Working Paper Series*, WP3/2013, December.

Filardo A and M Lombardi (2013): "Has Asian emerging market monetary policy been too procyclical when responding to swings in commodity prices?", mimeo.

Fleming, J M (1962): "Domestic financial policies under fixed and floating exchange rates", *IMF Staff Papers*, vol 9, pp 369–79.

Gadanecz, B, K Miyajima and J Urban (2014): "How could EM central banks respond to the influence of global monetary factors?", BIS Papers, no 78, August.

Gourinchas, P-O and M Obstfeld (2012): "Stories of the twentieth century for the twenty-first", *American Economic Journal: Macroeconomics*, American Economic Association, vol 4, no 1, pp 226–65, January.

He, D and R McCauley (2013): "Transmitting global liquidity to East Asia: policy rates, bond yields, currencies and dollar credit", *BIS Working Papers*, 431, October

Hofmann, B and B Bogdanova (2012): "Taylor rules and monetary policy: a global "Great Deviation"?", *BIS Quarterly Review*, September.

Lombardi, M and F Zhu (2013): "Filling the gap: a factor based shadow rate to gauge monetary policy", mimeo.

Miyajima, K, M S Mohanty and T Chan (2012): "Emerging market local currency bonds: diversification and stability", *BIS Working Papers*, no 391, November.

Mohanty, M (2014): "International transmission of monetary policy – an overview", BIS Papers, no 78, August.

Mohanty, M and P Turner (2008): "Monetary policy transmission in emerging market economies: what is new?", *BIS Papers*, no 35, January.

Montoro, C, E Takáts and J Yetman (2012): "Is monetary policy constrained by fiscal policy?", *BIS Papers*, no 67, October.

Moore, J, S Nam, M Suh and A Tepper (2013): "Estimating the impacts of U.S. LSAPs on emerging market economies' local currency bond markets", *Federal Reserve Bank of New York Staff Reports*, no 595, January.

Mundell, R A (1963): "Capital mobility and stabilization policy under fixed and flexible exchange rates", *Canadian Journal of Economics and Political Science*, vol 29.

Rey, H (2013): "Dilemma not trilemma: the global financial cycle and monetary policy independence", mimeo.

Ruch, F (2013): "The impact of international spillovers on the South African economy", *South African Reserve Bank Working Papers*, WP/13/02, May.

Shin, H S (2012): "Global banking glut and loan risk premium", Mundell-Fleming Lecture, *IMF Economic Review*, vol 60, issue 2, pp 155–92.

Shin, H S (2013): "The second phase of global liquidity and its impact on emerging economies", remarks at the 2013 Federal Reserve Bank of San Francisco Asia Economic Policy Conference, November.

Takáts, E (2010): "Was it credit supply? Cross-border bank lending to emerging market economies during the financial crisis", *BIS Quarterly Review*, June.

Takáts, E (2012): "Countercyclical policies in emerging markets", *BIS Quarterly Review*, June.

Taylor, J (2013): "International monetary policy coordination: past, present and future", *BIS Working Papers*, no 437, December.

Turner, P (2014): "The global long-term interest rate, financial risks and policy choices in EMEs", *BIS Working Papers*, no 441, February.

Wu, J, A C Luca, B N Jeon (2009): "The impact of foreign bank penetration on the transmission of monetary policy in emerging market economies: evidence from bank-level data", *Working Paper* no 356, Institute for Monetary and Economic Research, Bank of Korea, January.

Internationalisation of emerging market currencies[1]

Guonan Ma and Agustin Villar

Abstract

This note reviews the internationalisation of emerging market (EM) currencies. It summarises various indicators and discusses some possible drivers, drawing on both historical and recent experience. The potential costs and benefits of an EM currency having international status are briefly discussed.

Keywords: International monetary arrangements and institutions, foreign exchange, international financial markets

JEL classification: F33, F31, G15

1 Comments from BIS seminar participants and from Claudio Borio, Andrew Filardo, Robert McCauley, Madhusudan Mohanty, Philip Turner and Hyun Song Shin are gratefully acknowledged. Emese Kuruc, Lillie Lam, Bat-el Berger and Jimmy Shek provided excellent research assistance.

1. Introduction

The internationalisation of EM currencies has attracted increasing attention from both policymakers and market participants. Historically, central banks have chosen to hold their own foreign reserves in only a few major advanced economy currencies (Table 1). Although the US dollar's share in official reserves has declined secularly, it remains the dominant reserve currency. The share of the euro, since its inception in 1999, has been relatively stable at around 24%, while that of other currencies has ebbed and flowed. The yen's share increased in the 1970s and 1980s as Japan's share of world output rose; in recent years, however, the Japanese currency's share has fallen. Conversely, sterling's share declined for many years, but has recently gone up to about 4%. The Australian and Canadian dollars have been recognised as new commodity reserve currencies over the past two years, although their shares remain small. The reported share of EM currencies, included under "Other" in the table, has changed little in the past decade. Nonetheless, some large emerging market economies (EMEs) do not report the currency composition of their reserves to the International Monetary Fund (IMF); the coverage of Table 1 is therefore incomplete.

Currency composition of foreign exchange reserves at current exchange rates

As a percentage of allocated reserves[1] Table 1

	1976	1988	1995	2000	2005	2010	2011	2012	2013[2]
US dollar	76.50	54.60	58.96	71.13	66.52	61.84	62.36	61.05	61.44
Japanese yen	2.00	6.90	6.77	6.06	3.96	3.66	3.61	4.08	3.86
Pound sterling	1.80	2.30	2.11	2.75	3.75	3.94	3.83	4.03	3.92
Euro	…	…	…	18.29	23.89	26.00	24.66	24.28	24.16
Deutsche mark	9.00	14.20	15.75	…	…	…	…	…	…
Australian dollar	…	…	…	…	…	…	…	1.47	1.65
Canadian dollar	…	…	…	…	…	…	…	1.50	1.82
Other	10.70	22.10	16.41	1.76	1.89	4.57	5.53	3.60	3.14
Memo: Share of global foreign exchange reserves									
Developing countries	*53.50*	*36.10*	*32.92*	*37.13*	*51.89*	*66.62*	*66.70*	*66.30*	*67.08*

[1] Reserves whose currency composition has been identified. Allocated reserves accounted for 78% of global reserves in 1998 and 54% in 2013. "…" = not available. [2] As of Q3.

Sources: IMF (1984, 1998); IMF, *COFER*; Roger (1993).

Thus, there seems to have been very little official diversification of EMEs' reserve assets into new currencies even though collectively EMEs now account for over 65% of global reserve holdings, up from 37% in 2000. Given the rising share of EMEs in global trade and output as well as internationally traded bonds and equities, this seems odd. What can explain this anomaly? What are the constraints and prospects?

This note tries to answer these questions indirectly by looking at a broader set of indicators of the internationalisation of EM currencies. Even if the US dollar is likely to retain a dominant role, there are grounds for thinking that some EM currencies could acquire the international currency status and replace some of the currencies of advanced economies. The use of EM currencies in global financial markets is increasing. Some have been used for many years, the South African rand and the Hong Kong and Singapore dollars being cases in point. The newest development concerns the renminbi, which has been rapidly gaining in relative importance in the global currency market in recent years.

2. Definitions and stylised facts

The notion of an international currency broadly signifies the widespread use of a national currency by non-residents in both commercial and financial transactions. The currency performs externally some of the functions of money as a medium of exchange (a vehicle currency), unit of account (a nominal anchor) and store of value (for instance, a reserve currency). However, international currency status is subject to different interpretations and has various dimensions and degrees. A less restrictive definition is a national currency that is used in cross-border transactions to perform some of the functions of money in some regions. A stricter notion would require a national currency to be widely used between non-residents and to thereby fulfil all the functions of money globally. Thus a number of indicators may be needed to gauge the evolution and extent of currency internationalisation.

This note looks at four sets of such indicators, which, when combined, should provide a composite proxy for the development of the internationalisation of EM currencies. The first set is based on the international portfolio liabilities of EMEs, which more or less reflect the trend allocation by global investors to EME financial assets. Second is the foreign ownership of domestic currency securities in EMEs, indicating how open the local capital market is to foreign investors. The third set covers foreign exchange turnover in EM currencies and may shed light on their uses by non-residents. The fourth set is trade invoicing in the home currency, suggesting the currency's external role as a medium of exchange and unit of account.

2.1 Portfolio liabilities of EMEs

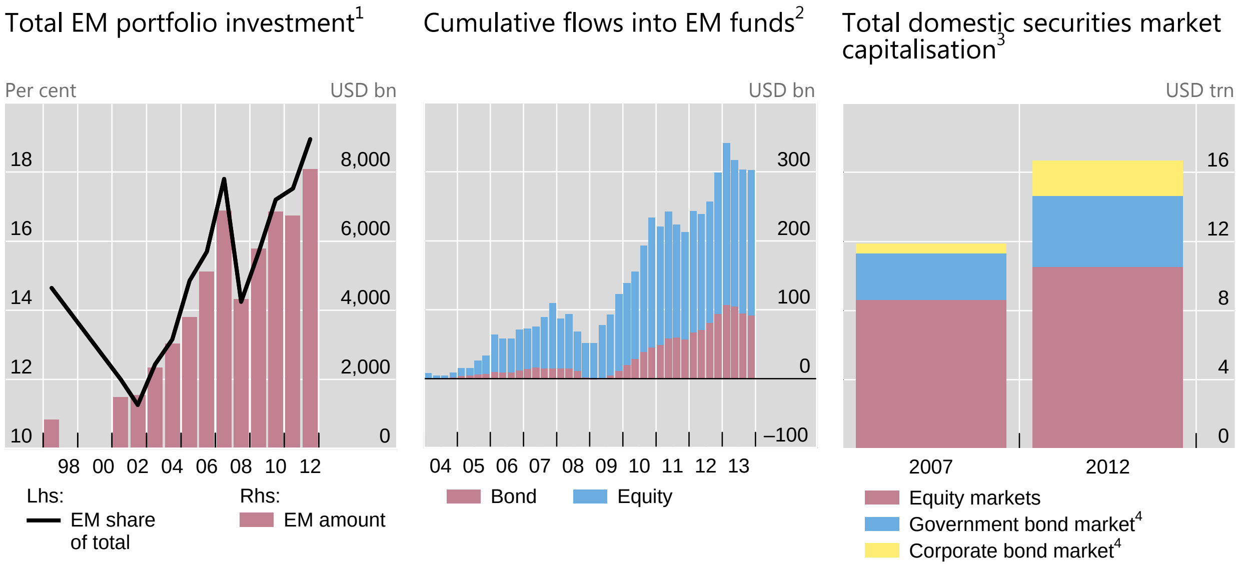
There has been a marked increase in the portfolio liabilities of EMEs to non-residents over the past decade. The share of EME financial assets in the portfolios of global international investors has increased.

According to data captured by the IMF's *Coordinated Portfolio Investment Survey* (CPIS), the estimated total holdings of EMEs financial assets by international investors increased more than fivefold between 2002 and 2012, with their share in world total foreign portfolio liabilities rising from 11% to 18% (Graph 1, left-hand panel). This indicator covers both institutional and retail investors but also includes both local and hard currency securities.

A second indicator, from EPFR, is that the EME assets held by global mutual funds have grown substantially in recent years. The cumulative net investment by mutual funds in EM equities and bonds has risen thirtyfold over the past decade (Graph 1, centre panel). This indicator is more up to date than the CPIS, but for the most part covers only retail investors.

Foreign portfolio liabilities of and foreign ownership of local government bonds issued by EMEs

Graph 1



[1] Total EM-derived portfolio investment is defined as the total of all reporting countries minus 24 advanced economies. The EME share of the total is defined as total EM-derived portfolio investment as a share of the total minus international organisations. [2] Data up to 30 October 2013. Sums across major economies in each region. Data cover net portfolio flows (adjusted for exchange rate changes) to dedicated funds for individual EMEs and to EM funds for which country or at least regional decomposition is available. [3] Sum of Algeria, Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hungary, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Thailand and Turkey. [4] Local currency.

Sources: IMF, *Coordinated Portfolio Investment Survey*; EPFR; BIS questionnaire, March 2014; BIS calculations.

2.2 Foreign ownership of local government debt securities in EMEs

The second set of related indicators is the foreign ownership of local currency securities issued by EMEs. According to the survey of central banks conducted for this meeting, the weighted average of foreign ownership between 2007 and 2012 rose from 15% to 20% for equity and from 8% to 17% for local currency government bonds.[2] This suggests that local currency assets in EMEs are more widely held by foreign investors, although differences across markets are substantial. Note that the foreign ownership of EM equity was generally higher than that of EM local currency government bonds.

Moreover, the level of foreign ownership rose at a time when domestic currency markets in the EMEs were expanding. The survey also indicates growing local currency equity and debt securities outstanding in EMEs (Graph 1, right-hand panel). The combined market capitalisation of local currency securities for the EMEs in this sample rose by 40% between 2007 and 2012. This is also true for each of the three instruments: equity, government bonds and corporate bonds. However, this indicator does not cover offshore local currency securities held by non-residents.

[2] See the paper entitled "International transmission of monetary policy – an overview of recent trends, central bank views and issues" in this volume for details.

2.3 Foreign exchange turnover in EM currencies

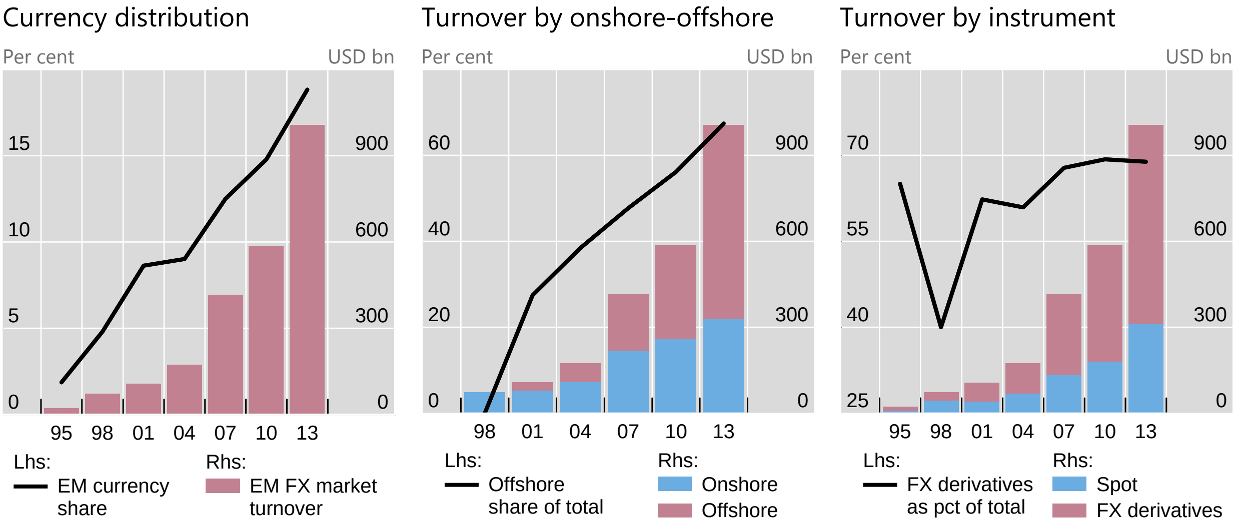
The third set of indicators is the volume of trading in EM currencies and its geographical pattern, as increased holdings of EM currency assets by global investors call for greater hedging. Also, liquidity and tradability (both onshore and offshore) are important attributes of an international currency. The Triennial Central Bank Survey of foreign exchange bears out the growing internationalisation of EM currencies over the past decade.

First, the trading volume of EM currencies increased tenfold between 1995 and 2013. In addition, the share of EM currencies in the global aggregate of foreign exchange turnover rose from below 2% in 1995 to above 16% by 2013 (Graph 2, left-hand panel). Moreover, the offshore share in the overall trading volume of EM currencies doubled, from 30% in 2001 to 60% in 2013, suggesting that most of the EM currency trading involved non-residents (Graph 2, centre panel).

Foreign exchange turnover in EM currencies[1]

Daily averages in April

Graph 2



[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis).

Sources: Triennial Central Bank Survey; BIS calculations.

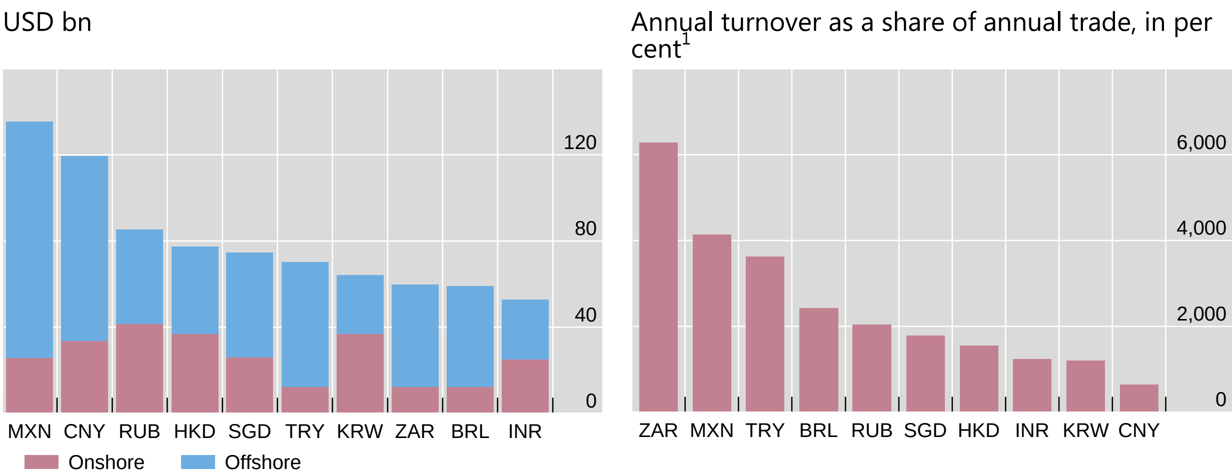
Much of this rise in EM currency trading has been driven by increased demand for foreign exchange derivatives (Graph 2, right-hand panel). In addition to hedging, the demand for foreign exchange derivatives could relate to positioning. Currency markets are usually the first port of call for global investors venturing into EMEs. Derivatives markets – often offshore – offer the market depth that global investors demand to consider investing in EM currencies. The share of foreign exchange derivatives in total EM over-the-counter currency turnover rose from 60% in 2001 to 70% in 2013.

Finally, the left-hand panel of Graph 3 shows the 10 most traded EM currencies. In most cases, the offshore share of their turnover is 60% or more. The top three EM currencies in terms of total daily turnover are the Mexican peso, Chinese renminbi and Russian rouble. However, once we adjust for merchandise exports and imports, the rankings change dramatically. Beyond commercial transactions and long-term capital movements, the renminbi is now the least traded among the aforementioned top 10 EM currencies, in part because of very light short-term and high-frequency cross-border financial flows (Graph 3, right-hand panel).

Thus, the EM currencies have been traded more actively, with a greater share offshore and more in the form of foreign exchange derivatives. This fact supports the idea that some EM currencies might have been gaining a greater international status.

FX turnover in EM currencies

Daily averages in April 2013 | Graph 3



BRL = Brazilian real; CNY = Chinese yuan; HKD = Hong Kong dollar; INR = Indian rupee; KRW = Korean won; MXN = Mexican peso; RUB = Russian rouble; SGD = Singapore dollar; TRY = Turkish lira; ZAR = South African rand.

[1] Daily FX turnover averages times 250 divided by total trade in 2013 (WEO forecast).

Sources: IMF, *World Economic Outlook*; Triennial Central Bank Survey; BIS calculations.

2.4 Trade currency invoicing

The fourth indicator is trade invoicing in the home currency. Exporters could choose to invoice their trade in the producer currency, or destination currency, or simply a third vehicle currency. This choice depends, among others, on market share, industry, exchange rate regime and inertia. Ito and Chinn (2014) estimate that the home currency invoicing share of exports in the Asia-Pacific region has on average fallen from 15% to 10% in recent years, in contrast to a renminbi invoicing share that has risen to 15% from practically nothing a few years ago (see Section 5.2).

In sum, the evolving role of EM currencies in the global market has been shaped by a combination of structural and cyclical factors. The structural factors could be both financial and real. Cycles can be defined in terms of many different variables (Moore et al (2013)). While cyclical swings affecting these four indicators are bound to be sizeable at times, the trend rise in the weight of the EM currencies in the global financial and currency markets over the past decade is unmistakable.

3. Drivers of internationalisation of EM currencies

What drives the internationalisation of a currency? The demand for a currency by non-residents tends to rise with the size of the issuing economy, its trade, its financial market and its wealth. The quality of its institutions also matters. Beyond these "fundamentals", the exchange networks are also important, for the currency to function internationally as a medium of exchange, unit of account and store of value. Finally, offshore markets and public sector asset managers could be catalysts in the internationalisation of EM currencies.

3.1 Economic size and market development

National currencies that have achieved international status are issued by countries that are relatively large and wealthy, account for a considerable share of world trade and have relatively large financial markets. Table 2 provides the profiles of such economies. The United States, Japan and euro area countries rank amongst the top places on at least two of the indicators. Other advanced economies with currencies that have achieved international status also rank highly on all three indicators (eg the United Kingdom and Canada).

World's top 10 economies in terms of GDP, trade and government debt[1]

2013 Table 2

Share of world GDP		Share of world trade		Share of world general government gross debt[2]	
Country	Share	Country	Share	Country	Share
United States	22.8	United States	11.0	United States	30.3
China	12.2	China	10.0	Japan	20.6
Japan	6.8	Germany	7.7	Germany	5.0
Germany	4.9	Japan	3.9	Italy	4.8
France	3.7	United Kingdom	3.5	France	4.5
United Kingdom	3.4	France	3.3	United Kingdom	4.1
Brazil	3.0	Korea	2.9	China	3.6
Russia	2.9	Netherlands	2.8	Canada	2.7
Italy	2.8	Hong Kong SAR	2.7	Brazil	2.5
Canada	2.5	Italy	2.6	Spain	2.2

[1] WEO forecasts. 2 World general government gross debt is calculated as the sum of US dollar-denominated debt for 168 economies.

Sources: IMF, World Economic Outlook, October 2013; BIS calculations.

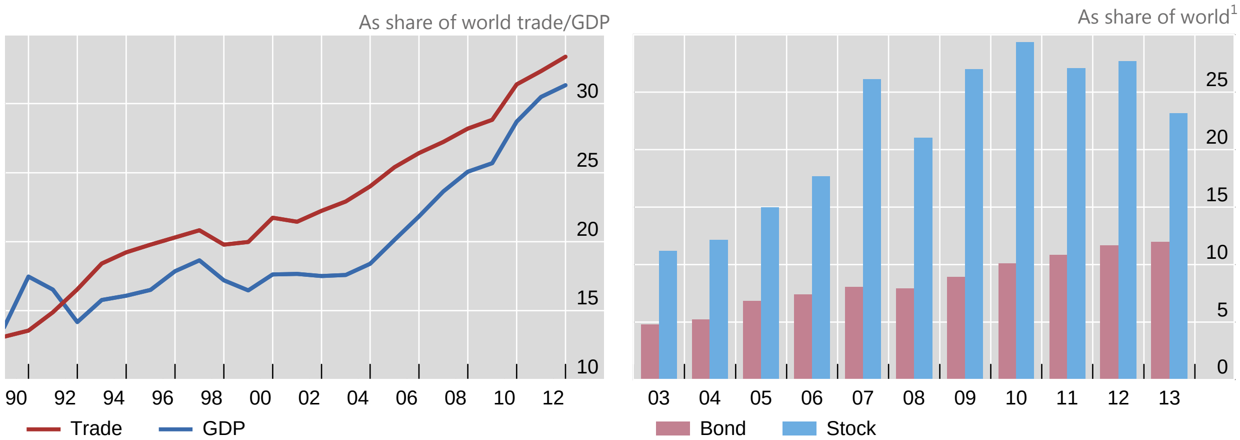
But in recent years, a handful of EMEs have also been registered by some of these indicators. The strong position of China and the rise of Brazil and Korea are particularly noteworthy. Furthermore, the aggregate weight of EMEs in the global economy and global trade has doubled. Over the past two decades, the aggregate

EME share of both world GDP and world trade has risen, from 15% in 1992 to 30% in 2012 (Graph 4, left-hand panel).

The development of domestic financial markets is important to any effort to promote the international use of a national currency. The right-hand panel of Graph 4 suggests that EM financial markets have grown in importance, even if their current size is not commensurate with their countries' trade and economic weight. The share of EM debt in the world total more than doubled between 2003 and 2013, from 5% to 12%, while EMEs' share of global equity market capitalisation rose from 12% to around 25% in the same period. As noted earlier, the presence of foreign players in expanding local currency securities markets has also increased in recent years. This has contributed to market depth and the inclusion of EM currencies in foreign investors' portfolios.

Economic and market weight of EMEs[1] Graph 4

Aggregated EM trade and GDP | EM domestic debt securities outstanding[2] and stock market capitalisation



[1] Covering 23 emerging market economies. [2] By residence. [3] Sum of amount outstanding of total debt securities for 25 advanced economies and domestic debt securities for 23 emerging market economies.

Sources: IMF, *Direction of Trade Statistics* and *World Economic Outlook*; Bloomberg; BIS.

3.2 Financial and real economy network effects

Exchange network effects complement economic and market "fundamentals" as drivers of a currency's international status. Such networks are often the sources of positive externalities. First, network effects on the real side of the economy work mainly through closer regional trade integration. Examples are the ASEAN+3 mechanism and the intra-Asian supply chain. Such network effects that operate through trade integration and specialisation can complement and amplify the growing weight of EMEs in the global economy and trade. A greater role for EMEs in that regard can boost the potential demand for their national currencies by non-residents, especially in a regional context.

In the currency market, one such positive externality of exchange networks stems from the convenience of using the currency that is already being widely used and held by other economic agents. An intensively used currency can therefore more easily extend its use in international transactions. Section 2 has already documented the growing liquidity of EM currencies in global trade over the past decade.

The liquidity in financial markets involves similar externalities. Liquid financial markets can promote the international status of an EM currency by attracting more foreign investors into EM local currency markets and furthering the use of the country's currency by non-residents. Investors are more inclined to engage in trading in markets where they are confident that their demand or supply will be matched. The right-hand panel of Graph 4 suggests that the weight of the EMEs in global financial market capitalisation is rising, despite occasional marked fluctuations. This should help improve financial market depth and liquidity in EMEs.

Better cross-border clearing infrastructure and the expansion of cross-border banking may also strengthen the real and financial network effects in trade, currency and securities markets, thus facilitating the international use of a currency. In this light, the recent overseas expansion of Chinese banks into international financial centres and some EMEs, such as South Africa and Brazil, may support the development of a nascent offshore market for the renminbi.

3.3 Offshore markets

Establishing an offshore market in a national currency is often the first stage towards its gaining acceptance among global market players, so that the market can play a special role. Although offshore trading volumes of EM currencies have risen rapidly over the past decade, the markets are still not deep enough to be considered on a par with those for the major international currencies.

Evidence suggests that most offshore trading of EM currencies is between non-residents and that a main driver is the holdings of assets denominated in EM currencies (Rime and Schrimpf (2013)). These holdings may relate to both hedging and currency positioning. In addition, the growth of offshore markets may be linked to the growth of the onshore market because banks and firms, both domestic and global, will arbitrage between markets. Increasing the access of non-resident participants to the onshore market is likely to require a more open financial system and convertibility of the national currency in the current and capital accounts.

3.4 Foreign reserve and wealth diversification

Could policy actions in EMEs help enhance the international role of the national currency? As discussed in the introduction, EMEs have built up sizeable official foreign reserves. But they hold only a small part of those reserves in each other's currencies. Several EMEs have enjoyed a long-lasting boom in commodity prices and have accumulated large current account surpluses. Yet commodity currencies have so far played only a negligible role in international reserve diversification.

Sovereign wealth funds are another group of potential investors that to date have carried out limited investing activity in EM currencies. Sovereign funds may have greater risk appetite and a longer investment horizon than central banks, and may be willing to build up sizeable portfolios of EM assets. A shift in their portfolios away from developed country assets to EM assets might also be a catalyst for greater demand by the private sector of EM currencies.

To explore the issue of diversification, Table 3 presents indicators of bilateral exchange rate correlations. As the table shows, many EM and commodity currencies are more volatile than the established major reserve currencies vis-à-vis the US dollar. This is even more so in times of market stress. The only exception is the renminbi: this might be because its exchange rate has not been market-determined. If currencies are highly and positively correlated, the gains from risk diversification may be limited. The broad pattern of exchange rates correlations shown in Table 3 is that they are far from perfect, suggesting possible gains from currency diversification. The dollar exchange rate of all EM currencies is positively correlated with the euro/dollar exchange rate, so that holding EM currencies might not provide more diversification of dollar risks than holding the euro does. But their exchange rates tend to be negatively correlated with the yen/dollar exchange rate.

Volatility and correlation of monthly average exchange rate movements[1] Table 3

	Standard deviation of % changes against USD	Correlation between % change against US dollar with	
		% change of EUR/USD	% change of JPY/USD
Australian dollar	3.37	0.65	0.01
Pound sterling	2.35	0.71	0.09
Euro	2.43	na	0.22
Japanese yen	2.38	0.22	na
Brazilian real	3.67	0.42	–0.22
Chinese renminbi	0.38	0.31	0.14
Korean won	2.73	0.60	–0.09
Mexican peso	2.73	0.41	–0.34
South African rand	3.96	0.49	–0.06

[1] Percentage change of monthly average exchange rate in the period 2004–13.

Sources: National data; BIS calculations (based on Roger (1993)).

4. Prospects for EM currency internationalisation

The prospect for the internationalisation of EM currencies varies across dimensions. The sovereign credit rating of the issuing country is important. The credit standing of many EMEs has improved. Some EM currencies may become more actively traded in global markets and used in international transactions, as has been the case with the Australian, Canadian and New Zealand dollars or the Swedish krona. And despite large cyclical fluctuations, aggregate foreign holdings of EM local currency financial assets have risen over the past decade.

There are also downsides. Managing currency risk in a global portfolio is costly; and there are diminishing returns to including additional currencies in a global portfolio. Because there are a presumably small, optimal number of currencies in a global portfolio, only a few EM currencies could become major reserve currencies at the global level. In time, some EM currencies could displace the currencies of the smaller advanced economies.

A second ground for caution is the considerable degree of home bias in global portfolios. Nevertheless, as discussed in Section 2, foreign investors now play a greater role in connection with EM local currency assets, although the recent turmoil in EM financial markets underscores some underlying financial vulnerabilities. Thus it may take longer for EMEs to gain ground in international transactions and investments. As historical experience shows, inertia can be quite considerable, further raising the bar for any EM currency to become an international one.

Finally, the relative benefits and costs could play a role in any consideration to internationalise EM currencies. While international status for an EM currency may have beneficial impacts by lowering funding and transaction costs and helping residents to better share currency risks with the rest of the world, it could also imply large costs. A sustained appreciation of the currency owing to increased demand from the rest of the world may result in frequent misalignment, giving rise to unsustainable current account deficits. This is a variation of the Triffin dilemma.[3]

Moreover, to the extent that international currency status would typically be associated with a more open capital account, global shocks are also more likely to propagate into the domestic economy through either the exchange rate or financial channels. Given a lesser degree of policy discretion, the financial system might come under strain during large adverse external shocks.

5. Historical and recent experiences

The historical experience offers some noteworthy lessons: the force of habit and inertia in the international status of a currency can be important.

5.1 A brief historical review

Sterling was the first national currency to gain international currency status under a gold standard. There are three related facets to this. The first was the large and growing size of the UK economy in the 19th century. Second, the United Kingdom's dominant position in international trade and politics resulted in the pound becoming the most important national currency worldwide. London also became a major financial centre. Financial development included a process of monetary standardisation that resulted in the effective operation of the payment system. The Bank of England also took on the role of lender of last resort for the banking system. Third, the consolidation of the gold standard in the 1830s and 1840s as an international monetary arrangement went hand in hand with the expansion of British banks' activities abroad.[4] That expansion created networks that added to the United Kingdom's unrivalled position, in turn bestowing international currency status on the pound.

3 But the causality is far from mechanical. For a given current account balance, international currency status may follow from more two-way gross capital flows being denominated in the currency.

4 There are differences in the interpretation of this process. Some authors emphasise the development of the merchant banks as the main financiers of foreign trade (Eichengreen (2010, 2011)). Others emphasise the overseas expansion of UK banks, with the establishment of branches in British colonies and foreign countries (Jones (1990)).

At the beginning of the 20th century, sterling was still the dominant international currency even though the United States had overtaken the United Kingdom as the world's largest economy. However, the United Kingdom accounted for the largest share in world trade, at 12% (Krugman (2004)). Another reason why the dollar was still playing a negligible role in international trade and payments was that the United States maintained restrictions on the branching of its banks abroad (Eichengreen (2013)).

The First World War was a major watershed. After the war, the role of sterling started to wane and it was gradually replaced by the dollar (Krugman (1984)). Exchange restrictions eroded the international standing of the pound. This development might have also been related to the strength of the US Treasury market. Financial markets in the United States benefited from sound fiscal and monetary institutions and credible financial policies (Bordo et al (2005)).

The historical record also illustrates the role of inertia or persistence. The Second World War further weakened the pound's standing, but did not completely deprive it of its international status. While the dollar's role continued to grow over the next 50 years, sterling maintained its international status in transactions concentrated in its former sphere of imperial influence.

Events after the Second World War feature some other interesting developments. The dollar retained its hold as an international currency against the backdrop of an international monetary system of floating exchange rates after the breakdown of the Bretton Woods agreement. At the same time, the depth of US financial markets and free international capital movements played a greater role in sustaining the dollar as a dominant global currency.

The yen experience is also of interest. Japanese banks started expanding overseas to recycle the country's large current account surpluses in the 1980s. Government action to promote Tokyo as an international financial centre encouraged the use of the yen as an international currency. However, a protracted banking crisis and economic stagnation in the 1990s and 2000s led to a retreat of Japanese banks from overseas. In addition, foreigners' access to the domestic bond and currency markets remained limited, holding up the process of yen internationalisation.

The euro inherited an immediate international role from the currencies it replaced, thanks almost entirely to the Deutsche mark's credibility. Before the advent of the euro, the mark had become the second reserve currency, given Germany's sound monetary policy, deep capital market, solid growth and trade expansion. Although the banking and sovereign crises in 2008–09 and 2010–12 gave rise to uncertainty about the future of the euro, its use internationally was not much affected. One lesson from this experience is that international currency status is very much tied to a sound banking sector (as well as to sound macroeconomic policies) and its smooth cross-border operation.

5.2 The case of renminbi internationalisation

The recent momentum of renminbi internationalisation presents an interesting case from a historical perspective. First, despite being the second largest economy and trader in the world, China now is less dominant than either the United Kingdom or the United States was when sterling or the US dollar was the world's dominant currency. Second, China is currently experiencing fast growth, currency appreciation and a gradual financial liberalisation process – a scenario bearing some resemblance to the experiences of Germany and Japan in the 1980s, when the Deutsche mark and yen became second-tier reserve currencies. However, in terms of China's per capita income, financial openness and the quality of its institutions, there is still some way to go before its currency can be compared with the mark and yen.

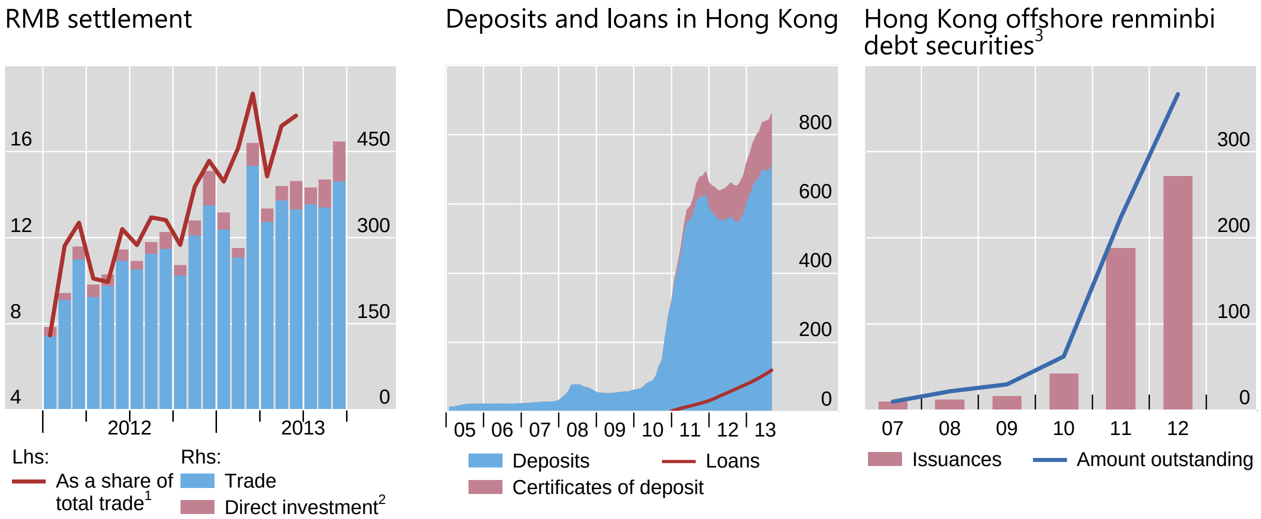
That said, over the past decade, several milestones have been passed by the renminbi on its path to greater internationalisation. In 2003, the offshore renminbi market started up with retail banking business in Hong Kong SAR, whereby local residents could convert the Hong Kong dollar into renminbi subject to a daily limit. In 2009, the Chinese government unveiled a pilot scheme for settlements in cross-border renminbi trade and it issued the first renminbi-denominated treasury bonds in Hong Kong SAR. In 2010, all banks and corporations in Hong Kong SAR could open renminbi accounts and conduct business in renminbi. In addition, some central banks and banks participating in renminbi trade settlements and clearance were invited to participate in the onshore interbank bond market in China. In 2011, the first renminbi-denominated corporate bond was issued in Hong Kong SAR, and restrictions were also lifted on renminbi-denominated outward and inward direct investment from and into China and offshore funds to be invested in onshore debt and stock markets under a quota. By 2012, any non-resident could open a renminbi account and trade renminbi products in Hong Kong.

The Chinese government has been following a three-pronged approach to promoting the external uses of the renminbi by removing some of the restrictions placed on such uses. The first move was to encourage cross-border trade settlements in the renminbi, even while China's capital account was still heavily managed. The second has been selective and incremental capital account opening. The two-way cross-border renminbi flows now also take place through the direct investment channel and via managed schemes of portfolio investment and bank loans. The third step has been the creation of offshore renminbi markets where renminbi products trade between non-residents. Once exclusively offshore, the renminbi is now fully convertible, with most renminbi products being traded freely, albeit cross-border renminbi flows are still managed.

The renminbi's international status has been growing (Graph 5). Cross-border renminbi trade settlements have expanded from nil before 2009 to a current level of 15% of China's total exports and imports. Renminbi deposits rose tenfold between 2008 and 2013 in Hong Kong SAR, exceeding 10% of Hong Kong SAR's total bank deposits, although still below 1% of China's total domestic bank deposits. Renminbi-denominated bonds outstanding in Hong Kong SAR have also risen more than 10 times. There is a wider range of renminbi products now available offshore, including spot and foreign exchange derivatives, interest rate derivatives, certificates of deposit, bonds and equity-linked products. The renminbi was the ninth most traded currency in 2013, up from 29th in 2004 (Table 4). Geographically, offshore renminbi markets have spread from Hong Kong SAR to Chinese Taipei, Singapore and London. Some 20 central banks have reportedly invested in China's onshore interbank bond market, and more have gained renminbi exposure via Hong Kong SAR.

RMB internationalisation

In billions of renminbi — Graph 5



[1] Total trade is defined by the sum of imports to and exports from China. [2] Direct investment includes foreign direct investment and China's overseas direct investment. [3] Debt securities include both medium and long-term notes, CDs and commercial papers.

Sources: Hong Kong Monetary Authority; CEIC.

Top 10 traded currencies

Shares of average daily currency trading — Table 4

	1998		2001		2004		2007		2010		2013	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
US dollar	86.8	1	89.9	1	88.0	1	85.6	1	84.9	1	87.0	1
Euro	na	na	37.9	2	37.4	2	37.0	2	39.1	2	33.4	2
Japanese yen	21.7	2	23.5	3	20.8	3	17.2	3	19.0	3	23.0	3
Pound sterling	11.0	3	13.0	4	16.5	4	14.9	4	12.9	4	11.8	4
Australian dollar	3.0	6	4.3	7	6.0	6	6.6	6	7.6	5	8.6	5
Swiss franc	7.1	4	6.0	5	6.0	5	6.8	5	6.3	6	5.2	6
Canadian dollar	3.5	5	4.5	6	4.2	7	4.3	7	5.3	7	4.6	7
Mexican peso	0.5	9	0.8	14	1.1	12	1.3	12	1.3	14	2.5	8
Chinese renminbi	0.0	30	0.0	35	0.1	29	0.5	20	0.9	17	2.2	9
New Zealand dollar	0.2	17	0.6	16	1.1	13	1.9	11	1.6	10	2.0	10
Total[1]	200		200		200		200		200		200	

[1] Because two currencies are involved in each transaction, the percentage shares of individual currencies sum to 200% instead of 100%.

Sources: Mauldin Economics; Triennial Central Bank Survey, September 2013.

There are at least three reasons why Chinese policymakers should encourage the internationalisation of the renminbi. First, the wider external use of the renminbi would allow China to better share currency risk with the rest of the world, mitigating the country's huge long-dollar and short-CNY position (Cheung et al (2011)). Second, a more internationalised renminbi may spur further domestic financial liberalisation, a parallel being China's preparation for WTO accession in 2001, which helped remove many barriers to domestic economic liberalisation. And third, China aims to have the renminbi become one of the important reserve currencies, such as those that make up the SDR, and thus join the group of countries at the core of the international monetary system.

It remains to be seen how quickly the renminbi can become a meaningful reserve currency. There are two pivotal factors. First, while China is the second largest and fastest-growing economy, the top exporter and the third largest international investor globally, it is still faced with the very challenging task of achieving a deep and liquid domestic financial market and open capital account (McCauley (2011)). And second, the prospect of a greater global role for the Chinese currency also in part depends on the evolving relative fundamentals of the incumbent global reserve currencies.

Conclusion

The use of EM currencies in international financial markets is very limited. But that use is growing as global investors venture to diversify their portfolios. The demand for EM currencies by non-residents is related to the increasing economic, trade and market weight of the EMEs. The development of domestic financial markets in EMEs, including the greater participation in them of global institutional investors, is crucial for an EM currency to achieve international status. Exchange and banking networks and liquidity considerations can create externalities that promote the external use of some EM currencies. The historical record shows that improvements in fundamentals and network effects are both powerful drivers of an international currency. Nevertheless, there are both potential benefits and costs arising from the international status of an EM currency. Governments should see that the latter do not outweigh the former for their economies.

References

Bordo, M, C Meissner, and A Redish (2005): "How original sin was overcome: the evolution of external debt denominated in domestic currencies in the United States and the British Dominions, 1800–2000", in B Eichengreen and H Ricardo (eds), *Other people's money*, University of Chicago Press, pp 122–53.

Cheung, Y, G Ma and R McCauley (2011): "Renminbising China's foreign assets", *Pacific Economic Review*, vol 16, no 1, pp 1–17.

Cohen, B and T Benney (2012): "What does the international currency system really look like?", University of California, Santa Barbara, mimeo.

Eichengreen, B (2010): "The renminbi as an international currency", mimeo.

——— (2011): *Exorbitant privilege*, Oxford University Press.

International Monetary Fund (1994): *Annual Report of the Executive Board for the Financial Year Ended April 30, 1994*.

——— (1998): *Annual Report of the Executive Board for the Financial Year Ended April 30, 1994*.

Ito, H and M Chinn (2014): "The rise of the 'redback' and China's capital account liberalization: an empirical analysis on the determinants of invoicing currencies", paper prepared for the ADBI conference *Currency Internationalisation: Lessons and Prospects for the RMB*.

Jones, G (1990): "Competitive advantages in British multinational banking since the 1890s", in G Jones (ed), *Banks as multinationals*, Routledge.

Kennen, P (2012): "Currency internationalisation: an overview", in *Currency internationalisation: lessons from the global financial crisis and prospects for the future in Asia and the Pacific*; *BIS Papers*, no 61, January, pp 1–10.

Krugman, P (1984): "The international role of the dollar: theory and prospect", in J Bilson and R Marston (eds), *Exchange rate theory and practice*, University of Chicago Press, pp 261–78.

McCauley, R (2011): "Renminbi internationalisation and China's financial development", *BIS Quarterly Review*, December, pp 41–56.

Moore, J, S Nam, M Suh and A Tepper (2013): "Estimating the impacts of US LSAPs on emerging market economies' local currency bond markets", Federal Reserve Bank of New York, *Staff Reports,* no 595.

Moss, F (2012): "The euro: internationalised at birth", in *Currency internationalisation: lessons from the global financial crisis and prospects for the future in Asia and the Pacific*; *BIS Papers*, no 61, January, pp 57–74.

Rime, D and A Schrimpf (2013): "The anatomy of the global FX market through the lens of the 2013 Triennial Survey", *BIS Quarterly Review*, December, pp 27–43.

Roger, S (1993): "The management of foreign exchange reserves", *BIS Economic Papers*, no 38.

What have emerging market central banks learned about the international transmission of monetary policy in recent years?

Miguel A Pesce[1]

International financial spillovers: policy responses and coordination

Abstract

The monetary and exchange rate policies of some economically significant countries – especially those whose currencies are accepted as international reserves – have large external effects over the rest of the countries who must take great care in designing their domestic policies to address changes in external conditions. We have seen in recent years that a significant portion of the financial spillovers resulted from the impact on global risk aversion and the evolution of commodity prices -which show a negative correlation with emerging economies (EEs) sovereigns amplifying business cycles -.

In spite of having more sensitivity to financial volatility, after the outbreak of the subprime crisis, most (EEs), remained relatively unharmed due the implementation of policies characterized by more flexible exchange rate regimes; commercial surpluses; sound fiscal policies; less dependence on capital flows; more solid financial systems; abundant levels of international reserves; and macroprudential policies to avoid the negative impact of short-term capital flows. That was the case of Argentina that before the 2007´s outburst implemented a policy scheme which included a reserve requirement for short-term financial capital flows, regulations on capital outflows and inflows and a currency-managed float regime aimed at moderating exchange rate volatility and avoiding a leveraging process. It also included an international reserves accumulation precautionary policy, accompanied by an adequate sterilisation of any surplus resulting from monetary issues.

The recent global reversal of short-term capital flows has confirmed once again that even when the appetite for EE risk is a function of both international (push) and domestic (pull) factors, the former have a decisive weight. In fact, there is a strong asymmetry between, on one hand, the spillover effects from monetary policy in major advanced economies and, on the other, the focus strictly on domestic fundamentals. Thus, attributing capital surges and sudden stops in EEs to internal (pull) factors is a view that can be considered at least misleading, especially in the case of short-term flows.

[1] Deputy Governor, Central Bank of Argentina.

In the current scenario, monetary policy coordination between EEs and advanced economies is essential to avoid the potentially deleterious effects of abrupt changes in short-term flows and the potential side effects of the first stages of tapering and should play a key role in facilitating a timely and smooth exit from expansionary and unconventional monetary policies in order to avoid jeopardising the global economic recovery. Capital flow reversal and greater financial and exchange rate volatility could cause a tightening of domestic demand and thereby affect economic activity. A good example of international coordination was seen in 2009 when, in the G20 framework, the IMF issued two rounds of Special Drawing Rights (SDRs), and in the currency swaps agreements signed among trading partners to enhance trade and financial cooperation.

Keywords: Central Banks and their policies; International Financial Policy, financial transactions, capital controls; International Policy coordination and transmission.

JEL classification: E58; F38; F42

1. Effects of financial spillovers

The monetary and exchange rate policies of some economically significant countries – especially those whose currencies are accepted as international reserves – have large external effects. Countries experiencing those effects, and who do not issue currency accepted as international reserve, must take great care in designing their domestic policies to address changes in external conditions. This is the case for most emerging economies (EEs), characterised as medium-sized economies generally open to trade and capital flows.

In recent decades, trade openness, and the emergence of certain low-cost manufacturing economies (primarily those of China and Southeast Asia), have had a generally positive transmission effect on prices. By reducing costs, these countries – aided by the buoyancy of international commerce – have helped to lower global industrial prices, regardless of local monetary and fiscal policies. As a consequence, increased international trade has helped to keep inflation low and to boost international capital flows.

The literature relating to financial spillovers, policy responses to them, and the need for international coordination is extensive. The International Monetary Fund (IMF) has pointed out on several occasions that the results of financial spillovers depend significantly on the nature of the policy. Direct purchases of long-term government assets have been the main source of spillovers from the United States and the United Kingdom, while in the euro area, bank intervention mattered.[2] The results also suggest that a significant portion of the spillovers resulted from the impact on global risk aversion and the evolution of commodity prices. By and large, spillovers entailed a rise in equity prices and exchange rates, consistent with the view that they both buoyed domestic activity and involved capital inflows.

In its 2012 *Annual Report*, the BIS stated that:

While prolonged monetary easing probably has only limited potency to rekindle sustained growth in the advanced economies, its global spillover effects may be substantial. Persistently large interest rate differentials … support capital and credit flows to fast-growing emerging market economies and have put upward pressure on their exchange rates. This makes it more difficult for emerging market central banks to pursue their domestic stabilisation objectives. Interest rates have been raised only hesitantly in response to buoyant domestic macroeconomic and financial conditions out of concerns that this would widen interest rate differentials and further boost capital inflows. …

The growing relevance of monetary policy spillovers suggests that central banks need to take better account of the global implications of their actions. In a highly globalised world, a more global monetary policy perspective is also called for to ensure lasting price and financial stability.[3]

2 See IMF, *2011 Spillover Report* and *2012 Spillover Report*, various issues; and IMF, *Global Financial Stability Report,* April 2013, Chapter 3, "Do central bank policies since the crisis carry risks to financial stability?", pp 93–126. See also Tamim Bayoumi and Andrew Swiston, "Foreign entanglements: estimating the source and size of spillovers across industrial countries", *IMF Working Paper*, no 07/182, 1 July 2007.

3 See BIS, *82nd Annual Report,* June 2012, pp 45 and 47.

After the outbreak of the subprime crisis, the EEs, especially in Latin America, remained relatively unharmed. This was because of several factors: more robust fundamentals and better commodity prices and terms of trade together with more flexible exchange rate regimes; commercial surpluses; sound fiscal policies; less dependence on capital flows; more solid financial systems; and abundant levels of international reserves. Indeed, a large number of countries have implemented a currency-managed float regime[4] along with a policy of accumulating international reserves. It is said that this combination generates costs associated with the monetary sterilisation process. However, in the absence of an international lender of last resort, it has been proven that these countries correctly chose these policies as insurance against eventualities, since the benefits might outweigh the costs.

In particular, prior to the 2007–10 crisis, Argentina implemented a multifaceted monetary policy scheme. It includes a reserve requirement for short-term financial capital flows, regulations on capital outflows and inflows and a currency-managed float regime aimed at moderating exchange rate volatility. It also includes an international reserves accumulation precautionary policy, accompanied by the sterilisation of any surplus resulting from monetary issues, so that it is compatible with the liquidity needs of the economy.

The accumulation of international reserves acts as insurance when a country is faced with temporary changes in international financial conditions. It promotes macroeconomic stability, which has a number of important advantages – it increases financial independence; raises confidence in the domestic currency; helps to avoid asset bubbles; and, in some EEs, helps to reduce the impact of foreign shocks and the cost of public and private financing. In addition, it reduces sovereign risks and foreign financing costs, making it possible to meet external payments in times of crisis, when such funding is non-existent or prohibitively costly.

The managed float exchange rate regime also helped to mitigate fluctuations not associated with macroeconomic fundamentals. This is important because, in an economy with some level of currency substitution, excessive volatility could severely affect financial stability.

In addition, the introduction of measures to discourage short-term capital inflows and reduce sudden outflows is an alternative way of reducing foreign exchange market volatility in EEs. In order to diminish the negative effects of short-term capital flows and avoid a leveraging process, Argentina since mid-2005 has successfully taken a series of measures tending, directly or indirectly, to regulate and discourage short-term capital flows:

- New financial borrowing or trading in the domestic foreign exchange market, as well as rollovers of residents' nonfinancial private sector and financial sector external liabilities, must be made and kept within the system for at least 365 consecutive days (under the earlier regulation, the term was 180 days). These loans cannot be paid before the maturity date, regardless of the settlement modality and whether or not it involves access to the domestic foreign exchange market.
- In response to the increasing amount of capital inflows, the Central Bank of Argentina established a one-year interest-free deposit equivalent to 30% of

[4] Among advanced economies, Switzerland provides an example of exchange rate intervention.

certain capital inflows (financial sector and nonfinancial private sector financial liabilities).[5] This deposit applies basically to portfolio investments in secondary securities markets and foreign loans allocated to investments in financial assets; it is aimed at reducing part of the yield of local assets in order to discourage short-term financial investments.

Furthermore, the macroprudential measures regulating capital flows significantly limited the external risk of the Argentine economy. They were supported by a number of other policies, such as external debt reduction with the private sector policy and the previously mentioned prudential accumulation of international reserves.

Finally, in reviewing capital flows, it is critical to differentiate foreign direct investment (FDI) from speculative short-term capital flows. The former has a permanent positive effect, leading to more robust economic growth with more solid fundamentals; the latter boosts the economy only in the short term and, moreover, increases asset volatility and weakens the local economy's ability to withstand external shocks. Hence, prudential regulations should be focused on deterring speculative short-term flows without affecting those associated with FDI and import and export financing.

2. Policy responses and coordination

Determining a country's actual economic outlook and the relationship of that outlook to the country's fundamentals is the starting point for assessing the potential effects of their chosen policies.

A key question, especially for EEs and small advanced economies, is the relationship between short-term interest rates and exchange rates. With US monetary conditions becoming less expansionary,[6] keeping the policy rate unchanged could put upward pressure on the exchange rate. Although this may provide some stimulus to the economy, a very sharp depreciation could be unwelcome for reasons of both macroeconomic and financial stability. Large swings in exchange rates could heighten financial risks in the presence of currency and maturity mismatches, especially in EEs. Another constraint that central banks could face is the degree of maturity transformation and, as a consequence, the credit growth that a widening term spread could entail. In highly dollarised economies, this effect is even more heightened.

The ability to decouple is diminished in EEs when financial deregulation is excessive, especially when it coincides with full capital account openness and within a framework of asymmetric financial architecture.

It is precisely the difference between advanced economies and EEs in respect to development and depth of the financial systems in advanced economies that makes EEs highly sensitive to financial volatility. Thus, the recent global reversal of short-

5 In response to Executive Order no 616/2005, issued by the Ministry of Economy; and Central Bank of Argentina communication no A 4359.

6 The Federal Reserve has already begun the reduction of its large-scale asset purchase programme.

term capital flows has confirmed once again that even when the appetite for EE risk is a function of both international (push) and domestic (pull) factors, the former have a decisive weight. In fact, there is a strong asymmetry between, on one hand, the spillover effects from monetary policy in major advanced economies and, on the other, the focus strictly on domestic fundamentals. Thus, attributing capital surges and sudden stops in EEs to internal (pull) factors is a view that can be considered at least misleading, especially in the case of short-term flows.

From a medium-term perspective, the consolidation of EE financial instruments as attractive assets during the past decade initially reflected a scenario of decreasing interest rates in international markets and, until 2008, a rising appetite for higher yields. With EEs recording high growth rates, this in turn supported a strong rising trend in commodity prices during the period 2002–08. In fact, a recent working paper by the Central Bank of Argentina describes a growing negative correlation between EE sovereign spreads and commodity prices and shows that it is mainly explained by the international financial framework.[7]

This result poses serious challenges for commodity exporters like Argentina and illustrates the additional dangers created by financial integration in countries with a non-diversified export structure. In these cases, financial and commercial shocks would tend to be positively correlated and amplify business cycles. This is so because, first, during the upside phase of the economic cycle, commodity prices tend to improve markedly and EE sovereign spreads tend to reduce sharply; then, in the downside phase, EE sovereign spreads would probably increase at the precise moment when commodity prices start to fall. However, financial markets have not paid enough attention to the possibility that, under this framework, financial and commercial shocks might be positively correlated, for various reasons. Among these are a better international environment along with a general improvement in EE macroeconomic fundamentals (a strengthened fiscal situation, better debt profiles, increased international reserves); this leads to a perception of lower risks that allows for a sustained increase in EE asset prices.

Rising asset prices were accompanied by increasing capital flows to EEs, led by both FDI and a volatile contribution of portfolio flows. Even though these flows were interrupted at the peak of the international crisis, in 2008–09, they eventually resumed, this time with more dynamic portfolio flows in relative terms. More significantly, portfolio flow dynamics in recent years have shown a higher correlation with push factors, as evidenced by periods of outflows mainly related to episodes of high volatility in international markets.

All these concerns emphasise the fact that unregulated financial openness amplifies financial volatility in EEs. Since variables such as growth rates, employment and GDP sector composition in these countries continue to be more sensitive to financial volatility, it is necessary for them to establish the prudential regulation of cross-border capital flows.

The hint in mid-May 2013 of less US monetary accommodation (tapering of bond purchases) initiated a reversal of capital inflows, which affected mainly some emerging market and advanced economies that were significantly dependent on

[7] See Diego Bastourre, Jorge Carrera and Javier Ibarlucía, "Commodity prices: structural factors, financial markets and non-linear dynamics", Central Bank of Argentina Economic Research Department, *BCRA Paper Series*, no 201050, 2010.

market-based external financing. A scenario of capital flow reversal and greater financial and exchange rate volatility could cause a tightening of domestic demand (reducing current account deficits) and thereby affect economic activity. The impact would be worse for countries with fragile macroeconomic conditions and large current account deficits.

In this scenario, a failure by some major economies to overcome the obstacles to external financing might reduce their domestic demand and the growth rate of the global economy. This effect would be greater now that emerging economies have a greater weight in the global production of goods and services.

Monetary policy coordination between EEs and advanced economies is essential to avoid the potentially deleterious effects of abrupt changes in short-term flows and the potential side effects of the first stages of tapering. However, coordination alone is not enough. It is also important to regulate short-term capital flows with a special focus on avoiding carry trade flows.

When the next round of exit policies are implemented, the resulting interest rate shock will most likely have an asymmetrical effect on EEs, since external positions have a significant impact on borrowing conditions. Also, most EEs have decreased their levels of foreign debt exposure over the past decade, which significantly reduces the potential negative effects of financial shocks. Countries with large current account deficits and low export dynamism might be severely hit by an interest rate shock, but many other EEs, even a majority, might not be so affected. In particular, countries with large stocks of international reserves may not necessarily be as deeply affected by an interest rate shock. Whether they have current account deficits or current account surpluses with low private sector indebtedness in foreign currencies, the large stocks of international reserves will act as a safeguard against interest rate shocks.

From the point of view of EEs, some important progress has been made. Nonetheless, it is still very important to monitor excessive increases in current account deficits, especially when they are the counterpart of short-term financing and are correlated with real exchange rate increases and consumption booms or asset bubbles.

3. Some thoughts for the next couple of years

In the short and medium term, it does not seem highly probable that there will be a sudden reversal in credit flows attributable to an abrupt hike in interest rates. This is because, according to the latest projections, the major advanced economies will not raise their target interest rates at least until early 2015.

International coordination should play a key role in facilitating a timely and smooth exit from expansionary and unconventional monetary policies in order to avoid jeopardising the global economic recovery. Until now, EEs have been instrumental in helping to lead the way out of the crisis, and a disorderly deployment of exit strategies could potentially be harmful to the current level of activity.

A good example of international coordination was seen in 2009 when, in the G20 framework, the IMF issued two rounds of Special Drawing Rights (SDRs) – a general allocation and a special one – for a total of SDR 161.2 billion, equivalent to

$244 billion. The issue and allocation of SDRs emerged as one of the main tools for strengthening the financial capabilities of small and medium-sized economies, supporting their domestic activities and expanding global demand; the result boosted economic growth worldwide. Moreover, the issue and allocation of SDRs is an important mean for liberating reserves from the security nets that EEs have been building, thus freeing assets to finance production, investment and consumption, or to reduce their debt.

This behaviour is also consistent with the IMF's original purpose, namely that of being an international coordinator capable of assisting its members in the event of balance of payments crises. In this regard, to help countries that may be suffering from sudden capital flow reversals, the IMF could consider establishing automatic mechanisms that would help to avoid unnecessary fluctuations in these economies. Such mechanisms could take the form of special direct credit lines, which should not be subject to conditionality.

Another coordination mechanism that has gained importance throughout the world is the use of currency agreements between countries, mainly to promote the trade of goods and services in local currencies. One of the principal instruments of such agreements is currency swaps among trading partners. China has been a key player in promoting such arrangements, not only among its main trade and geographical partners but around the world.

China has recently promoted the use of its currency as a monetary unit in the world's main financial centres, seeking to establish the renminbi on an equal footing with the US dollar, sterling and the yen. But the conditions under which a currency gains international stature still exist. One of those conditions is that the home economy must be large and stable enough to absorb external shocks without affecting the rest of the international financial system. This is a necessary condition to avoid relinquishing the reserve currency requirement in pursuit of domestic goals. During the last international financial crisis, some countries that were issuers of currencies with international stature rapidly abandoned that implicit role in order to address domestic difficulties. In some cases, this had undesirable side effects for the rest of the international financial system. Also, an incomplete and disorderly process of economic and financial integration could be another source of instability for these countries' currencies, diminishing their ability to become widely accepted as reserve currencies and sparking instability in the global economy.

What have central banks in EMEs learned about the international transmission of monetary policy in recent years?

João Barata R B Barroso, Emanuel W Kohlscheen and Eduardo J A Lima

Abstract

This note considers the international transmission of monetary policy conditions to emerging market economies (EMEs) with a focus on Brazil's experience. The main points are as follows: (i) growing foreign participation in Brazil's domestic Treasury markets has increased the sensitivity of the long end of the yield curve to global factors; (ii) the role of foreign factors in the term spread of most EMEs is growing in importance, but domestic factors still account for most of the variation; (iii) unconventional monetary policy in advanced economies (AEs) impacts asset prices and economic activity in EMEs, with capital inflows an important transmission channel; (iv) the prospect of tapering amplified asset price volatility, and interventions with swap instruments – backed by international reserves – are an effective way to cope with hedging demand; and (v) macroprudential instruments, including capital flow regulation and liquidity buffers, are effective in reducing financial instability associated with global factors.

Keywords: International transmission, yield curve, unconventional monetary policy, tapering, intervention, macroprudential policy

JEL: E50, E58, F36, F42

Introduction

This note considers the international transmission of global monetary policy conditions to emerging market economies (EMES) and associated policy choices in recent years, with a focus on Brazil. The first section argues that growing foreign participation in domestic treasury markets has increased the sensitivity of the long end of the yield curve to global factors. The second section looks at the term spread for a sample of emerging market economies and investigates the relative importance of domestic and foreign factors. The third section shows that unconventional monetary policy in advanced economies (AEs) impacts asset prices and economic activity, with capital inflows an important transmission channel. The following section describes how the prospect of tapering amplified asset price volatility and shows that intervention with swap instruments – backed by international reserves – are an effective way to cope with hedging demand. The final section argues that macroprudential instruments, including capital flow regulation and liquidity buffers, are effective in reducing financial instability associated with global factors.

Fading market segmentation and increased interdependence

Recent experience has taught us that the world has become more interconnected. Spillover effects of monetary policies have become more evident, in particular with regard to asset prices. Financial investment in the pre-crisis world, for instance, was based largely on an idea of clear market segmentation. There was a distinct segment composed of the low-priced risk to be found in advanced economies, and then there was a separate asset class composed of more speculative investments. The crisis challenged the underpinnings of this clear and rigid market segmentation, which in many cases had become institutionalised. When risk indicators in some advanced economies started to exceed those in several EMEs, changing risk perceptions helped to set a global portfolio rebalancing process in motion. This rebalancing and the growing weight of EME assets in global funds in the medium to long term have increased EMEs' links with the global economy.

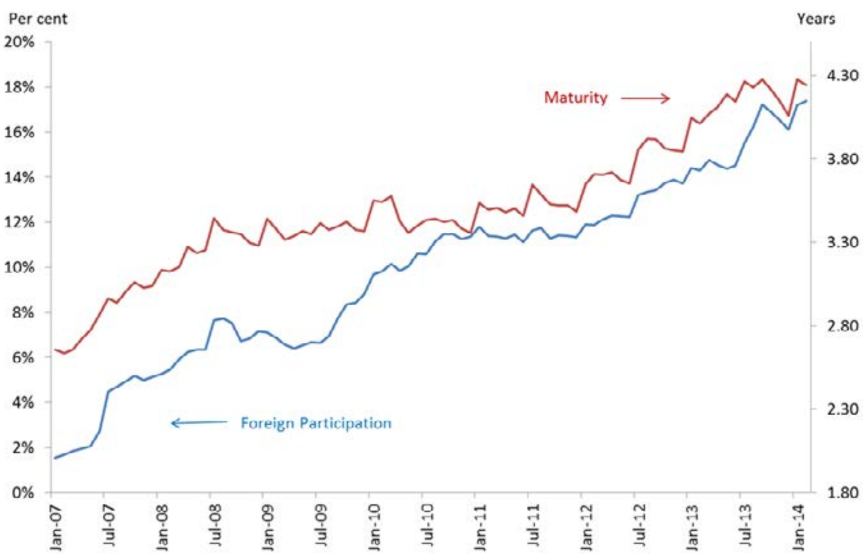
The asset class in EMEs that saw the largest net foreign inflows among all asset classes – by a very wide margin – was fixed income. Net inflows into this particular asset class were already a feature of the pre-crisis world, but they accelerated beginning in early 2010. In the case of Brazil, at one point, *net* capital inflows reached 6.1% of GDP (over 12 months), a very significant volume for what is still a relatively closed economy. Increased inflows coincided with non-conventional monetary policy actions in advanced economies that increased incentives for carry trade activities. Push factors clearly have been the dominant driving force for international capital flows. Indeed, a detailed study by Fratzscher (2012), which is based on a relatively comprehensive dataset, clearly shows that US monetary policy shocks have had a very strong effect on portfolio capital inflows across the globe,[1]

[1] With t-stats around 10.

whereas the effect of domestic monetary policy shocks in EMEs has generally not been significant, either from an economic or from a statistical viewpoint.

Financial globalisation has brought new opportunities and challenges to the table. Greater foreign participation in local bond markets tends to create opportunities for lengthening maturity structures in local markets, as foreign investors typically have longer investment horizons than local investors in EMEs and gravitate towards instruments with longer maturities and fixed rates. Indeed, the average maturity of domestic debt issued by the Brazilian Treasury increased from 3.84 years in December 2012 to 4.06 years at the end of 2013. In principle, however, greater foreign participation in local bond markets could also increase sensitivity to global rate changes and the risk of sudden outflows. Nevertheless, the level of foreign participation in Brazil's local sovereign debt markets is still relatively low, albeit growing, in comparison with other EMEs. To illustrate, as of November 2013 foreign investors held 16.6% of the federal government's debt instruments (see Graph 1). It is important to note that this figure – which was below 2% in January 2007 – includes the participation of foreigners in local investment funds.

Share of foreign participation and length of maturities in local debt markets Graph 1



Source: National Treasury of Brazil

Therefore, greater foreign participation has had the effect of increasing the sensitivity of the long end of the yield curve to global factors and to international risk cycles, with its risk-on and risk-off episodes (see Gourio et al (2013) and McCauley (2012)). Yet it is not clear whether US monetary policy has had strong effects on economic activity in EMEs with floating exchange rate regimes. While there is evidence of substantial effects of US monetary policy on foreign exchange markets and capital flows to EMEs, the empirical estimates of the effects on economic activity in EMEs appear to be surprisingly small. This suggests that floating exchange rates have been performing their function as shock absorbers quite well.[2] Even though international spillovers must certainly be taken into account, monetary policy should keep focusing on the domestic policy objective.

Monetary policy transmission and the term spread in EMEs[3]

With the binding zero lower bound in AEs since the financial crisis, the term spread has gained in importance as a transmission channel of monetary policy. Although EMEs may influence the domestic term spread through domestic policy rates, it may also be the case that the foreign term spread acts as an additional influence on the domestic yield curve. This section examines the relative importance of domestic policy and foreign factors in influencing the term spread in a group of emerging market economies. It updates the vector autoregression exercise in Moreno (2008), substituting term spreads in the foreign and domestic economies for the long-term yields (Tables 1 and 2).

Consider a vector autoregression with the following three variables for each EME: the term spread in the United States, the domestic policy rate and the domestic term spread. Both the foreign and the domestic term spreads are measured as the yield differential for domestic currency sovereign bonds at 10 years and 3 months maturity. The data are sampled weekly from May 2007 to February 2014, and all the results are checked for the post-crisis – defined as starting in May 2009 – subsample. All the variables are first differenced before estimation. We do not impose exogeneity of the foreign policy rate based on Granger causality tests.

When necessary we use recursive identification, with the foreign spread first, the policy rate second and the domestic spread last. This assumes that the policy rate does not respond to exogenous shocks to the domestic term spread within the same week. Intuitively, this assumes that most of the exogenous shocks to the term spread are shocks to long-term rates. Also, as suggested in Moreno (2008), monetary policy reaction to any shifts in long rates would not be immediate.

The results for the full sample are summarised in Table 1. There is strong evidence of Granger causality from the domestic policy rate to the domestic term spread (14 out of 18 economies), with the exception of Brazil, Indonesia, Peru and the Philippines. There is also evidence of Granger causality from the foreign term spread to the domestic term spread (11 out of 18 economies), with the exception of Chile, Colombia, Hungary, Malaysia, Peru, Russia and Thailand. Nevertheless, most of the forecast error variance of the domestic term spread (around 90%) is explained by its own innovations, with a small role for the policy rate (around 5%) and the foreign term spread (around 3%).

[2] A recent study conducted at the Federal Reserve Board (for Argentina, Brazil, Mexico, Peru, South Africa and Turkey) suggests that while global financial risk shocks explain about 20% of movements in risk spreads and economic activity in EMEs, US interest rate shocks have a negligible effect on macroeconomic fluctuations in EMEs (Akinci (2013)).

[3] This section was prepared by João Barata R B Barroso

Results for the full sample

May 2007–Feb 2014 Table 1

	Granger causality for domestic term spread			Forecast error variance decomposition of domestic term spread (long run)				Impulse domestic term		
	US term spread	Policy rate		US term spread	Policy rate	Domestic term spread		US term spread	Policy rate	Lags
South Africa	**0.066**	**0.016**		1.95	0.88	97.17		–	neg	10
Turkey	**0.034**	**0.000**		0.41	13.01	86.58		pos	neg	5
Brazil	**0.000**	0.225		6.93	3.91	89.16		pos	neg	8
Chile	0.980	**0.007**		2.12	0.63	97.25		–	neg	5
Colombia	0.142	**0.001**		3.19	5.89	90.92		pos	neg	13
Mexico	**0.000**	**0.000**		4.98	1.70	93.32		pos	neg	5
Peru	0.888	0.297		1.97	0.61	97.42		–	neg	5
Korea	**0.096**	**0.004**		4.65	9.13	86.22		pos	neg	12
Philippines	**0.014**	0.387		2.27	0.44	97.29		pos	pos	6
India	**0.052**	**0.000**		2.82	3.71	93.47		–	neg	12
Indonesia	**0.000**	0.366		2.04	4.06	93.90		pos	neg	5
Malaysia	0.475	**0.000**		5.02	5.99	88.98		pos	neg	8
Thailand	0.284	**0.000**		8.87	10.07	81.06		pos	neg	8
Chinese Taipei	**0.000**	**0.000**		8.84	10.18	80.98		pos	neg	12
Hungary	0.125	**0.000**		6.18	6.65	87.18		–	neg	6
Poland	**0.001**	**0.000**		1.49	5.41	93.10		–	neg	9
Czech Republic	**0.022**	**0.007**		5.37	3.49	91.14		pos	neg	7
Russia	0.376	**0.000**		2.34	11.16	86.50		–	neg	13
#signf.	11	14	Med.	3.01	4.74	91.03	#signf.	11	18	
#total	18	18	Avrg.	3.97	5.39	90.65	#total	18	18	

NB: The ordering is by region and, within region, alphabetically according to the name in Portuguese.

Results for the post-crisis sample

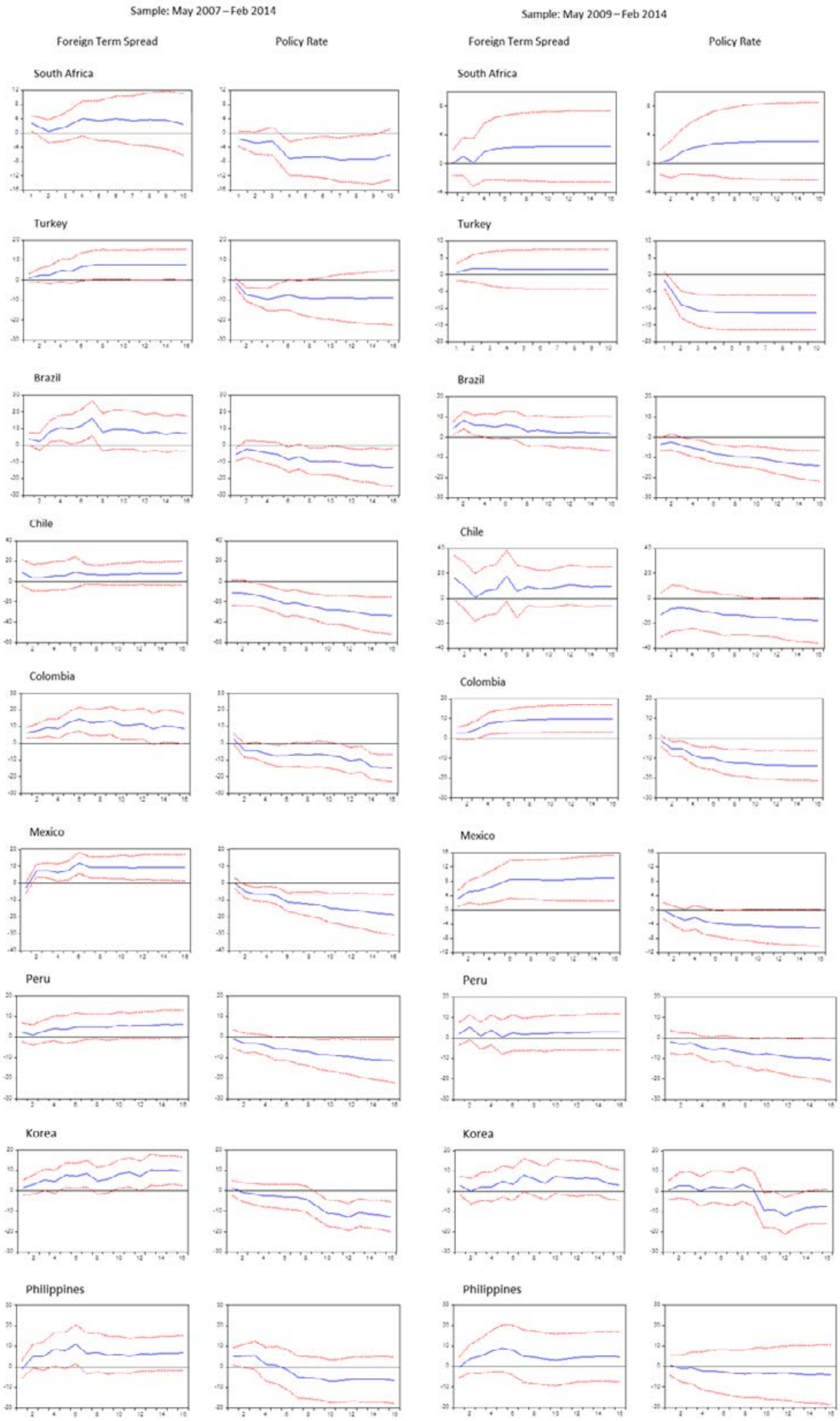
May 2007–Feb 2014 Table 2

	Granger causality for domestic term spread			Forecast error variance decomposition of domestic term spread (long run)				Impulse domestic term		
	US term spread	Policy rate		US term spread	Policy rate	Domestic term spread		US term spread	Policy rate	Lags
South Africa	0.160	0.460		8.02	6.67	85.31		–	–	3
Turkey	0.707	**0.000**		2.83	9.22	87.95		–	neg	1
Brazil	0.128	**0.024**		10.95	4.86	84.20		pos	neg	7
Chile	0.820	0.880		0.52	0.80	98.68		–	–	6
Colombia	0.376	**0.005**		8.07	8.30	83.63		pos	neg	3
Mexico	0.205	**0.085**		13.96	5.15	80.89		pos	neg	5
Peru	0.463	0.498		0.69	0.66	98.65		–	neg	5
Korea	0.428	**0.008**		4.37	3.26	92.38		–	neg	11
Philippines	0.542	0.982		4.63	3.53	91.84		–	–	6
India	0.763	0.886		6.93	10.49	82.58		–	–	11
Indonesia	0.174	**0.100**		9.81	1.29	88.90		–	–	4
Malaysia	0.435	**0.006**		3.88	7.81	88.30		pos	neg	10
Thailand	**0.024**	**0.015**		4.07	15.00	80.93		pos	neg	6
Chinese Taipei	**0.001**	**0.010**		16.18	10.22	73.60		–	neg	12
Hungary	**0.021**	**0.006**		8.54	8.76	82.70		–	neg	5
Poland	0.474	**0.005**		8.76	9.36	81.88		pos	neg	4
Czech Republic	**0.019**	**0.016**		4.87	4.90	90.23		pos	neg	3
Russia	0.995	**0.000**		2.95	12.25	84.81		–	neg	12
#signf.	4	13	Med.	5.90	7.24	85.06	#signf.	7	13	
#total	18	18	Avrg.	6.67	6.81	86.53	#total	18	18	

NB: The ordering is by region and, within region, alphabetically according to the name in Portuguese.

Impulse response of domestic term spread

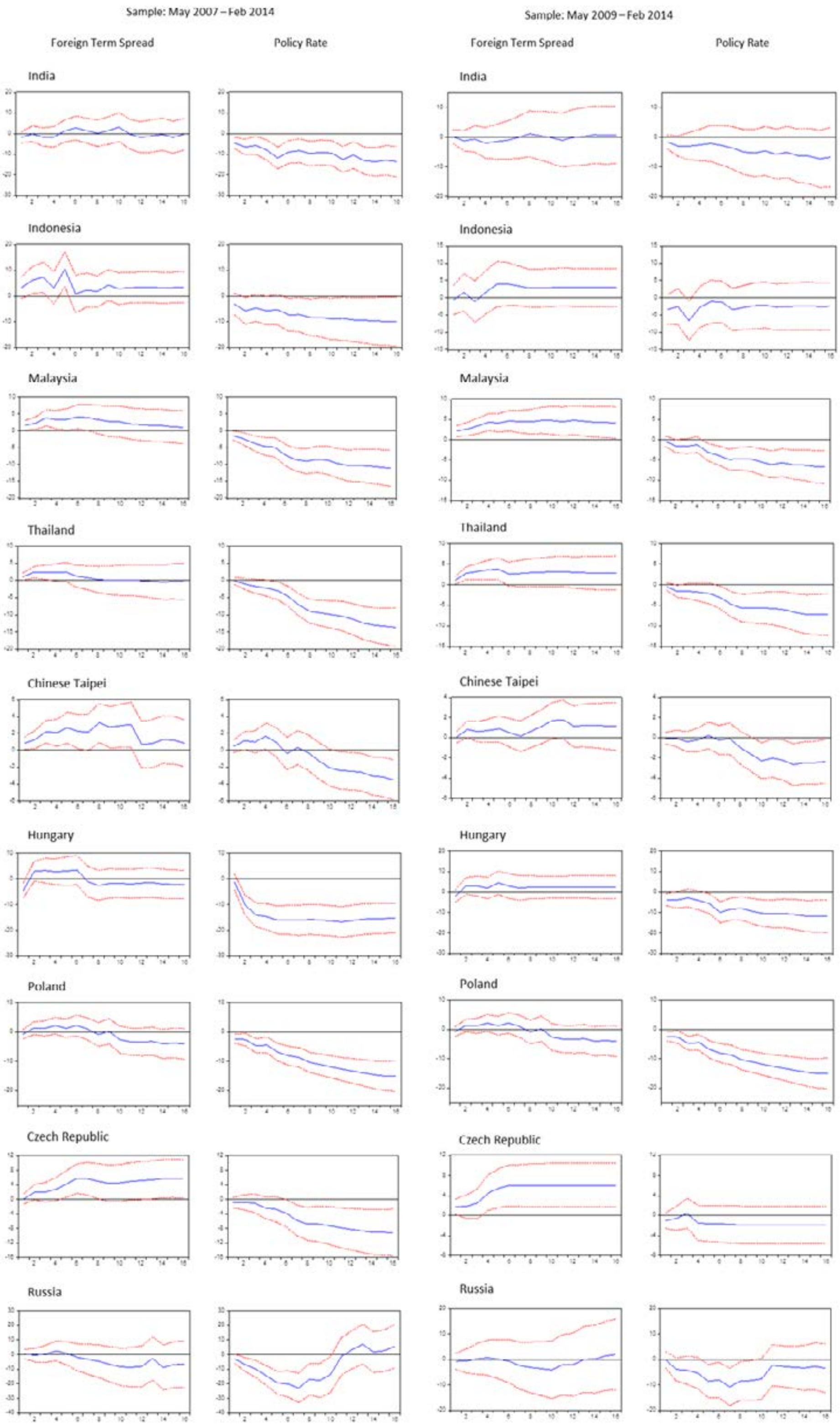
Graph 2



Source: Authors' calculations

Impulse response of domestic term spread

Graph 3



Source: Authors' calculations

The impulse responses (also shown in the leftmost columns of Graphs 2 and 3), suggest that the domestic term spread decreases after a domestic monetary policy shock, which is consistent with an ongoing tightening cycle for the average policy shock. The only exception to this pattern is seen in the Philippines, which has the opposite impact response and a non-significant response in later weeks. The response of the domestic term spread to an increase in the foreign term spread is usually positive and significant, with the exception of Chile, Hungary, India, Peru, Poland, Russia and South Africa. Most of the significant effects happen in the next four to six weeks, with the response after that non-significant in general.

The results for the post-crisis sample are summarised in Table 2. The strong evidence of Granger causality from the domestic policy rate continues (13 out of 18 economies), but there is much less evidence of causality from the foreign term spread to the domestic one (four out of 18 economies). However, the innovations to the domestic term spread play less of a role in the overall forecast error variance (around 86%), with a much larger role for the foreign term spread (around 7%) and the policy rate (around 7%). The average increase in the share explained by the foreign term spread is driven mostly by the results from Brazil, Chinese Taipei, Colombia, Hungary, Indonesia, Mexico, Poland and South Africa, for which the foreign term spread explains a significant share of the forecast error variance (around 10.5%). The average increase due to the domestic policy rate is driven by Chinese Taipei, Colombia, India, Russia and Turkey (around 10.5%).

As regards the impulse responses for the post-crisis period (see also the rightmost columns of Graphs 2 and 3), there is still robust evidence of a negative impact from the domestic policy rate. But significance is lost in some economies, such as Chile, India, Indonesia, the Philippines and South Africa. There is weaker evidence of a significant response of the domestic term spread to the foreign one, although a significant positive response is still observed in Brazil, Colombia, the Czech Republic, Malaysia, Mexico, Poland and Thailand; moreover, the effects are long-lasting, with significant effects still observed several months later.

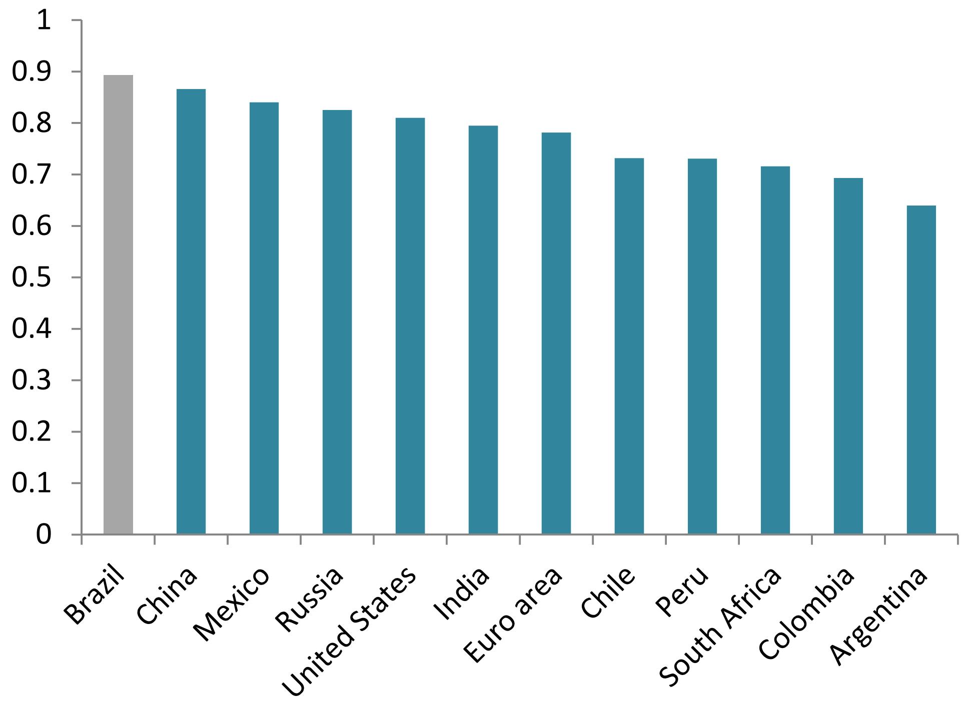
We may summarise the exercise from this section as follows: there is robust evidence that the domestic term spread in EMEs responds negatively to the domestic policy rate and some evidence that it responds positively to the foreign term spread. A similar pattern is observed for the Granger causality of the shocks to the domestic term spread. Although the domestic policy shock and the foreign term spread shock account for a small share of the long-run forecast error variance of the domestic term spread, this share has increased in the post-crisis subsample. There is a lot of heterogeneity in the significance patterns of the results, but the direction and economic magnitudes are relatively homogeneous whenever the effects are significant.

International transmission of unconventional monetary policies to Brazil

In view of asset return correlations, investing in Brazilian assets could mean, in many ways, taking a position in the whole emerging market asset class (see Graph 4). This fact is quite striking since Brazil has a relatively closed and isolated economy that is strongly affected by commodity prices, and participation by foreign investors in local bond markets is low. Of course, the price and derivative exposure is several times higher than the quantity exposures. Amplification mechanisms in the domestic economy also matter, since fast expansion of the domestic credit market is usually a good indicator of tight financial constraints, and hence of the amplification potential of external shocks. These reasons may explain why domestic assets have shown a comparative advantage in synthesising other emerging market positions.

Correlation among EMEs stock prices

Corr(Δ%MSCI, Δ%Emerging MSCI (Jan 2003–Sep 2013) Graph 4



Source: Bloomberg

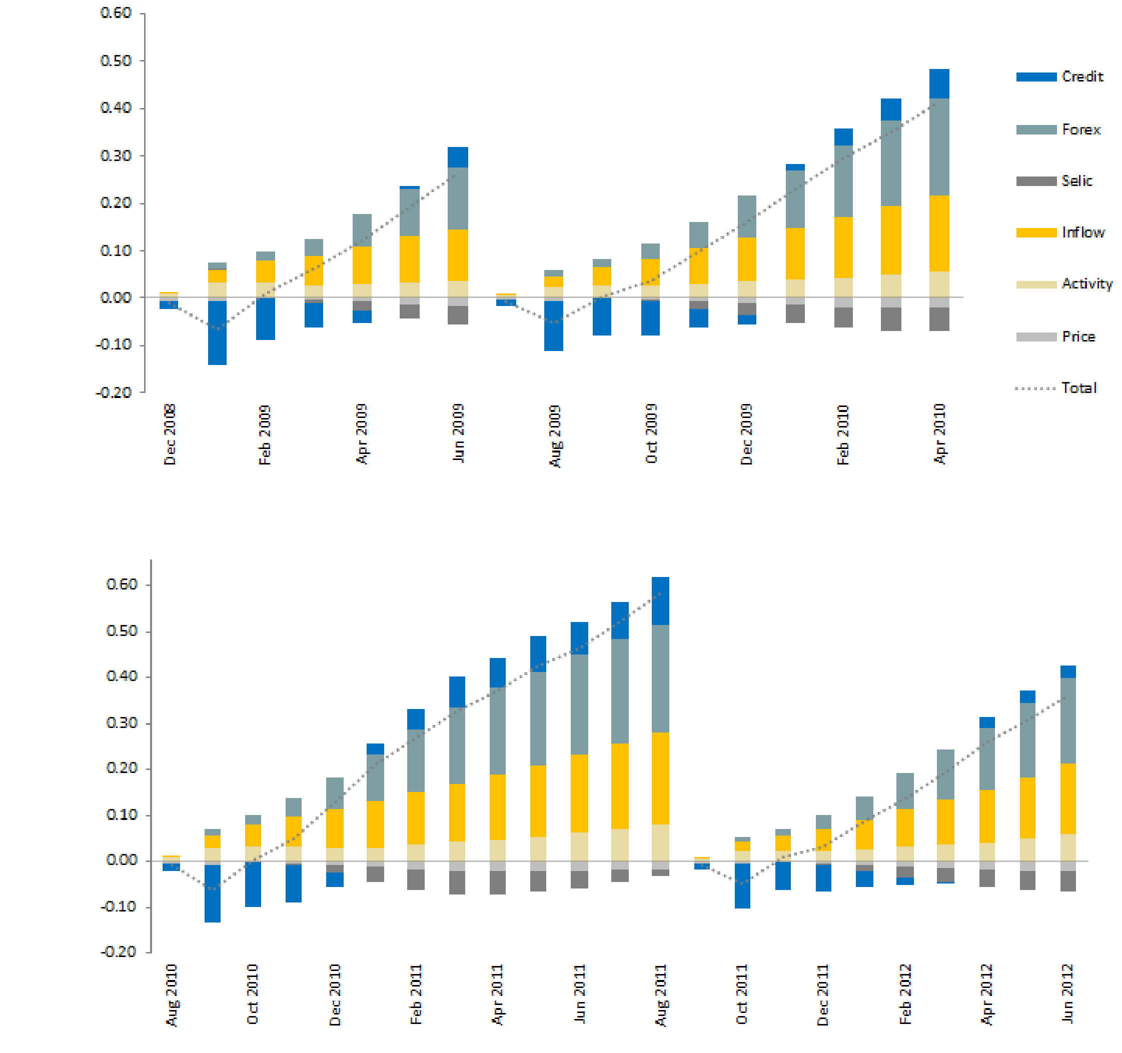
It may therefore be particularly relevant to consider Brazil's experience with the transmission of unconventional monetary policies from advanced economies, with a focus on price incentives driving different carry trade operations. Brazil's relatively open capital account, floating exchange rate regime and deep foreign exchange derivatives market have encouraged such operations. One may consider the approach in Barroso et al (2013), who use the historical correlation between international prices, capital inflows and domestic variables as the reference in constructing counterfactual scenarios for the domestic economy. Of particular interest are the effects on the term spread implied by the counterfactual scenarios.[4]

[4] The goal of quantitative easing policies has often been characterised as a qualitative goal for the term spread, especially in the case of the Federal Reserve. But the term spread responds to many structural shocks, and so it may summarise conflicting signals with respect to future developments. It appears that the sample was selected to reflect mostly liquidity shocks, and the robustness of the sample was thoroughly considered.

Of course, the quantitative results depend on the exact counterfactual scenario. What is interesting is that the qualitative results and the significance of the effects are robust to the specific scenario considered. These results point to the following responses to the Federal Reserve's implementation of unconventional monetary policies: higher capital inflows; exchange rate appreciation; stock market price increases; and a credit boom, with new credit extended mainly to households, stimulating retail sales and economic activity in general. According to a decomposition of the transmission channels proposed in Barroso et al (2013), capital inflows were consistently found to be the most important transmission channel of quantitative easing (QE) to other domestic variables (see Graph 5 for the case of domestic credit).

Propagation channels to domestic credit

Graph 5



Source: Authors' calculations

To give a quantitative, if arbitrary, idea of the results, consider the following scenario: had QE policies not been implemented by the Federal Reserve, the term spread on US treasuries would have been 150 basis points higher.[5] In addition, if commodity prices and world trade volume were a bit lower, and emerging market spreads a bit higher, as predicted by a parsimonious vector autoregression model, the additional capital inflows resulting from QE2, for instance, would be of the order of US$ 100 billion. This result was associated with an additional 0.9% of GDP of non-earmarked credit to households, a fall of 5 percentage points in interest rates on reference loans, an increase of 12% of GDP in stock market value, and a nominal exchange rate appreciation of nearly 13%. Barroso et al (2013) estimate that the capital inflow channel accounts for 60% of the effects. Moreover, the capital inflow channel was the only channel that was consistently significant across variables and samples. Credit variables, including credit aggregates and interest rates, show a particularly acute sensitivity to the capital inflow channel.

Tapering and recent policy responses

The beginning of the discussion about the exit from accommodative monetary policies in advanced economies led to a repricing of risk and sell-off of emerging market assets. Since May 2013, many emerging market economies have seen depreciating exchange rates, increasing bond yields and credit default swaps and, in many cases, falling stock market prices. In the case of Brazil, the elimination in June 2013 of the financial transactions tax on incoming foreign fixed income investment and the continuous rise of the monetary policy target rate since April 2013 have helped to counteract the impact of Federal Reserve tapering.

The sell-off has manifested itself mostly in a search for protection, rather than in actual outflows. Most of the selling pressure has come from foreign investors seeking to hedge their portfolios against currency devaluation, Brazilian companies hedging their foreign exchange liabilities, and foreign companies hedging their exposure to local assets. Brazil's Central Bank responded by using accumulated buffers to reduce volatility, avoiding abrupt changes that could potentially threaten macroeconomic stability. In order to mitigate risk, the Central Bank announced a program of regular daily FX interventions through foreign exchange swaps and dollar credit line auctions through August 2013. It offered US$ 2 billion in foreign exchange swaps and US$ 1 billion in credit line auctions every week. This program was recently extended, with modifications, through the first half of 2014. The amount of foreign exchange swaps to be offered was reduced to US$ 1 billion per week, and US dollar credit line auctions will be held as needed.

Macroprudential policies

It is well known that periods of excessive inflows and exchange rate market pressure are usually followed by reversal and exposure to tail risks. Ideally, the domestic

[5] This is about 75 basis points higher than the announcement effects estimated in the literature, assuming that the non-observable scenario with an unconventional policy "turned off" actually deteriorates.

policies adopted under more favourable circumstances would build enough policy space to cope with higher volatility should it be needed in the future. For instance, the regulatory regime for capital flows may be strengthened during periods of particularly heavy inflows and relaxed when they suddenly dry up. In the five years since the financial crisis, EMEs have experimented with such policies, and it is possible to begin to take stock of their effectiveness. We consider capital controls, foreign exchange intervention and macroprudential policies in turn.

Capital control measures were introduced by many EMEs, including Brazil, Chinese Taipei, Indonesia, Korea and Thailand, particularly in late 2010 and early 2011 – that is, before the worsening of the euro crisis. The most recent research at the IMF suggests that such measures have discouraged not only portfolio flows but also total capital flows (Ahmed and Zlate (2013)).

Brazil's recent elimination of its capital inflow tax illustrates the effectiveness – in the other direction – of another type of policy. On 4 June 2013, as concern about tapering was increasing exchange rate volatility and stimulating capital outflows, Brazil reduced its Financial Transactions Tax (IOF) on foreign inflows into fixed income securities from 6% to 0%. The three-month moving average of net inflows by foreigners into fixed income securities went from US$ 0.8 billion in April to US$ 4.3 billion in July. At the same time, combined net stock and credit inflows by foreigners dropped from US$ 3.4 billion in April to US$ –2.3 billion in July. Therefore, the end of the IOF tax on capital inflows, along with the steepening of the domestic yield curve, apparently helped to offset capital outflows.

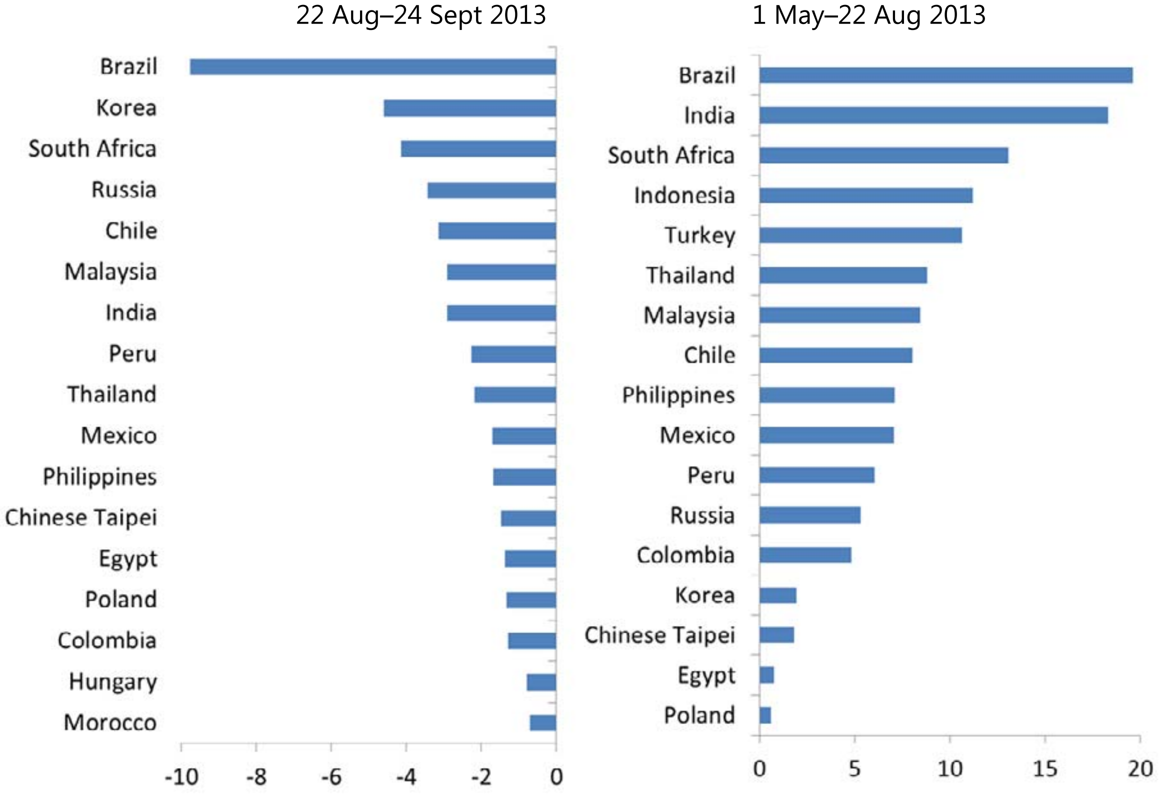
Emerging markets anticipated by a decade the macroprudential approach of accumulating international reserves to hedge against the effects of external shocks on the domestic financial system. International reserves should be sizeable to enable credible intervention when it is needed most.[6] Intervention policies may vary according to specific events. For instance: (i) swap instruments may address a futures market squeeze (margin calls, rollover risk or simply hedging demand); (ii) repo agreements directed at foreign trade may mitigate a credit squeeze; and (iii) intervention using international reserves directly may provide liquidity in a stressed spot market.

As mentioned above, the recent extensive use of swap instruments reflects the perception of high hedging demand. Since the future and the spot markets are linked by arbitrage, the intervention also alleviates depreciation pressures in the spot market. After depreciating almost 20% from 1 May to 22 August 2013, the Brazilian real appreciated almost 10% from 22 August to 24 September, attesting to the effectiveness of the policy along this dimension (see Graph 6). Also, the risk reversal indicator for the real decreased from 2.75 to 1.80, in absolute terms, right after the announcement of the FX intervention program, which shows that the policy reduced tail risk. Although other market events have since driven the exchange rate and tail risks, it is clear that there are effective tools available to address excessive volatility.

6 A possible measure of reserve adequacy would consider severe scenarios of portfolio outflows and export contraction, say the 90% percentile of such contractions in absolute value. By this measure, international reserves in Brazil increased from one year in 2001 to four years in 2013, in year equivalents to a severe and protracted balance of payments crisis.

Exchange rate depreciations

Graph 6



Source: Authors' calculations

As regards macroprudential policies that target the banking sector specifically, the most recent research at the IMF suggests that they are effective in reducing procyclicality (Claessens and Ghosh (2012)). Macroprudential policies are effective in reducing growth in non-core liabilities most associated with capital flows. According to the same study, reserve ratios are most effective in dampening asset growth and leverage.

During the 2008–09 financial crisis, Brazil used reserve requirements to redistribute liquidity among financial institutions. Reserve ratios proved to be an effective tool in reducing cross-sectional financial instability resulting from the different sensitivity of individual financial institutions to external funding shocks or tighter domestic funding conditions, or simply from the exposure of their assets to the international environment. This is a tested tool that Brazilian policymakers can use if conditions require. In light of the growing integration of the global economy, the development of macroprudential tools in the context of international shocks is of the highest importance.

References

Ahmed, S and A Zlate (2013): "Capital flows to emerging market economies: a brave new world?", *IFDP Working Papers* 2013–1081, Board of Governors of the Federal Reserve System, June.

Akinci, O (2013): "Global financial conditions, country spreads and macroeconomic fluctuations in emerging countries", *IFDP Working Papers* 2013–1085, Board of Governors of the Federal Reserve System, August.

Barroso, J B, L A Pereira and A S Sales (2013): "Quantitative easing and related capital flows into Brazil: measuring its effects and transmission channels through a rigorous counterfactual evaluation", *Working Paper Series*, no 313, Central Bank of Brazil, July.

Claessens, S and S Ghosh (2012): "Macroprudential policies: lessons for and from emerging markets", draft, International Monetary Fund and World Bank, 11 July.

Fratzscher, M (2012): "Capital flows, push versus pull factors and the global financial crisis", *Journal of International Economics*, vol 88, no 2, November, pp 341–56.

Gourio, F, M Siemer and A Verdelhan (2013): "International risk cycles", *Journal of International Economics*, vol 89, no 2, March, pp 471–84.

McCauley, R: (2012): "Risk-on/risk-off, capital flows, leverage and safe assets", *BIS Working Papers*, no 382, July.

Moreno, R (2008): "Monetary policy transmission and the long-term interest rate in emerging markets". *BIS Papers*, no 35, pp 61–79.

Monetary policy independence in Chile[1]

Sebastián Claro[2] and Luis Opazo[3]

Abstract

International financial integration and a high co-movement in risk premia have caused long-term interest rates in developing countries to become highly correlated with long-term interest rates in the main financial centres. Arguably, this reveals a limit to monetary policy independence. We analyse the case of Chile since the early 2000s, showing that exchange rate flexibility and inflation credibility have enhanced the ability to have a monetary policy based upon domestic inflationary objectives. The apparent tension between a central bank's capacity to determine short-term monetary conditions while exerting a less strong influence on the long end of the yield curve suggests that a complementary role for other macroprudential tools is required if price and financial stability objectives are to be achieved.

Keywords: Monetary policy independence, interest rates, financial integration, Taylor rules

JEL classification: E43, E58, F3

[1] Prepared for the BIS Deputy Governors' meetings on "What have EME central banks learnt about the international transmission of monetary policy in recent years?", 6–7 March 2014, Basel. We thank Álvaro González for excellent support. The views expressed in this note do not necessarily represent those of the Central Bank of Chile. At the time this paper was written, Opazo was Head of the Financial Stability Group at the Central Bank of Chile.

[2] Board member, Central Bank of Chile.

[3] Head of Research, Banking and Financial Institutions Association of Chile.

1. Introduction

The international financial conditions faced by emerging market economies (EMEs) have changed significantly over the last decade. The low interest rates and the stable risk premium of the 2000s gave way during the 2008–09 financial crisis to extremely low risk-free interest rates in the main financial markets and, in contrast, a very high risk premium for EME debt. In the last few years, interest rates in the main financial centres have remained at historically low levels in response to the aggressive monetary policies undertaken by the main central banks, while EME spreads have been reduced, albeit with some volatility. Overall, financial conditions for EMEs have been very attractive since 2011.

In contrast to previous episodes, the positive environment for financial assets in EMEs was accompanied by several economic problems in developed economies in the aftermath of the 2009 financial crisis. The combination of expansionary monetary policies and poor macroeconomic conditions in developed markets, together with deleveraging financial institutions, enhanced a global financial cycle that has affected all developing countries. As pointed out by Rey (2013), the ability of EMEs to influence or manage domestic financial conditions has come under pressure, as financial flows and asset prices have been more affected by conditions in developed markets than by domestic macroeconomic conditions.[4]

This phenomenon is especially relevant as many developing countries shifted toward flexible exchange rate regimes during the 2000s as they adopted or moved towards inflation targeting regimes.[5] Conceptually, the ability to run an independent monetary policy implies the adoption of a flexible exchange rate system. In a context of perfect capital mobility, monetary policy independence results in exchange rate adjustments and asset price changes. These adjustment valves should prevent the development of flows that may contribute to the build-up of financial vulnerabilities. More generally these adjustments should help to mitigate potential imbalances.

Two questions arise in this context. First, how far have emerging market economies been able to run independent monetary policies in the last few years, or is it the case that global liquidity conditions have generated a global cycle to which EMEs have been unable to adjust. A second question points to the implications that this debate on monetary policy independence has on asset prices changes and, in particular, on exchange rate fluctuations.

Using evidence from Chile, this paper seeks to shed some light on the following dimensions: (i) the ability of the central bank to steer domestic short-term interest rates independently of the level or direction of foreign short-term interest rates, (ii) its ability to affect interest rates on the long part of the yield curve, (iii) the consequences of monetary independence for the exchange rate.

4 See also BIS (2014) for a discussion on financial spillovers from advanced economies' monetary policies.

5 See Claro and Soto (2013) for the experience of Chile.

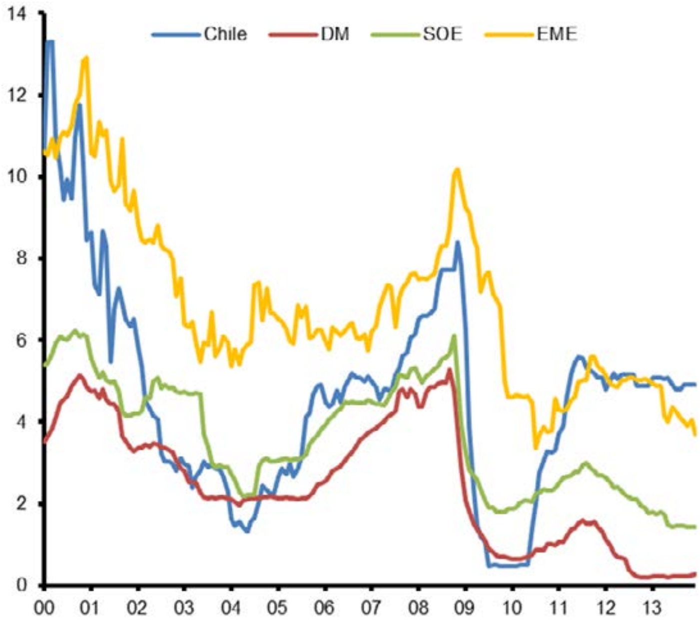
2. Some facts

i. Short-term rates

Figure 1 plots the 90-day nominal interest rate in a series of countries: emerging economies (EME), developed economies (DM), small open economies (SOE) and Chile. We use these series as a proxy for the monetary policy stance. Alternatively, we could use the monetary policy rate, which shows a very similar pattern. However, for the sake of analysing the exchange rate and financial flows' responses to interest rate differentials, we think the 90-day rate is more relevant as a market reference.

Short-term interest rates[1]

(percentage) Figure 1



[1] The interest rate for EMEs, DMs and SOEs corresponds to the median rate of each group. For the countries included see Annex 1.

The figure shows an interesting pattern. During the 2000s, Chile's short-run monetary policy conditions were very similar to those in developed markets, both in levels as well as in its cyclical pattern. During the 2009 crisis, Chile was also able to lower interest rates to record low levels as DMs did, while a period of monetary policy normalisation started in 2010. Since then, monetary conditions in Chile have been different from those in developed economies and, if anything, closer to those in other developing countries.

Table 1 presents additional evidence on this point. It reports the correlation coefficient between Chile's nominal rate and the median rate in different groups of countries for different maturities. We divide the sample into pre-crisis and post-crisis periods: January 2000–August 2008, and January 2010–November 2013, respectively.[6] In the 2000–08 period, we observe a high correlation between Chile's 90-day nominal rates and those in the rest of the world. After the crisis, the Chilean short-run correlation essentially breaks down, especially with developed countries. In contrast, correlations between long-term interest rates have increased in the last few years (this point will be developed later).

Correlation coefficient between domestic rates in Chile and alternative groups[1]

(percentage) Table 1

		2000-2008.08	2010-2013
Short-Term rate[2]	DM	77.1	2.3
	SOE	80.3	11.5
	EME	81.4	32.2
Long-Term rate[3]	DM	56.6	65.9
	SOE	15.4	75.7
	EME	40.2	48.0

[1] Correlation coefficient between Chile and the median country in each group. [2] 90-day interest rate. [3] 10-year government bond interest rate.

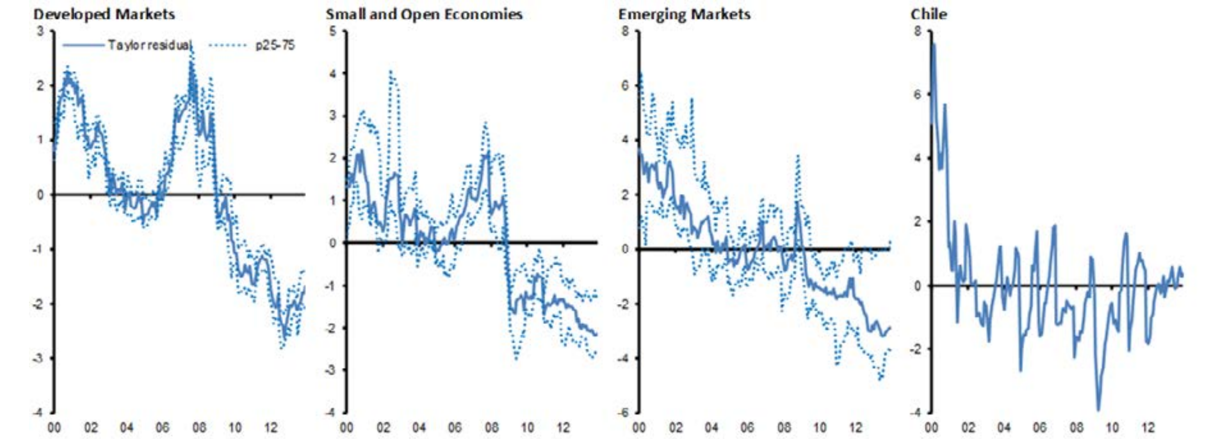
Although one might be tempted to attribute these changes to gains in monetary policy independence with respect to DMs, for instance, it is important to point out that these correlations could be explained by cyclical conditions. In particular, it is possible that the obvious differences in macroeconomic conditions in the last few years between developed and developing markets explain the gap in short-run rates. Figure 2 explores this issue more formally. It reports the unexplained component of the short-term interest rates as derived from a simple Taylor rule. In each group we report the error term of the median country, as well as the p25 and p75 values. The figure shows that Chile's short-term monetary conditions have been roughly consistent with the Taylor rule, revealing that local macroeconomic conditions have been the main driver of rates since the early 2000s. In essence, the high correlation of monetary conditions between Chile and DMs in the pre-crisis period has been driven by similar cyclical conditions, while in the last years the fall in the correlation relates to fundamentally different domestic conditions.

Apparently, this is not the case in other emerging market economies. In some, short-term interest rates in the last few years have been lower than a simple Taylor rule would have prescribed. This suggests that global monetary conditions could have had some impact on the ability or willingness of EMEs' central banks to manage short-term interest rates exclusively from a consideration of domestic conditions. Alternatively, this could reveal that considerations other than inflation – such as exchange rate fluctuations – might help to explain monetary policy conditions in some emerging economies.

[6] We skip the last quarter of 2008 and all of 2009 where risk spreads surged in all countries and asset prices co-moved very significantly.

Short-term interest rate not explained by a simple Taylor rule[1]

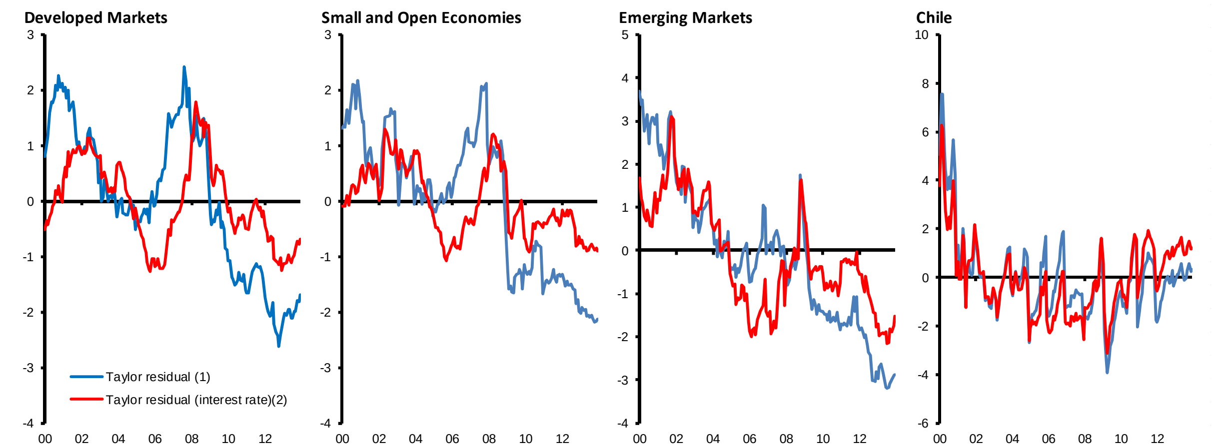
(percentage) Figure 2



[1] Corresponds to the residual from the following equation $i = \alpha + \beta(y - y^P) + \gamma(\pi - \pi^P) + u$ where i is the 90-day interest rate, $(y - y^P)$ is the GDP differential between the current GDP and the cycle GDP approximated with a Hoddrick-Prescott filter, and $(\pi - \pi^P)$ the gap between the inflation rate and the long-term inflation approximated with a Hodrick-Prescott Hoddrik-Prescott filter. The sample period goes from 2000m1 and 2013m12. For the countries included see Annex 1.

Impact of US short-term interest rate on domestic interest rates

(percentage) Figure 3



Notes: (1) Corresponds to the residual from the following equation $i = \alpha + \beta(y - y^P) + \gamma(\pi - \pi^P) + u$ where i is the 90-days interest rate, $(y - y^P)$ is the GDP differential between the current GDP and the cycle GDP approximated with a Hodrick-Prescott Hoddrik-Prescott filter, and (π-π^P) the gap between the inflation rate and the long-term inflation approximated with a Hodrick-Prescott Hoddrik-Prescott filter. (2) The augmented Taylor rule corresponds to: $i = \alpha + \beta(y - y^P) + \gamma(\pi - \pi^P) + i^* + u$, where i^* is the 90-day lLibor rate in the United States. The sample period goes from 2000m1 and 2013m12. For the countries included see Annex 1.

Another way to check for the potential influence of external conditions on the local short-term interest rate is to incorporate the US short-term interest rate into our simple Taylor rule specification. The results shown in Figure 3 reveal that the US short-term interest rate effectively influenced the expansiveness of the monetary policy stance of DMs, SOEs and EMEs. In Chile, this effect is negligible, suggesting that the Central Bank of Chile's management of short-term interest rates has not been driven by global conditions above and beyond the effects that they have on Chile's cyclical condition and inflation perspective.

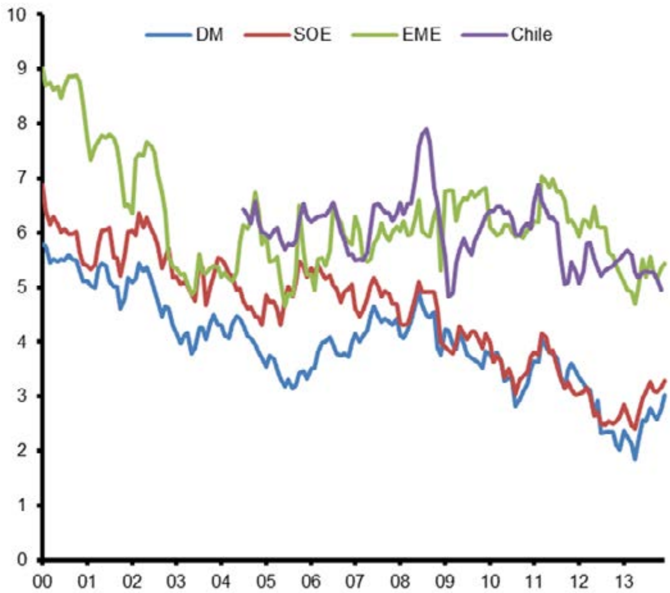
ii. Long-term rates

Figure 4 plots the evolution of 10-year nominal interest rates for the same group of countries. The pattern across time and countries is different from that at the short end of the yield curve, as expected. Developed economies consistently have lower long-term nominal interest rates on sovereign bonds than EMEs, reflecting – on average – lower inflation rates and lower risk spreads. It is also worth highlighting that long-term interest rates in developing countries are much more stable than short rates. In contrast with the evidence presented in Figure 1, the monetary policy cycle has a much milder impact on long-term rates.

Long-term local currency-denominated bonds[1]

(percentage)

Figure 4



[1] The lines of the country groups are the median rate of the 10-year government bond of the respective group. For the countries included see Annex 1.

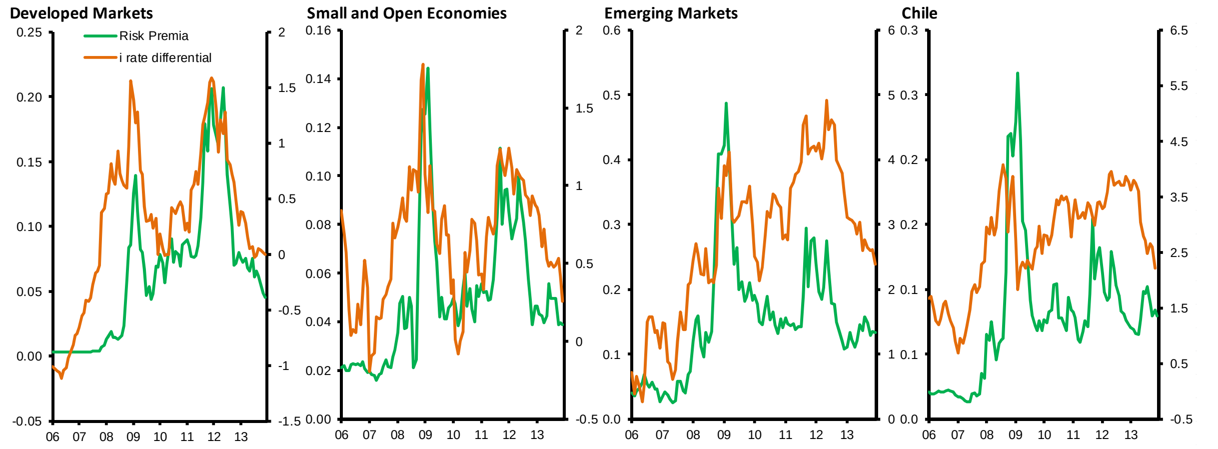
As the bottom part of Table 1 shows, the correlation coefficient of long-term rates across different groups of countries has been high throughout the period. Indeed, if anything, this correlation has increased in the last few years. This reveals several features. The dynamics shaping the valuation of long-term assets are less affected by short-run conditions; instead, long-term determinants of macroeconomic performance (Claro and Soto (2012)) as well as global factors (Longstaff et al (2011), IMF (2013)) have a much more significant effect in determining long-term rates. This was true in the period before the crisis, and it seems to be even more relevant after the crisis.

To illustrate this point, Figure 5 shows that the higher co-movement of long rates is closely matched with the co-movement of risk spreads, which has a strong global component, and Figure 6 shows that the risk premium across countries is highly correlated with the VIX index, which is a metric of global risk conditions.

Therefore, in contrast with short-term monetary conditions (previous section), the dynamics of sovereign long-term interest rates is highly influenced by global factors.[7]

Long-term interest rate and risk premium[1]

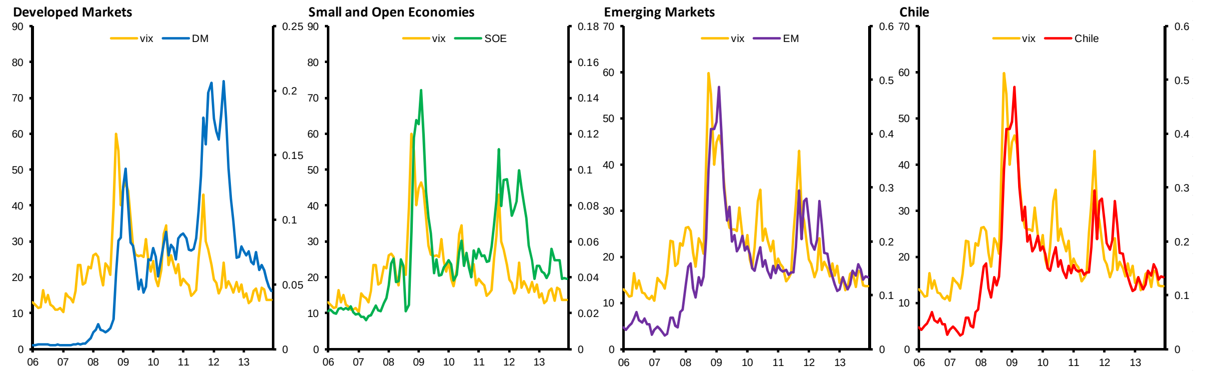
(percentage) Figure 5



[1] The lines of the country groups are the median of the described variable, of the respective group. For the countries included see Annex 1.

Risk premia and volatility index[1]

(percentage) Figure 6



[1] The lines of the country groups are the median of the described variable of the respective group. For the countries included see Annex 1.

[7] The evidence that global factors are relevant in determining long-term rates, and that this relationship has increased in the last few years, is consistent with Rey (2013), who suggests that push factors related to liquidity conditions in developed markets have been a critical driver of long rates. In this line, Longstaff et al (2011) show for a group of economies that the explained variance for the first principal component is 43% during the period 2000–06, while the explained variance increases to 75% during the period 2007–10. In particular, the first principal component estimated by Longstaff et al is quite close to the VIX. A similar conclusion is obtained by Pan and Singleton (2008), who find a strong relation between sovereign credit spreads and the VIX index.

The difference in the role of global factors in short-term and long-term interest rates is very relevant, especially because no definition of monetary policy independence is comprehensive enough. In a context of financial integration, it is probably the case that a better assessment of monetary policy independence could be done by analysing the dynamics of short-term rates. This does not mean, of course, that long rates are not relevant for macrofinancial decisions; they are – for instance, consumption and investment decisions are affected by interest rates all along the yield curve. However, with capital mobility, the capacity of monetary policy to affect long-term interest rates is clearly smaller, and global factors play a much more prominent role. Also, the global drivers of long-term rates can change over time; in the last few years one hypothesis worth pursuing is that global liquidity in developed countries and the search for yield of financial intermediaries have affected risk spreads and hence rates in emerging markets.

Whether this implies a reduction in monetary policy autonomy or whether it rather reveals a high level of global interdependence is a question of semantics. As mentioned above, the reduced ability of the short-term interest rate to influence the long-term rate could imply that monetary policy is less capable of influencing decisions based on long-term interest rates – for instance, funding and investments in the real state sector. This doesn´t mean that central banks have been deprived of any ability to achieve their inflation or financial stability goals. Instead, it probably suggests that, in a context of global financial integration, monetary policy independence reflects the ability to affect financial conditions in different degrees across the yield curve.

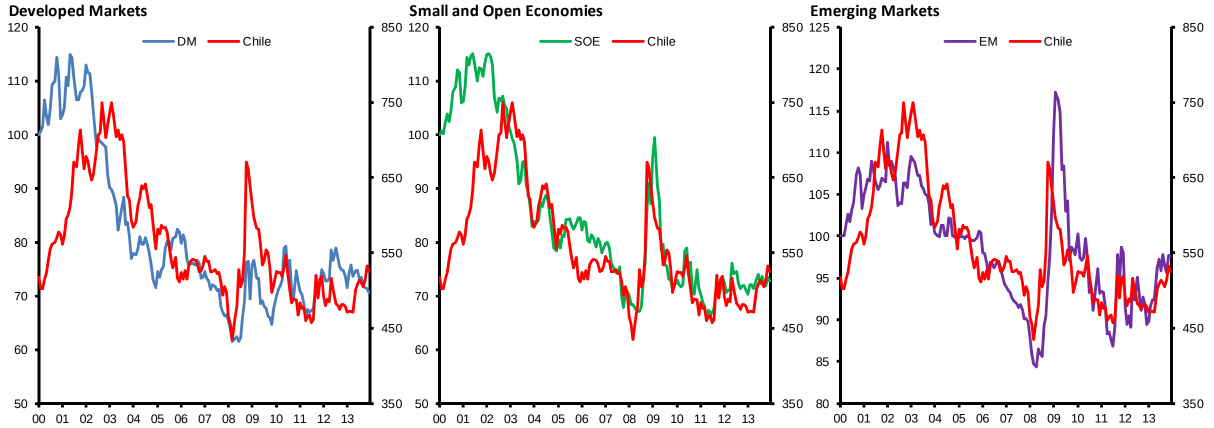
iii. Independent monetary policy and the nominal exchange rate

Figure 7 plots the evolution of Chile's peso against a group of other currencies. An increase means a depreciation of the peso. Overall, since the early 2000s all currencies have had a similar performance against the US dollar. We observe a strengthening of domestic currencies in developing countries in the first half of the 2000s, following by a sharp depreciation during the crisis, which rapidly reversed itself in a few quarters. The last few years have been a period of strong EME currencies. But this trend has strongly reversed since the second half of 2013.

The evolution of the exchange rate also seems to be highly influenced by common and global factors. This is true at low frequency, as Figure 7 shows for a period with heterogeneous monetary policy and cycles. But it also holds at high frequencies, even when idiosyncratic shocks play a larger role. Obviously the short-run dynamic of the nominal exchange rate could be associated with a wide range of shocks, including the implementation of policies oriented to mitigate its changes. Table 2 shows a variance decomposition of a rolling window of quarterly exchange rate changes. Even at high frequencies, the analysis shows that the risk premium is a key driver of exchange rate volatility.

Chilean peso vis-à-vis other countries' currencies[1]

(January 2000=100) Figure 7



[1] The lines of the country groups are the median of the described variable, of the respective group. For the countries included see Annex 1.

Exchange rate variation: components of the explained volatility[1]

(percentage) Table 2

	2010-2013		
	EME	SOE	Chile
		(standard deviation)	
Exchange rate (% change)	4.92	4.91	4.82
		(percentage explained of the dependent variable volatility)	
i differential	2	8	0
Risk premia	28	21	25
Cov (i, risk)	0	-11	0
Residual	71	77	75

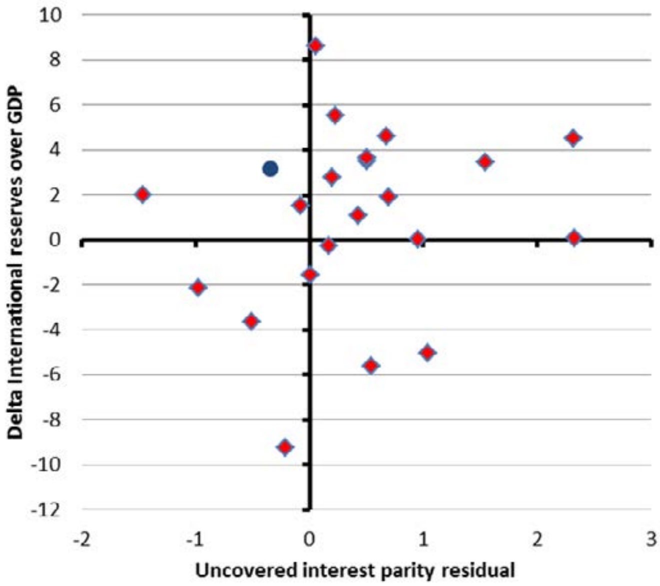
[1] After estimating the exchange rate percentage variation from the equation: $\frac{\Delta e}{e} = \alpha + \beta(i - i^*) + \gamma(CDS - CDS^*) + u$, the table shows the standard deviation of the four components of the equation, where $\frac{\Delta e}{e}$ is the quarterly percentage variation of the exchange rate, $(i - i^*)$ is the short-term interest rate differential, and $(CDS - CDS^*)$ the risk premia differential with respect to the US interest rate.

In this regard, it is useful to recall that the literature on the effectiveness of policy interventions suggests only short-lived effects (Edwards (1999); Tapia and Tokman (2004); Cowan, Rappoport and Selaive (2007); and Claro and Soto (2013)). To illustrate this point, Figure 8 plots the unexplained component of the exchange rate derived from UIP vis-à-vis the change in reserves as a percentage of GDP. As we can see, no clear relationship arises between these variables.

Uncovered interest rate parity equation residual and international reserve variation: Emerging markets 2010–13[1]

(percentage)

Figure 8



[1] The residual corresponds to the error u in the equation: $\frac{\Delta e}{e} = \alpha + \beta(i - i^{*}) + \gamma(CDS - CDS^{*}) + u$.

Conclusion

The international financial conditions faced by emerging market economies have changed significantly over the last decade. Expansionary monetary policies combined with poor macroeconomic conditions in developed markets and deleveraging by financial institutions has enhanced a global financial cycle that affects all developing countries. This global cycle has evinced a higher co-movement of some key asset prices. In particular, the analysis shows that this higher co-movement has been observed in long-term interest rates and exchange rates. Nonetheless, short-term interest rates have shown different degrees of co-movement across countries, suggesting different responses to such global effects.

In general, the short-term monetary policy stance in developed and developing countries has responded to domestic conditions, but it has also been influenced by global liquidity conditions, or by other domestic factors, such as exchange rate volatility. In many developing countries, these factors have driven interest rates below the levels suggested by traditional Taylor-rule interest rate policies. A different result is found for Chile, where the evolution of the domestic interest rate follows the domestic cycle rather closely.

That global factors act differently on short-term and on long-term interest rates is a very relevant consideration when assessing the degree of monetary policy independence. On the one hand, global factors do not necessary dilute the potential influence of central banks on short-term interest rates, and hence on decisions based upon short rates. On the other hand, global factors could have a stronger influence on agents' decisions based on long-term interest rates (eg housing investments).

The fact that, even with exchange rate flexibility, long-term rates are strongly affected by global factors does not mean in our opinion that monetary policy independence is non-existent, but rather that the limits of monetary policy in affecting price stability and financial stability have become more apparent. These limitations suggest that the old principle of "one instrument – one goal" is even more valid than ever before. In other words, central banks will find it increasingly difficult to achieve price and financial stability by relying solely on interest rates. Therefore, macroeconomic management must be complemented with macroprudential tools. This is precisely the reason why the latter area has been the focus of attention in recent years, within both central banks and institutions responsible for financial supervision.

Annex 1. Country list

Developed Markets	Emerging Markets		Small and Open Economies
Austria	Argentina	Malaysia	Australia
Belgium	Brazil	Mexico	Canada
Finland	Bulgaria	Nigeria	Denmark
France	Chile	Peru	Israel
Germany	China	Poland	New Zealand
Greece	Colombia	Romania	Norway
Ireland	Croatia	Russia	South Korea
Italy	Czech Rep.	Slovakia	Sweden
Japan	Hungary	South Africa	
Netherlands	India	Thailand	
Portugal	Indonesia	Turkey	
Slovenia	Latvia	Ukraine	
Spain	Lithuania	Vietnam	
Switzerland			
United Kingdom			
United States			

References

Bank for International Settlements (2014): "International transmission of monetary policy – an overview of recent trends, central bank views and issues", this issue.

Claro, S and C Soto (2012): "Macro policies and public debt in Chile", *BIS Papers*, no 67, pp 103–12.

——— (2013): "Exchange rate policy and exchange rate interventions: the Chilean experience", *BIS papers*, no 73, pp 81–93.

Cowan, K, D Rappoport and J Selaive (2007): "High frequency dynamics of the exchange rate in Chile", Central Bank of Chile, working paper, no 433.

Edwards, S (1999): "How effective are capital controls?", *Journal of Economic Perspectives*, vol 13(4), pp 65–84.

International Monetary Fund (2013): "Dancing together? Spillovers, common shocks, and the role of financial and trade linkages", *World Economic Outlook*, Chapter 3, October.

Longstaff, F, J Pan, L Pedersen and K Singleton (2011): "How sovereign is sovereign credit risk?", *American Economic Journal*, Macroeconomics, vol 3, pp 75–103.

Pan, J and K Singleton (2008): "Default and recovery implicit in the term structure of sovereign CDS spreads", *Journal of Finance*, vol 63(5), pp 2345–84.

Rey, H (2013): "Dilemma, not trilemma: the global financial cycle and monetary policy independence", Proceedings of the Jackson Hole conference, Federal Reserve Bank of Kansas City.

Tapia, M and A Tokman (2004): "Effects of foreign exchange intervention under public information: the Chilean case", *Journal of the Latin American and Caribbean Economic Association*, vol 4.

Taylor, J (2013): "International monetary policy coordination: past, present and future", *BIS working paper*, no 437.

International monetary policy spillovers and responses

The People's Bank of China

Abstract

This paper briefly discusses the view of the People's Bank of China (PBC) on the spillover effects of the monetary policies of advanced economies and on the policy responses of emerging market economies. The paper also explains China's policy measures to combat these spillover effects, and calls for closer international policy coordination and cooperation.

Keywords: Monetary policy, international spillover, emerging market economies

JEL classification: E52, F30, O10, O16

1. International monetary policy spillovers and responses

Since the 2008 international financial crisis, the central banks of the world's main developed economies have maintained their interest rates at extremely low levels and carried out a series of unconventional measures such as quantitative easing (QE) and forward guidance. The aim of these unconventional monetary policies, such as the large scale asset purchases and forward guidance, are aimed at expanding the scope of the monetary policy and exploring new mechanisms, in order to maintain economic and financial stability around the zero-rate bound. The observed effects show that the developed economies' QE has played an important role in stabilising their domestic situations and in promoting economic recovery. To some degree, it has also boosted the external demand of emerging market economies (EME). However, as EMEs and developed economies differ in terms of both where they are in the economic cycle and their policy influences, the QE measures have had some negative impacts on a number of EMEs, greatly adding to their difficulty in managing the macroeconomic situation and also entailing downside risks.

Recent research shows that the developed economies' QE impacted on EMEs in five ways. First, it lowered the EMEs' short-term policy rates. Second, it brought down the EMEs' long-term rates. Third, it has had an influence on global asset allocation, dramatically increasing the fluctuations in EME exchange rates and foreign reserves. Fourth, EMEs face mounting currency mismatches as they accumulate more local currency assets and more foreign currency liabilities. Fifth, cross-border capital flows have had impacts on EMEs' domestic capital markets.

2. China's measures in response to external risks

The QE of the developed economies has flooded the globe with liquidity. Under such circumstances, cross-border capital flows tend to be large, fast and easily reversible, posing challenges to EMEs' macroeconomic and financial management. While China's economic foundations are still sound, these large-scale capital inflows and outflows have had a number of adverse impacts. To cope with these external spillover effects, the PBC has implemented a series of measures.

First, the PBC has strengthened its overall liquidity management. It keeps a close eye on the influence of global conditions on capital flows and has improved its monitoring of cross-border capital flows. A combination of various monetary policy tools, such as quantitative tools and price tools, are now employed to better sterilise and manage the country's liquidity situation. With these tools, the PBC has maintained a proper level of liquidity and reasonable growth in credit and social financing. When capital inflows are reduced or reversed, the PBC applies measures such as open market operations (OMO), a reserve requirement ratio and innovative tools such as short-term liquidity operations (SLO), standing lending facilities (SLF) etc, to adjust its liability structure and provide liquidity to the banking system.

Second, the PBC has improved the exchange rate mechanism and increased the flexibility of the RMB exchange rate. In 2012, the floating band for the spot RMB exchange rate in the interbank market was expanded from 0.5% to 1%. The market now plays a more important role in determining the RMB exchange rate, which is becoming more flexible and contribute to the balance of international payments. The PBC has also largely reduced interventions in the foreign exchange market, and the RMB is exhibiting "two-way fluctuations" to a greater extent. In 2013, the current account surplus to GDP ratio declined to 2.1%, showing that the RMB exchange rate is getting closer to its equilibrium level.

Third, the PBC continues to improve its macroprudential management framework. Based on the lessons from the financial crisis, the PBC carried out systemic research of macroprudential management in 2009 and accordingly conducted a number of experiments. In 2011, the PBC introduced the dynamic adjustment mechanism of differentiated reserve requirement, which relates credit expansion to macroprudential requirements, systemic importance, the soundness of financial institutions and the economic environment. With transparent rules, the measure is used to guide and encourage financial institutions to maintain sound operations. At the same time, the PBC continues to improve its monitoring and reviewing framework for financial stability purposes and carries out on-site inspections of the soundness of financial institutions. It has implemented prudential tools such as the loan-to-value ratio (LTV) to restrain banks' issuance of mortgage loans. It also draws on the latest international experience of macroprudential policies, with which it sets specific rules related to countercyclical capital buffers and systemically important banks.

3. Strengthening monetary policy cooperation and coordination

Against the backdrop of economic globalisation, economies increasingly depend on each other. When one jurisdiction implements monetary policy measures to fulfil its domestic macroeconomic objectives, it causes spillover effects on other economies and the effects could further spill back to the original jurisdiction. This requires the authorities to take into account both the objectives and responses of other economies when determining their own policies. Therefore, to strengthen policy cooperation is a reasonable and inevitable course of action.

The extra-accommodative monetary environment of developed economies has had evident effects on EMEs, and the tapering of the unconventional measures also exposes the EMEs to risks of capital reversals and outflows. Recently, when the US Federal Reserve reduced its asset purchases, some EMEs suffered large capital outflows in the short run. For now, the major developed economies should properly manage the rhythm of their tapering measures, and strengthen policy coordination with EMEs via platforms such as the G20 and international organisations. They should also take a gradual, transparent and predictable approach in their tapering measures to avoid turbulence in the global financial markets or even a new crisis.

An empirical analysis of the relationship between US and Colombian long-term sovereign bond yields*

Alexander Guarín, José Fernando Moreno and Hernando Vargas†

Abstract

We study two issues: (i) the relationship between interest rates on US and Colombian sovereign debt and (ii) the short-term response of the Colombian long-term bond yield and other asset prices to shocks to the US long-term Treasury rate. We use daily data between 2004 and 2013. Separating the period into three intervals (before, during and after the financial crisis), we consider the first issue with a moving window linear regression, and we address the second by estimating a VARX-MGARCH model. Our findings show that the link between sovereign bond yields has changed over time, and that the short-run responses of local asset prices to foreign financial shocks were qualitatively different in the three periods. The role of US Treasury securities as a safe haven asset during highly volatile periods seems to be at the root of these changes.

Keywords: Long-term bond yields, global financial crisis, emerging markets, moving window linear regression, VARX-MGARCH model

JEL classification: C30, E43, E58, F42, G15

* We are grateful to Luis Fernando Melo for his advice on empirical methods and to Lisset Venegas for her research assistance. We benefited from comments by José E. Gómez, Franz Hamann, Carlos León, Jair Ojeda, Jorge Toro and Juan Pablo Zárate. Any remaining errors and omissions are our responsibility. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of the Republic or its Board of Directors.

A previous version of this paper has been accepted for publication in the Journal: "Ensayos Sobre Política Económica".

† Researcher (aguarilo@banrep.gov.co), Professional Economist (jmorengu@banrep.gov.co) and Technical Deputy Governor (hvargahe@banrep.gov.co) of the Bank of the Republic.

1 Introduction

During the recent global financial crisis and economic slowdown, central banks in advanced economies pushed down their monetary policy rates to boost the economy and to prevent a deeper recession. The policy rate reached the zero lower bound, preventing further monetary stimulus with that policy tool (Doh (2010) and Chen et al (2012)).

In consequence, central banks adopted unconventional measures to add further stimulus.[1] For instance, the Federal Reserve has since late 2008 issued "forward guidance" that informs the public about the future path of monetary policy to influence expectations. At that time it also implemented a quantitative easing (QE) program in which it buys long-term Treasury bonds and mortgage-backed securities.[2] The QE policy has led to a reduction of the net supply of long-term bonds, raising their prices and lowering their yields. The same measures also boosted other asset prices (eg commodities and equities) and increased market liquidity (Jones and Kulish (2013) and Cronin (2014)).

QE measures in the advanced economies have also spilled over to emerging market economies, lowering yields on their long-term sovereign bonds and generating other spillover effects such as appreciation of the local currency, rapid credit growth, inflationary pressures and booms in asset prices (see García-Cicco (2011); Chen et al (2012); Glick and Leduc (2012); Moore et al (2013); Fratzscher et al (2013); and Londoño and Sapriza (2014)).

The shifts in the yield on local currency long-term sovereign bonds are crucial for the financial market because that yield is a benchmark for the pricing of long-term assets. For example, a reduction encourages lengthening the maturity of credit obligations and undertaking long-term investment projects (see Turner (2014)). Nevertheless, if the benchmark long-term yield stays low for a prolonged period, financial stability risks could arise. For instance, excessive leverage could lead to a credit boom and the overvaluation of long-term assets such as houses and equities (Turner (2013) and Turner (2014)).

Therefore, the relationship between long-term bond yields of emerging market and advanced economies, its evolution over time and the effects of changes in these rates are crucial issues for macroprudential policy, financial stability, government debt management and monetary policy.

Our aim in this paper is two-fold. First, we study the changing relationship between the US and Colombian long-term sovereign bond yield over time. Second, we analyse the response of Colombian asset prices to shocks to the US Treasury yield and how these responses changed during the global financial crisis.

To study the first topic, we employ a moving window linear regression (MWLR) to examine the link between local asset prices and the US long-term Treasury rate. We also use the MWLR to study the relationship between Colombian and US bond

1 See Bernanke and Reinhart (2004) for a detailed description of instruments used under this policy scheme.

2 The Federal Reserve also performed the "Operation Twist" in 2011. In this action, the Fed sold short-term Treasury bonds and bought the same class of securities with long-term maturities.

yields while controlling for the sovereign risk premium and expected currency depreciation.

Second, we estimate a VARX-MGARCH model to compute the response of local asset prices to three distinct shocks to the US long-term Treasury yield. The sources of these shocks are changes in global volatility, the Treasury term premium and the stance of monetary policy in United States. The local asset prices we consider are the Colombian long-term sovereign interest rate, the foreign exchange rate, CDS spreads and the stock market index value.

The exercises employ daily data on US and Colombian financial variables between June 2004 and November 2013. For the second exercise, we divide the sample period into three segments – namely before, during and after the global financial crisis – and perform the estimations on each segment.

This paper contributes to the burgeoning literature on monetary policy spillovers in three ways. First, using daily data for financial variables, we model volatility using GARCH processes. Second, by computing results for the pre-crisis, crisis and post-crisis periods, we account for effects derived from periods with distinct economic and financial characteristics that otherwise could be missed. Third, we assess three distinct shocks to the US long-term bond yield to capture any differences in their effects on the response of Colombian asset prices.

Our findings show that the relationship between US and Colombian long-term sovereign bond yields has changed over time. In fact, the sign on this link turned negative between the second half of 2007 and the 1 May 2013 FOMC statements suggesting that the Federal Reserve would begin reducing (tapering) its bond purchases sooner than the markets were expecting. Our results also suggest that since 2008 the importance of the effects of movements of the US long-term Treasury rate on Colombian asset prices has increased. We also find that the short-run responses of both the Colombian interest rate and other local asset prices to shocks to the US long-term bond yield have been qualitatively different, depending on the sample period and the source of the shock. These changes seem to suggest, first, a special role for US Treasuries as a safe haven asset during the global financial crisis period, and second, a subsequent differentiation of local assets.

The remainder of the paper is organised as follows. In Section 2 we present the literature review, and in Section 3 we describe the main stylised facts on the recent evolution of interest rates on US and Colombia sovereign debt. In Section 4, we conduct a moving window linear regression analysis to study the relationship between long-term bond yields over time. Section 5 estimates the short-run responses on local asset prices to shocks to the US Treasury rate, and Section 6 concludes.

2 Literature review

A burgeoning segment of the literature has been addressing the effectiveness and spillover effects of the unconventional monetary policy actions taken after the September 2008 Lehman Brothers bankruptcy. One strand of this literature studies the impact of these actions on advanced economies. For instance, Doh (2010), Cúrdia and Woodford (2011), Gagnon et al (2011), Jones and Kulish (2013) and D’Amico and King (2013) examine the effects of the zero policy rate and QE measures on the US long-term interest rates. They find that announcements about the future path of the monetary policy rate, and especially purchases of assets on a large scale, effectively reduced the long-term interest rate. This reduction reflected mainly a lower term premium.

Cúrdia et al (2012), Glick and Leduc (2012) and Cronin (2014) analyse spillover effects of unconventional measures on macroeconomic aggregates and asset prices of advanced economies. Particularly, Cúrdia et al (2012) explore the QE effects on both US GDP growth and inflation, while Glick and Leduc (2012) and Cronin (2014) examine the same effects on the foreign exchange rate, commodity prices, stocks and government bonds.

Likewise, Ugai (2007), Peersman (2011), Joyce et al (2011) and Schenkelberg and Watzka (2013) analyse the spillover effects of the unconventional monetary policy on advanced economies other than the United States. Ugai (2007) and Joyce et al (2011) highlight the impact of QE measures on the monetary base, aggregate demand and asset prices in Japan and England. Similarly, Lenza et al (2010) describe how the Federal Reserve, the Bank of England and the European Central Bank (ECB) have conducted monetary policy since 2007.

The other strand of this literature studies the spillover effects of QE measures on emerging market economies. For example, Neely (2010), Landau (2011), Chen et al (2012), Glick and Leduc (2012) and Londoño and Sapriza (2014) find that these policy measures not only stimulated the US domestic economy but also affected market expectations and extended global liquidity. The latter led to spillover effects on emerging market economies; the effects included large capital inflows, a boost to a broad range of asset prices, rapid credit growth, appreciation of local currencies and inflationary pressures. Similar results are found by Fratzscher et al (2013), who analyse the impact of each part of the QE program on the US market and across 65 other countries. In addition, Moore et al (2013) and Turner (2013) find that spillover effects also reduced long-term sovereign bond yields in emerging market economies.

This line of the literature also considers the spillover effects of unconventional monetary policy on specific countries. For example, Quispe and Rossini (2011) and Carrera et al (2013) evaluate the effects of QE measures on macroeconomic variables of Peru's economy (eg domestic growth, inflation, international reserves, liquidity and public debt). Carrera et al (2013) highlight that the response of macroeconomic variables is not uniform across each QE episode. García-Cicco (2011) and Barata et al (2013) measure spillover effects of unconventional policies in Chile and Brazil, respectively. They find that the most important consequences of these policies are capital inflows, the appreciation of the currency and a significant increase in credit.

3 Stylised facts

In the first part of this section, we illustrate the dynamics of long-term bond yields for the United States as well as for Colombia and other emerging market economies. We also compare the evolution of some financial variables for Colombia with net capital inflows into this economy during recent years.

In the second part, we analyse the changing relationship between US and Colombian interest rates. We divide our sample into three time spans and highlight the main financial characteristics of those periods.

3.1 Long-term sovereign bond yield dynamics

For the whole of the period from June 2004 to November 2013, both the 10-year US Treasury rate and the 10-year Colombian sovereign bond yield exhibit a negative trend (Figure 1, panel A). However, the trend varies for shorter intervals within that time span.

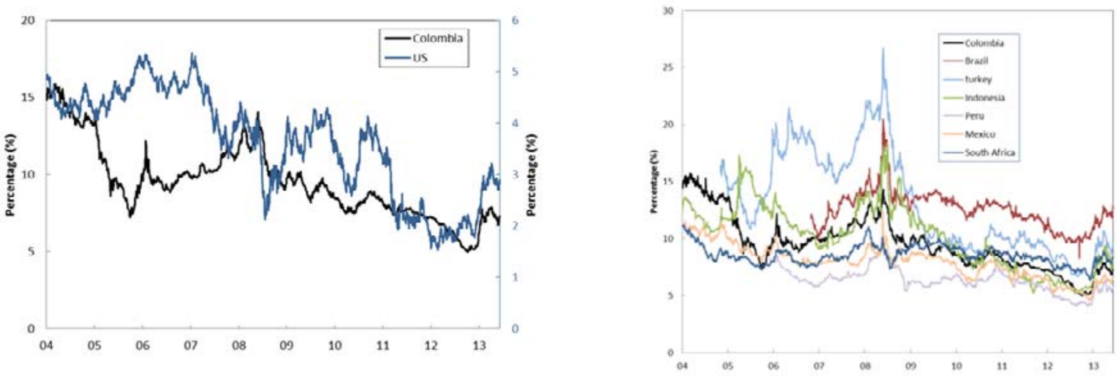
Between 2004 and the first half of 2007, the US Treasury yield exhibits a positive slope as a consequence of the increases in the federal funds rate (the US policy rate) to control inflation expectations. From there, bond yields have been decreasing as a result of the expansive monetary policy adopted by the Federal Reserve (ie the policy rate at the zero lower bound, the QE program and Operation Twist) to cope with the global financial crisis. Nonetheless, during short periods in 2009 and 2010, the US Treasury yield corrected upwards after reductions in global risk perceptions.

In the Colombian case, the long-term interest rate showed sharp variations through the sample period. Between June 2004 and February 2006 this rate dropped as a result of better fundamentals and external conditions in emerging market economies, and the decline in the Colombian risk spread.[3] From March 2006 to October 2008, the same interest rate rose mainly in response to two facts. First, the increase in Colombia's policy rate to cope with domestic inflationary pressures, and second, the rise of global risk since the mid-2007 beginnings of the global financial crisis. Since October 2008, the long-term sovereign bond yield has been decreasing as a consequence of the spillover effects of the unconventional measures adopted by the United States and other advanced economies.

3 This reduction is associated with better terms of trade, fiscal consolidation, improvements in security conditions and the deepening of the market for local currency public debt .

Evolution of long-term sovereign interest rates: 2004–13 Figure 1

(A) US and Colombia (B) Emerging market economies



Source: Bloomberg.

Ten-year sovereign bond yields for Brazil, Colombia, Indonesia, Mexico, Peru, South Africa and Turkey between June 2004 and November 2013 exhibit similar dynamics and seem to be completely aligned after the Lehman Brothers bankruptcy (Figure 1, panel B). This behaviour appears to be related to the lower risk perception and better terms of trade of emerging market economies.

Colombia has recorded net capital inflows[4] during the past decade, with the exception of a short period at the end of 2010 (Figure 2, panels A–D).[5] Furthermore, since 2011 these capital inflows have been larger than in previous years due in part to positive net portfolio investments.

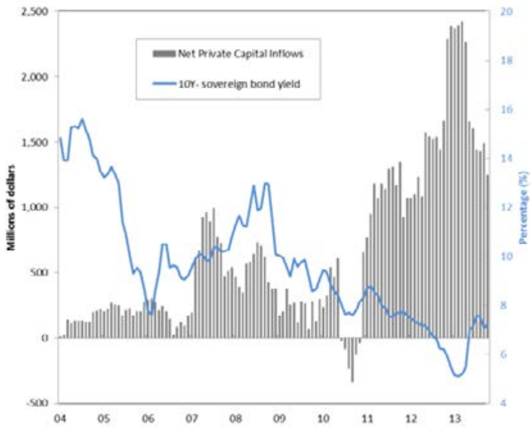
On the other hand, our four financial variables exhibited clear trends along the sample period. In particular, the long-term bond yield, the foreign exchange rate and CDS spreads dropped, while the stock market index rose. The behaviour of these variables before 2007 is explained mainly by local factors in the Colombian market. Between 2007 and 2008, there are specific breaks in the trend of these time series as a consequence of the risk and the economic uncertainty associated with the beginning of the global financial crisis. After this period, these financial variables resumed a decreasing trend. The tendency in this period is associated with the spillover effects of QE measures (see eg García-Cicco (2011), Chen et al (2012), Glick and Leduc (2012), Moore et al (2013), Fratzscher et al (2013) and Londoño and Sapriza (2014)).

4 The capital flows include both portfolio and foreign direct investment.

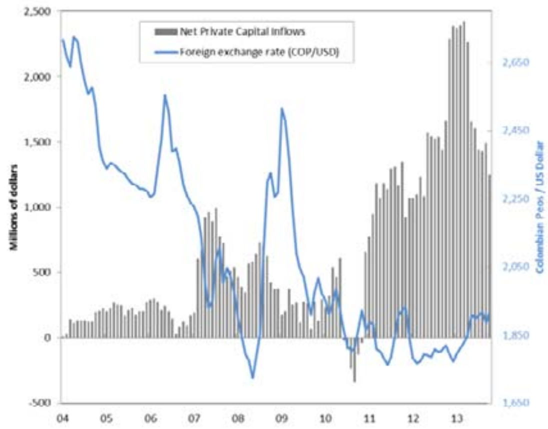
5 Each panel also draws the sixth-order moving average of monthly net private capital inflows observed in the consolidated exchange balance. The sixth order captures the average of capital inflows during the last half year and hence allows us to avoid excessive volatility in our analysis. The consolidated exchange balance corresponds to current and capital account cash transactions conducted in the US dollar spot market.

Financial variables and net private capital inflows for Colombia: 2004–13 Figure 2

(A) Long-term sovereign bond yield



(B) Foreign exchange rate



(C) CDS spreads

(D) Stock market index

Sources: Bloomberg; and Bank of the Republic (central bank of Colombia).

3.2 The relationship between US and Colombian bond yields: before, during and after the global financial crisis

Here we divide the June 2004 to November 2013 period into three sub-periods: pre-crisis (June 2004 to February 2007), crisis (February 2007 to October 2009) and post-crisis (November 2009 to November 2013). The dates of each sub-period are chosen to reflect significant changes in the correlation between long-term bond yields arising from financial events or news with a high impact on the market.

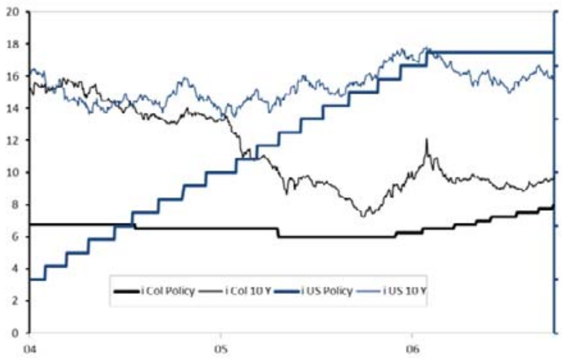
US monetary policy tightening and developments in the Colombian bond market

The pre-crisis period (June 2004 to February 2007) is characterised by a positive correlation between long-term bond yields and a non-significant relationship between monetary policy rates (Figure 3, panel A). In this period, the Federal Reserve sharply increased its policy rate to reduce inflationary pressures. Moreover, beginning in July 2006 the US market presented an inverted yield curve, giving an early warning signal of future recession. In the same time span, Colombian long-term bond yields dropped, while the policy rate remained relatively stable. In fact, banks increased their fixed income portfolios in local sovereign debt and earned exceptional profits as the inflation rate fell.

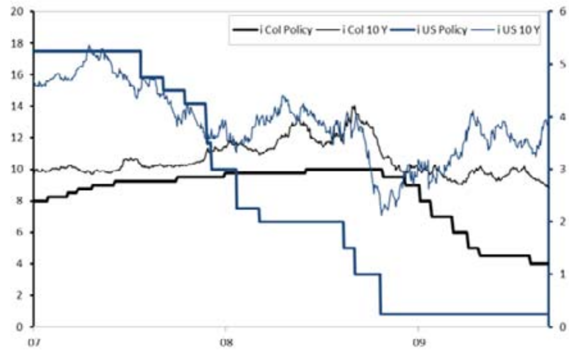
Evolution of US and Colombian sovereign interest rates

Figure 3

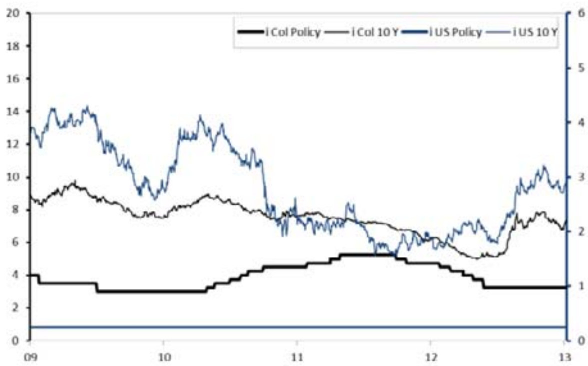
(A) Pre-crisis period



(B) Crisis period



(C) Post-crisis period



Sources: Bloomberg and Bank of the Republic (central bank of Colombia)

The global financial crisis and the international recession

The crisis period (February 2007 to October 2009) was in general defined by a negative correlation between US and Colombian long-term bond yields, the reduction of the federal funds rate to nearly the zero lower bound, a decreasing trend of the long-term Treasury rate and a large demand for safe assets (Figure 3, panel B). Moreover, the period included several financial events and news with high impact in the market.[6] On the other hand, between 2006 and 2008, the central bank of Colombia raised its policy rate to arrest inflationary pressures and then began reducing the rate at the end of 2008. Since the second half of 2008, the Colombian long-term sovereign bond yield also exhibited a declining trend.

At the end of 2008 the correlation between long-term sovereign bond yields turned positive, in great part as a result of the 15 September collapse of Lehman

6 For example, in February 2007 HSBC fires to the head of its US mortgage lending division and Freddie Mac announced that it would not buy risky mortgage securities. Furthermore, along 2007 and 2008 financial and real sector companies reported losses associated to the mortgage business, and the Fed warned on its negative effects on the economy.

Brothers. This event increased economic uncertainty as well as risk perceptions in the global financial market. To avoid a financial collapse, the Federal Reserve announced in November 2008 that it would initiate a QE programme (what became the first of three such programmes) in March 2009.

QE2, QE3, the Greek debt crisis and tapering

The post-crisis period (November 2009 to November 2013) was characterised by low interest rates in the US and Colombian markets as a result of the US QE programmes, particularly QE2 and QE3, Operation Twist and its spillover effects on emerging market economies (see for example García-Cicco (2011), Glick and Leduc (2012), Moore et al (2013), Fratzscher et al (2013) and Londoño and Sapriza (2014)). In general, the correlation between long-term bond yields after the global financial crisis is positive (Figure 3, panel C). The Greek debt crisis increased the demand for local safe assets in emerging market economies. In May 2013, statements by the Federal Reserve indicated to the market that the central bank's bond purchases would end sooner than expected, which led immediately to the rise of bond yields in both markets.

4 The changing relationship between US and Colombian sovereign bond yields

In this section we analyse the relationship between US and Colombian long-term interest rates over time. Our analysis is based on the MWLR.

4.1 Data

Our data set considers daily time series of local and foreign financial variables between June 2004 and November 2013. The domestic variables are the 10-year Colombian sovereign bond yield (i^{Col}); the Colombian stock market index ($igbc$); sovereign credit default swap (CDS) spreads (cds) on five-year[7] Colombian sovereign bonds denominated in US dollars; and the foreign exchange rate denominated as Colombian pesos per US dollar (cop) and its expected value for a horizon of 10 years ($cope$).[8] Our foreign variable is the 10-year US Treasury yield (i^{US}).

All our econometric exercises employ the logarithm of the Colombian stock market index ($ligbc$), the logarithm of the foreign exchange rate ($lcop$) and its

[7] Ten-year CDS spreads data are not available for our full sample period. Nevertheless, five-year CDS contracts are highly liquid and effectively represent the country risk.

[8] $Cope$ is calculated as $cope = cop \times \left(\left[\frac{rer_t^{Trend}}{rer_t}\right] \times \left[\frac{1+bei_t^{Col}}{1+bei_t^{US}}\right]\right)$

where rer_t is the real exchange rate; rer_t^{trend} is its trend; and bei_t^{Col} and bei_t^{US} are, respectively, Colombian and US break-even inflation to 10 years. The construction of $cope$ assumes that agents expect a correction of real exchange rate misalignments. The variables rer_t and rer_t^{trend} correspond to the Colombia-US bilateral trade weighted real exchange rate. The real exchange rate trend is computed with the Hodrick-Prescott filter. The data for rer are from the Bank of the Republic, and those for the remaining variables are from Bloomberg.

expected value for a horizon of 10 years ($lcope$). CDS spreads are expressed as a percentage.

The variable i^{Col} is constructed with the Nelson-Siegel methodology with data from the Bank of the Republic. Data for variables other than i^{Col} and rer are taken from Bloomberg.

4.2 Moving window linear regression (MWLR) analysis

We perform two sets of MWLR exercises to understand how the relationship between US and Colombian long-term bond yields and other local asset prices have changed over time.[9] In particular, these exercises provide evidence on the pattern of this link during the global financial crisis and the US implementation of the QE program.

The MWLR exercises are run with a rolling sample of 435 business days (approximately two years). The first sample period is from 29 January 2003 to 4 January 2005 and the final one is from 28 December 2011 to 7 November 2013.[10] In our estimates, we use a GJR-GARCH(1,1) process to model the variance of errors and thereby take into account the changing volatility commonly found in high-frequency financial data (see Appendix A).

First exercise

The first MWLR exercise examines the relationship between changes in the US long-term Treasury rate and changes in a Colombian asset price. The latter could be the local long-term sovereign bond yield, the foreign exchange rate, CDS spreads or the stock market index. In particular, we estimate the model stated by

$$\Delta y_{t_k} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + a_{t_k} \tag{1}$$

where k indexes the rolling sample. For each window k, $\boldsymbol{\beta}(\mathbf{k}) = [\beta_0(k), \beta_1(k)]$ is the estimated coefficient vector, y_{t_k} denotes the dependent variable, $i_{t_k}^{US}$ is the US long-term Treasury rate, and a_{t_k} are the errors. The latter are assumed to be heteroscedastic.

We carry out four MWLR calculations of equation (1), and Figure 4 plots the estimated coefficient and its confidence interval for each (the dates on the horizontal axes correspond to the end-day of each rolling regression). In each calculation, y_{t_k} takes the value of one of the following variables for Colombia: the long-term interest rate $i_{t_k}^{Col}$ (panel A), the logarithm of the foreign exchange rate $lcop_{t_k}$ (panel B), the value of CDS spreads cds_{t_k}(panel C) or the logarithm of the stock value index $ligbc_{t_k}$ (panel D).[11]

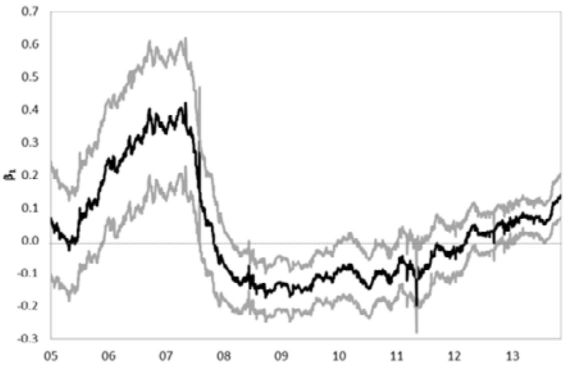
9 Cronin (2014) highlights that the analysis over time of the relationship between financial variables provides more information that a static assessment with the full sample.

10 For the MWLR exercises, we have extended our original sample period back to 2003 to have at least two years of observations in the first window of our rolling regression.

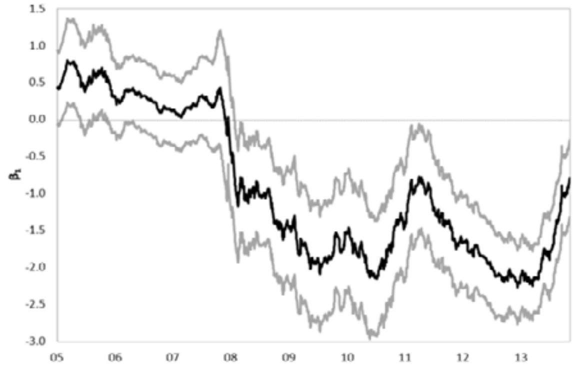
11 This econometric exercise could suffer from omitted-variable bias. However, this MWLR meets the aim of providing evidence on the changing relationship between i^{US} and the four Colombian financial variables. In addition, our results are robust to including the VIX in the MWLR.

MWLR: univariate models Figure 4

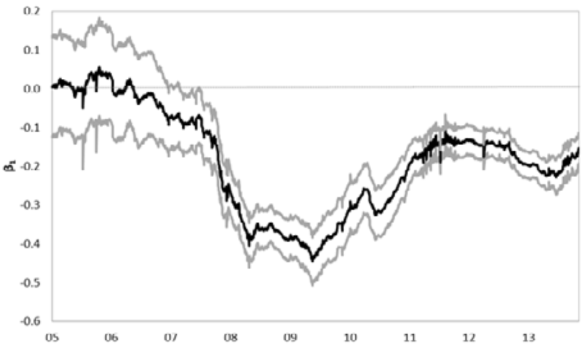
(A) $\Delta i_{t_k}^{Col} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + a_{t_k}$



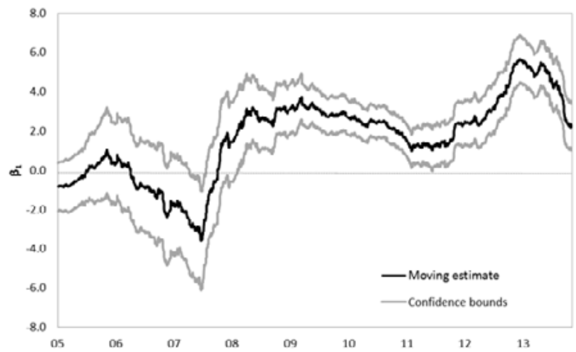
(B) $\Delta lcop_{t_k} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + a_{t_k}$



(C) $\Delta cds_{t_k} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + a_{t_k}$



(D) $\Delta ligbc_{t_k} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + a_{t_k}$



Source: Authors' calculations

The MWLR estimate of β_1 for the values of the Colombian long-term interest rate i^{Col} illustrates a remarkable shift through time in the relationship between the long-term interest rates (Figure 4, panel A). The positive correlation from 2006 to 2007 turns negative between 2008 and 2011 and then turns positive again after 2012.

Regarding the remaining three calculations for the relationship between local asset prices and the US long-term Treasury rate, our estimates show that before the second half of 2007 those relationships were not statistically significant. Nevertheless, during and after the crisis (since the end of 2007) the link between the US Treasury rate and $lcop$ (negative), cds (negative) and $ligbc$ (positive) became significant (Figure 4, panels B, C and D, respectively). These sharp variations suggest important changes in the nature of shocks hitting these variables throughout the sample period, and particularly, during the crisis.

Second exercise

In our second MWLR exercise, we again analyse the relationship between changes in the Colombian and US long-term interest rates, controlling for other relevant financial variables. In this case we estimate the equation stated by

$$\Delta i_{t_k}^{Col} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + \beta_2(k)\Delta lcop_{t_k-1} + \beta_3(k)\Delta cds_{t_k-1} + a_{t_k} \quad (2)$$

where k indexes the rolling sample. For each window k, $\boldsymbol{\beta}(\mathbf{k}) = [\beta_0(k), \beta_1(k), \beta_2(k), \beta_3(k)]$ is the new estimated coefficient vector, and a_{t_k}

denotes the regression errors. The latter are again assumed to be heteroscedastic. In this new specification we include both cds_{t_k-1} and $lcop_{t_k-1}$ as explanatory variables to control for the effects that changes in the sovereign risk premium and the expected depreciation could have on $i_{t_k}^{Col}$. Note that we consider the lagged values of cds_{t_k} and $lcop_{t_k}$ to minimise problems of endogeneity.

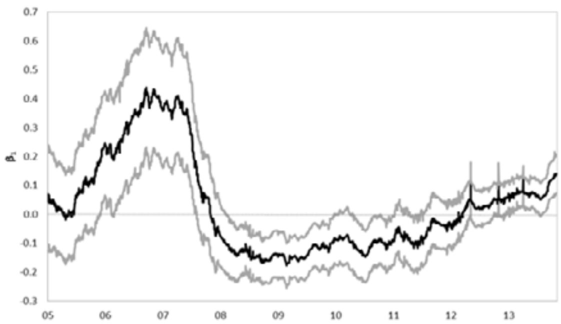
The moving window estimate of β_1 for the explanatory variable i^{US}, shows that the link between US and Colombian bond yields is positive before the second half of 2007 and then turns negative up to the end of 2012 (Figure 5, panel A). Moreover, the dynamics of our estimated β_1 coefficient are similar to those found in Figure 4, panel A.

On the other hand, the relationships between i^{Col} and the variables $lcop$ and cds have also changed through time. These two links are positive and significant before the second half of 2007 (Figure 5, panels B and C). Even more, in the first part of that year, the impact of changes in CDS spreads on the Colombian sovereign bond yield is stronger than in the previous period. Nevertheless, beginning in 2008, these relationships are not statistically significant.[12]

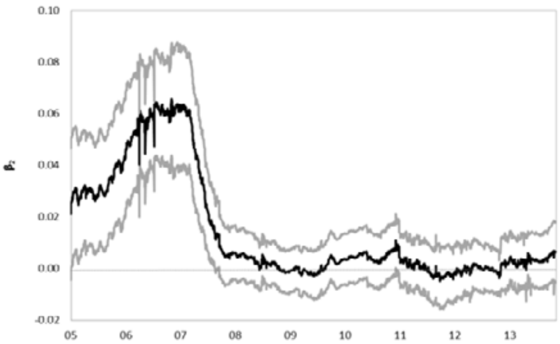
[12] We also carry out the MWLR of Equation (2) using the difference between $lcope_t$ and $lcop_t$ as a proxy for the expected devaluation $dlcope_t^*$. Figure 10 in Appendix B presents the moving window estimate of coefficients β_1, β_2 and β_3 of this exercise. The dynamics of the estimated coefficients β_1 and β_3 in Figure 10 are very similar to those exhibited in Figure 5. These findings show that there are no relevant differences in the estimated coefficient β_1 when either $lcop_{t_k-1}$ or $dlcope_{t_k-1}^*$ is used as a proxy for expected depreciation.

MWLR: $\Delta i_{t_k}^{Col} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + \beta_2(k)\Delta lcop_{t_k-1} + \beta_3(k)\Delta cds_{t_k-1} + a_{t_k}$ Figure 5

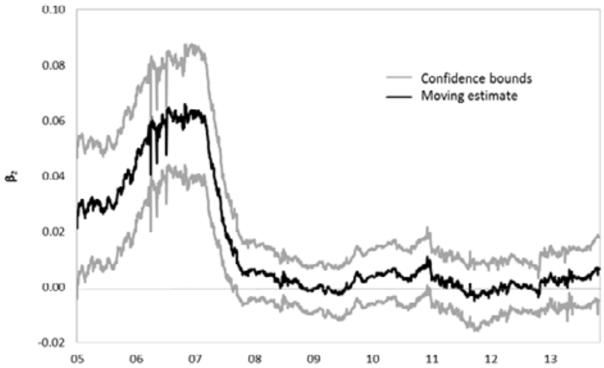
(A) Moving window estimate of β_1



(B) Moving window estimate of β_2



(C) Moving window estimate of β_3



Source: Authors' calculations

4.3 The link between US and Colombian long-term interest rates from the perspective of shocks

US and Colombian long-term interest rates bear a positive relationship before the second half of 2007 and after the end of 2012 (Panel A, Figures 4 and 5). This link is negative during the crisis, and it is also negative afterwards, when the Federal Reserve was implementing unconventional stimulus policies.

The relationship between long-term bond yields can be understood from the source of the shock affecting the US Treasury rate. For example, a positive link between both interest rates could be explained by a shock whose origin is the tightening or expected tightening of monetary policy in the US. This shock induces the sale of local bonds, capital outflows from Colombia and, consequently, an increase of long-term interest rates and the depreciation of the local currency.

This response would be greater if the change in the US Treasury rate is perceived as permanent or highly persistent. In this case, domestic factors determining the short-term local interest rate or its expected future path would also be affected by the shock (eg increases in the "natural interest rate" of the small open economy, inflationary pressures derived from the depreciation of the currency, or the reaction of the local central bank to these effects).

Similarly, a shock to the US Treasury rate stemming from a rise in the term premium induces a positive link between US and Colombian long-term bond yields.

This shock reflects an increase in the uncertainty on the future path of the US short-term interest rate. The latter effect could also be associated to increases in the risk and the uncertainty derived from US economic conditions. In this case, the shock would also affect the country risk.

On the other hand, a negative relationship between US and Colombian long-term bond yields could be explained by the role of US Treasuries as a safe haven asset during the global financial crisis. Under this context, shocks buffeting the US long-term interest rate are linked to movements toward or away from safe assets. Therefore, a reduction in the US Treasury rate is associated to a larger appetite for safe assets, capital outflows from emerging market economies and the decline in the prices of local assets, including sovereign bonds.

In this case, shocks to the US long-term Treasury rate would not only include surprises associated with expectations about US monetary policy or the Treasury term premium, but also a safe haven premium during the crisis period. Moreover, shifts in the appetite for safe assets would not only be reflected in the prices of US Treasuries, but also in the price of emerging market economy assets. This hypothesis highlights the usefulness of including a measure of global risk and economic uncertainty in our analysis. The VIX index is the natural candidate for this purpose.

In the next section we explore the short-term responses of some Colombian asset prices to external financial shocks.

5 The short-term responses of Colombian asset prices to external financial shocks

US Treasury interest rates are endogenous variables subject to various shocks that may likewise affect emerging market economy asset prices, including long-term interest rates, the foreign exchange rate, CDS spreads and the stock market index. Hence, the "transmission" of changes in US long-term bond yields to local asset prices implies the response of all these variables to shocks from different sources. Moreover, the frequency and predominance of these shocks change over time.

To capture this transmission idea, we estimate the response of the Colombian long-term interest rate and other asset prices to three shocks, namely (i) global volatility and economic uncertainty, (ii) the term premium and (iii) the stance of monetary policy. These shocks can impact asset prices directly and through the US Treasury rate channel.

Consider the following $\mathrm{VARX}(p, q)$ model:

$$\Delta\mathbf{Y}_t = \mu + \sum_{i=1}^{p} A_i \Delta\mathbf{Y}_{t-i} + \sum_{i=0}^{q} B_i \Delta\mathbf{X}_{t-i} + \boldsymbol{\epsilon}_t \tag{3}$$

where μ is a vector of means, A_i and B_i stand for the coefficient matrices associated with the endogenous and exogenous variables, respectively, and $\boldsymbol{\epsilon}_t \sim WN(0, \boldsymbol{\Sigma}_t)$ is a vector of errors. We assume a Baba-Engle-Kraft-Kroner (BEKK) multivariate GARCH model as defined in Engle and Kroner (1995). The latter is used to model the high volatility of financial time series with daily frequency in the sample.

Vectors $\mathbf{Y}_t = \left(i_t^{Col}, ligbc_t, lcop_t, lcope_t, cds_t, i_{MP,t}^{Col}\right)$ and $\mathbf{X}_t = (VIX_t, i_t^{US}, MOVE_t)$ stand for the sets of endogenous and exogenous variables, respectively.[13] These vectors are included in first differences in the estimation.[14]

Variables $i_t^{Col}, ligbc_t, lcop_t, lcope_t, cds_t$ and i_t^{US} were already defined in Section 4.1. The variable $i_{MP,t}^{Col}$ denotes the monetary policy rate for Colombia. We use the Colombian interbank rate as a proxy for $i_{MP,t}^{Col}$. The VIX[15] and MOVE[16] indexes are proxies for US market volatility and the US Treasury term premium, respectively. The VIX picks the effects of global uncertainty shocks, while the MOVE captures the uncertainty on the future path of short-term interest rates in the US market. Tobias et al (2013) and Cieslak and Povala (2013) point out that the $MOVE$ is highly correlated with the 10-year US Treasury term premium.

$VARX$ equations consider contemporaneous and lagged values of our exogenous variables (i_t^{US},VIX_t,$MOVE_t$). Hence, the responses of local asset prices to an i_t^{US} shock capture the impact of changes in the US long-term Treasury rate that are not explained by movements of the VIX or MOVE. Therefore, the responses to i_t^{US} shocks must reflect changes in the stance of monetary policy in the US and "*other effects*".

The VARX-MGARCH model is estimated for our three sample periods (before, during and after the financial crisis), as defined in Section 3.2. The estimates of the VARX-MGARCH for each sample period are used to perform the impulse-response analysis to shocks to exogenous variables (multiplier analysis). In particular, we study the responses of Colombian asset prices[17] to shocks to VIX, $MOVE$ and i_t^{US}. Appendix C presents the technical details of the estimation method, compiles the main results and briefly summarises the specification test.

5.1 Pre-crisis period

Figure 6 shows the multiplier analysis for the pre-crisis period (June 2004 to February 2007). For this sample, shocks to VIX lead to positive responses in cds, $lcop$, $lcope$, i^{Col} and a negative reaction in $ligbc$. Hence, an increase in US market volatility induces a rise in Colombian long-term interest rates (ie a fall in the value of the long-term bond portfolio) and a decline in stock prices. Investors reallocate their

13 To control for specific events like FOMC meetings and the publication of its minutes (as suggested by Wright (2012) and Londoño and Sapriza (2014)), we included a dummy variable that covers the dates of those events.

14 As a robustness check, we estimated the VARX-MGARCH model without the variable $lcope$. The latter is not observable, and hence it may introduce noise in the estimation. The results do not alter the findings reported in this section.

15 The VIX is the Chicago Board Options Exchange Market Volatility Index. It is a measure of the implied volatility of S&P 500 Index options over the next 30 days.

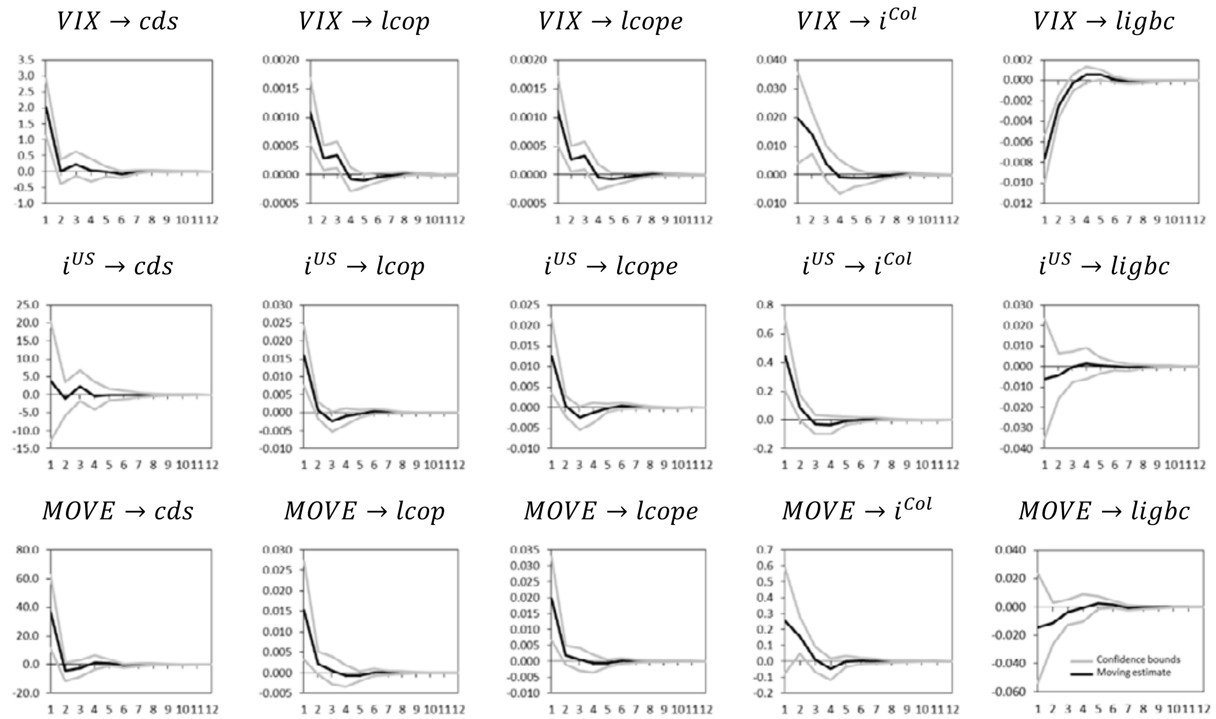
16 The MOVE is the Merrill Lynch Option Volatility Estimate Index. It is a weighted average of the normalised implied yield volatility for 1-month Treasury options on the two-year (20%), five-year (20%), 10-year (40%) and 30-year (20%) maturities. The weights are based on option trading volumes in each maturity.

17 For all sample periods, the responses of i_{MP}^{Col} to external financial shocks in this analysis are not statistically significant.

resources away from local markets, which causes a depreciation of the currency and an increase in the perception of country risk.

For the same period, a positive shock to either the stance of US monetary policy (i_t^{US}) or the term premium (*MOVE*) produces a depreciation of the currency ($lcop$) and an increase in the Colombian long-term bond yield (i^{Col}). Moreover, the shock to *MOVE* also leads to a positive response in the country risk perception (*cds*) and higher expectations of future devaluation. On the other hand, none of these two shocks has a significant effect on the stock market index (*ligbc*).

Pre-crisis period: multiplier analysis ($Impulse \rightarrow Response$) Figure 6



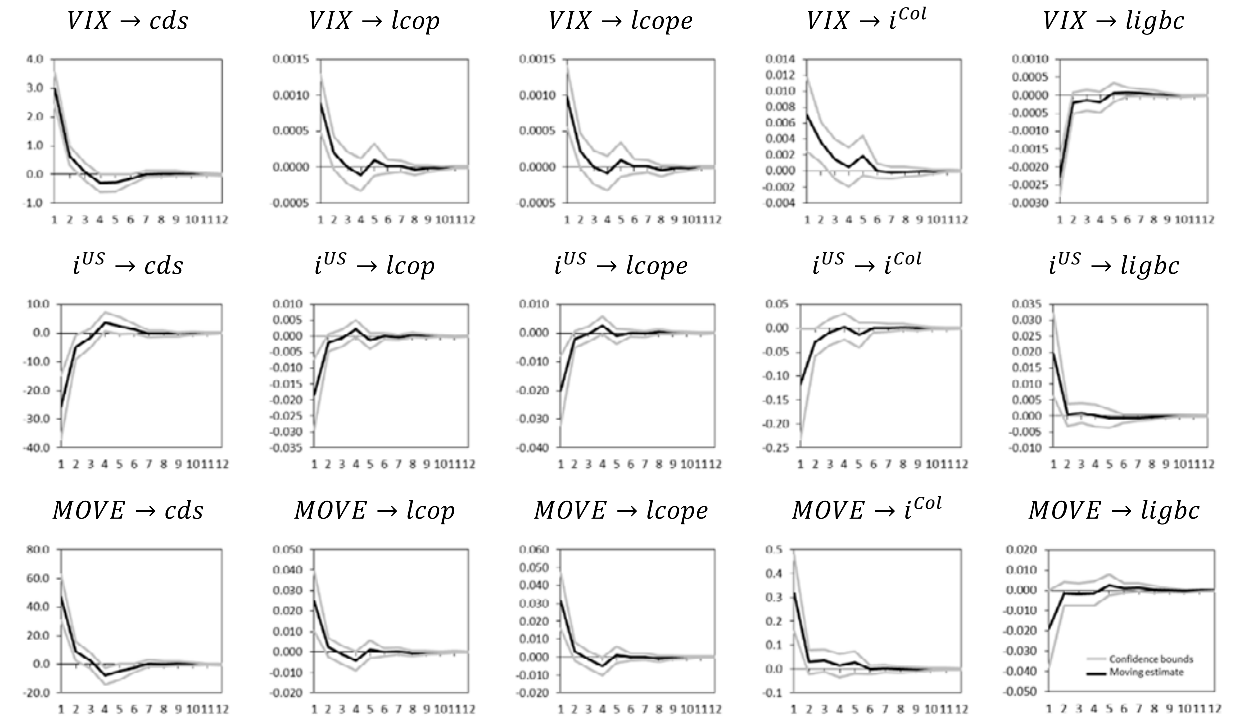
Source: Authors' calculations.

These results suggest that in this period of relative stability in the market, bond investment decisions are characterised mainly by the search for high returns. Positive shocks to global volatility, the term premium and the stance of US monetary policy increase the Treasury yield and lead to sales of sovereign long-term bonds and local currency. Further, in this period only risk shocks produce significant shifts in stock prices.

5.2 The crisis period

Figure 7 illustrates the multiplier analysis for the crisis period (February 2007 to October 2009). As in the results for the pre-crisis period, positive shocks to either US risk (VIX) or the Treasury term premium ($MOVE$) lead to a decline in the prices of sovereign bonds (ie a rise in the long-term bond yield (i_t^{Col})), a depreciation of the local currency ($lcop_t$), a decline in stock prices ($ligbc_t$) and a rise in the perception of sovereign risk (cds_t).

Crisis period: multiplier analysis ($Impulse \rightarrow Response$) Figure 7



Source: Authors' calculations.

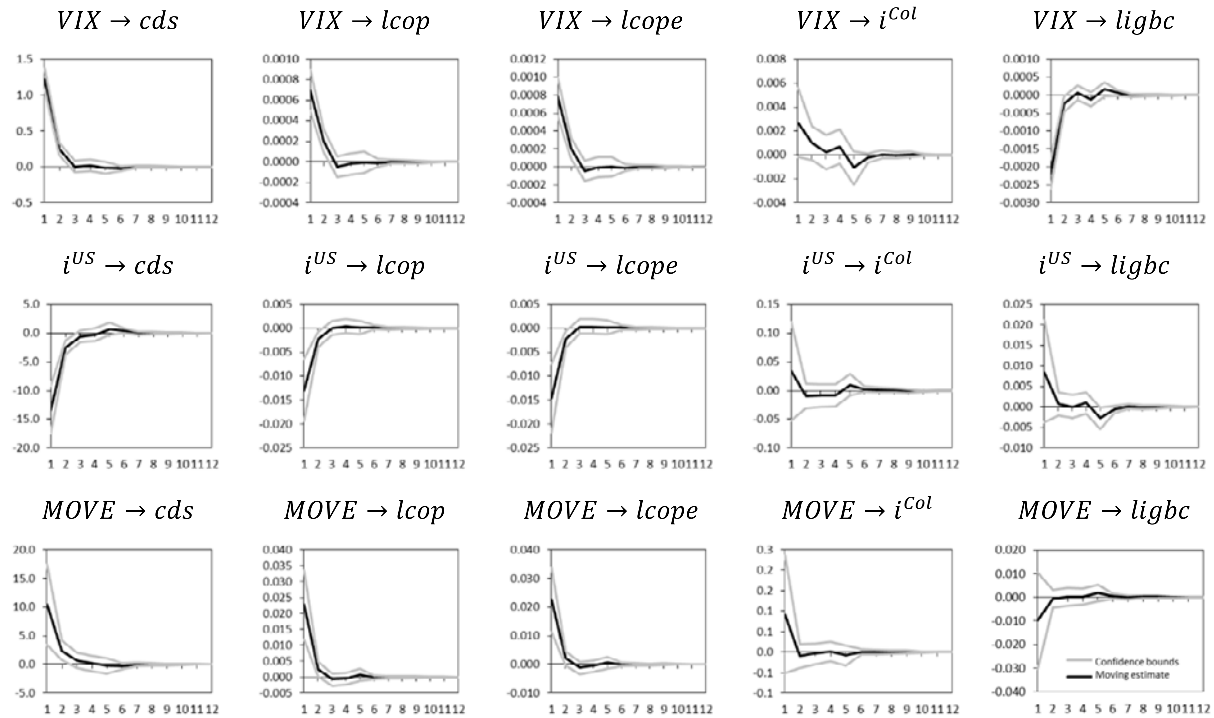
However, a positive shock to i_t^{US} provides a qualitatively different story. The response to this shock is opposite to that observed in the pre-crisis period: a reduction in local long-term bond yields, an appreciation of local currency, an increase in stock prices, and a decline in country risk perception. Moreover, the impacts on *cds* and *ligbc* become statistically significant.

In contrast, if the i_t^{US} shock is negative (a reduction in the US long-term Treasury rate and hence a higher market value of these securities), the response is an increase in the Colombian long-term bond yield (a decline in the value of the local bond portfolio), a devaluation of the currency and a decline in stock prices.

In the crisis period, the response of local asset prices to a shock to i_t^{US} suggests that US Treasuries became a safe haven in the midst of economic uncertainty and high levels of risk. Under these circumstances, Colombia and other emerging market economies are observed as a potential source of losses in an episode of crisis. In this scenario, a negative shock to i_t^{US} reduces the US long-term Treasury rate and leads to capital outflows from the Colombian financial market and into the US Treasury market.

As already mentioned, the shock to i_t^{US} encompasses surprises in the stance of monetary policy and "other effects". We suggest that in the climate of high uncertainty, the "other effects" component captures the desire of investors to hedge exposures to emerging market economies by using safe haven assets. These results also suggest that the *VIX* does not completely capture changes in global risk aversion or in the fear of a generalised economic collapse. In the crisis period, shocks to i_t^{US} captures mostly movements toward or away from safe assets.

Post-crisis period before the "*Tapering*" announcement: multiplier analysis ($Impulse \rightarrow Response$) Figure 8



Source: Authors' calculations.

5.3 Post-crisis period

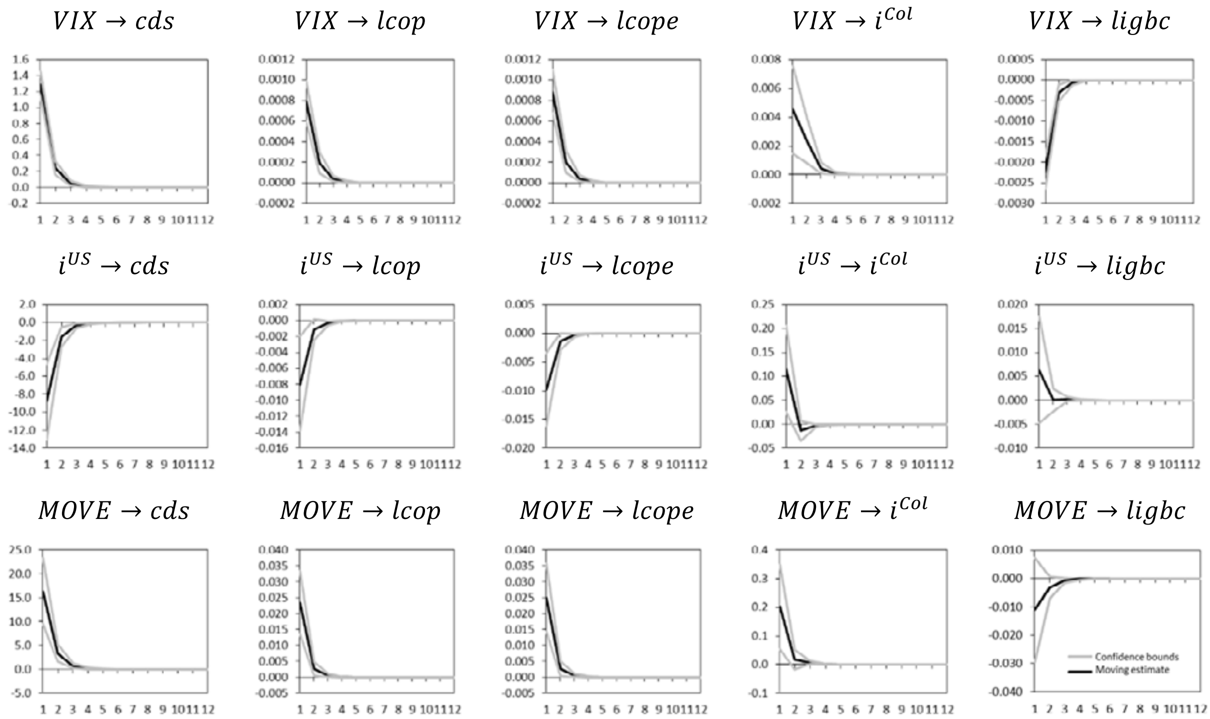
For the post-crisis period we examine a subsample as well as the overall period. The subsample covers data between November 2009 and April 2013 (ie before the tapering-related turmoil that began in May); the overall interval runs beyond, to November 2013.

Post-crisis period before tapering-related statements

In the November 2009–April 2013 subsample, the qualitative responses of the country risk spread (*cds*), the foreign exchange rate (*lcop*) and the expectations of future depreciation (*lcope*) to *VIX* , i_t^{US} and *MOVE* shocks do not change with respect to the results presented for the crisis period (Figure 8).

These results suggest that US Treasuries partially kept their safe-haven status. Possible explanations for this condition are the uncertainty associated with the slow recovery of the US economy, with the Greek debt crisis and with the unconventional policies adopted by advanced economies.

Overall post-crisis period: multiplier analysis ($Impulse \rightarrow Response$) Figure 9



Source: Authors' calculations.

However, for this period, not all local assets behave in the same fashion. In particular, unlike in the crisis period, *MOVE* and i_t^{US} shocks do not produce statistically significant responses of the long-term interest rates. This result provides evidence of market differentiation that distinguishes long-term sovereign bonds from other Colombian assets. Accordingly, the sensitivity of local long-term bonds to external financial shocks may have been reduced.

Overall post-crisis period

Figure 9 exhibits the multiplier analysis for the overall post-crisis period (November 2009 to November 2013). The qualitative responses of local asset prices other than the local long-term interest rate are similar to those observed in the post-crisis subsample, which precedes the tapering-related statements in May.

The responses of the long-term bond yield to shocks to *VIX*, i_t^{US} and *MOVE* are positive and statistically significant. These results are consistent with the gradual retrenchment of the unconventional monetary policy adopted by the Federal Reserve through its QE3 program. These findings suggest that the local long-term interest rate was more sensitive to the tapering-related turmoil than other local asset prices.

6 Conclusions

Understanding the relationship between the long-term interest rates of advanced and emerging market economies requires the identification of specific shocks that affect their dynamics. Our findings suggest that changes in the nature and importance of these shocks are behind the time-varying link between the US Treasury rate and Colombian asset prices, including local long-term bond yields.

In particular, our results show that the short-run response of the local long-term interest rate, CDS spreads, the foreign exchange rate and the stock market index to shocks to the US Treasury rate have been qualitatively different depending on both the sample period (ie before, during and after the global financial crisis) and the source of the shock.

Our findings suggest that in the pre-crisis period, investment decisions were characterised mainly by the search for high returns. Positive shocks to global volatility, the term premium and the stance of US monetary policy increase the Treasury yield and lead to a rise in local long-term interest rates, a decline in stock prices, a depreciation of the currency and a perception of higher country risk.

During the crisis, shocks to the US Treasury rate caused by changes in global volatility or the Treasury term premium show the same qualitative responses observed in the pre-crisis period. However, the responses to an i^{US} shock provide a different story, leading to a reduction in local long-term bond yields, the appreciation of the local currency, an increase in stock prices, and a fall in the country risk perception.

We suggest that in the atmosphere of economic uncertainty and high levels of risk that characterised the crisis period, a shock to i_t^{US} captures the desire of investors to hedge against such stress by using safe haven assets. The latter effect was dominant during the crisis. These results also suggest that the *VIX* does not completely capture changes in global risk aversion or in the fear of a generalised economic collapse.

In the post-crisis period, the responses of the Colombian long-term bond yield and other asset prices are similar to those observed during the crisis. Our findings indicate that this period is also characterised by a safe haven role for US Treasuries. Nevertheless, there are signals of a possible differentiation between local asset types.

A Moving window linear regression (MWLR) with GJR-GARCH variance

We discuss here the main details of the econometric strategy used to estimate the rolling coefficients of the regression exercises presented in Section 4.

To provide an estimation of time-varying model parameters, we carry out an analysis based on a MWLR (see Zivot and Wang (2006) and Stock and Watson (2011)). Moreover, we capture the changing volatility of financial time series used in these exercises by assuming that the volatility follows a conditional heteroscedastic model.[18]

In particular, we consider a MWLR model with fixed windows of length n. The model is defined as

$$Y_{t_k} = \beta_0(k) + \beta_1(k)X_{t_k} + a_{t_k}, \quad for \quad k = 1, \dots, T-n+1, \quad and \quad t = k, \dots, n+k-1, \tag{4}$$

where k indexes the rolling window, t indexes the time in the regression and T is the total number of observations.

For each window k, Y_{t_k} denotes an $(n \times 1)$ vector of observations on the dependent variable; X_{t_k} is an $(n \times 1)$ vector of values on the explanatory variable; $[\beta_0(k), \beta_1(k)]$ are scalars that stand for the intercept and slope of the regression, respectively; and a_{t_k} is an $(n \times 1)$ vector of error terms. For the window k, the n observations in Y_{t_k} and X_{t_k} correspond to the n most recent values of the sample for time $t = k{:}n + k - 1$ (see also Zivot and Wang (2006)).

We also consider that heteroscedastic errors a_{t_k} are given by

$$a_{t_k} = \sigma_{t_k}\epsilon_{t_k} \tag{5}$$

and that the conditional variance $\sigma^2_{t_k}$ evolves over time following a GJR-GARCH(1,1) process

$$\sigma^2_{t_k} = \alpha_0(k) + \left(\alpha_1(k) + \gamma_1(k)N_{t_k-1}\right)a^2_{t_k-1} + \delta_1(k)\sigma^2_{t_k-1} \tag{6}$$

where N_{t_k-1} is an indicator for negative values of a_{t_k-1}, that is,

$$N_{t_k-1} = \begin{cases} 1 & if \;\; a_{t_k-1} < 0, \\ 0 & if \;\; a_{t_k-1} \geq 0, \end{cases}$$

with parameters $\alpha_0(k) > 0$, $\alpha_1(k) \geq 0$, $\delta_1(k) \geq 0$, $\gamma_1(k) \geq 0$ and $\alpha_1(k) + 0.5\gamma_1(k) + \delta_1(k) < 1$ (for more details see Tsay (2010)). The $\alpha_1(k)$, $\delta_1(k)$ and $\gamma_1(k)$ are referred as the $ARCH$, $GARCH$ and $Leverage$ parameters, respectively. The GJR-GARCH is commonly used to model asymmetry in the ARCH process. We also assume that ϵ_{t_k} is a sequence of Student's t errors.

For each window k, the estimation is performed by maximum likelihood. All regression exercises are performed using the Matlab econometric toolbox. Each figure in Section 4 shows the moving window estimate of the coefficient $\hat{\beta}_{(\cdot)}$ and its 95% confidence interval.

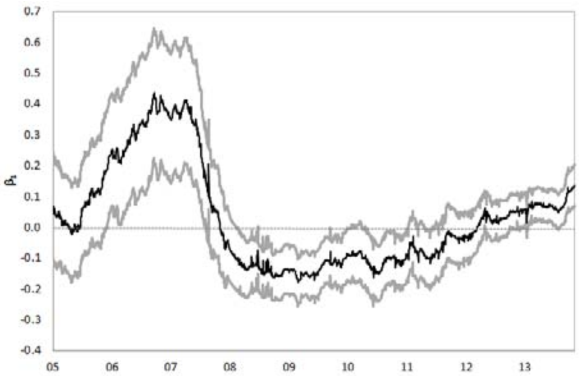
[18] The volatility modelling can improve the efficiency in parameter estimation and the accuracy in confidence intervals (Tsay (2010)).

B MWLR: multivariate model

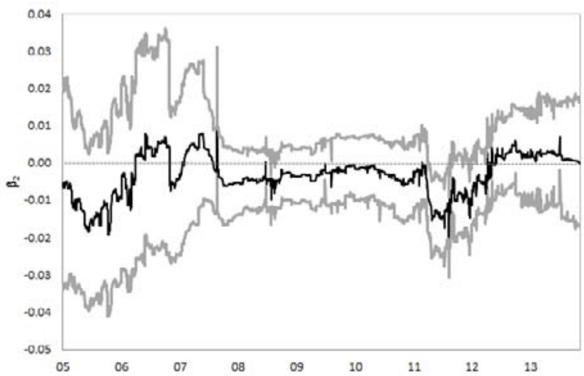
Figure 10 shows the evolution of the moving window estimate of β_1, β_2 and β_3 for the explanatory variables i^{US}, $dlcope$ and cds (panels A, B and C, respectively). This exercise also provides evidence on the changing relationship between long-term sovereign interest rates. The relationships between i^{Col} and variables $dlcope$ and cds have also changed through time.

MWLR: $\Delta i_{t_k}^{Col} = \beta_0(k) + \beta_1(k)\Delta i_{t_k}^{US} + \beta_2(k)\Delta dlcope_{t_k-1} + \beta_3(k)\Delta cds_{t_k-1} + a_{t_k}$ Figure 10

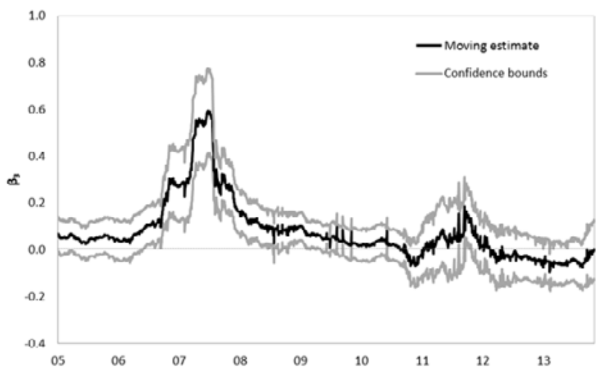
(A) Moving window estimate of β_1



(B) Moving window estimate of β_2



(C) Moving window estimate of β_3



Source: Authors' calculations.

C VARX-MGARCH model

We discuss here the main details of the econometric methodology used to estimate the VARX(*p*,*q*)-MGARCH(*l*,*m*) model and the impulse-response to shocks to exogenous variables (ie multiplier analysis) considered in Section 5.

We consider the VARX(*p*,*q*)-MGARCH(*l*,*m*) model,

$$\Delta\mathbf{Y}_t = \mu + \sum_{i=1}^{p} A_i\Delta\mathbf{Y}_{t-i} + \sum_{i=0}^{q} B_i\Delta\mathbf{X}_{t-i} + \boldsymbol{\varepsilon}_t \quad (7)$$

$$\boldsymbol{\Sigma}_t = C_0'C_0 + \sum_{i=1}^{l} F_i'\boldsymbol{\varepsilon}_{t-i}\boldsymbol{\varepsilon}_{t-i}'F_i + \sum_{j=1}^{m} G_j'\boldsymbol{\Sigma}_{t-j}G_j \quad (8)$$

where μ is a vector of means; A_i and B_i stand for the coefficient matrix associated with the endogenous and exogenous variables, respectively; and $\boldsymbol{\varepsilon}_t \sim WN(0, \boldsymbol{\Sigma}_t)$ is a vector of errors. We assume a Baba-Engle-Kraft-Kroner (BEKK) multivariate GARCH model as defined in Engle and Kroner (1995). The vectors

$$\mathbf{Y}_t = \left(i_t^{Col}, ligbc_t, lcop_t, lcope_t, cds_t, i_{MP,t}^{Col}\right)$$

and

$$\mathbf{X}_t = (VIX_t, i_t^{US}, MOVE_t)$$

denote the sets of endogenous and exogenous variables. These vectors are order-one integrated $I(1)$.

The estimation of the model is carried out in two steps.[19] First, we estimate the VARX model defined in equation (7). Second, we use residuals obtained from the previous step to estimate the MGARCH model stated by equation (8). We then perform the multiplier analysis.[20]

We carry out the estimation of the $VARX - MGARCH$ model in Section 5 for four specific periods. The first one corresponds to dates from June 2004 to February 2007 (ie pre-crisis period). The second time span goes from February 2007 to October 2009 (ie crisis period). The third period includes dates from November 2009 to April 2013 (ie post-crisis period before the "Tapering" announcement). Our fourth period considers the post-crisis period until November 2013.

Table 1 reports the unit-root tests performed in our analysis. The order of integration is determined using the augmented *Dickey-Fuller, Phillips & Perron (PP), Elliott, Rothenberg & Stock (ERS)* and *KPSS* tests. These results indicate that variables are order-one integrated.[21] We assume that variables are not cointegrated.

Tables 2, 3 and Figures 11, 12, 13 and 14 show the specification test for each model. These tests were carried out on $MGARCH$ standardised residuals. There is no evidence of misspecification.

19 The lags of the endogenous and exogenous variables p and q in equation 7 are determined using standard information criteria. The lags in equation 8 are determined from the specification tests of $MGARCH$ models.

20 Two points are clarified. First, problems on simultaneity and identification are precluded because the shock occurs on an exogenous variable. Second, as endogenous and exogenous variables are assumed $I(1)$, the resulting multipliers do not need to be integrated to obtain the responses of endogenous variables in levels.

21 Unit-root tests were also carried out on the first difference of the variables to confirm the order of integration.

The multiplier analysis presented in Section 5 shows the response of the level of endogenous variables to a one-unit shock on the level of exogenous variables VIX, i^{US} and $MOVE$. Confidence bounds for our multiplier analysis are estimated by bootstrapping techniques after controlling for $GARCH$ effects. Our results are based on 5,000 replications.

Unit-root test

Table 1

Test	Variable	Stat	Critical value	Evidence	Test	Variable	Stat	Critical value	Evidence
ADF trend	cds	–3.93	–3.96	Unit root	ERS	cds	–0.94	–3.48	Unit root
	i^{Col}	–2.72	–3.96	Unit root		i^{Col}	–2.39	–3.48	Unit root
	$lcop$	–2.88	–3.96	Unit root		$lcop$	–2.19	–3.48	Unit root
	$lcope$	–2.75	–3.96	Unit root		$lcope$	–2.01	–3.48	Unit root
	$ligbc$	–2.21	–3.96	Unit root		$ligbc$	–0.58	–3.48	Unit root
	VIX	–3.34	–3.96	Unit root		VIX	–2.38	–3.48	Unit root
	i^{US}	–2.99	–3.96	Unit root		i^{US}	–2.29	–3.48	Unit root
	$MOVE$	–3.03	–3.96	Unit root		$MOVE$	–2.96	–3.48	Unit root
PP	cds	–3.67	–3.97	Unit root	KPSS	cds	3.04	0.22	Non-stationary
	i^{Col}	–2.33	–3.97	Unit root		i^{Col}	1.85	0.22	Non-stationary
	$lcop$	–2.65	–3.97	Unit root		$lcop$	1.93	0.22	Non-stationary
	$lcope$	–2.65	–3.97	Unit root		$lcope$	2.06	0.22	Non-stationary
	$ligbc$	–1.88	–3.97	Unit root		$ligbc$	4.50	0.22	Non-stationary
	VIX	–4.24	–3.97	No unit root		VIX	2.01	0.22	Non-stationary
	i^{US}	–3.04	–3.97	Unit root		i^{US}	2.72	0.22	Non-stationary
	$MOVE$	–3.34	–3.97	Unit root		$MOVE$	2.25	0.22	Non-stationary

Q-test

Table 2

Sample period	Standardised residuals		Standardised square residuals	
	Statistic	P-value	Statistic	P-value
1 June 2004–26 February 2007	3617.43	0.4157	2775.87	0.9162
26 February 2007–5 November 2009	3729.26	0.0651	2941.91	0.2064
5 November 2009–30 April 2013	3626.32	0.3755	2930.61	0.2509
5 November 2009–7 November 2013	3502.18	0.8761	2835.85	0.7177

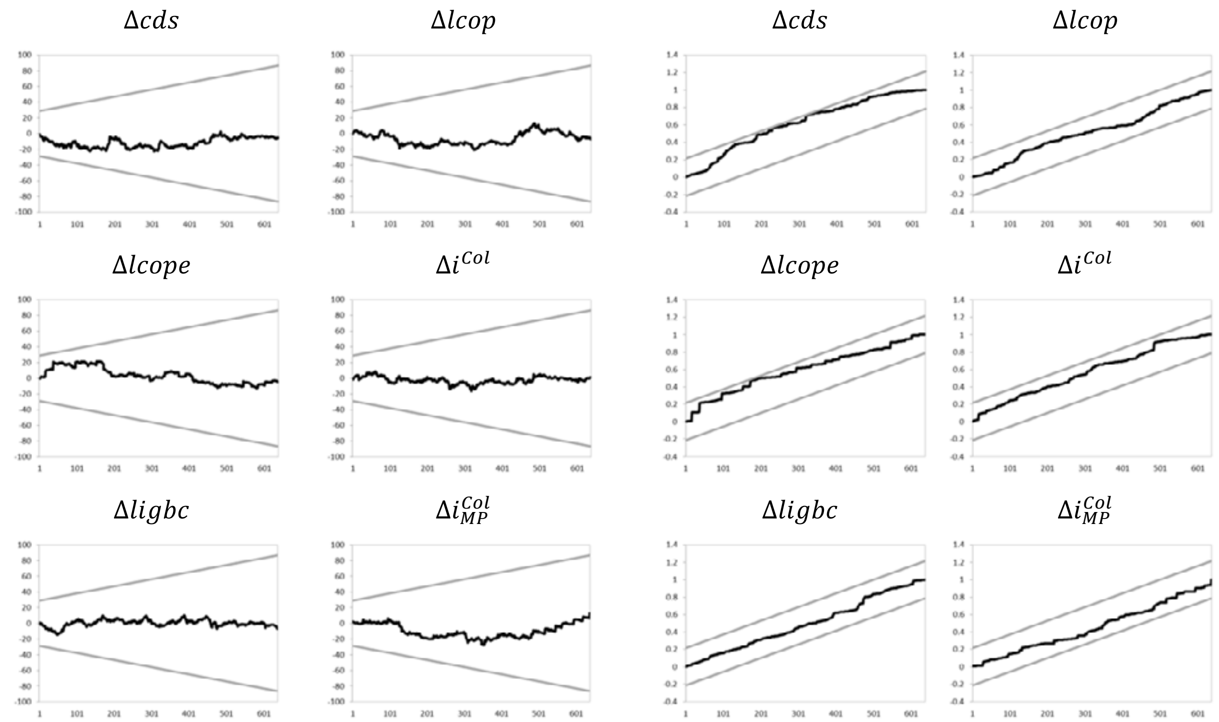
Maximum eigenvalue

Table 3

Sample period	Maximum eigenvalue	
	VAR	$MGARCH$
1 June 2004–26 February 2007	0.5203	0.9433
26 February 2007–5 November 2009	0.6473	0.9262
5 November 2009–30 April 2013	0.2006	0.9378
5 November 2009–7 November 2013	0.5549	0.9467

CUSUM and CUSUM-squared tests: pre-crisis period

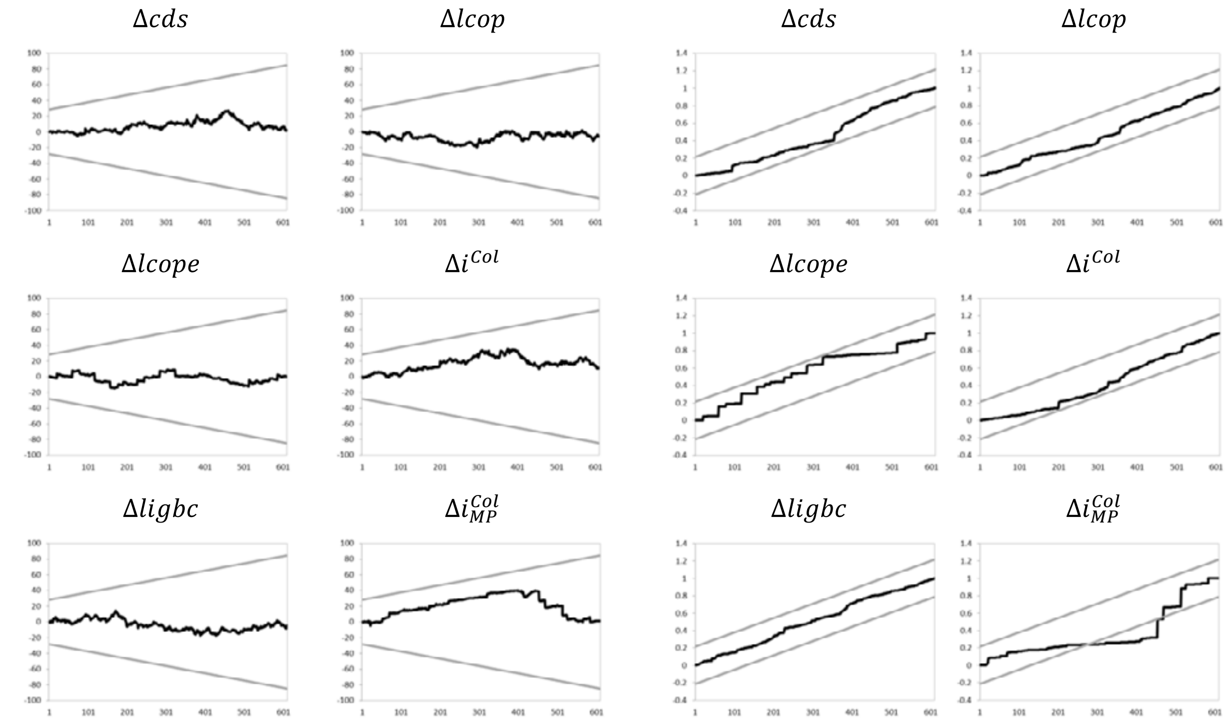
Figure 11



Source: Authors' calculations.

CUSUM and CUSUM-squared tests: crisis period

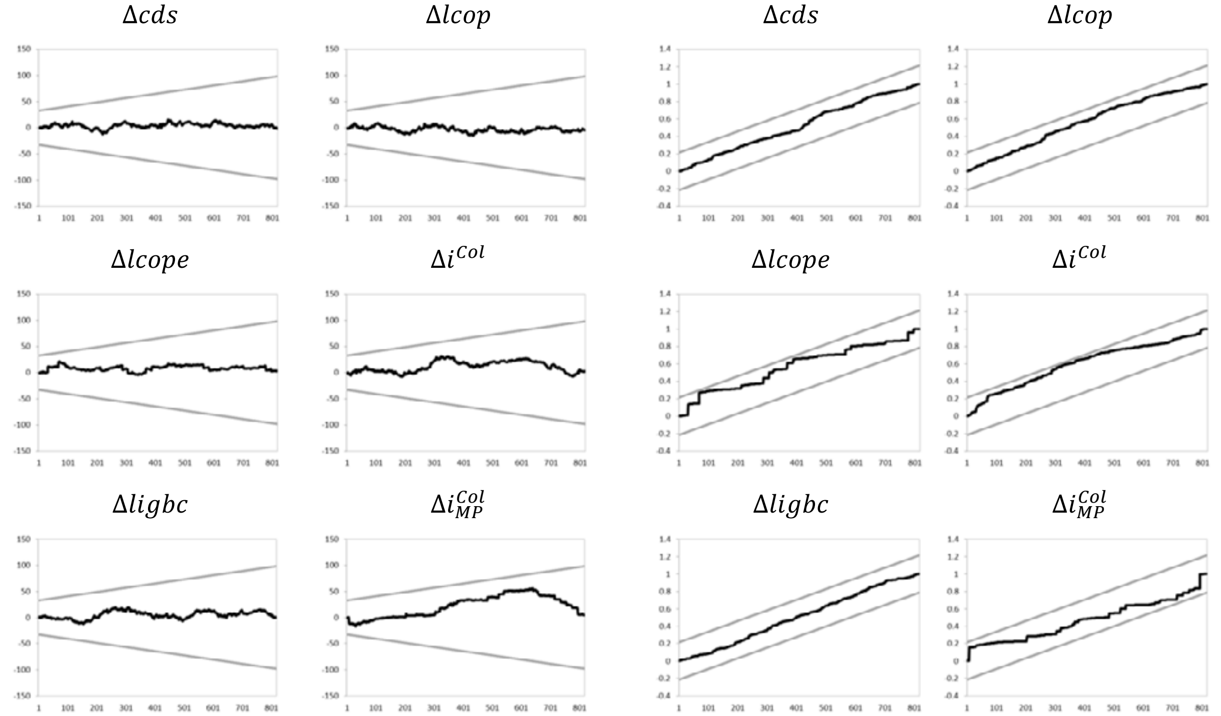
Figure 12



Source: Authors' calculations.

CUSUM and CUSUM-squared tests: post-crisis period before the "*Tapering*" announcement

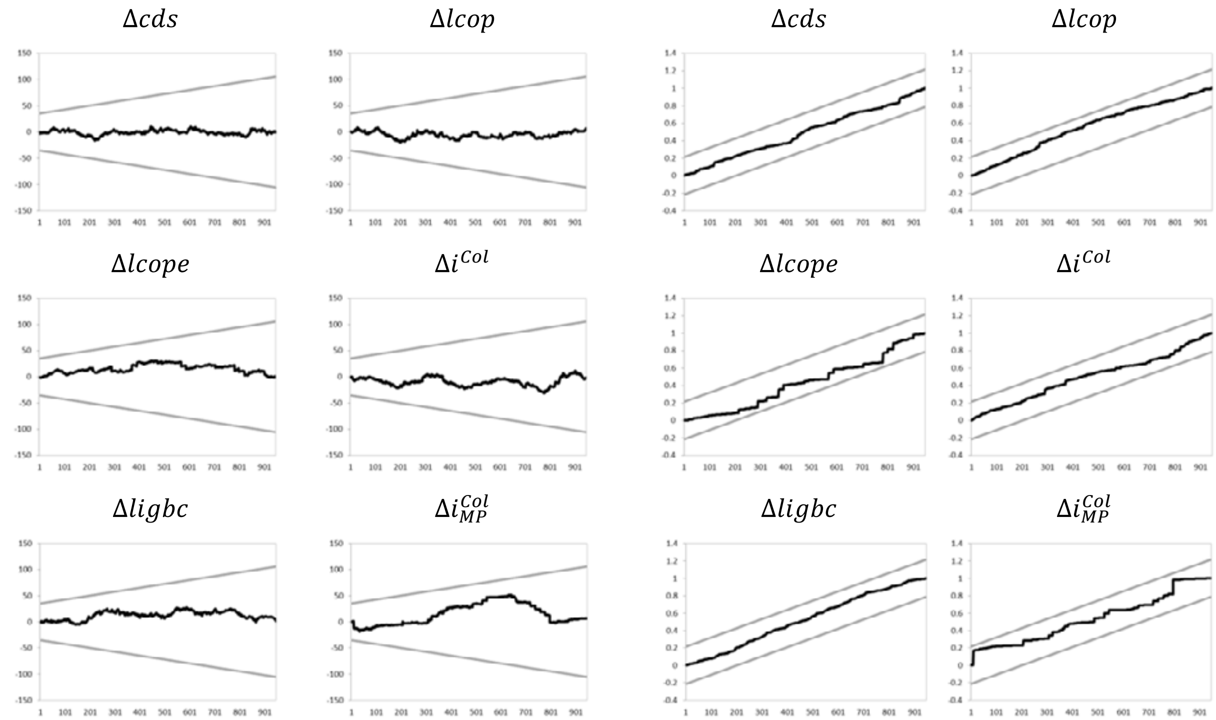
Figure 13



Source: Authors' calculations.

CUSUM and CUSUM-squared tests: overall post-crisis period

Figure 14



Source: Authors' calculations.

References

Barata, J, L Pereira and A Soares (2013): "Quantitative easing and related capital flows into Brazil: measuring its effects and transmission channels through a rigorous counterfactual evaluation", *Working Papers Series*, 313, Central Bank of Brazil, Research Deparment.

Bernanke, B and V Reinhart (2004): "Conducting monetary policy at very low short-term interest rates", *American Economic Review*, 94(2), pp 85–90.

Carrera, C, R Gondo and N Ramírez-Rondán (2013): "Effects of US quantitative easing on the Peruvian economy", working paper, Central Reserve Bank of Peru.

Chen, Q, A Filardo, D He and F Zhu (2012): "International spillovers of central bank balance sheet policies", in Bank for International Settlements (ed), *Are central bank balance sheets in Asia too large?*, vol 66, pp 220–64.

Cieslak, A and P Povala (2013): "Information in the term structure of yield curve volatility", working paper, Northwestern University.

Cronin, D (2014): "The interaction between money and asset markets: a spillover index approach", *Journal of Macroeconomics*, 39, pp 185–202.

Cúrdia, V, A Ferrero and H Chen (2012): "The macroeconomic effects of large-scale asset purchase programs", *Meeting Papers*, 372, Society for Economic Dynamics.

Cúrdia, V and M Woodford (2011): "The central-bank balance sheet as an instrument of monetary policy", *Journal of Monetary Economics*, 58(1), pp 54–79, 2011.

D'Amico, S and T King (2013): "Flow and stock effects of large-scale treasury purchases: evidence on the importance of local supply", *Journal of Financial Economics*, 108(2), pp 425–48.

Doh, T (2010): "The efficacy of large-scale asset purchases at the zero lower bound", *Economic Review*, Q II, pp 5–34.

Engle, R and K Kroner (1995): "Multivariate simultaneous generalized ARCH", *Econometric Theory*, 11(1), pp 122–50.

Fratzscher, M, M Lo Duca and R Straub (2013): "On the international spillovers of US quantitative easing", *DIW Discussion Papers*, 1304, German Institute for Economic Research, Berlin.

Gagnon, J, M Raskin, J Remanche and B Sack (2011): "The financial market effects of the Federal Reserve's large-scale asset purchases", *International Journal of Central Banking*, 7(1), pp 3–43.

García-Cicco, J (2011): "On the quantiative effects of unconventional monetary policies in small open economies", *International Journal of Central Banking*, 7(1), pp 53–115.

Glick, R and S Leduc (2012): "Central bank announcements of asset purchases and the impact on global financial and commodity markets", *Journal of International Money and Finance*, 31(12), pp 2078–101.

Jones, C and M Kulish (2013): "Long-term interest rates, risk premia and unconventional monetary policy", *Journal of Economic Dynamics & Control*, 37(12), pp 2547–61.

Joyce, M, A Lasaosa, I Stevens and M Tong (2011): "The financial market impact of quantiative easing in the United Kingdom", *International Journal of Central Banking*, 7(3), pp 113–61.

Landau, J (2011): "Global liquidity – concept, measurement and policy implications", *CGFS Publications*, 45, Committee on the Global Financial System, Bank for International Settlements.

Lenza, H, M Pill and L Reichlin (2010): "Monetary policy in exceptional times", *Economic Policy*, 25, 295–339, April.

Londoño, J and H Sapriza (2014): "US unconventional monetary policy and contagion to emerging market economies", *International Finance Discussion Papers*, Federal Reserve Board.

Moore, J, S Nam, M Suh and A Tepper (2013): "Estimating the impacts of US LSAPs on emerging market economies' local currency bond markets", *Staff Reports*, 595, Federal Reserve Bank of New York.

Neely, C (2010): "The large scale asset purchases had large international effects", *Working Papers*, 2010–018, Federal Reserve Bank of St Louis.

Peersman, G (2011): "Macroeconomic effects of unconventional monetary policy in the euro area", *Working Papers Series*, European Central Bank, 1397, November.

Quispe, Z and R Rossini (2011): "Monetary policy during the global financial crisis of 2007–09: the case of Peru", in Bank for International Settlements (ed), *The global crisis and financial intermediation in emerging market economies*, vol 54, pp 299–316.

Schenkelberg, H and S Watzka (2013): "Real effects of quantitative easing at the zero lower bound: structural VAR-based evidence from Japan", *Journal of International Money and Finance*, 33, pp 327–57.

Stock, J and M Watson (2011): *Introduction to econometrics*, Addison-Wesley, Boston, third edition.

Tobias, A, R Crump and E Moench (2013): "Pricing the term structure with linear regressions", *Journal of Financial Economics*, 110(1), pp 110–38.

Tsay, R (2010): *Analysis of financial time series*, John Wiley & Sons, Hoboken, New Jersey, third edition, September.

Turner, P (2013): "Benign neglect of the long-term interest rate", *BIS Working Papers*, 403, Bank for International Settlements.

——— (2014): "The global long-term interest rate, financial risks and policy choices in EMEs", *BIS Working Papers*, 441, Bank for International Settlements.

Ugai, H (2007): "Effects of the quantiative easing policy: a survey of empirical analyses", *Monetary and Economic Studies*, 25(1), pp 1–48.

Wright, J (2012): "What does monetary policy do to long-term interest rates at the zero lower bound?", *The Economic Journal*, 122(564), pp 447–66.

Zivot, E and J Wang (2006): *Modeling financial time series with S-Plus*, Springer, second edition.

Evolution of the Czech National Bank's holdings of foreign exchange reserves

Michal Skořepa and Mojmír Hampl[1]

Abstract

A central bank may decide to conduct foreign exchange interventions when it concludes that the exchange rate level without such interventions would be insufficiently strong. A by-product of such interventions will then be a build-up of official foreign exchange (FX) reserves. A case in point is the evolution, since the late 1990s, of the official FX reserves held by the Czech National Bank (CNB). In this paper, we take a closer look at this particular case, focusing specifically on the interventions that the CNB conducted in late 2013. We also examine some less traditional ways in which the CNB's activities have directly or indirectly affected the Czech koruna exchange market over the past dozen years.

Keywords: Appreciation, economic convergence, foreign exchange intervention, international reserves, privatisation

JEL classification: E52, F31, F41, O24

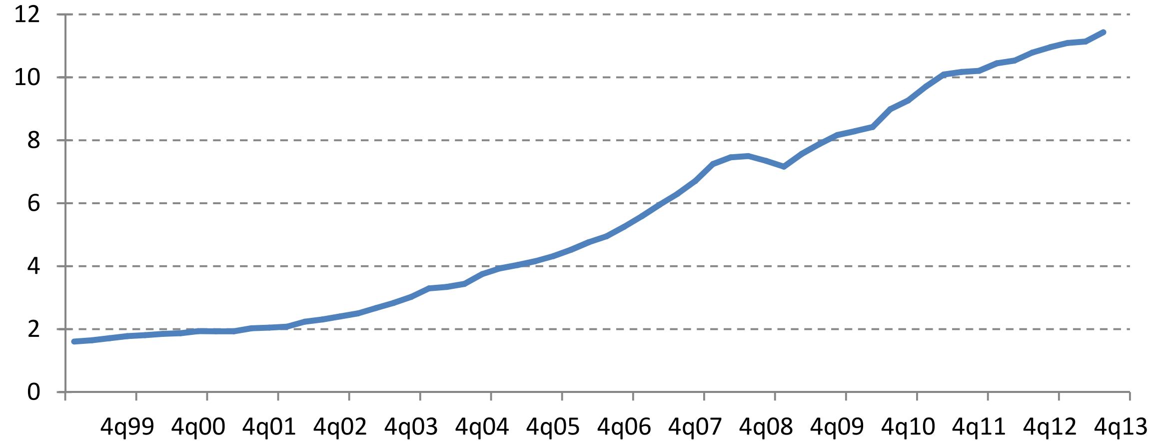
[1] Czech National Bank.

One of the most striking stylised facts of the past one and a half decades is the rapid rise in the volume of official FX reserves, as illustrated in Graph 1.

Rise in worldwide holdings of official FX reserves since 1999

In trillions of US dollars

Graph 1



Source: IMF, Currency Composition of Official Foreign Exchange Reserves (COFER) database.

Table 1 shows that the geographical distribution of this rise has been very uneven. While official FX holdings worldwide have risen about seven times, for advanced economies this ratio is less than 4:1, and for emerging and developing economies it is more than 12:1.

Rise in holdings of official FX reserves since 1999, by type of economy

In billions of US dollars

Table 1

	Q1 1999	Q4 2013	Ratio
	1	2	2:1
World economy	1606	11434	7:1
Advanced economies	993	3764	3:8
Emerging and developing economies	613	7671	12:5
Czech Republic	12	56	4:7

Sources: IMF, COFER database; CNB; authors' calculations.

Given that much of this increase has taken place in Southeast Asian countries recovering from the Asian exchange rate crisis, a major explanation of the rise in official FX reserves seems to be that it represents an effort to build a high target level of FX reserves as a buffer against devaluation pressures in future exchange rate crises (IMF (2011)).

However, in at least some countries where official FX reserves have increased, the rise may be partly or even fully a product of foreign exchange interventions aimed, rather, at slowing or stopping appreciation of the currency (De Gregorio (2011)). Central banks usually undertake such interventions in cases where the observed appreciation is deemed excessive or, more generally, the exchange rate level without the interventions is considered insufficiently strong.

A case in point is the evolution, over the past dozen years, of the official FX reserves held by the Czech National Bank (CNB). The experience with traditional exchange rate interventions has been analysed extensively, both in general (Sarno and Taylor (2001), Cavusoglu (2011), and Fatum and Yamamoto (2012)) and in connection with the CNB's interventions in the early 2000s (Disyatat and Galati (2005), Geršl and Holub (2006), Égert and Komárek (2006) and Lízal and Schwarz (2013)). This being the case, we provide some details on the interventions that the CNB launched in late 2013 and also on some less traditional ways in which the CNB's activities have directly or indirectly affected the Czech koruna exchange market over the past decade.

1. Sizeable increase in the CNB's FX reserves since 1999

As Table 1 shows, the CNB's official FX reserves, expressed in US dollars, are now 4.7 times higher than in the first quarter of 1999. This ratio is far below that of emerging and developing economies, but not too far below that of the world as a whole and somewhat higher than that of advanced countries. These figures show that the CNB, while not having been a major contributor, clearly has participated in the recent wave of reserves building.

As regards the CNB, there are four major factors that have affected the evolution of the volume of FX reserves held:

(a) capital and interest rate income on the instruments in which the reserves are invested;

(b) changes in the cross-exchange rates of the reporting currency vis-à-vis the other currencies in which the FX reserves are invested (eg the value expressed in euros of the CNB reserves held in euros, US dollars and other currencies may change because of shifts in the exchange rates of the euro vis-à-vis those other currencies);

(c) traditional interventions;

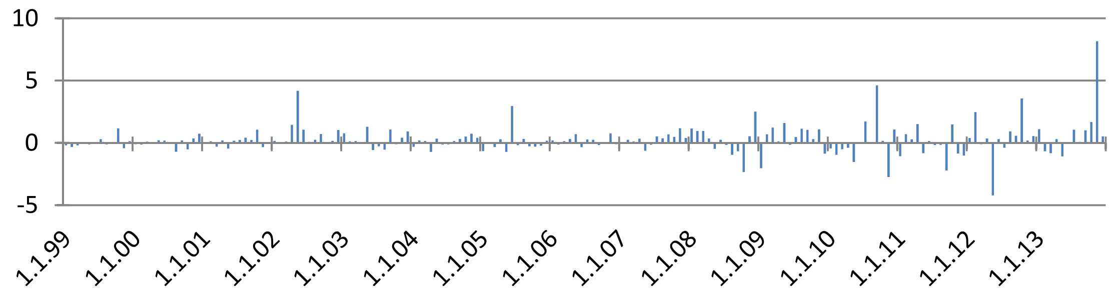
(d) quasi-interventions, that is, FX transactions where the CNB is one of the two parties, but its decision to conduct that transaction is not made in the traditional, entirely discretionary way. As we will describe in greater detail below, two such factors have co-determined the evolution of the CNB's FX reserves. One is the conduct of "client operations" in the sense of off-market FX transactions with the government based on a long-term master agreement. The other factor is a regular sale of part of the capital and interest rate income generated by the FX reserves.

The total monthly changes in the CNB's FX reserves owing to all four factors listed above are shown in Graph 2. Given that factors (a) and (b) are purely technical, however, in what follows we will focus on factors (c) and (d), that is, FX interventions, whether of the traditional or "quasi" character.

Monthly changes in the CNB's holdings of FX reserves

In millions of US dollars

Graph 2



Sources: CNB; authors' calculations.

Expressed in euros – the currency in which the CNB holds most of its reserves – the two biggest quarterly increases by far in the CNB's reserves since the start of 1999 occurred in Q2 2002 (almost EUR 5.6 billion) and Q4 2013 (almost EUR 7 billion (see Graph 2)). Indeed, the spring of 2002 and November 2013 are the only two periods since the 1998 launch of inflation targeting in the Czech Republic when the CNB conducted traditional FX interventions. But as we will see, the quasi-interventions have also had a sizeable impact on the CNB's FX holdings, even if it has been spread out over time.

2. FX interventions conducted by the CNB prior to 2013

During most of the 1990s and 2000s, the Czech transition economy went through a fairly standard process of real and nominal convergence with its western European peers (for a discussion of such "convergence shocks", see Hampl and Skořepa (2011)).[2] In 1997, the CNB decided to switch from a hybrid exchange rate/monetary targeting regime to inflation targeting. Ever since then, the macroeconomic consensus in the Czech Republic has been that the medium-term equilibrium real exchange rate appreciation implied by convergence should take the form of nominal exchange rate appreciation, while the inflation differential vis-à-vis the economy's main trading partners should be gradually brought to zero and then kept close to that level.

Needless to say, the actual pace of nominal appreciation has on many occasions deviated from what the CNB viewed as appropriate at a given stage. At times, when the deviation was deemed excessive and verbal interventions did not have the desired effect, the CNB decided to conduct actual FX interventions. Prior to 2013, these interventions took place in the following periods: February 1998–July 1998, October 1999–March 2000 and October 2001–September 2002.

[2] This convergence process was interrupted by the recent global financial and economic crisis, but the CNB expects it to resume at least to a limited extent.

According to analyses conducted by the CNB during those periods, a major cause of the repeated instances of excessive appreciation was a foreign capital inflow higher than what would have been justified by the relevant fundamentals. As a result, on the one hand, policy interest rate cuts were often considered to be only a supporting measure; on the other hand, other measures apart from standard FX interventions were used to fight the appreciation – namely, better policy coordination, as will be described below. Details on the FX interventions conducted by the CNB prior to 2013, their macroeconomic justification and assessments of their effectiveness are provided eg in Geršl and Holub (2006) and Lízal and Schwarz (2013).

3. FX interventions conducted by the CNB in 2013

During 2012 the Czech economy saw domestic inflation fall gradually, for both external and domestic macroeconomic reasons, from above the target level of 2% annually to below it. Towards the end of the year, the CNB's forecasts for the next several quarters started to signal that, in order to keep inflation from falling below 1%, that is, from leaving the 1 percentage point target band around the target level, the monetary policy stance should be eased enough to bring market interest rates just a few tenths of a percentage point above zero. Given the fairly constant spread of roughly 0.4 percentage points between the three-month market interest rate and the two-week policy rate, the required easing would technically mean reducing the policy rate below the zero lower bound. The Bank Board decided to reduce the policy rate to zero and to commit to keeping the rate at that level for an extended period. On top of that, however, official CNB communication flagged – for the first time in a decade – the possibility of implementing the rest of the needed monetary policy easing "by influencing the exchange rate of the koruna" (CNB (2012)).[3]

During 2013, new forecasts indicated that inflation would most likely fall even lower than had been expected, reaching zero or even a slightly negative level for a short time at the beginning of 2014. The probability of several quarters of negative inflation ceased to be negligible, implying the threat of a subsequent deflation spiral not unlike the one observed some 10 years earlier in Japan.

Throughout 2013, the Bank Board kept emphasising the possibility of FX interventions, but the impact of these verbal initiatives seemed to wane gradually. Under those circumstances, on 7 November 2013, the Bank Board decided to initiate actual FX interventions immediately, with the publicly announced objective of weakening the exchange rate so that it would not fall below EUR 1 = CZK 27. Formally, then, these interventions were in the "Swiss" style: fully transparent, without a pre-specified time horizon, and asymmetrical in the sense of aiming to keep the domestic currency's exchange rate vis-à-vis the euro from strengthening below a certain floor.

Given the doubts that quite a few market participants initially had about the CNB's resolve to achieve the stated aim, it took several hours before the exchange

[3] Actually, the rate was reduced only to 0.05%. The main reason for not setting it at 0% is that, under Czech law, the policy rate serves as a basis for the calculation of penalty premia in business transactions.

rate actually reached the EUR 1 = CZK 27 level.[4] Within about three days, the volume of the Czech currency that the CNB had to sell in the market to keep the exchange rate from falling below EUR 1 = CZK 27 dropped to almost zero. The resulting rise in the CNB's holdings of FX reserves between end-September and December 2013 was about 20% (almost EUR 7 billion), by far the highest quarterly increase in FX reserves in the CNB's two-decade history.

To conclude this discussion of interventions as one source of the growth of FX reserves, it may be pointed out that the 2013 interventions differ from the previous ones conducted by the CNB in two important respects. First, the 2013 interventions were initiated even though the CNB did not perceive the exchange rate as drifting too far from a level consistent with the current inflation differential and the equilibrium real exchange rate vis-à-vis the Czech Republic's main trading partners; instead, the interventions were used as a supplementary tool to meet the monetary policy target after the basic tool – the policy interest rate – could no longer be used. Such a temporary use of the exchange rate to escape a deflationary trap and to achieve the inflation target once the interest rate has hit the zero lower bound is fully consistent with the recommendations based on the theory of inflation targeting (Svensson (2001, 2003)).

Second, unlike previous interventions, the CNB's action in late 2013 was followed by an intense public backlash. While partly fuelled by some market analysts who complained that the intervention's effects would be negligible or even contractionary (that is, opposite to those that the CNB intended), the public also reacted negatively, fearing a rise in the prices of both imported and domestic goods and services. This was an indirect indication that a deflation-plus-appreciation mindset had actually started to become widespread in the Czech economy, and that some type of policy action – such as forceful FX intervention – was called for in order to push general inflationary expectations back towards the 2% inflation target.

4. FX agreements with the government

As noted above, the FX interventions conducted by the CNB prior to 2013, namely, in the late 1990s and early 2000s, were meant to fight the recurring and fundamentally unjustified appreciation of the koruna. However, while this tendency towards excessive exchange rate appreciation was not supported by macroeconomic fundamentals, it seemed clearly, even if perhaps not exclusively, related to another factor: the government's privatisation programme (involving primarily banks and utility companies). The bouts of appreciation seemed to be fanned by the actual implementation of this programme, as well as by its expected continuation.

For this reason, the CNB and the government repeatedly negotiated ways to reduce the impact of the privatisation programme on the exchange market. In essence, the two institutions were looking for a policy mix that would result in very

4 At that time, the day-on-day depreciation of the euro exchange rate was about 4.5%, the largest change in the Czech koruna/euro exchange rate since the euro's introduction in 1999.

specific kinds of FX interventions – those targeted at eliminating or at least reducing the exchange rate impact of certain fiscal operations.

4.1 The agreement of 2000

These negotiations started in 1999. The first result was a document titled *Monetary policy strategy in a period of foreign capital inflow*, approved by the CNB in October 1999 and by the government in January 2000 (CNB (1999)). The key measure in this agreement, as well as in its later incarnations, was the government's commitment to keep its privatisation receipts off the market – specifically, to keep them in foreign exchange accounts. From there the receipts would be released in such a way as not to cause excessive appreciation or to arouse overly high expectations of appreciation.

4.2 The agreement of January 2002

Towards the end of 2001 the government declared that, in the following year, the volume of assets to be privatised and transferred into foreign hands would be particularly large. Based on this, and on the suspicion that the government had and still would have a hard time abstaining from using the proceeds, the market again started to anticipate a period of strong appreciation. The result was sharp actual appreciation even before the end of 2001. On the policy mix side, apart from the FX interventions mentioned earlier, the CNB responded by inducing the government to adopt, in January 2002, a new, strengthened agreement titled *Strategy for dealing with the exchange rate effects of capital inflows from privatisation of state property and from other foreign exchange revenues of the state* (CNB (2002a, 2002b)).[5]

The strategy listed a number of commitments of varying specificity, ie: the government should not issue FX bonds in 2002; it should make all the ministries and state agencies cover as much as possible of their various FX expenditures with the proceeds from privatisation; it should ensure that part of the price in any future privatisation deals would be paid in korunas, using koruna credits; if the government needed to convert any of the remaining privatisation and other FX revenues kept in the foreign exchange account at the CNB, it should sell them off-market, directly to the CNB.

To prevent the CNB's losses from sterilising these direct conversions, or to mitigate their effects, the strategy provided that part of the government's FX account at the CNB would be non-interest-bearing and that, in addition, the CNB would charge the government an agreed fee for the direct conversions.

4.3 The agreement of April 2008

After a few years of relative calm, characterised by the koruna's gradual nominal and real appreciation, excessive appreciation pressures seemed to have returned during 2007 and especially in the first quarter of 2008, when on some days the market saw

5 A revision of the agreement announced in May 2002 (CNB (2002c)) was largely of a technical nature.

month-on-month changes of up to almost 4%. Also, certain large-scale privatisation projects were expected to take place later in 2008. For this reason, the CNB and the government returned to the table to negotiate an update to the 2002 agreement that would suit the conditions at that time.

The result, summarised in CNB (2008a) and explained in detail in CNB (2008b), was an agreement which, while similar in spirit to the previous one, nonetheless contained a few new elements. First, in the light of the Czech Republic's entry into the European Union (EU) in 2004, the agreement tackled the new issue of inflows of funds from various EU sources. Here, both parties to the agreement confirmed their mutual understanding that the flows should, as far as possible, be converted by the CNB off the FX market, and that all ministries and state agencies should avoid any speculative operations affecting that market.

The new agreement also foresaw the possibility of a change in the conditions under which the CNB provided certain services to the government. If such changes were to be considered, they would have to avoid being unilaterally disadvantageous to the CNB and to pose no significant additional risks to the CNB beyond those to which it was already exposed in connection with the agreed currency conversions.

In addition, the agreement allowed the government to draw upon its privatisation revenues solely via foreign exchange swaps that could potentially be rolled over for any period of time, ideally until the Czech Republic's adoption of the euro. Another novelty was the government's pledge that, if it were to issue FX bonds, these would be hedged against exchange rate risk in such a way as not to affect the exchange rate.

4.4 Implementation of the agreements

Provided that the government's FX revenues really were the dominant force behind the excessive appreciation of the koruna, all of the agreements, to the extent that they were credible, had the potential to send strong signals and to manage expectations. Their ex ante credibility was, however, far from perfect: after all, the essence of these agreements was the politically difficult promise on the government's part to refrain from, or at least to postpone, using some of the fiscal revenues.

The available data are too inconclusive to enable a determination of the extent to which the government actually did honour the agreements. For example, proceeds from the privatisation of two major Czech utility companies in 2002–03 (gas, over EUR 4 billion) and 2005–2007 (telecommunications, almost EUR 2.8 billion) were exchanged in full with the CNB. For other transactions, also involving billions of euros, which took place around the mid-2000s, there is some uncertainty in the data as to whether all of the proceeds were treated in accordance with the agreements.

All in all, from 2000 up to now, the amount of the CNB's FX reserves that is due to off-market conversions with the government is around EUR 10 billion. While precise data are not available, indirect estimates by CNB experts indicate that, in spite of the anti-appreciation agreements, several billion additional euros were converted in the market by successive governments. Similarly, the information available indicates that the commitment to fully hedge newly issued FX bonds has been observed for some issues only.

5. Regular sale of income from FX reserves

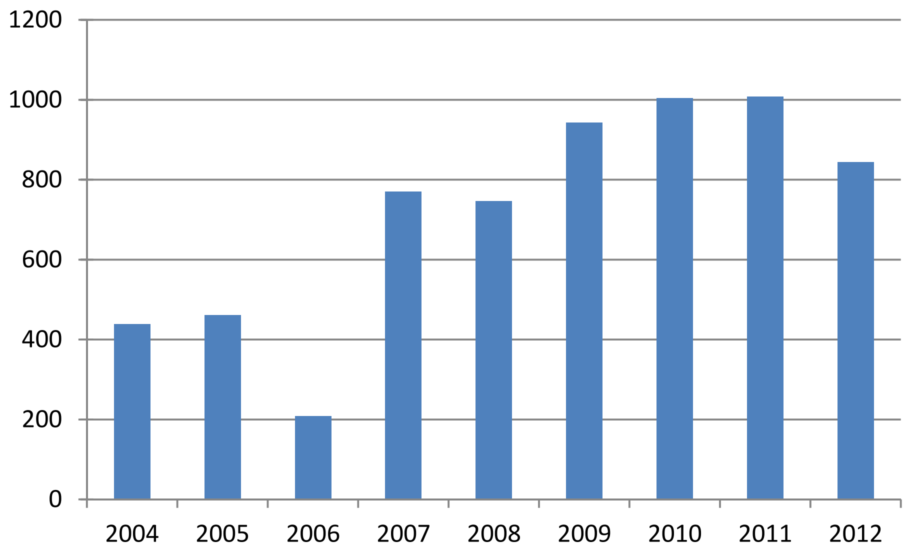
During 2003 and early 2004, the risk that the excessive appreciation pressures observed two years earlier would reoccur was rapidly fading. At the same time, the CNB was openly admitting that its holdings of FX reserves were higher than adequate and were growing further owing to the realisation of returns on them. Accordingly, the CNB decided in April 2004 to launch a programme of regular sell-offs of at least part of those returns.

At first, the volumes to be sold each day were determined – within certain longer-term ceilings – by the CNB's trading department based on the then-current situation in the market; since the summer of 2007, however, this regime has been replaced by a largely automatic sale of a fixed daily amount of reserves.

Yearly volumes of FX reserve returns sold by the CNB

In millions of euros

Graph 3



The programme was suspended in November 2012 when the CNB started to announce that, having reached the zero lower bound for the policy interest rates, it might have to use FX interventions in order to push inflation back up towards the 2% target. Continuation of the sale of returns from FX reserves would, even if only marginally, mitigate the impact of such interventions, and thus would send confusing signals and make the inflation target more difficult to achieve.

6. Conclusion

The volume of FX reserves held by the CNB has risen 4.7 times over the past 15 years. In this regard, the CNB has also participated in the worldwide trend towards increased official holdings of FX reserves during that period. The rise in the CNB's reserves has a single explanation: it has been a side effect of policy measures aimed at preventing inflation from straying too far from the inflation target, either when the exchange rate appreciated too quickly, or when the policy interest rate hit the zero lower bound while further easing of monetary conditions was still needed.

Besides traditional exchange rate interventions in the early 2000s and towards the end of 2013, the volume of FX reserves held by the CNB has also been influenced by two less traditional measures: first, a series of agreements with the Czech government on ways to limit the exchange rate impact of privatisation and some other fiscal operations, and second, a programme of regular sales of part of the returns from the reserve holdings. While having been honoured by successive governments only to some extent, the agreements can be deemed successful in helping to keep the exchange rate from excessive appreciation. The regular sales also seem to have achieved their aim of gradually reducing the volume of the CNB's FX holdings without fuelling undue appreciation pressures.

References

Cavusoglu, N (2011): "Exchange rates and the effectiveness of actual and oral official intervention: a survey on findings, issues and policy implications", *Global Economy Journal*, vol 10, no 4, January, pp 1–42.

Czech National Bank (1999): Press release on the CNB Board Meeting of 7 October 1999, www.cnb.cz/en/public/media_service/press_releases_cnb/1999/184.html.

——— (2002a): "Strategy for dealing with the exchange rate effects of capital inflows from privatisation of state property and from other foreign exchange revenues of the state", *Inflation Report*, January 2002, annex, www.cnb.cz/en/monetary_policy/inflation_reports/2002/2002_january/boxes_annexes/zpinflace_02_january_a1.html.

——— (2002b): *Strategy for dealing with the exchange rate effects of capital inflows from privatisation of state property and from other foreign exchange revenues of the state*, selected parts of the document approved by the government at its session on 16 January 2002, www.cnb.cz/en/monetary_policy/strategic_documents/download/vlada_cnb_kurz_en.pdf.

——— (2002c): *Revision of the strategy for dealing with the exchange rate effects of the foreign exchange revenues of the state*, selected parts of the document approved by the government at its session on 22 May 2002, www.cnb.cz/en/monetary_policy/strategic_documents/download/cnb_vlada_kurz_zpresneni_en.pdf.

——— (2008a): Joint agreement between the Czech Government and the Czech National Bank, www.cnb.cz/en/monetary_policy/strategic_documents/download/20080409_dohoda_vlady_a_CNB_en.pdf.

——— (2008b): *Updated strategy for dealing with the exchange rate effects of foreign exchange revenues of the state*, www.cnb.cz/en/monetary_policy/strategic_documents/download/20080409_strategie_reseni_kurzovych_dopadu_en.pdf.

——— (2012): Minutes of the Bank Board Meeting on 19 December 2012, www.cnb.cz/en/monetary_policy/bank_board_minutes/2012/amom_121219.html.

De Gregorio, J (2011): "International reserve hoarding in emerging economies", Central Bank of Chile, *Economic Policy Papers*, no 40, January.

Disyatat, P and G Galati (2007): "The effectiveness of foreign exchange intervention in emerging market countries: evidence from the Czech koruna", *Journal of International Money and Finance*, vol 26, no 3, April, pp 383–402.

Égert, B and L Komárek (2006): "Foreign exchange interventions and interest rate policy in the Czech Republic: hand in glove?", *Economic Systems*, vol 30, no 2, June, pp 121–140.

Fatum, R and Y Yamamoto (2012): "Does foreign exchange intervention volume matter?", Federal Reserve Bank of Dallas, *Globalization and Monetary Policy Institute Working Papers*, no 115, May.

Geršl, A and T Holub (2006): "Foreign exchange interventions under inflation targeting: the Czech experience", *Contemporary Economic Policy*, vol 24, no 4, October, pp 475–491.

Hampl, M and M Skořepa (2011): "Long-run equilibrium exchange rate notions in monetary policy strategies: the case of the Czech National Bank", *BIS Papers*, no 57, September.

International Monetary Fund (2011): "Assessing reserve adequacy", policy paper prepared by the Monetary and Capital Markets, Research, and Strategy, Policy, and Review Departments in consultation with other departments, *IMF Policy Papers*, 14 February.

Lízal, L and J Schwarz (2013): "Foreign exchange interventions as an (un)conventional monetary policy tool", *BIS Papers*, no 73, October.

Sarno, L and M P 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, September, pp 839–68.

Svensson, L E O (2001): "The zero bound in an open economy: a foolproof way of escaping from a liquidity trap", Bank of Japan, *Monetary and Economic Studies*, vol 19, no S-1, February, pp 277–312.

——— (2003): "Escaping from a liquidity trap and deflation: the foolproof way and others", *Journal of Economic Perspectives*, vol 17, no 4, fall, pp 145–166.

What have we learnt about the international transmission of monetary policy in recent years? Perspectives from Hong Kong SAR

Hong Kong Monetary Authority[1]

Abstract

This paper discusses how the unconventional monetary policies in advanced economies have impacted Hong Kong SAR through the financial channel. Following the 2008–09 global financial crisis, the monetary expansion in advanced economies has led to extremely loose liquidity conditions on a global scale and caused significant spillovers to Hong Kong SAR through the channels of interest rate diffusion and capital flows. Credit and household indebtedness have grown at a fast pace as a result, while home prices have risen to highly stretched levels. These developments have increased the risk of a build-up of macrofinancial vulnerability in Hong Kong SAR. To guard against and mitigate these spillovers, the Hong Kong SAR authorities have introduced various types of macroprudential measures targeting credit growth and the property market. Evidence from the available research suggests that these measures have helped safeguard financial stability and have influenced loan growth, interest costs, property market transactions and speculative activity.

Keywords: International transmission channels, macroprudential policy, financial stability, Hong Kong SAR, global financial crisis, unconventional monetary policies

JEL classification: E51, E61, G18, G28

[1] Prepared by Philip Ng and Raymond Yuen of the Research Department.

1. Background

The monetary expansion undertaken in the world's advanced economies in recent years has no parallel in modern economic history. After the collapse of Lehman Brothers in September 2008, central banks in the advanced economies lowered their policy interest rates to historically low levels and started large-scale asset purchases in the financial markets. These measures created an exceptionally loose monetary environment and helped restore financial stability and support the recovery of the advanced economies. But they also caused significant spillovers to emerging market economies (EMEs), mainly through the financial channel by giving rise to highly accommodative global liquidity conditions. Many EMEs were faced with massive capital inflows, low interest rates, fast credit growth and asset price increases that could have fuelled the accumulation of domestic macrofinancial imbalances. The spillovers through the trade channel, whereby an exceptionally loose monetary environment helped bolster the real activity of the advanced economies and hence world trade and EMEs' export performance, have been less important, however.[2]

This paper focuses on the spillovers to Hong Kong SAR through the financial channel and the policy response of the Hong Kong SAR authorities. Section 2 discusses the international transmission mechanism and its overall impact on Hong Kong SAR's macrofinancial conditions. Section 3 illustrates how the authorities in Hong Kong SAR mitigate the risk of a build-up of domestic imbalances. Section 4 concludes.

2. International transmission of advanced economies' monetary policy

In the years following Lehman's collapse, monetary expansion in the advanced economies has led to extremely loose liquidity conditions on a global scale and caused significant spillovers to Hong Kong SAR through the channels of interest rate diffusion and capital flows. Credit and household indebtedness have grown at a fast pace as a result, while home prices have risen to highly stretched levels. These developments have increased the risk of a build-up of macrofinancial vulnerability in Hong Kong SAR.

a. Interest rates

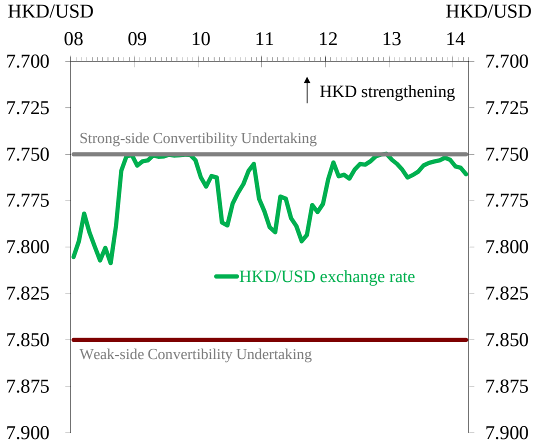
US monetary policy is imported into Hong Kong SAR through the Linked Exchange Rate system, with the domestic currency (Hong Kong dollar, or HKD) linked to the US dollar (USD) within a very narrow band of HKD 7.75–7.85 to USD 1. Currency stability is maintained through an automatic interest rate adjustment mechanism and a firm commitment by the Hong Kong Monetary Authority (HKMA) to honour its

[2] For example, since the global financial crisis of 2008–09, demand for Asian exports from the G3 has remained sluggish. Despite some encouraging signs of recovery recently, it is uncertain to what extent a stronger recovery in the advanced economies would provide support for the region's growth.

Convertibility Undertakings (CUs).[3] Moreover, changes in the US policy interest rate have a direct impact on the discount rate (or Base Rate) in Hong Kong SAR, which is set at 50 basis points above the prevailing US Fed Funds target rate.[4] So there are no large deviations between the HKD and USD interest rates in the long term.[5]

HKD/USD exchange rate

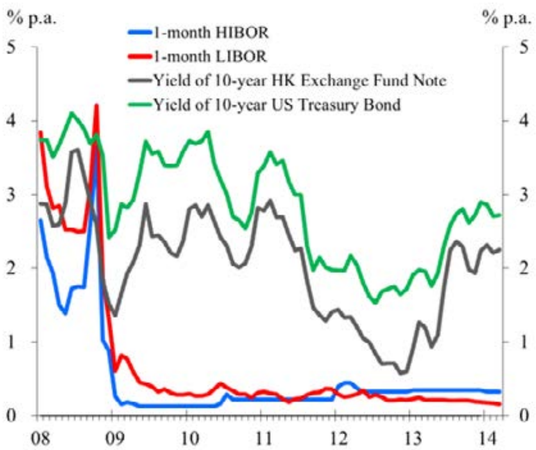
Chart 1



Source: HKMA.

Interbank rates and bond yields

Chart 2



Sources: HKMA and St-Louis Fed.

3 Under the strong-side CU, the HKMA undertakes to buy USD from licensed banks at HKD 7.75. Under the weak-side CU, the HKMA undertakes to sell USD at HKD 7.85.

4 The Base Rate is the interest rate that forms the foundation upon which the discount rates for repo transactions through the HKMA Discount Window are computed. It is currently set at 50 basis points above the prevailing US Fed Funds target rate or the average of the five-day moving averages of the overnight and one-month Hong Kong Interbank Offered Rate (HIBOR), whichever is the higher.

5 Wong and Wong (2011) find empirical evidence that under the Linked Exchange Rate system, HIBORs track LIBORs closely in the long term. There could still be short-term deviations between the HKD and USD interbank rates, reflecting in part domestic liquidity conditions.

With the Linked Exchange Rate system enjoying a high degree of market credibility, the HKD has remained stable in the past few years, and the HKD interbank rates and long-dated bond yields have fallen to historically low levels and have rarely diverged from their USD counterparts by a significant margin (Charts 1 and 2). For example, the overnight and three-month HKD interbank rates have hovered below 0.13% and 0.55%, respectively, since mid-2009, while the yield on 10-year Exchange Fund Notes has fallen to an average 1.9% (though it has risen to around 2.2% in recent months amid market concerns about the US Federal Reserve's tapering plan).[6] The composite interest rate, which measures the average cost of HKD funds for retail banks, has also stayed below 0.55% since mid-2009. The low wholesale funding costs have also fed through into retail interest rates. The savings deposit rate has dropped to 0.01% throughout the period. Moreover, with an average net interest margin of around 1.35%, the overall lending interest rate could have fallen below 2%. In particular, the average mortgage interest rate for newly approved loans once fell below 1% in the second half of 2009 and remained below 2.5% in 2013, compared with an average of about 5% over the past 20 years.

b. Capital flows

International transmission of advanced economies' monetary policy has also taken place through capital flows induced by overseas investors' global search for yield and investment opportunities. In Hong Kong SAR, one of the most visible and readily available indicators of HKD fund flow pressures is the change in the Aggregate Balance resulting from Currency Board market operations by the HKMA.[7] There have been three recent phases during which the Aggregate Balance has risen sharply, for a total increase of about HKD 747 billion (or USD 96 billion) (Chart 3).[8] The first phase (September 2008 to March 2009), involving inflows of HKD 220 billion, was driven by the repatriation of funds by local banks and corporations from abroad to meet liquidity needs at home at the height of the global financial crisis and partly by the introduction of the full deposit guarantee scheme that made Hong Kong SAR a safe haven. The second and third phases (April to December 2009 and the fourth quarter of 2012) were mainly attributable to portfolio inflows from overseas investors searching for yield as the various monetary programmes in the United States and Europe took effect and global risk appetite increased as a result. These two phases involved massive inflows of HKD 420 billion and HKD 107 billion, respectively.

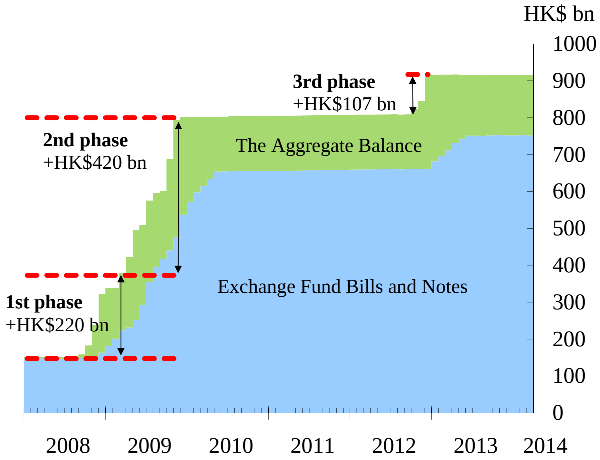
6 Exchange Fund Notes are HKD fixed income debt instruments issued by the Hong Kong SAR government for the account of the Exchange Fund under the Exchange Fund Ordinance.

7 Such operations refer to the triggering of the strong-side Convertibility Undertaking, for instance, and strong inflow pressures will ultimately show up as an increase in the Aggregate Balance, which is the sum of the balances in the clearing accounts maintained by the banks with the HKMA for settling interbank payments and payments between banks and the HKMA.

8 The HKMA has issued additional Exchange Fund Bills to meet banks' demand, leading to an increase in the outstanding Exchange Fund papers and a corresponding decrease in the Aggregate Balance. These operations, representing a change in the composition of the Monetary Base, were in line with Currency Board principles, as the Monetary Base remained fully backed by foreign exchange reserves.

Aggregate Balance and outstanding Exchange Fund Papers

Chart 3



Source: HKMA.

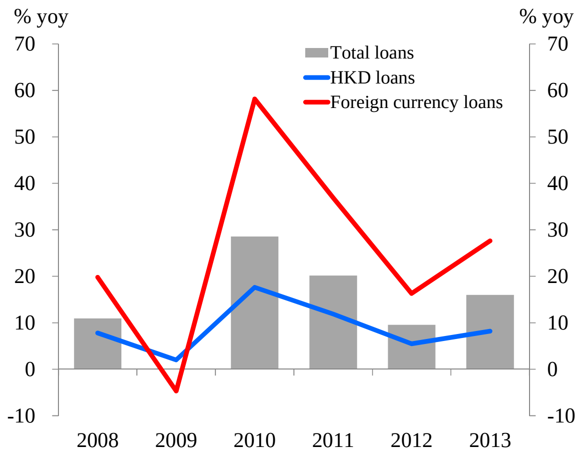
c. Credit

The low interest rate environment imported into Hong Kong SAR and the massive capital inflows have considerably increased bank liquidity in Hong Kong SAR and allowed for easier credit access for the non-bank private sector. Between 2009 and 2013, total bank credit in Hong Kong SAR almost doubled (Chart 4). Within this total, bank credit denominated in HKD grew by a cumulative 50% (or an annualised 11%), compared with 28% growth (or an annualised 6.3%) in Hong Kong SAR's nominal GDP in the same period. As a result, the ratio of domestic credit to GDP increased from 145% to about 170%. There was a notable increase in lending to financial concerns, in part driven by buoyant equity market activities amid "search-for-yield" inflows. Personal loans also expanded rapidly, but the growth rate in mortgage loans has been contained at a cumulative 36% by macroprudential measures notwithstanding the sharp rise in home prices. These developments will be discussed in greater detail later in this paper.

Meanwhile, foreign currency bank credit (mainly in USD) in Hong Kong SAR grew by a cumulative 220% (or an annualised 34%) between 2009 and 2013 amid advanced economies' monetary expansion. As foreign currency loans have been rising much faster than foreign currency deposits in Hong Kong SAR, the foreign currency loan-to-deposit ratio has risen from a low base to around 60% at end-2013. Within this figure, the USD loan-to-deposit ratio has risen from around 30% in 2009 to about 85%. While the ratios remain below critical levels, the pace of increase is a cause for concern.

Growth in bank credit

Chart 4



Source: HKMA.

The accommodative global liquidity conditions have been the key underlying driver of these developments. First, to the extent that USD credit is usually priced off global benchmarks, monetary accommodation in the US makes for immediately easier financial conditions offshore wherever there is a substantial stock of USD funds, as in Hong Kong SAR. The low USD interest rates then provide an incentive for firms to substitute USD credit for local currency credit. Second, monetary expansion in the advanced economies is putting upward pressure on many Asian currencies which carry higher interest rates and whose economies have been growing at faster rates. Appreciation expectations can provide a further incentive to borrow in foreign currency given the potential for reductions in the capital value of liabilities.

As for Hong Kong SAR, these incentives have led to a phenomenal rise in USD borrowing by Mainland China-related firms in Hong Kong SAR.[9] Specifically, given appreciation expectations for the RMB at home and arbitrage opportunities from onshore-offshore USD interest rate differentials, firms in Mainland China have used their deposits at home to secure letters of credit and helped their overseas affiliates obtain USD loans in Hong Kong SAR against this "collateral", thereby raising loan demand in Hong Kong SAR. Partly as a result, the external claims of the Authorized Institutions (AIs) in Hong Kong SAR vis-à-vis Mainland non-banks rose to HKD 845 billion at the end of 2013 from HKD 145 billion at the end of 2009.[10] These developments also reflect Hong Kong SAR's evolving role as a USD funding and lending centre in the region.

Rising dollar credit could make banks in the region become more vulnerable to liquidity risk in international dollar funding. Liquidity risk has increased especially for banks that do not have a sufficient dollar deposit base. These banks must rely on global wholesale funding markets and this makes banks vulnerable to dollar liquidity shocks and increases systemic risks. International credit on dollar liquidity

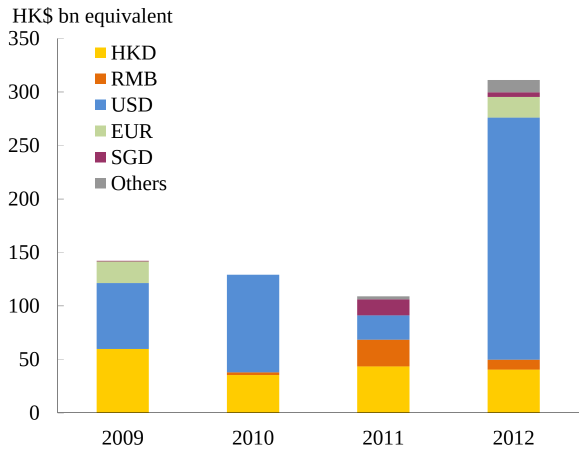
9 See HKMA (2013a) and He and McCauley (2013).

10 AIs are institutions authorised under the Banking Ordinance to carry on the business of taking deposits. All AIs in Hong Kong SAR are supervised by the HKMA.

could become tight, for instance, if the risk appetite of global financial intermediaries decreased in the event of an abrupt deterioration in the global economic environment. In particular, to the extent that the funding of dollar credit involves short-term dollar interbank borrowing from overseas, which is large relative to the dollar assets of the private and public sectors, it increases the risk of currency and maturity mismatch, giving rise to substantial financial stability risks.

Meanwhile, credit in the form of bond issuance has increased remarkably in Hong Kong SAR, reaching HKD 414.0 billion in 2012. This is about twice the amount seen in 2009 and has been driven by local corporate issuances, which accounted for over 70% of the total and were mainly denominated in USD (Chart 5). This rapid rise in USD corporate bond issuance partly reflects a development associated with capital market deepening and more market-based financing. The financing of USD credit in the form of bond issuance also helps avoid heavy reliance on short-term bank credit for corporate funding.[11]

Corporate bond issuance by currency | Chart 5



Note: Only notes with original maturity of more than one year are included.

Sources: Newswires and HKMA staff estimates.

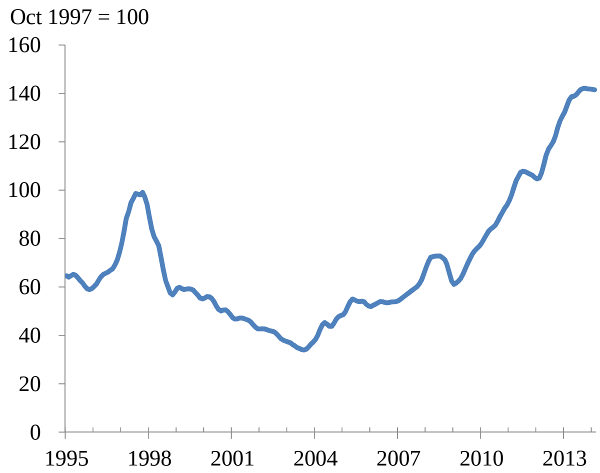
As a result of rising bank credit and bond issuance, corporate leverage has trended higher in Hong Kong SAR. According to the balance sheet statistics of major listed non-financial companies, the debt leverage (defined as the ratio of total assets to shareholders' funds) of Hong Kong SAR's corporate sector had risen to 1.76 times at the end of 2012, from about 1.66 times in 2007. At the same time, the interest coverage ratio of Hong Kong SAR's corporate sector, which gauges the ability to cover interest expenses with earnings, dropped to 8.1 times in 2012, from over 12.6 times two years ago. While these two debt burden indicators remain significantly more favourable than during the Asian financial crisis, when the leverage level and interest coverage ratio were at 1.94 times and 2.9 times, respectively, in 1998, the recent rise in corporate leverage suggests that the debt-servicing ability of the corporate sector could be put to the test when interest rates rise.

11 See HKMA (2013c).

d. Property prices

Abundant global liquidity and lower interest rates could also have distorted asset prices and particularly home prices in Hong Kong SAR, which have risen sharply, with the level in 2013 about twice that seen in 2009 (Chart 6). This rapid run-up in home prices reflects low interest rates, the search for yield, and very tight housing supply conditions. Mortgage interest rates went as low as 1% in the second half of 2009 and have stayed below 2.5%. A large housing demand-supply imbalance has also persisted, with supply having fallen below the estimated demand by a large margin since mid-2006. These developments, together with the US Federal Reserve's forward guidance of keeping its policy rate at low levels for a rather long period, have led to strong market expectations that home prices will keep rising. On the other hand, property valuations have become highly stretched relative to household affordability, with the price-to-income ratio reaching 14.6 in the fourth quarter of 2013, a level comparable to the 1997 peak.[12] The possibility of a housing market bubble has been an important macroeconomic and financial stability concern in recent years. Essentially, a housing downturn could have a severe adverse impact on the Hong Kong SAR economy, with consumer confidence, household spending, economic growth and labour market conditions all weakening significantly.

Home prices — Chart 6



Source: Rating and Valuation Department.

e. Household indebtedness

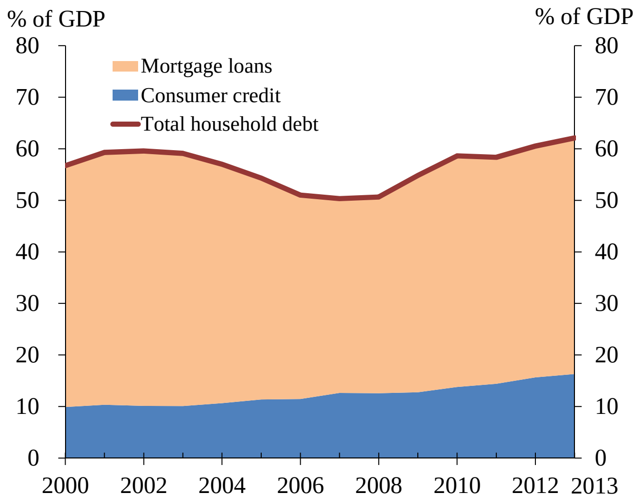
Partly as a result of easy credit and the low interest rate environment, there has been a notable increase in household indebtedness (which comprises mortgage and consumer credit), from 55% of GDP at the end of 2009 to 62% at the end of 2013 (Chart 7). While mortgage loan growth has been contained by macroprudential

[12] The price-to-income ratio measures the average price of a typical 50-square-metre flat relative to the median annual income of households living in private housing.

measures, consumer credit surged by a cumulative 76% (or an annualised 15%) between 2009 and 2013. The rise in household indebtedness made household debt payments more sensitive to changes in interest rates, although the household debt-to-GDP ratio remained low by international standards and the overall household balance sheets were still in relatively good shape with a substantial rise in the value of assets offsetting the increase in debt.

Another sign of economic vulnerability has emerged in the form of a notable deterioration in Hong Kong SAR's current account balance, from a surplus of 15% of GDP in 2008 to around 2% in 2013. While also partly attributable to weaker external demand, this mainly reflected much stronger domestic consumption and a marked decline in household savings.[13] It also appeared that instead of labour income growth, consumer credit and positive housing wealth effects might have supported the majority of the consumption growth in recent years. However, access to consumer credit could tighten eventually and housing wealth is subject to large volatility. These could pose risks to macroeconomic and financial stability in Hong Kong SAR, particularly when the advanced economies normalise their monetary policy.

Household indebtedness Chart 7



Sources: HKMA and Census and Statistics Department.

3. Policy response

To guard against and mitigate the spillovers arising from advanced economies' unconventional monetary policy, the authorities in Hong Kong SAR have introduced various types of macroprudential measures targeting credit growth and the property market. In what follows, the key macroprudential measures implemented in Hong Kong SAR are highlighted and their effectiveness discussed.

[13] See the HKMA (2013b).

a. Macroprudential measures targeting credit growth

The HKMA adopts a "continuous supervision" policy to supervise banks through a variety of techniques such as on-site examinations, off-site reviews, prudential meetings, cooperation with external auditors and sharing information with other supervisors. It also introduces specific macroprudential measures when deemed necessary. In view of the strong bank credit growth in 2010 and early 2011, the HKMA issued a circular in April 2011 to require banks to reassess their business plans and funding strategies for the rest of the year. In particular, the rapid pace of credit growth had raised concerns about the potential stress on banks' liquidity positions and credit risk controls in a crisis-prone environment of global excess liquidity and heightened domestic overheating pressures. In the second half of the year, a matched term funding requirement (tenor matching) was introduced for banks. In the same year, the HKMA required banks to increase their regulatory reserves to build up a bigger cushion against possible deterioration in asset quality in the future.

These credit-related measures have had an impact on loan growth and all-in interest rate costs. Loan growth began to slow in July 2011, and the composite interest rate, which is a measure of the average cost of retail banks' HKD funds, increased by a total of 32 basis points in that year. He and McCauley (2013) further show that the credit-related measures have had the effect of driving up the cost of HKD and USD credit in the syndicated loans market, with the interest rate spreads reaching levels characteristic of the global financial crisis of 2008–09. They also find empirical support that, after the HKMA circular in April 2011, banks responded to tighter liquidity regulations by raising costs for borrowers of medium-term loans.

More recently in October 2013, amid signs of resurgence in loan growth, the HKMA introduced the Stable Funding Requirement (SFR), obliging banks with loan growth exceeding 20% to maintain a specific level of stable funds starting from the beginning of 2014. The aim of the SFR is to ensure that AIs can maintain stable business operations continuously when market liquidity comes under significant stress and to help mitigate the risk arising from the tapering of the US Federal Reserve's asset purchase programme and possible volatilities in the global financial markets. After the announcement of the SFR, loan growth moderated in late 2013. In view of rising household indebtedness, the HKMA issued a circular in January 2014 calling on banks to review the underwriting standards for their personal lending business, including the prudent use of instruments such as a debt-servicing ratio limit, maximum loan tenor, portfolio-based limit structure, and internal stress testing assuming a 300-basis-point increase in the loan interest rate.

As regards the rise in Mainland-related business conducted by AIs, the HKMA stepped up surveillance of these activities and requested AIs to report more detailed information on their non-bank Mainland exposures. Thematic examinations on the AIs active in these areas were also conducted. Moreover, with local banks expanding their branch networks into Mainland China, the HKMA also conducted regular on-site examinations of these Mainland operations.

Overall, capitalisation of Hong Kong SAR's banking sector has remained well above minimum international standards. The consolidated capital adequacy ratio of locally incorporated AIs was stable at 15.9% at the end of 2013. Liquidity conditions continue to be sound, with the average liquidity ratio of retail banks at end-2013 staying at 39.6% and remaining well above the regulatory minimum of 25%. Asset quality has also remained good. The ratio of classified loans to total loans stayed low at 0.48% at the end of 2013, while the delinquency ratio for credit card lending was 0.2%. The HKMA will continue to closely monitor developments in the banking sector and ensure that banks remain resilient and prudent.

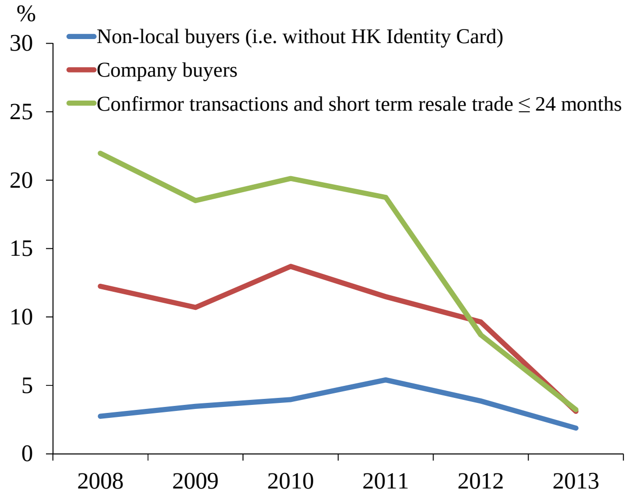
b. Macroprudential measures targeting the property market and mortgage business

As regards the property market, the HKMA has used macroprudential measures for more than two decades to prevent bank credit from fuelling property-price bubbles and to ensure that banks and their customers have sufficient cushions on their balance sheets to weather volatilities in property prices. These policies do not target property prices but may help dampen the amplitude of property price cycles. Since 2009, the HKMA has implemented six rounds of macroprudential measures on mortgage lending business, by lowering the caps on the loan-to-value (LTV) ratio and debt service ratio (DSR) gradually, extending the prudential target from luxury homes to investment properties and later to those where borrowers repay their debt with foreign income or have multiple mortgages, and imposing a risk-weighted floor of 15% for residential mortgages.

The HKMA has also coordinated efforts with the fiscal and land authorities. As a long-term solution, the land authorities have introduced land- and housing-supply measures to redress the tight supply conditions. Meanwhile, the fiscal authority has introduced demand-management measures to dampen speculative and investment activities to buy time for supply-side measures to take effect. In November 2010, a special stamp duty (SSD) of as much as 15% was introduced for properties resold within two years. In October 2012, the SSD rate was raised to as much as 20% and covered properties resold within three years. At the same time, a 15% buyer’s stamp duty (BSD) was imposed on residential properties acquired by companies and non-locals, which had accounted for about 13% of total transactions. Then, in February 2013, the rates of existing *ad valorem* stamp duty (also known as DSD) were doubled for transactions in all types of properties, except for those residential properties where the purchasers are local individual buyers who do not own any other residential properties in Hong Kong SAR at the time of acquisition.

The HKMA prudential measures have been effective in reducing the leverage of banks and households in mortgage finance. The annual growth rate in residential mortgage loans has slowed from 14.1% in 2010 to 6.7% in 2011, 7.6% in 2012 and 3.9% in 2013. The average LTV ratio for new mortgages has dropped from 64% in September 2009 before the policy measures to 54% in December 2013, while the average DSR has decreased from over 40% to 35%. As regards the stamp duty measures, the SSD has practically wiped out speculative activities such as confirmor transactions and short-term resale trades, while the BSD and the DSD have effectively reduced the investment activities of companies and non-local buyers (Chart 8).

Buyer profile for residential properties and short-term resale trades — Chart 8



Source: Financial Services and the Treasury Bureau.

Wong et al (2011) find empirical support that tighter LTV caps would reduce household leverage (as measured by the ratio of mortgage loans to GDP), and that the effect on leverage plays a major role in reducing mortgage default risk. They also find that the effect of LTV caps on loan growth is likely to be state-dependent, being more effective when there is excess credit demand but less so when there is excess credit supply. However, there is no clear evidence that lowering the LTV caps can dampen property prices. In comparison, preliminary findings in Chan and Yuen (2014) show that higher transaction taxes in the form of additional stamp duties appear to be effective in constraining housing demand and restraining housing price growth.[14] Nevertheless, further evidence needs to be accumulated to better understand whether the effects of tax policies on housing prices and transaction volumes will be sustained.

4. Concluding remarks

The transmission of international monetary policy is often much more complicated than one would imagine, particularly given the increased interconnectedness of the global financial system. As for Hong Kong SAR, it imports US monetary policy under the Linked Exchange Rate system, and HKD interest rates have stayed at ultra-low levels since late 2008. Credit and household indebtedness have grown at a fast pace, while the massive influx of global liquidity has bolstered asset prices and particularly home prices. Proactive steps have been taken to rein in excessive credit growth and cool down property market activities. More recently, there have been concerns about advanced economies' eventual exit from their unconventional monetary policy actions and the potential impact on the rest of the world. The fluctuations in emerging market currencies and equities in May 2013 and in early

[14] See He (2014) for more discussion and references therein.

2014 due to fears of QE tapering is clearly a warning shot. In the light of these potential financial stability concerns, the authorities in Hong Kong SAR will continue to guard against the build-up of vulnerabilities, such as excessive reliance on wholesale and external funding, and take a proactive approach to mitigating risks associated with the eventual normalisation of monetary policy in the advanced economies.

References

Chan, S-T and R Yuen (2014): "How do macro-prudential measures and stamp-duty measures affect Hong Kong's property market and the mortgage business of banks? An Evaluation", unpublished manuscript, Hong Kong Monetary Authority.

He, D (2014): "The effects of macro-prudential policies on housing market risks: evidence from Hong Kong", *Bank of France Financial Stability Review*, April 2014.

He, D and R N McCauley (2013): "Transmitting global liquidity to East Asia: policy rates, bond yields, currencies and dollar credit", *BIS Working Papers* no. 431, October 2013.

Hong Kong Monetary Authority (2012): "How do we monitor Hong Kong dollar fund flows?", *HKMA Quarterly Bulletin*, June 2012.

——— (2013a): "Changing business models of Hong Kong branches of US and European global banks", *HKMA Half-yearly Monetary and Financial Stability Report*, March 2013.

——— (2013b): "Recent movements of the current account balance in Hong Kong", *HKMA Half-yearly Monetary and Financial Stability Report*, March 2013.

——— (2013c): "Driving forces behind the recent rapid growth of the Hong Kong bond market", *HKMA Half-yearly Monetary and Financial Stability Report*, September 2013.

Wong, E and J Wong (2011): "Effects of the loan-to-deposit ratio of the Hong Kong banking sector on domestic interest rates", *HKMA Occasional Papers* no. 02/2011, October 2011.

Wong, E, T Fong, K Li and H Choi (2011): "Loan-to-value ratio as a macro-prudential tool – Hong Kong's experience and cross-country evidence", *HKMA Working Papers* no. 01/2011, February 2011.

Short-rate expectations and term premia: experiences from Hungary and other emerging market economies

Dániel Horváth, Péter Kálmán, Zalán Kocsis and Imre Ligeti[1]

Abstract

This study focuses on the elements of short-dated forward yields in Hungary and other emerging market economies – short-rate expectations and the term premium – and the influences on their behaviour. The rate expectations are proxied by median values of analyst surveys. Principal components analysis shows that, during the sample period 2009–13, rate expectations and term premia in emerging market economies co-moved closely with the corresponding elements of US yields. The term premium appears to have been driven by global news events, and rate expectations less so. As for Hungary, the yield elements periodically followed the dynamics of factors in emerging market economies generally, but country-specific effects seem to have been important as well.

Keywords: Emerging markets, interest rate expectations, principal components, surveys, term premia

JEL classification: E43, E58, G15

[1] The authors thank Ádám Balog for comments.

The views expressed in the document are those of the authors and do not necessarily reflect the official stance of Magyar Nemzeti Bank (the central bank of Hungary).

1. Introduction

Yields in financial markets are valuable sources of information for central banks and policymakers. An accurate assessment of the implications of the yield curve's level, shape and dynamics enhances the information base on which policymakers can rely, thus supporting the quality of their decision-making. The long-run trend in financial market yields is driven by economic fundamentals and the risks associated with such fundamentals. Nonetheless, a volatile yield environment can arise from a number of factors, including sudden changes in market sentiment, that are not necessarily justified by the economic fundamentals. Such volatility complicates the assessment of the yield curve.

Understanding the information in the yield curve has become more challenging since the 2007–08 financial crisis, after which central banks expanded their policy toolbox. In contrast to traditional interest rate policy – which sets the base rate and affects the yield curve through the usual monetary transmission channels – the unconventional measures of liquidity provision, quantitative easing and forward guidance each have distinct impact mechanisms. They influence different elements of longer-term yields; affect different maturity segments; and have varying effects on the yields of different instruments, such as government securities, interest rate swaps and corporate bonds. The cross-border effects of these new policy steps have also been significant, as evidenced, for instance, by the global impact of communications from the Federal Reserve in the summer of 2013 on scaling back its third quantitative easing programme (QE3).

In this paper, we investigate the main elements of yields in Hungary and in emerging market economies (EMEs) generally. Our focus is on the shorter, one- to two-year segment of the yield curve. We study the cross-border correlations of the yield elements and aim to explain how major news events contributed to their changes in the period 2009–13.

We follow the literature on yield curve term structures, which separates the two main elements of yields: future short-rate expectations and the term premium. The existence of the term premium implies that central banks need to take this factor into account when inferring market expectations from the yield curve. The empirical literature has generally found positive term premia, the size of which increases with maturity (eg Fama and Bliss (1987), Campbell and Schiller (1991)). Estimates of no-arbitrage term structure models also highlight the premium's time-varying nature (see Gürkaynak and Wright (2012) for a recent literature survey).

Empirical studies have linked term premia in the US to structural factors (eg the effect of quantitative easing), liquidity premia and the uncertainty of future short rates. The uncertainty factor may originate from two different sources. One is uncertainty about macroeconomic fundamentals – the future path of the economy. The other is uncertainty regarding the central bank reaction function. Backus and Wright (2007), for instance, attribute the "Greenspan conundrum" in 2004–05 (US long yields remaining low despite a significant increase in the short rate) to the effect of reduced uncertainty regarding both factors, which in turn reduced the term premium element of long-term yields.

Empirical work on EME term premia is scarce. Whilst there is a vast body of empirical literature on advanced country experiences regarding the term structure of interest rates, the lack of adequate data has probably hindered an extensive analysis of emerging markets. Related, but still distinct topics of the forward premium puzzle and default risk term structures are available for the developing region.We contribute to the literature by assessing the common tendencies in EME short-rate expectations and term premia in the period 2009–13. We use survey forecasts to proxy short-rate expectations because such forecasts are available for a sufficiently large cross section of EMEs. We capture the common tendencies in EMEs by applying principal components analysis to both the survey forecasts and the term premium time series. In the next section of the paper, the resulting EME principal component time series are evaluated in terms of global news events during the period and in the light of US rate expectations and term premia.

Hungarian experiences are considered in the paper from two distinct perspectives. In Section 3, Hungarian rate expectations and the term premium are compared with their EME counterparts to assess how Hungarian data fit in with international tendencies. In Section 4, we evaluate how different sources of information about future rate expectations – such as yields on government bonds and forward rate agreements as well as survey forecasts – have performed in terms of predicting the short rate. Section 5 concludes by summarising the empirical results.

2. Emerging market short-rate expectations and term premia

Although there is a vast amount of empirical literature investigating the term premia of advanced economies, similar studies for EMEs are scarce.[2] This is probably due to the lack of adequate data. As shown, for example, by Kim and Orphanides (2007), popular regression-based methods of estimating the term premium are highly sensitive to sample selection because of the complexity of their data-generating process. No-arbitrage term structure models, another popular method for measuring premia, capture some of the complexity related to time variance, but they still require long time series of yields from a period that is homogeneous in terms of model parameters. For EMEs, the necessary multiple-decade time series are not available, and even if they were, structural breaks in the data-generating process would render interpretation of the estimation results problematic.

To circumvent the data problems of other methods, we use median values of analyst survey forecasts to proxy the expectation component of yields. Survey median values are model-free and are independent of the length of the time series. They can accommodate structural breaks in the yield's data-generating process. Survey data are also available for several EMEs. Although these survey forecasts are

[2] Some exceptions are, for Hungary, Gábriel and Pintér (2006); for Malaysia, Ghazali and Low (2002); for Brazil, Guillen and Tabak (2008); and for Poland, Konstantinou (2005).

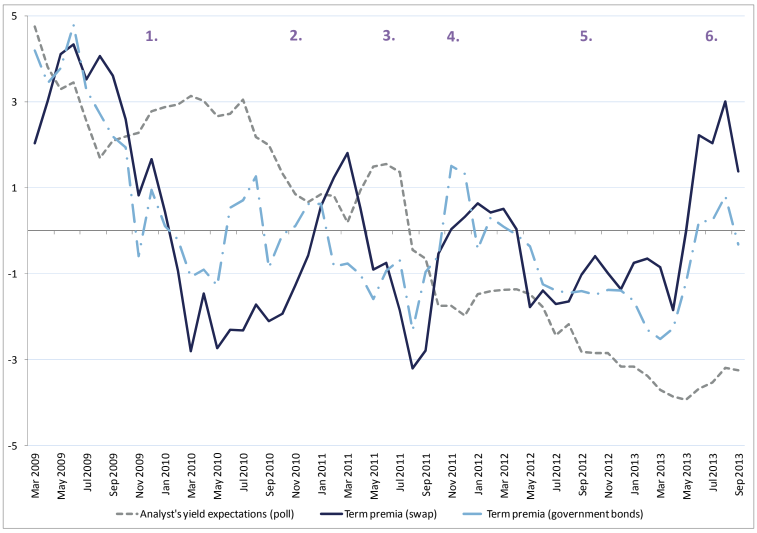
There is a larger empirical literature on EME interest rates examining the related topic of the forward premium puzzle (see eg Bansal and Dahlquist (2000) and Frankel and Poonawala (2010)). This exercise is less affected by data availability problems, however, as the comparisons are usually for interest rates of one (short) maturity. Another related literature segment that elaborates on EMEs is concerned with default-risk term structure modelling (eg Longstaff et al (2011)). However, instead of decomposing an expected short rate and the term premium, these studies aim to isolate pure default risk and a risk premium component.

available only for horizons of up to two years, this is the most relevant horizon in terms of central bank interest rate policy.

Nonetheless, survey expectations have several drawbacks. They may include observation and rounding errors; analysts may provide forecasts on the basis of different information (for example, due to delivering forecasts at different points in time); and they may target the mode of the expectation distribution, which may be different from the expected value.

EME rate expectations and term premia in interbank (FRA/IRS) and government bond markets

Figure 1



Turning points in EME term premia and key global events in the period 2009-13. 1: easing of the 2007–08 financial crisis; 2: first escalation of euro-area debt problems related to Greece; 3: Greece-EU deal and the beginning of the Federal Reserve's QE2 programme; 4: European sovereign debt problems in focus again, US loses AAA rating, Federal Reserve terminates QE2; 5: commitment of ECB, Federal Reserve QE3 programme; 6: potential tapering of QE3 programme.

Sources: Thomson Reuters; Bloomberg; authors' calculations.

Our data set consists of an unbalanced panel of monthly short-term forward rates sourced from Bloomberg. They are calculated from government bond/note yields, interbank rates – forward rate agreements (FRA) and interest rate swaps (IRS) – and analyst surveys in the period March 2009-September 2013 for 15 EMEs.[3] The one-year-ahead horizon was chosen for short-rate forwards and survey values.[4] Term premia were calculated as the difference between the forward yields and rate expectations. Unfortunately, due to differences in data availability in the country panel,[5] the levels of term premia are not comparable in the cross section.

[3] Colombia, the Czech Republic, Hungary, India, Indonesia, Israel, Mexico, the Philippines, Poland, Singapore, South Africa, South Korea, Thailand, Turkey and Russia.

[4] Quarter-end projections were available in surveys. In cases where the one-year-ahead horizon was not available, we interpolated survey data from the two quarters nearest to the one-year horizon. As base rate data change infrequently, the two-quarter data used in the interpolation were often equal.

[5] For most countries, one-month forwards were available in the case of the interbank market and three-month forwards were available in the case of government bond markets. Where these were missing, we used other tenors (three cases) of the same instruments. In one case, only FRAs were

Nevertheless, correlations among term premia indicators can still be interpreted because the direction of changes due to common shocks will be similar for different instruments, even if the sensitivity to shocks is dissimilar.

To pin down the common tendencies across EMEs with respect to rate expectations and term premia, we extracted the first principal components of the balanced subset of panels. Hence, three time series were created, one from analyst rate expectations and two from term premia (of government bond and interbank rates). Principal component analysis is useful because, by virtue of its construction, it extracts the factor that represents the largest proportion of the total variance in the data set and also because it filters out noise due to the forward data differences across countries and some of the data errors that may be present in the analyst survey data. Due to the importance of country-specific features (both real country differences and those due to the data), first principal components explained 30–50% of the total variance of the original variables.[6]

Regarding principal component time series, it appears that important global news events had a significant impact primarily on the dynamics of EME term premia. The principal component of EME term premia (both in the interbank and government bond market) usually increased during periods of higher uncertainty caused by events of economic importance, such as Federal Reserve and ECB decisions, stages of the euro area sovereign debt crisis, etc (Figure 1). By contrast, the principal components of EME rate expectations exhibited a gradual downward trend, and their response to global news events was more moderate.

Relation to US yield components

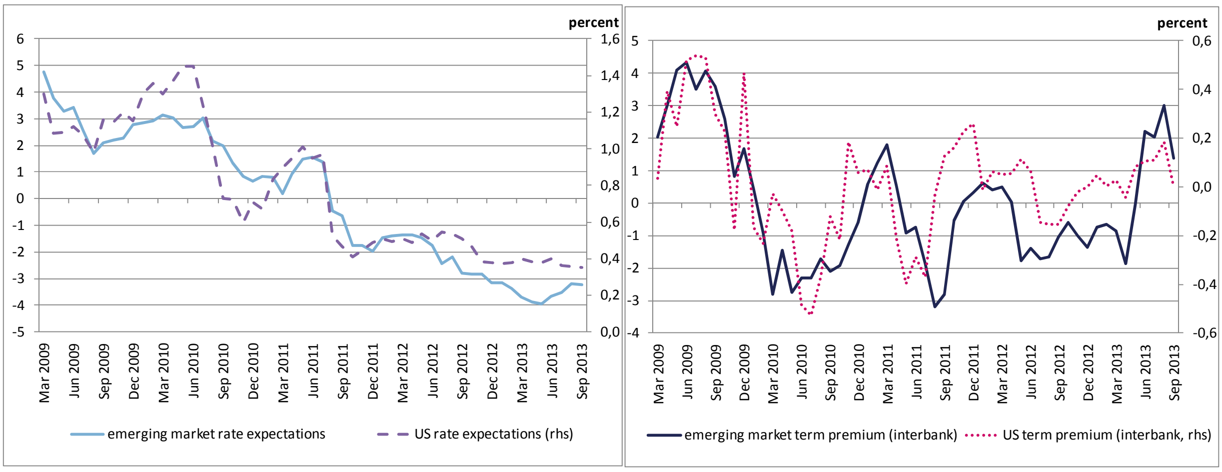
Next, we compare the elements of EME yields – expectations and term premia – with similar indicators for the US. The rationale of this comparison is that the term structure of US yields has been studied intensively and we can therefore rely on this knowledge. Also, the US economy's impact on EMEs has been a recurring theme in financial economics. It is therefore interesting to see whether US rate expectations correlate with EME rate expectations (EME rate cycles coincide with those of the US). Also, factors influencing the US term premium (eg economic uncertainty or the Federal Reserve's quantitative easing) can theoretically affect both EME short rates (if EMEs react to accommodate external shocks through interest rate policy) and EME term premia or neither. So, which of these possibilities eventually occurred is an empirical question.

available and in another case OIS curve forwards were available. Analyst polls referred to the base rate in most countries, but there was one exception where forecasts of the three-month interbank rate were available.

6 Using the sum of the first three principal components instead would have explained more than 70% of the total variances. However, there were no notable differences between, on the one hand, the dynamic patterns of time series created this way and, on the other, the first principal components. Thus, our description of EME factors' co-movement with global shocks, as well as with US and Hungarian yield components, are valid for such series as well.

US and EME yield components between 2009 and 2013

Figure 2



The EME term premium is the first principal component of interbank forward rates. EME rate expectations are the first principal component of EME poll medians. The principal components were scaled to the sample mean and standard deviation of the respective US yield component.

Sources: Thomson Reuters; Bloomberg; authors' calculations.

The need to assess the effect of the mechanism and magnitude of the Federal Reserve's quantitative easing programmes on the US yield curve has generated a surge of research on the US term structure.[7] Event-studies have examined price changes in US Treasuries during a short time period around important statements and news concerning the QE programmes. Model-based methods have instead aimed to use continuous samples and incorporate all other possible impacts (macroeconomic uncertainty, central bank policy uncertainty and liquidity effects). Depending on the method used, the studies have shown that the first programme (QE1) reduced the yield on the 10-year Treasury by between 40 and 110 basis points, while the reduction attributable to QE2 was estimated to be 15–45 basis points. Comprehensive studies on the impact of QE3 have not emerged yet, but the increase in yields on long-term Treasury securities in May 2013 attracted the attention of market analysts. Official communication about the possibility of reducing ("tapering") quantitative easing resulted in an increase in term premia and in the expected interest rate path, which contributed to the rise in US yields.

Figure 2 indicates a strong co-movement between the term premia in EMEs and in the US, and between indicators of interest rate expectations in the US and in EMEs. The rise in US term premia has generally coincided with an increase in term premia in EMEs, although in some cases the reaction occurred with a delay, which intuitively suggests causality running from the US to EMEs.[8]

Strong correlation can be observed between interest rate expectations in the US and in EMEs. This reinforces the finding that EME and US rate cycles have

7 For example, Gagnon et al (2010), Hamilton and Wu (2012), Krishnamurthy and Vissing-Jorgenson (2011), Li and Wei (2012), Meaning and Zhu (2011), Wright (2012).

8 The indicator of US term premia is noisier than the EME equivalent. This partly reflects the construction of the EME term premium indicator because principal components in EMEs filter out country-specific noise.

generally coincided. In recent years, however, as the US base rate has reached the zero bound, this relationship has weakened somewhat. Expectations for three-month US Libor rates have been stuck in the 0–0.5% range since 2011. Meanwhile, in EMEs, the decreasing trend continued until May 2013, followed by a small upturn.

Our data also suggest that, although it was a theoretical possibility, there was no significant co-movement between EME rate expectations and US term premia, or between US rate expectations and EME term premia. Thus, EME rates in the largest part of the sample did not react to shocks affecting US term premia. Apparently, the QE1 and QE2 programmes, which impacted US term premia, also spilled over into the term premium component of EME yields and left rates less affected. Nonetheless, the recent impact of QE3 tapering, which seems to have reversed the EME rate cycle (along with its large impact on EME term premia), points to a somewhat different mechanism.

3. Evolution of Hungarian yield components

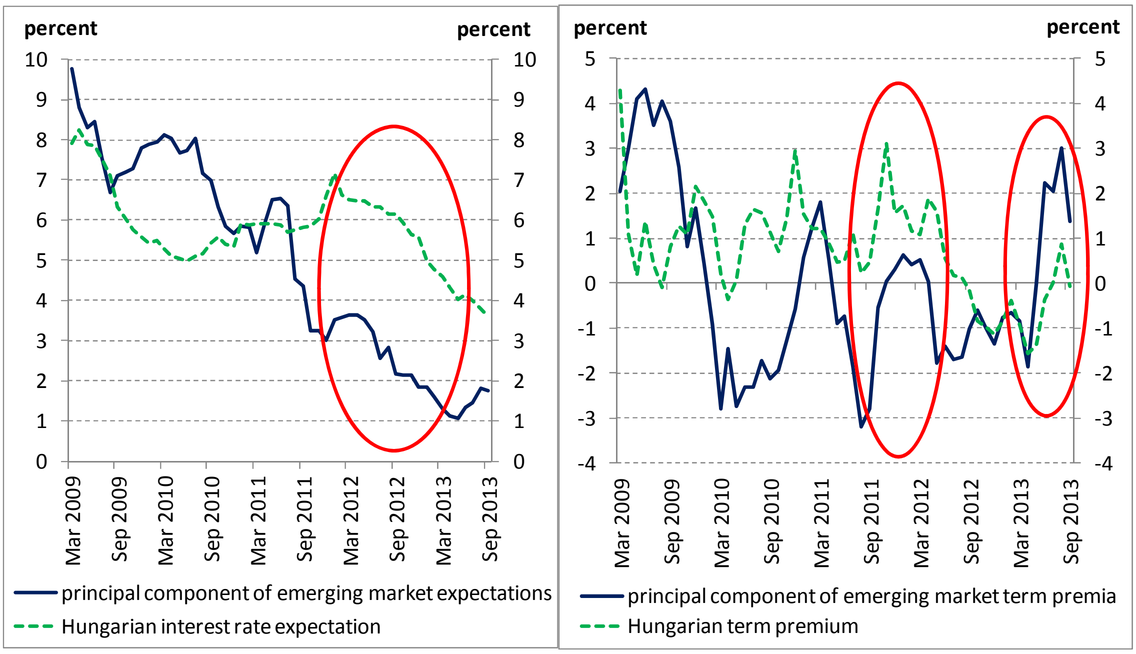
The methodology used so far provides policy-relevant information on two grounds. First, separation of the expectation and term-premium components of yields allows for a deeper understanding of the evolution of longer-dated yields in various domestic financial markets. Second, a comparison of Hungarian and EME yield components indicates how shocks of domestic and international origin have affected the Hungarian yield curve.

In a comparison of Hungarian and EME components, a lack of co-movement between domestic and emerging term premia, for example, would suggest that country-specific shocks were more important in the Hungarian premium. These shocks may be more relevant for policymakers than external effects, which are beyond policymakers' influence. But correlation does not imply causation. Co-movement between domestic and EME components could thus also be a consequence of the effects of country-specific shocks coinciding with the impact of global shocks on EME components. Therefore, an understanding of important global and domestic events is essential for interpreting these processes.

Figure 3 suggests that Hungarian yield components have occasionally moved with their EME counterparts, but this has not been characteristic of the entire period.

Regarding both Hungarian and EME expectations of short rates, there has been a general downward trajectory since early 2009 as the effects of the financial crisis has faded. However, the decline followed different paths in the 2010–11 period, hinting at the greater importance of country-specific factors. Increases in Hungarian rate expectations at the end of 2011 were attributable partly to renewed global imbalances (although in EMEs it was more the term premium component that increased and not rate expectations) and partly to country-specific events. The general downward trend in 2012–13 aligns with a similar trend in EME rate expectations, although country-specific events were also significant. The increase in EME rate expectations after May 2013 did not halt the downward trend in the corresponding Hungarian component.

EME and Hungarian rate expectations and term premia one year ahead | Figure 3



The EME principal components have unit variance and zero mean by design. Here, for easier visualisation, we have scaled these time series to the respective Hungarian yield components. As a result, the figure can aid in gauging only correlation between EME and Hungarian variables; the levels and magnitudes of change of these variables are not comparable. EME expectations are derived from Bloomberg surveys; Hungarian rate expectations are the Reuters poll median values. Both Hungarian and EME term premia are calculated from interbank (FRA and IRS) forward rates.

Source: Thomson Reuters; Bloomberg; authors' calculations

The Hungarian term premium component has periodically co-moved with EME term premia. One such episode was between the end of 2011 and mid-2012, when global imbalances significantly – though only temporarily – raised both Hungarian and EME term premia. As mentioned above, Hungarian rate expectations were also impacted in that period. The Hungarian term premium decreased further in late 2012, when EME premia were already levelling off, indicating an improvement in Hungary-specific factors. In 2013, the global impact of the Federal Reserve's policy affected the Hungarian term premium but not rate expectations.

4. Monitoring interest rate expectations in Hungary

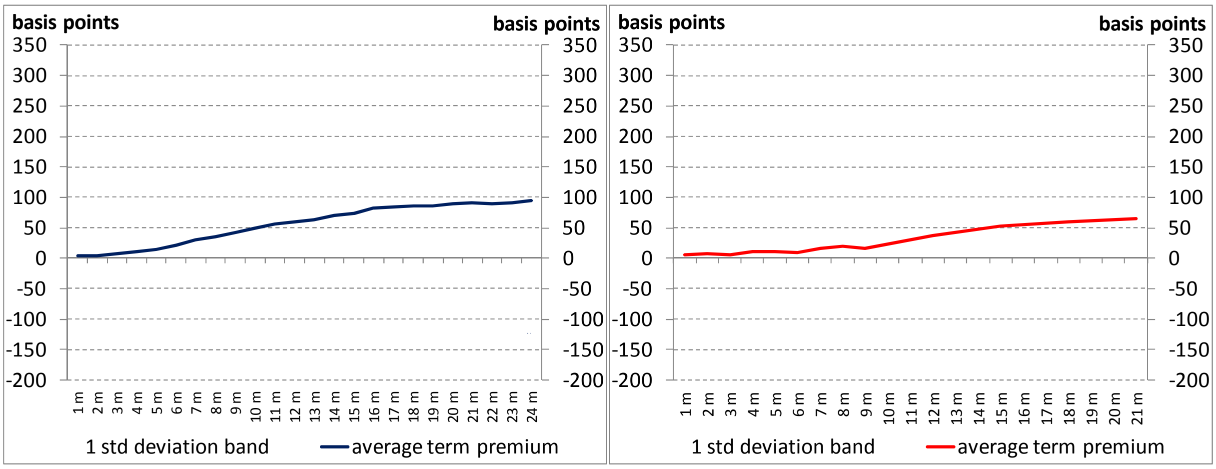
From the viewpoint of a central bank, one key objective of analysing the yield curve and its term premium component is to gauge market expectations of future rates. In this section we turn to this issue and look at yields as key sources of information about future short rates. We use a different methodology than before. Rather than identifying the term premium using analyst surveys, we infer the term premium from the historical performance of yields in predicting future short rates.

In Hungary, there are three major sources of information regarding expectations of short-term interest rates: yields on government notes and bonds; interbank rates (FRA and IRS); and analyst surveys. Medians of analyst survey results can be interpreted as a straightforward measure of rate expectations, but forward rates calculated from government bond yields and interbank rates contain a term premium. Here, we choose a direct measurement of the term premium component: we compare forward short rates with realised short rates. If a systematic bias is identifiable, this forecast error can be considered as the term premium.

We use data for the 10-year period between January 2004 and December 2013, as reliable data for the Hungarian FRA market is available only after 2003.

Average term premium in the government securities market (left panel) and in the FRA market (right panel)

Figure 4



Sources: Thomson Reuters; authors' calculations

Our calculations suggest that, on average, the term premium was positive and increased with maturity, both for government securities and for the FRA market (Figure 4). However, the forecast error of forward rates fluctuated in a wide range during the period, as illustrated by the sizable one-standard-deviation bands. Thus, the term premium estimates for distinct periods can differ considerably. In the case of FRA rates, the average term premium was half the size of the term premium in government bond yields and for the shortest maturities was close to zero . Our results are in line with the conclusions of Gábriel and Pintér (2006), who conducted a similar analysis for government bond yields using a different sample period, running from 2001 to 2006.

To assess the reliability of the three information sources for predicting the future short rate, we run a Diebold-Mariano (DM) test.[9] This test performs a pairwise comparison of forecasting methods' predictive ability. To allow for differences in predictive ability at various horizons, we divide the available two-year forecasting horizon into four half-year segments and perform the DM test for each segment.

9 The Diebold-Mariano test compares two methods' forecasting errors by calculating the average of the forecasting error differences and testing whether this value is significantly different from zero. The test accounts for autocorrelation of forecasting errors, for example due to overlapping forecast periods. See Diebold and Mariano (1995) for details.

Results of the Diebold-Mariano forecasting test on four forecast horizons												Table 1
	1–6 months			7–12 months			13–18 months			19–24 months		
	Random walk	FRA	Gov. yields	Random walk	FRA	Gov. yields	Random walk	FRA	Gov. yields	Random walk	FRA	Gov. yields
survey	–3.49*	0.53	–1.86*	–2.75*	1.07	–2.34*	–1.96*	–0.47	–1.94*	–3.54*	–0.48	–1.56
gov. yields	–7.15*	1.28		–0.91	3.03*		–2.25*	2.19*		0.34	4.35*	
FRA-s	–9.47*			–2.63*			–2.52*			–1.82*		

* Significance at the 5% level. Negative values signal a higher forecasting accuracy of the method in the row heading, while positive values signal a higher forecasting accuracy of the method in the column heading.

Sources: Thomson Reuters; Bloomberg; authors' calculations.

First, we compare the three information sources with the random walk specification for the four horizons. The random walk specification assumes that the last available value of the short rate is the best forecast of future values. This is useful for assessing whether the forecasting power of each of the three methods is significant at all. Our results suggest that the short-rate paths implied by FRAs and analyst forecasts have significant forecasting power at all horizons (up to two years), ie both of them beat the random walk specification. By contrast, the forecasting ability of government bond yields is significant in only two maturity segments.

Next, we test the three information sources against each other. Table 1 summarises the results. We find that the forecasting power of FRAs and analyst forecasts is similar at all horizons. In contrast, forecasts based on government bond yields prove to be significantly worse at three of the four horizons.

From a theoretical point of view, the weak forecasting performance of government bond yields relative to FRAs may be a consequence of two factors: the higher liquidity risk of government security investments, and the asymmetry of investment positions in this market. FRA contracts have considerably lower liquidity requirements than government security investments because interest rate positions in FRA deals can be taken without transferring the face value; usually only a fraction of this is needed for initial margining. Furthermore, the amount of short positions in the government bond market is less relevant, and therefore most investors assume a long bond position. This leads to a higher risk of systemic liquidity shocks as increasing interest rates cause market-wide losses and can cause and reinforce a sell-off. By contrast, in the case of FRAs, position-taking is symmetric (the values of short and long investment positions are equivalent), so losses and gains are also more balanced between market participants.

These two key features resulted in the larger volatility of government yields relative to interbank rates in Hungary. The volatility has been greater in the bond market in both turbulent and relatively calm periods. As Figure 4 shows, the forecasting bias (a measure of the term premium) has on average been larger and also more volatile in this market. A more thorough examination of the data than is presented here reveals that the weaker forecasting ability of government bond yields is strongly related to their performance in the 2008-09 period, when the Hungarian government bond market was hit by several shocks.

5. Conclusions

Financial market yields are important sources of information for central banking and economic policy. Separation of their main constituents – rate expectations and term premia – is useful for monitoring market forecasts of future rates as well as for gauging general risk perception and monetary conditions in various financial market segments.

This paper adds to the empirical literature by using principal components analysis to assess the tendencies in EME term premia in the period 2009-13. We choose surveys to proxy rate expectations and to calculate the term premia in forward rates. In doing so, we circumvent the problem of data availability for EMEs that prevents the use of other popular methodologies. However, short forecast horizons in the surveys restrict our analysis to the shorter-dated segment of the yield curve.

The first principal component of EME rate expectations shows a trend decline in the sample period. By contrast, the principal component of EME term premia – seems to have fluctuated consistently with major global news stories. The Federal Reserve's communication regarding its QE3 measures in 2013 also mostly impacted the term premium element of EME yields. We found that both EME term premia and rate expectations co-moved closely with their counterparts in US yields.

As for Hungary, the rate expectations and term premia only periodically moved in tandem with EME yield factors. This suggests the importance of country-specific events in shaping Hungarian yield components, at least at short maturities. Some co-movement can still be seen; notably, the decline in Hungarian rate expectations in recent years was accompanied by decreases in EME rates, and the Hungarian term premium appears to have been affected by external shocks at end-2011 and in mid-2013.

Regarding Hungarian markets, both government bond yields and interbank rates contained positive term premia based on the difference between forward rates and realised rates. The average premium and its volatility was larger in the government bond market, probably as a consequence of liquidity factors. Based on our tests assessing the power to predict future short rates, FRAs and analyst surveys were better at gauging market expectations, while government bond yields provided negligible additional information.

References

Backus, D and J Wright (2007): "Cracking the conundrum", *Brookings Papers on Economic Activity*, no 1, pp 293–329.

Bansal, R and M Dahlquist (2000): "The forward premium puzzle: different tales from developed and emerging economies", *Journal of International Economics,* vol 51, no 1, pp 115–44.

Campbell, J and R Schiller (1991): "Yield spreads and interest rate movements: a bird's eye view", *Review of Economic Studies*, vol 58, no 3, pp 495–514.

Diebold, F and R Mariano (1995): "Comparing predictive accuracy", *Journal of Business and Economic Statistics*, vol 13, no 3, pp 253–63.

Fama, E and R Bliss (1987): "The information in long-maturity forward rates", *American Economic Review*, vol 77, no 4, pp 680–92.

Frankel, J and J Poonawala (2010): "The forward market in emerging currencies: less biased than in major currencies", *Journal of International Money and Finance,* vol 29, no 3, pp 585–98.

Gábriel, P and K Pintér (2006): "Kinek higgyünk? Az elemzői várakozások és a hozamgörbe információtartalmának elemzése", *MNB-szemle,* December.

Gagnon, J, M Raskin, J Remache and B Sack (2010): "Large-scale asset purchases by the Federal Reserve: did they work?", *Federal Reserve Bank of New York Staff Reports*, no. 441, March.

Ghazali, N and S Low (2002): "The expectations hypothesis in emerging financial markets: the case of Malaysia", *Applied Economics*, vol 34, no 9, pp 1,147–56.

Guillen, O and B Tabak (2008): "Characterizing the Brazilian term structure of interest rates", *Banco Central do Brasil Working Paper Series,* no 158.

Gürkaynak, R and J Wright (2012): "Macroeconomics and the term structure", *Journal of Economic Literature*, vol 50, no 2, pp 331–67.

Hamilton, J and J Wu (2012): "The effectiveness of alternative monetary policy tools in a zero lower bound environment", *Journal of Money, Credit and Banking*, no 44, pp 3–46.

Kim, H and A Orphanides (2007): "The bond market premium: what is it and how can we measure it?", *BIS Quarterly Review*, June, pp 27–40.

Konstantinou, P (2005): "The expectations hypothesis of the term structure: a look at the Polish interbank market", *Emerging Markets Finance and Trade,* vol 41, no 3, pp 70–91.

Krishnamurthy, A and A Vissing-Jorgensen (2011): "The effects of quantitative easing on interest rates: channels and implications for policy", *NBER Working Papers*, no 17555, October.

Li, C and M Wei (2012): "Term structure modelling with supply factors and the Federal Reserve's large scale asset purchase programs", Federal Reserve Board, *Finance and Economics Discussion Series,* no 2012-37, May.

Longstaff, F, J Pan, L Pedersen and K Singleton (2011): "How sovereign is sovereign credit risk?", *American Economic Journal: Macroeconomics*, vol 3, no 2, pp 75–103.

Meaning, J and F Zhu (2011): "The impact of recent central bank asset purchase programmes", *BIS Quarterly Review*, December, pp 73–83.

Wright, J (2012): "Term premiums and inflation uncertainty: empirical evidence from an international panel dataset", Federal Reserve Board, *Finance and Economics Discussion Series*, no 2008–25, May.

The transmission mechanism and policy responses to global monetary developments: the Indonesian experience

Perry Warjiyo[1]

Abstract

This note describes Indonesia's experiences of the monetary policy transmission mechanism and the country's policy responses to global monetary developments, with a focus on the period following the Federal Reserve's announcement in May 2013 of its plans to begin tapering its quantitative easing measures. The Fed's unconventional monetary policy and its normalisation process have given rise to the policy "trilemma" of trying to find the optimal interest rate response while maintaining exchange rate flexibility and managing capital flows. In the case of Indonesia, we have managed this "trilemma" through a mix of monetary and macroprudential policies. Clear communication, policy coordination with the government on inflation, fiscal and structural reforms, as well as central bank cooperation on strengthening regional financial arrangements have also played a crucial role in these efforts.

Three particular issues are discussed here. First, the setting of interest rates supported by exchange rate flexibility and capital flow management in response to the policy "trilemma" arising from global monetary developments. Second, the efficacy of macroprudential measures in reinforcing the lending channel of the monetary policy transmission mechanism on the back of volatile capital flows and an underdeveloped financial market. Third, the importance to domestic monetary and financial system stability of financial market deepening through its role in smoothing out the transmission of global monetary developments. The note concludes with an agenda for further strengthening macroeconomic stability in the short term and for accelerating reforms to promote sustainable and balanced growth in the medium term.

Keywords: Unconventional monetary policy, policy mix, monetary policy, macroprudential policy, central banking, financial market deepening

JEL classification: E52, E58, F31

[1] Deputy Governor, Bank Indonesia.

I. Introduction

Indonesia this year is coping relatively well with the spillovers from the normalisation of the advanced countries' unconventional monetary policies (UMP). In fact, over the past two months portfolio inflows have increased, equity prices have rebounded, bond yields have decreased and the exchange rate has appreciated (Graphs 1–4). This is evidence that strengthening domestic macroeconomic fundamentals and financial system stability play a crucial role in mitigating such spillovers. The country's bold mix of monetary and macroprudential measures since June 2013 have resulted in a spate of positive data showing benign inflation, a faster than expected decline in the current account deficit, and better than expected GDP growth. Nevertheless, there is no room for complacency. In the short term, the focus of macroeconomic policy is still stabilisation ahead of growth. Meanwhile, structural reforms in the real economy as well as financial market deepening are also a priority for ensuring strong, balanced and sustainable growth over the medium term.

This note describes Indonesia's experiences of the monetary policy transmission mechanism and its policy responses to global monetary developments, with a focus on the period following the Fed's announcement in May 2013 of its plans to start tapering its quantitative easing measures. In particular, three main issues are discussed. First, the setting of interest rates supported by exchange rate flexibility and capital flow management in response to the policy "trilemma" that has arisen from global monetary developments. Second, the efficacy of macroprudential measures in reinforcing the lending channel of the monetary policy transmission mechanism on the back of volatile capital flows and an underdeveloped financial market. Third, the importance to domestic monetary and financial system stability of financial market deepening through its role in smoothing out the transmission of global monetary developments. The note concludes with an agenda for further strengthening macroeconomic stability in the short term and for accelerating reforms to promote sustainable and balanced growth in the medium term.

II. Making possible the policy "trilemma"

The UMP and its normalisation have given rise to the policy "trilemma" of trying to find the optimal interest rate response while also maintaining exchange rate flexibility and managing capital flows. Interest rate policy needs to be geared toward maintaining price stability, taking into account the impacts of global interest rates and leaving some scope for exchange rate flexibility to act as a shock absorber. However, market overreactions and structural rigidities can cause unnecessary exchange rate overshooting and volatility that may hamper growth as well as overall monetary and financial system stability. Volatility in capital flows also complicates the task of finding the optimal monetary policy response for achieving domestic economic objectives.

In the case of Indonesia, we have addressed this policy "trilemma" by pursuing a mix of policies consisting of interest rate actions complemented by exchange rate flexibility, capital flow management and macroprudential measures. Clear communication, policy coordination with the government on inflation, fiscal and structural reforms, as well as central bank cooperation on strengthening regional financial arrangements have also played a crucial role. Our interest rate policy, as in other inflation-targeting countries, is our main instrument for anchoring inflation expectations and forecasts within the targeted range. Our exchange rate policy is geared toward keeping the exchange rate stable along its fundamental path. We also pursue capital flow management to an extent with a view to dampening excessive short-term volatility in these flows. Our macroprudential measures aim to manage procyclicality and excessive lending in specific sectors. Overall, the policy mix is intended to reinforce the effectiveness of all monetary transmission channels (the interest rate, exchange rate, money and lending, asset price, and expectation channels) to better withstand the spillover impacts of global monetary developments.

Interest rate policy

Indonesia was one of the first central banks to raise its policy rate in the aftermath of the Fed's announcement in May 2013 that it planned to begin tapering its quantitative easing measures. We started by raising the BI policy rate by 25 bp in June 2013. We then aggressively raised the policy rate by 50 bp in July, by another 50 bp in August and by 25 bp in September 2013. After pausing in October, we again raised the policy rate by 25 bp in November. In total, the policy rate was raised by 175 bp to 7.50% within six months. We have kept the policy rate on hold since then and maintained our tight monetary policy stance.

The primary objective of this aggressive interest rate policy has been to anchor inflation expectations, which initially had risen due to food price shocks. Another aim has been to contain the second-round impacts of fuel price hikes that caused CPI inflation to peak at 9.0% in July 2013. Moreover, the sharp increase in the policy rate has had the goal of dampening domestic demand in order to rein in the current account deficit, which rose to a peak of 4.4% of GDP in Q2 2013. The timing of the aggressive policy rate increases has also been important as they have helped respond to the capital reversals, rising interest rates and increasing risks in the global financial markets following the Fed's announcement of its tapering plans. We believe the bold interest rate response has been key in sending a strong, clear signal to the markets regarding our monetary policy deliberations. Greater consideration has been given to domestic factors, although global monetary conditions and trends are always taken into account.

Our interest rate response has succeeded in containing inflation pressures and has helped reduce the current account deficit faster than initially forecast. CPI inflation has returned to its normal path since September 2013 and dropped to 8.3% in December, much lower than our earlier forecast of 9.0–9.8% (Graph 5). The inflation rate decelerated further to 7.7% in February 2014 and we believe it will come down to 4.9% by the end of 2014, thus falling within our targeted range of 4.5% ± 1 percentage point (Graph 6). The trade balance is now in surplus and the current account deficit is falling much faster than expected, from 4.4% of GDP in Q2 2013 to 3.8% of GDP in Q3 2013 to 1.9% of GDP in Q4 2013 (Graphs 7 and 8). We aim to lower the current account deficit from 3.3% of GDP in 2013 to about 2.5% of GDP in 2014 and around 2.0% of GDP in 2015. We believe this level is more sustainable in the longer term for Indonesia. The good news is that this price stability and external stability can be achieved with better than expected economic growth. GDP growth reached 5.8% in 2013 (Graph 9) and is forecast to be at the lower end of the 5.8–6.2% range in 2014.

The interest rate transmission mechanism is working, though not yet fully. Following the 175 bp increase in the policy rate, bank deposit rates have risen by 240 bp as liquidity conditions have tightened and competition for funding among banks has increased (Graph 10). However, lending rates have increased by less than 50 bp due to a combination of factors, eg a time lag in setting interest rates, excess liquidity and aggressive lending by some banks, as well as shallowness in the domestic financial market. Liquidity and monetary aggregates have already declined substantially, eg M1 growth dropped from around 22% in January 2013 to 12% in January 2014 (Graph 11), even though liquidity is not evenly distributed among banks. Bank lending growth declined more gradually, from 23.5% to 21.1%, during the same period, although it accounts for 16.9% when adjusted for exchange rate depreciation (Graph 12). Looking ahead, even though the policy rate is being held constant, continuous monetary tightening will bring about a further increase in lending rates and a decline in lending growth.

Exchange rate policy

Although policy rate increases have succeeded in anchoring inflation expectations and helped dampen domestic demand, they alone could not be expected to bring about all the necessary economic adjustments, such as further reducing the current account deficit and mitigating the spillover effects from the UMP normalisation process. To do so would have required excessive increases in the policy rate. Instead, some scope for exchange rate flexibility was necessary to help facilitate the reduction of the current account deficit and the transmission of global monetary policy normalisation.

In Indonesia, exchange rate policy is geared toward maintaining the stability of exchange rate movements in a way that is consistent with the exchange rate's fundamental path. This path is calibrated by using a particular methodology for determining the fundamental exchange rate and then applying this rate in a simulation to check its consistency with macroeconomic forecasts before determining the policy interest rate. The real effective exchange rate (REER) is one approach for checking the consistency of exchange rate movements with the fundamental rate (Graph 13). To achieve the exchange rate policy objective, symmetric intervention in the foreign exchange market is conducted to smooth out the short-term volatility of day-to-day exchange rate movements along the path that is consistent with the fundamental equilibrium exercises. The objective is not to achieve a certain level or range of exchange rates, but merely to avoid excessive volatility that could give rise to panic or disrupt the smooth functioning of the foreign exchange market.

However, introducing greater exchange rate flexibility is not always easy when faced with a shallow domestic foreign exchange market. This was the case for Indonesia last year in the aftermath of the Fed's announcement regarding its planned tapering. The markets were not ready to adjust to our new policy of greater exchange rate flexibility to manage the spillover impacts of the Fed's tapering and facilitate the adjustments to the current account deficit, especially during the period June–August 2013. Along with increasing volatility and exchange rate depreciation during this period there was considerable divergence in the banks' exchange rate determination (Graph 14). Frequent and close communication with market participants was important to enable them to adjust their behaviour to the new policy direction. The domestic foreign exchange market began functioning smoothly again in September 2013 and has done so since.

Dual interventions

Our intervention in the foreign exchange market is conducted in a number of ways. Intervention in the spot market is indirectly channelled through agent banks so that it does not disrupt the functioning of the foreign exchange market. Intervention through forward and swap transactions is conducted both bilaterally and in weekly auctions with the banks. Certainty and continuity of the auctions are important for price discovery and for deepening the foreign exchange market.

Foreign exchange intervention is supported by central bank operations in the secondary market for government bonds, especially during periods of large capital reversals involving foreign investors' holdings of government bonds, a tactic that we call dual intervention. There are at least three reasons for Bank Indonesia's purchases of government bonds from the secondary market.

First, they help strengthen the effectiveness of foreign exchange intervention in stabilising the exchange rate. By buying bonds from the secondary market, the central bank sends a clear signal that it is prepared to buy government bonds that foreign investors wish to offload, especially in periods of severe capital reversal pressure, as evidenced in the aftermath of the Fed's announcement about its planned tapering.

Second, purchases of government bonds from the secondary market are also intended to synchronise liquidity management in both the foreign exchange and domestic money markets. Through these dual interventions, some of the rupiah liquidity that has been absorbed due to selling dollars in foreign exchange intervention can be recirculated back into the market, thus avoiding an excessive liquidity squeeze and increases in money market rates.

Third, the dual interventions are a way of achieving the objective of monetary stability in a manner that is consistent with maintaining financial system stability. By stabilising the foreign exchange and government bond markets, the dual interventions help stabilise the overall financial system. The dual interventions also help the transmission of short-term interest rates to longer-term interest rates, especially those of government bonds.

Capital flow management

Volatile capital flows, especially those of a short-term and speculative nature, increase the risks to both monetary and financial system stability. Carry trade flows often give rise to excessive volatility in exchange rate movements beyond that implied by fundamentals. Dual interventions are one strategy to smooth out this volatility. But in some cases, the capital flows need to be managed.

In Indonesia, our policy for capital flow management is guided by three principles. First, the objective is to help mitigate the negative impacts of short-term volatility in capital flows on the stability of both the exchange rate and the overall monetary and financial system. Second, the measures specifically target short-term and speculative capital flows; medium-to-longer-term flows are welcomed as they benefit the economy. Third, the measures are consistent with our broad principle of maintaining a free foreign exchange system. They are temporary, ie the measures are strengthened in the event of excessive capital inflows and relaxed in the event of excessive capital outflows, and do not differentiate between domestic and international investors.

The following provides a clear example. In response to the strong capital inflows following the UMP, we introduced in 2010 a six-month holding period for transactions in central bank bills and imposed a ceiling of 30% on banks' short-term offshore borrowings in relation to their capital. However, following the Fed's announcement in 2013 about its planned tapering we relaxed the holding period for central bank bills to one month and expanded the number of transactions that could be exempted from the calculation of banks' offshore borrowings.

We believe that these measures help dampen short-term and volatile capital flows, thus making them consistent with the objective of managing financial system stability.

III. Assessing the macroprudential measures

As previously mentioned, the interest rate channel of monetary policy is not always smooth or fully effective in a country with an underdeveloped financial market, such as Indonesia. Other channels of monetary transmission need to be used, including the lending channel. This is where macroprudential measures can play a key role, eg in their ability to smooth out the procyclical nature of bank lending behaviour. Thus, we take account of both the objectives of maintaining monetary and financial system stability when designing macroprudential measures.

In Indonesia, the formulation of macroprudential measures is done as follows. First, we develop a number of methodologies to estimate optimal lending growth for the banks, including what we call the non-accelerating inflation lending growth model. We then apply this model to aggregate lending growth and to the lending growth of each bank, as well as to certain types of lending (consumption, working capital, and investment) and by economic sector. By comparing these optimal growth figures with actual lending growth, we get an idea of where lending is excessive and therefore also of which macroprudential measures to use.

This is the approach that we applied when introducing the loan-to-value (LTV) ratio for lending to the automotive and property sectors in 2012. We subsequently strengthened the LTV ratio on lending to the property sector in 2013, especially on mortgages for second and subsequent purchases of certain types of houses and apartments. The measures were also complemented by supervisory measures against banks that we viewed as excessive in their lending behaviour. Note that the formulation and implementation of macroprudential measures required a very detailed and complex analysis and calibration, as well as the need for clear communication with the banks and the business community.

Our experience shows that the macroprudential measures and supervisory actions helped reinforce the effectiveness of the monetary transmission mechanism and supported financial system stability. Although lending growth increased prior to the implementation of these measures, it is likely that banks and their customers were taking advantage of the interim period before the measures came into effect. Once the measures were implemented, the banks and their customers adjusted their behaviour in a relatively short time. For instance, the growth in mortgages on housing of less than 21 square metres declined from more than 100% to negative growth during the period June–September 2012 (Graph 16). Likewise, the growth in mortgages on apartments of less than 21 square metres dropped from more than 300% to less than 10% during the period January–November 2013 (Graph 17). It should be noted that the automotive and property sectors have very large import content, so managing the growth in lending to these two sectors helped reduce the current account deficit.

IV. Financial market deepening

The stage of development and depth of the domestic financial market influence the transmission mechanism and the policy response to global monetary factors. This has been the case during both the UMP period and its normalisation process. The preceding discussions in this paper clearly show the challenges that we have faced in Indonesia. Interest rate transmission lags in the absence of domestic money and fixed income markets that can provide an efficient mechanism for interest rate and term structure determination. The shallowness of the domestic foreign exchange market often causes excessive volatility and overshooting of exchange rate movements in response to global monetary and financial shocks.

This is why we view financial market deepening as an integral part of our policy response to the normalisation of the UMP in the advanced countries. In addition to strengthening economic fundamentals and promoting sound macroeconomic and financial system stability, the best defence against the spillover effects of such global monetary and financial developments is to make our financial market more resilient to swings in international investor preferences.

We have launched a series of policy initiatives to deepen our financial market, especially the domestic money and foreign exchange markets. In the foreign exchange market, we have established the Jakarta Interbank Spot Dollar Rate (JISDOR), reflecting actual transacted exchange rates, as a reliable reference for the market. Recently, the Association of Banks in Singapore (ABS) recommended that their members use the JISDOR as a reference rate in fixing their non-deliverable forward (NDF) transactions. We have also introduced FX swap transactions with the banks, both bilaterally and in weekly auctions. We have further relaxed the regulations on underlying transactions for forwards and swaps as hedging instruments, and we are now campaigning for banks and corporates to use more hedging instruments when managing their increasing exchange rate risks.

We have also made significant progress in deepening the domestic money market, especially for collateralised transactions. We use more reverse repos with government bonds in our monetary operations. We have succeeded in developing an interbank repo using government bonds as the underlying securities. Within less than three months, the size of the interbank repos has increased sharply, from next to nothing to around USD 3 billion. The number of banks participating in the interbank repos has also increased, from only eight to 46, and more will join.

V. The next agenda

Despite the progress made by Indonesia, we cannot afford to be complacent. The road ahead is still bumpy, and the uncertainty and risks in the global financial markets remain high. Further strengthening the domestic economic and financial system is key for better withstanding the spillover impacts of the normalisation of the Fed's monetary policy. The monetary and macroprudential policy mix needs to be continuously adjusted in anticipation of the spillover impacts and to be closely coordinated with fiscal policy to maintain overall macroeconomic and financial system stability. Structural reforms in the real economy as well as financial market deepening are also a priority to ensure strong, balanced and sustainable growth over the medium term.

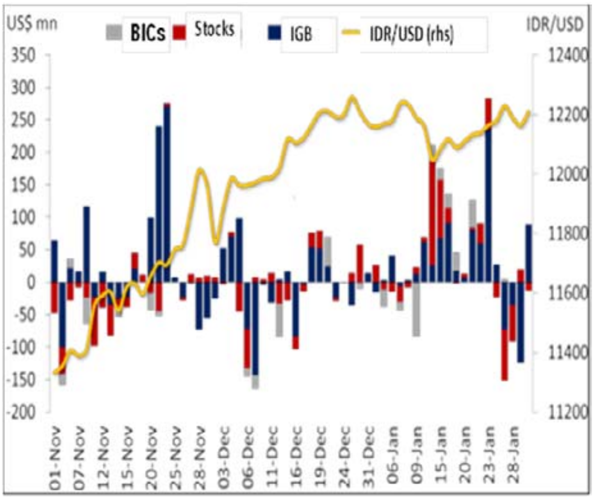
In the short term, the challenges to maintaining macroeconomic and financial system stability need to be continuously addressed. Monetary policy will remain tight to ensure that inflation expectations are anchored and that the current account deficit is reduced further. Macroprudential measures and supervisory actions will further strengthen the liquidity and credit channels of monetary policy transmission. Fiscal policy needs to be geared toward maintaining fiscal sustainability and, whenever possible, to provide better expenditure allocation for supporting growth and poverty alleviation, including reformulating energy subsidies if needed.

Further initiatives to develop the financial markets are key for creating an environment that is conducive to beneficial capital inflows and financing for the economy. The significant progress made so far in deepening the foreign exchange and money markets will be followed by additional measures to strengthen interest rate determination, product development, as well as market infrastructure and conduct. The objective is to expedite the development of interbank swaps to provide hedging facilities for the banks and corporates, thus enabling them to better mitigate increasing exchange rate risks. Close links between the already developed interbank repo market and the much-needed interbank swap market would facilitate the smooth functioning of the domestic money market in responding to global monetary transmission. More products will be introduced in both the money and foreign exchange markets, including negotiable certificate deposits, commercial paper, promissory notes and medium-term notes.

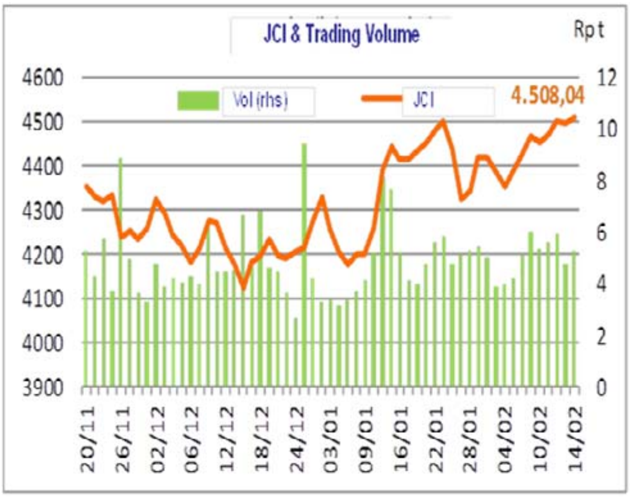
Structural reforms are also progressing, albeit at a slower pace. The strategy is to promote exports and substitute imports by expanding domestic production capacity, including moving our focus from natural resources to manufacturing in order to increase gains in value added. Last year, the government introduced a tax policy including measures to promote exports of a number of manufactured goods, provide tax incentives for production of import-substitution goods, and raise import tax on luxury goods. Amendments to the energy laws were also made by providing tax incentives and disincentives to encourage firms to advance their processing of natural resources. Some progress is also being seen in infrastructure development, including airports and seaports, railways, electricity and roads. However, more progress is needed to expedite the structural reforms in a number of key areas of investment, manufacturing, agriculture and infrastructure.

To conclude, Indonesia has coped relatively well with the spillover effects from the normalisation of the Fed's monetary policy. The policy mix of monetary and macroprudential measures has proven to be effective in anchoring inflation expectations, lowering the current account deficit and maintaining financial system stability, with a modest decline in economic growth. The mix of monetary and fiscal policies has also supported the stabilisation process over the short term. Nevertheless, some progress in structural reforms will be necessary to move the economy toward higher, sustainable and balanced economic growth over the medium to long term.

Portfolio inflows and IDR/USD Graph 1

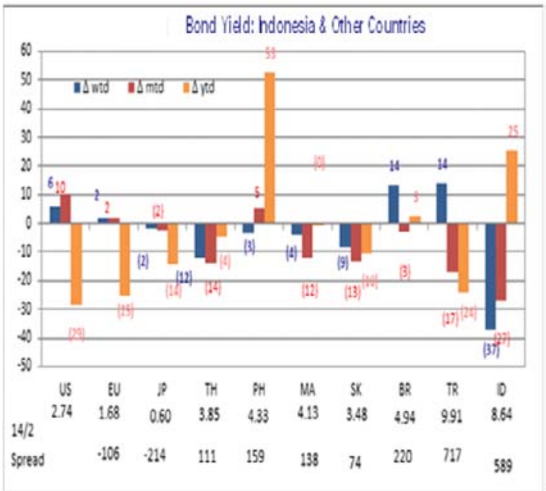


JCI stock prices and volume Graph 2



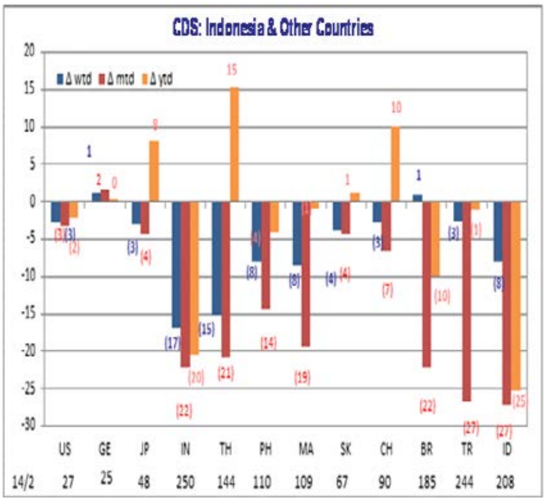
Bond yields: Indonesia vs others

Graph 3



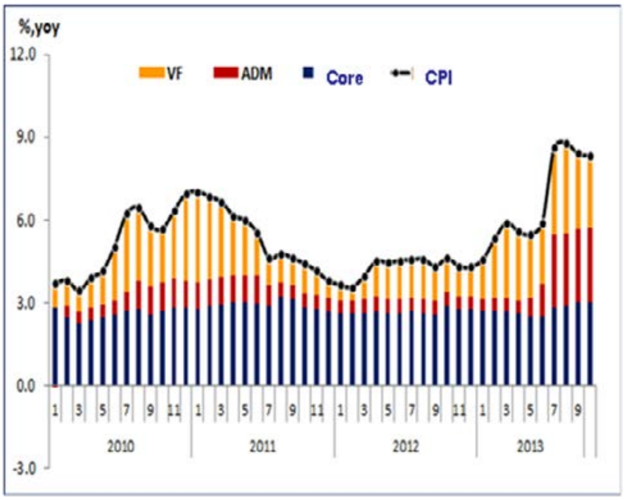
CDS spreads: Indonesia vs others

Graph 4



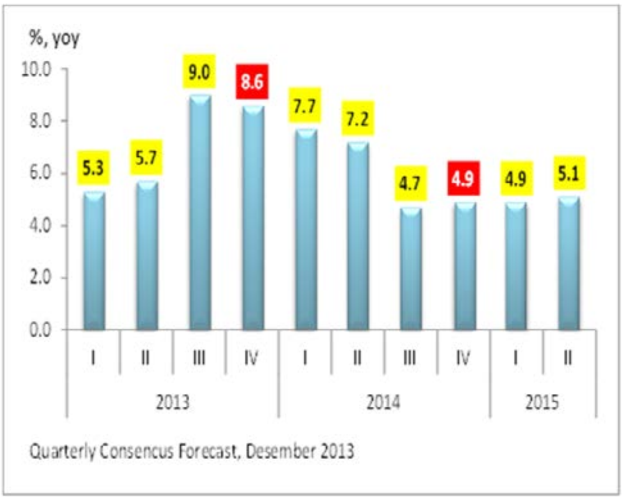
CPI inflation: core, food, energy

Graph 5



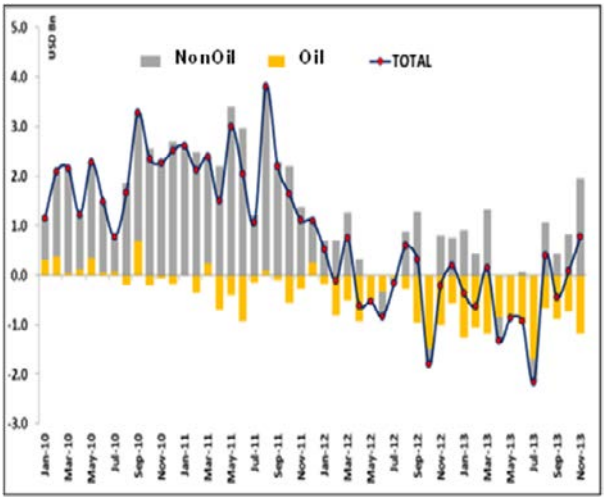
CPI inflation: consensus forecast

Graph 6



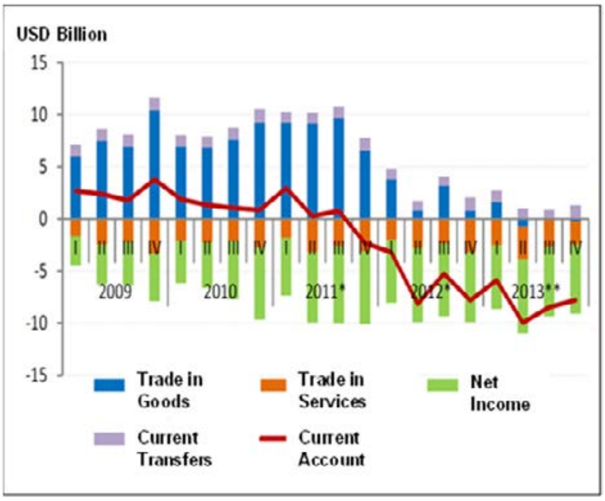
Trade balances: oil and non-oil

Graph 7



Current account deficit

Graph 8



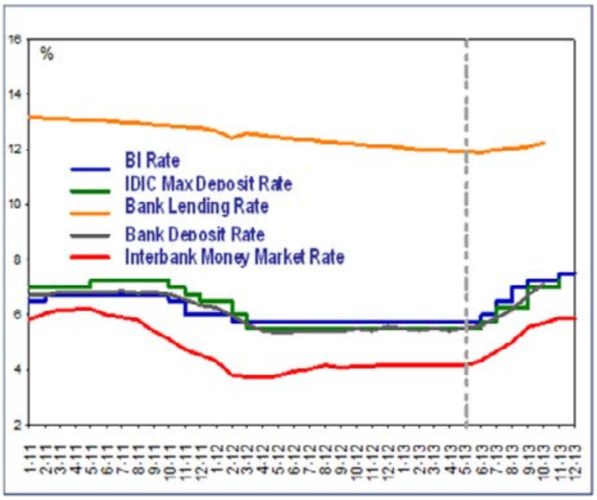
GDP growth by expenditure

Graph 9

No	Components	2012**					2013***					
										IV		
		I	II	III	IV	TOTAL	I	II	III	Fore-cast	Real-isation	TOTAL
A	**Domestic Demand^**	**6.40**	**7.38**	**5.94**	**4.90**	**6.12**	**4.99**	**4.69**	**5.50**	**5.68**	**5.13**	**5.08**
1	Consumption	5.09	5.64	4.50	3.91	4.76	4.77	4.78	5.89	6.13	5.44	5.23
	- Household C.	4.94	5.24	5.57	5.36	5.28	5.24	5.15	5.48	5.56	5.25	5.28
	- Government C.	6.52	8.66	-2.80	-3.31	1.28	0.44	2.17	8.91	9.21	6.45	4.87
2	Gross Fixed Cap Formation	9.86	11.96	9.68	7.49	9.69	5.54	4.47	4.54	4.55	4.37	4.71
	- GFCF Building	7.08	6.67	7.56	8.18	7.39	6.78	6.61	6.23	6.20	6.68	6.57
	- GFCF Nonbuilding	17.61	26.90	15.24	5.78	15.81	2.39	-0.64	0.40	0.36	-1.49	0.10
B	**Net Export**	**5.75**	**-27.32**	**-9.93**	**-22.03**	**-13.72**	**16.44**	**26.61**	**5.79**	**9.39**	**46.34**	**22.40**
3	Export	8.23	2.63	-2.56	0.48	2.00	3.58	4.82	5.25	6.00	7.40	5.30
4	Import	8.95	11.33	-0.17	6.82	6.66	-0.03	0.69	5.09	5.30	-0.60	1.21
	Gross Domestic Product	**6.33**	**6.34**	**6.21**	**6.18**	**6.26**	**6.03**	**5.76**	**5.63**	**5.49**	**5.72**	**5.78**

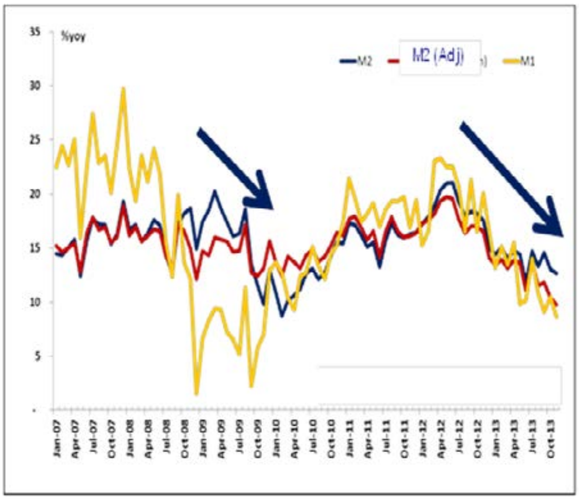
BI rate vs deposit and lending rates

Graph 10



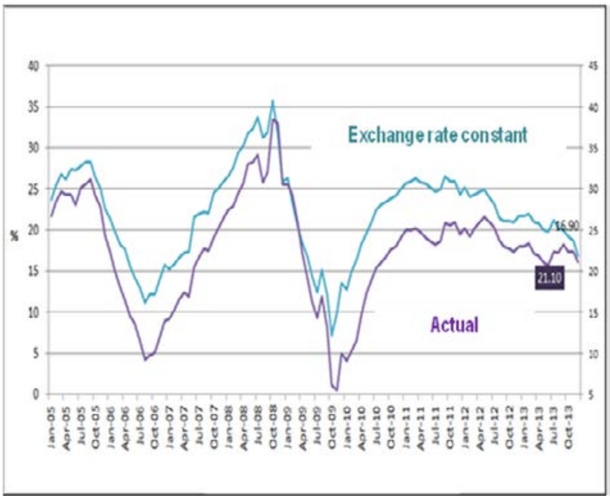
M1 and M2 growth

Graph 11

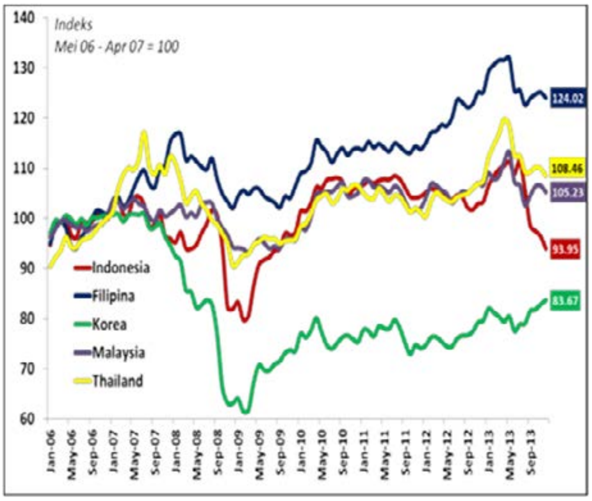


Lending growth

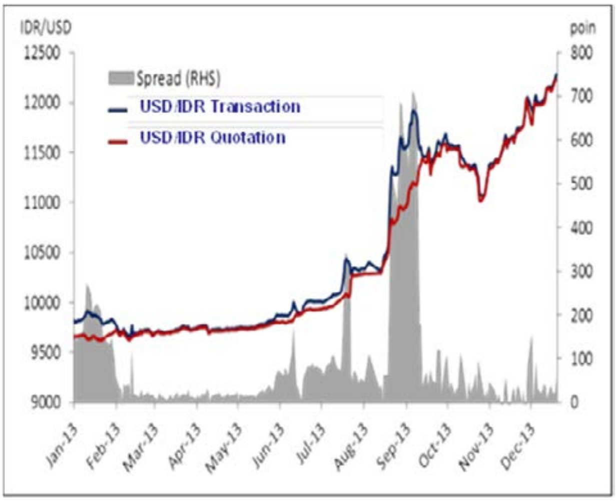
Graph 12



Real effective exchange rate (REER) Graph 13

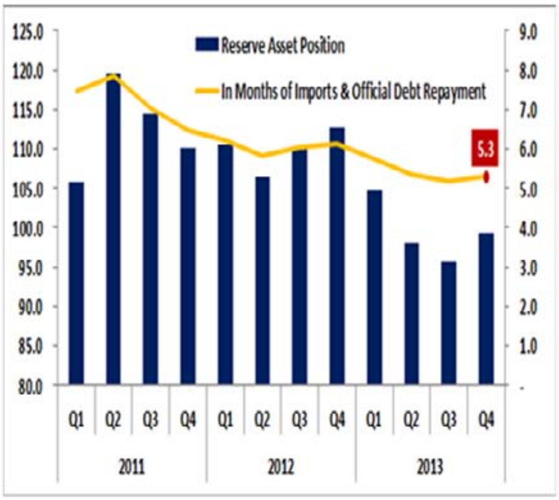


IDR/USD: quotation vs transaction Graph 14



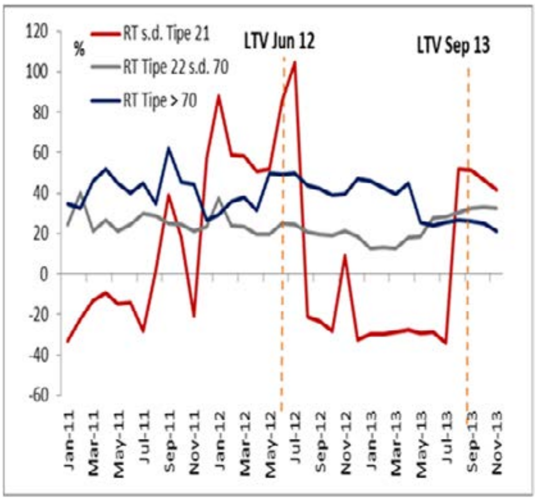
FX reserves

Graph 15



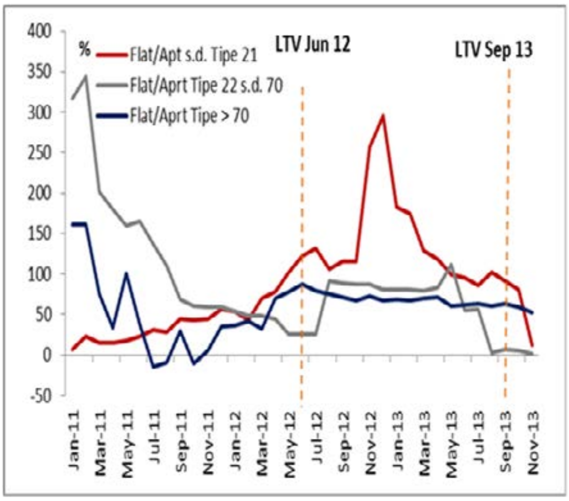
LTV and house mortgages

Graph 16



LTV and apartment mortgages

Graph 17



The international transmission of monetary policy: Korea's experience

Jun Il Kim[1]

Abstract

Monetary policy shifts in advanced economies are transmitted to emerging market economies (EMEs) through monetary policy responses by EME central banks and changes in cross-border capital flows. The ripple effects, however, depend upon the EMEs' macroeconomic fundamentals and the amount and composition of the portfolio investment funds that have already flowed into them. Since the 2008 global financial crisis, Korea, like other EMEs, has been influenced, directly and indirectly, by the quantitative easing (QE) and quantitative easing tapering (QET) of major advanced economies. This paper discusses the international transmission effects occurring during the transformation to QE and QET, the related monetary policy responses and the challenges ahead, with a focus mainly on Korea's experience.

Keywords: Financial spillovers, capital flows, long-term interest rates, monetary policy challenges

JEL classification: E52, F41

[1] Deputy Governor and Chief Economist, Bank of Korea. The author would like to thank Yongjin Park, Youngju Choi and Minsik Kim for their assistance and research input.

Monetary policy shifts in advanced economies have been transmitted to emerging market economies (EMEs) via two channels: monetary policy responses by EME central banks, and cross-border capital flows. In the early phase of the global financial crisis, EME central banks, including the Bank of Korea (BOK), lowered their policy rates to counter the sharp economic contraction and the collapse of international trade flows. Such policy responses were affordable in part because of the significant policy space created by major central banks' drastic cuts in policy rates to near zero; as a result, EME central banks were able to lower their own policy rates while maintaining adequate interest rate differentials vis-à-vis advanced economies. Although many EMEs experienced significant capital outflows immediately after the outbreak of the crisis, this would have occurred even if EME policy rates had not been reduced.

Faced with the so-called zero lower bound, major central banks deployed unconventional monetary policies that combined forward guidance on their future monetary policy stances with balance sheet operations. These included the large-scale asset purchases by the US Federal Reserve (the Fed) and the long-term financing operation of the ECB. The increased global liquidity under these policies helped to contain systemic risks and boost investors' appetite for risk, while at the same time flowing into emerging markets in the search for yield. Large EMEs whose macrofinancial fundamentals were relatively strong received significant capital inflows and experienced currency appreciation. As many global banks in advanced economies were forced to deleverage, the bulk of capital flows to EMEs was in the form of portfolio investments, which have been less volatile than banking flows.

The financial spillovers from unconventional monetary policies differed across EMEs, however, depending upon their macrofinancial fundamentals and their policy responses. Some EMEs instituted capital controls to put the brakes on surges in capital inflows and the attendant currency appreciation, while others used macroprudential tools in conjunction with sterilised FX intervention. For some EMEs, where capital inflows were large and accompanied by currency appreciation, domestic credit expanded and asset prices enjoyed buoyancy; at the same time, their external positions worsened, with current account deficits rising. The global financial markets were taken by surprise when the Fed first hinted at its intention to taper off its asset purchases in May 2013. They reacted with substantial asset price corrections even before the tapering began. In both advanced and emerging market economies, stock prices fell while long-term interest rates rose. Some fragile EMEs were hit hard with sharply falling currency values and sudden capital outflows. The global financial markets, however, remained relatively calm when the tapering actually began in 2014, although these fragile EMEs continued to face high financial market volatility.

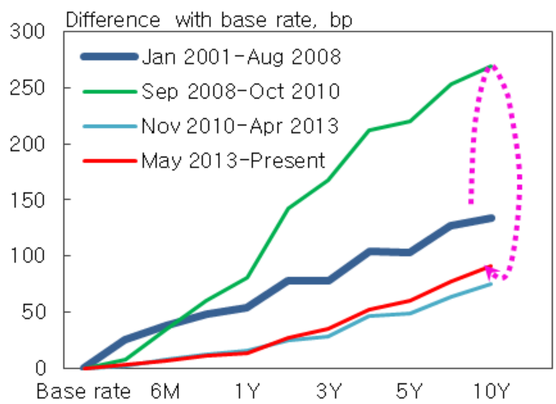
Korea has weathered the global financial crisis and the subsequent debt crises in the euro area relatively well, thanks to its strong fundamentals and adequate policy responses. Nevertheless, it has also been affected by financial spillovers from unconventional monetary policies, and has faced challenges in its conduct of monetary and foreign exchange policies. In what follows, this note summarises Korea's experience in addressing these spillovers and the associated challenges.

Financial spillovers and co-movements in long-term interest rates

Korea's open and liberalised capital markets have been fertile ground for financial spillovers and synchronised asset price movements. As global liquidity abounds, mainly because of extraordinary monetary easing in advanced economies, as discussed above, international portfolio investment funds have continued to flow into EMEs. Korea's long-term interest rates have consequently plummeted, and the yield curve has flattened since the commencement of the second round of quantitative easing (Figure 1). Moreover, through liquidity and portfolio effects, the co-movements in long-term interest rates between advanced and emerging market economies have in fact strengthened compared to the pre-crisis period, with significantly higher correlations (Figure 2).

Yield curve

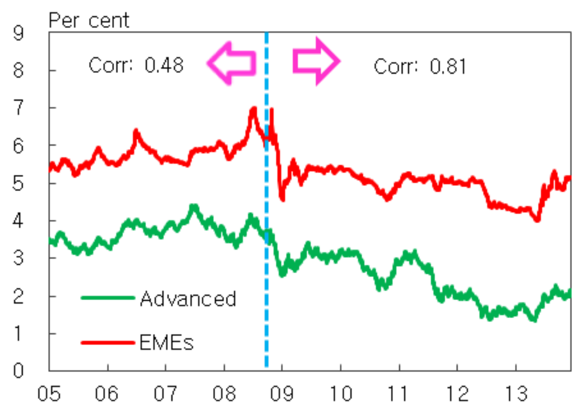
Figure 1



Source: Korea Securities Computing Corporation (KOSCOM).

Long-term interest rates[1] in advanced[2] and emerging market economies[3]

Figure 2

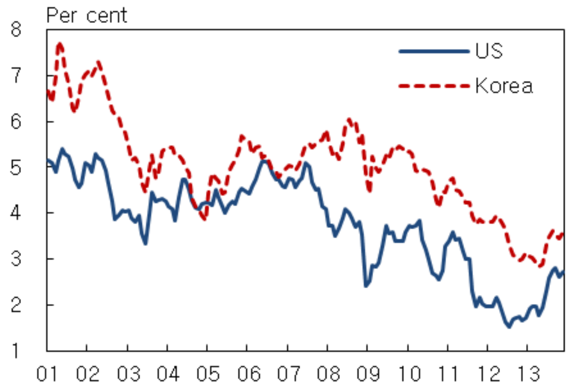


AEs = advanced economies; EMEs = emerging market economies. [1] Ten-year treasury bond yields (three-year yields for Korea). [2] Average of the United States, Japan, Germany, the United Kingdom and France. [3] Average of Korea, India, South Africa, Turkey, Chinese Taipei and Thailand.

Source: Bloomberg.

Korea is no exception in this regard. Over the past decade or so, long-term interest rates in Korea have trended broadly in parallel with those of the United States and other advanced economies, with even stronger co-movements since the global financial crisis (Figure 3). For instance, the correlation between 10-year treasury bond yields in Korea and the United States was 0.5 before the crisis, but has jumped to nearly 0.9 in the post-crisis period (Table 1).[2] As a result, the Bank of Korea has often encountered difficulties in controlling financial conditions by changing its policy rate, as long-term rates have tended to be affected more by capital flows and external factors, such as the US monetary policy stance, than by domestic short-term rates. Empirical evidence also supports the growing influence of foreign factors on long-term rates. First, Granger causality test results show that the causality runs unilaterally from US long-term rates to domestic long-term rates, particularly during the post-crisis period (Table 2). Second, formal regression analysis suggests that, during the post-crisis period, US long-term rates have had a significant impact on long-term rates, while domestic and other factors have had less influence than in the pre-crisis period (Table 3).[3]

Long-term interest rates: Korea and the United States[1] Figure 3



[1] Based on 10-year treasury bond yields.

Sources: Bank of Korea; Federal Reserve; Bloomberg.

[2] The coefficients of correlation between the 10-year treasury bond yields of Korea and those of the United Kingdom, Germany and Japan were 0.4, 0.8 and –0.1 before the crisis, but have all risen to 0.9 in the post-crisis period.

[3] The results are robust to various specification tests. The same results obtain, for instance, if five-year or three-year treasury bond yields are used for the dependent variable, or if a lagged dependent variable is added as an explanatory variable.

Correlation with US long-term interest rates[1]

Table 1

	Pre-crisis (Jan 2001–Dec 2008)	Post-crisis (Jan 2009–Aug 2013)
Korea	0.49	0.89
India	0.47	–0.40
Indonesia	–0.28[2]	0.74
Mexico	0.05[3]	0.87
South Africa	0.27	0.82

[1] Based on 10-year treasury bond yields. [2] From July 2003 to December 2008. [3] From August 2001 to December 2008.

Sources: Bank of Korea; Federal Reserve; Bloomberg.

Results of Granger causality test (F-statistics)[1]

Table 2

Null hypothesis	Pre-crisis (Jan 2001–Dec 2008)	Post-crisis (Jan 2009–Nov 2013)	Whole period (Jan 2001–Nov 2013)
US interest rates ⇏ Korean interest rates	1.20	2.18*	3.28**
Korean interest rates ⇏ US interest rates	1.42	1.11	1.05

The symbols * and ** indicate significance levels of 10% and 5%, respectively.

[1] Ten-year treasury bond yields; the lag is 4.

Source: Bank of Korea staff calculations.

Ordinary least squares estimation results: determinants of Korean long-term interest rates[1, 2]

Table 3

	Pre-crisis (Jan 2004–Dec 2008)	Post-crisis (Jan 2009–Oct 2013)	Whole period (Jan 2004–Oct 2013)
Constant term	0.504	8.371***	3.126**
	(2.613)	(1.777)	(1.406)
Expectations for base rate (R)[3]	0.459***	0.265**	0.310***
	(0.082)	(0.110)	(0.093)
Inflationary expectations[3]	0.541*	–0.074	0.087
	(0.320)	(0.159)	(0.186)
Composite leading indicators year-on-year	0.076*	0.013**	0.021**
	(0.041)	(0.007)	(0.010)
Real effective exchange rate of Korean won	0.001	–0.074***	–0.027**
	(0.013)	(0.016)	(0.011)
US 10-year Treasury bond yields	0.056	0.909***	0.760***
	(0.098)	(0.065)	(0.100)
Chicago Board Options Exchange Market Volatility Index (VIX)	0.012*	0.007	0.020**
	(0.007)	(0.007)	(0.009)
	N = 60	N = 58	N = 118
	Adj R^2 = 0.57	Adj R^2 = 0.92	Adj R^2 = 0.81

The symbols *, ** and *** indicate significance levels of 10%, 5% and 1%, respectively.

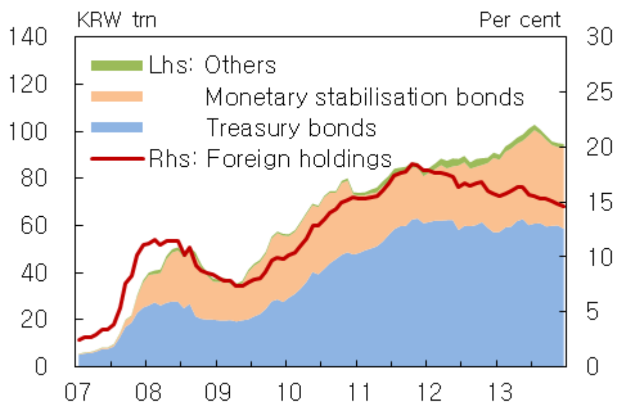
[1] Dependent variable: Korean 10-year treasury bond yields. [2] Figures in brackets are heteroscedasticity and autorcorrelation consistent (HAC) standard errors. [3] Public survey data.

Source: Bank of Korea staff calculations.

There are two related effects that appear to explain the strengthened impact of US interest rates on domestic long-term interest rates during the post-crisis period. First, the increased portfolio investment inflows have pushed long-term rates down through liquidity effects. Foreign investors' holdings of domestic bonds, which stood at only 5 trillion won at the end of 2006, have increased rapidly since 2008 to surpass 100 trillion won by mid-2013, with the bulk of this concentrated in treasury bonds and monetary stabilisation bonds issued by the BOK. As a consequence, the foreign share of treasury bond holdings had risen from a mere 3 per cent in early 2007 to 18 per cent by the end of 2011 (Figure 4). Second, the debt maturity structure has changed in favour of yield curve flattening. Faced with large capital inflows driven by abundant global liquidity, the authorities have not only deployed macroprudential tools, but have also undertaken sterilised interventions when the FX market volatility increased significantly. In this process, the BOK has mopped up the liquidity by issuing monetary stabilisation bonds with maturities of up to two years, ceteris paribus creating upward pressure on short-term interest rates. As foreign portfolio investment has been concentrated in treasury bonds with maturities of three years or longer, however, long-term interest rates have been subject to downward pressure, resulting in a flattened yield curve.

Foreign investment in Korean bonds

Figure 4



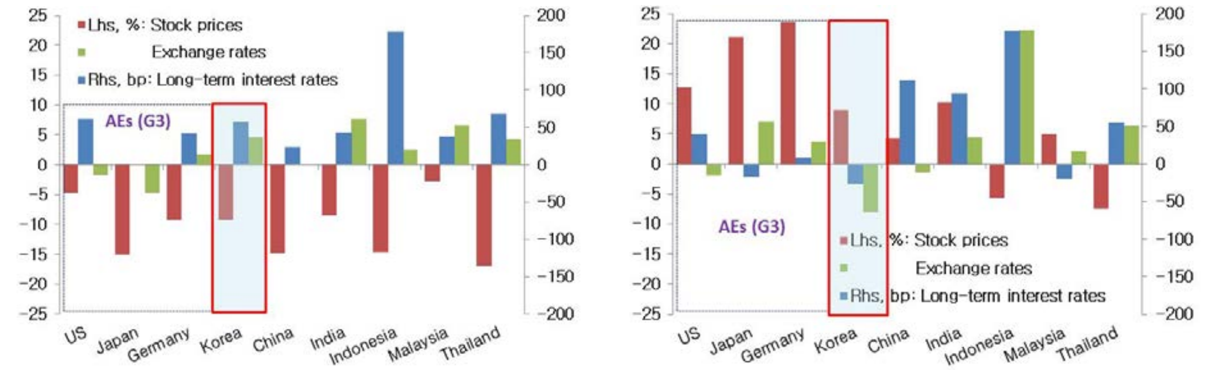
Source: Bank of Korea.

Since May 2013, when the Fed hinted at its intention to taper off its large-scale asset purchases, a second round of financial spillovers has been felt by many EMEs, but in the opposite direction. In May and June 2013, when the global financial market strains were at their (local) peak, all Asian EMEs experienced stock price declines, steep rises in interest rates and currency depreciations. The markets soon began to differentiate among EMEs on the basis of their fundamentals, however, and Korea has benefited from such differentiated reactions (Figure 5). Differentiated market reactions have been observed in terms of capital flows as well. Korea had in the past exhibited higher capital flow volatility than the EME average, perhaps owing to its open and liquid capital markets. Unlike many other EMEs, however, Korea witnessed relatively stable capital flows during the second half of 2013. For example, while many other EMEs were experiencing capital outflows, there were notable inflows of portfolio investment funds to Korea in this period (Figure 6).

Given its strong external position and financial fundamentals, Korea has thus far managed the financial spillovers from the somewhat acute and volatile asset price corrections in the global financial markets relatively well. Although Korea has received large amounts of bond flows since the global financial crisis, the talk of tapering did not lead to any significant increase in long-term interest rates or in their volatility. Foreign investment in Korean debt securities in 2008–2012 totalled more than US$ 90 billion, the third largest amount among EMEs after Brazil and Mexico. Between May and August 2013, however, yields on 10-year treasury bonds were, at their peak, only 1 percentage point higher than their end-April level in Korea, while ranging from 2 to 4 percentage points higher for other major EMEs in the G20 (Figure 7). The daily variation in market interest rates was likewise lower for Korea during this period (Figure 8).

Financial market developments: selected Asian EMEs[1, 2] Figure 5

Common market reactions (22 May 2013–24 June 2013) | Differentiated market reactions (25 June 2013–7 Jan 2014)

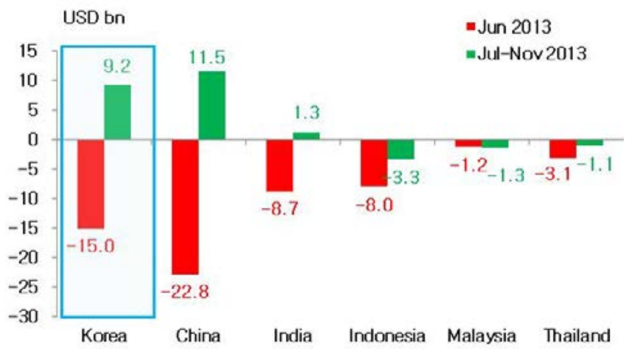


AEs = advanced economies; G3 = Group of Three (the United States, Germany and Japan).

[1] Interest rates: 10-year treasury bond yields for the United States, Japan and Germany; three-year treasury bond yields for Asian EMEs. [2] Exchange rates: a positive value indicates appreciation; the US Dollar Index was used for the US dollar.

Sources: Bank of Korea staff calculations; Bloomberg.

Portfolio investment in Asian EMEs[1] Figure 6

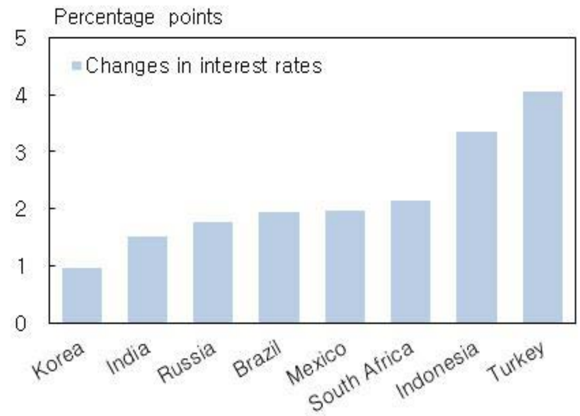


[1] Average monthly volumes.

Sources: Bank of Korea staff calculations; Emerging Portfolio Fund Research (EPFR).

Impact of tapering talk on long-term interest rates[1]

Figure 7



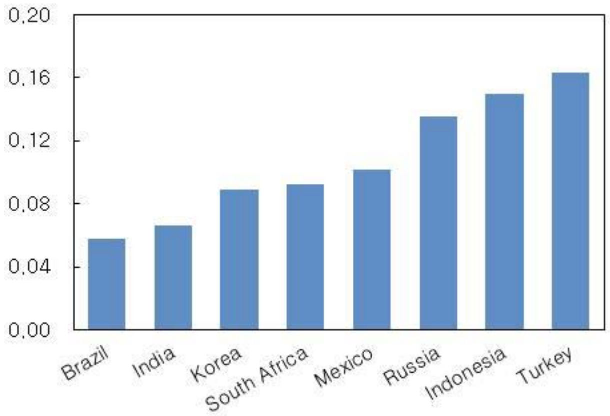
[1] Ten-year treasury bond yields compared to end-April 2013, based on record highs from May to August (1 May–2 July for Brazil).

Source: Bloomberg.

Volatility of long-term interest rates[1]

(Variation coefficient)

Figure 8



[1] Based on daily interest rates on 10-year treasury bond yields from May to August 2013 (1 May–2 July for Brazil).

Source: Bloomberg.

Policy responses

Given the ever growing cross-border financial linkages, the monetary policies of major advanced economies have provided important input to the BOK's policy rate decisions, particularly since the capital account liberalisation in the late 1990s. At the same time, volatile global market conditions, fickle capital flows, and exchange rate volatility have all posed significant challenges to EME monetary policymaking, and the financial linkages have often constrained the monetary policy response to developments in domestic inflation and the business cycle. In 2011, for instance, when the BOK raised its policy rate to counter rising inflation pressures, long-term interest rates reacted little to this monetary tightening.

In the early stage of the global financial crisis, the BOK deployed various non-interest rate policies in efforts to stabilise the exchange and interest rates, including the purchase of treasury bonds and liquidity operations targeting a large array of financial institutions (Table 4). Such policies helped to restore the monetary policy transmission channel and to reduce counterparty risks in the interbank markets. The BOK also intervened in the foreign exchange markets to stabilise the exchange rate by auctioning off FX liquidity to both the interbank markets and the FX/currency swap markets.

Use of non-interest rate policy instruments during the Lehman crisis — Table 4

Policy goal	Improving interest rate channels	Improving conditions for issuance of bonds with credit risk	Increasing banks' lending capacities	Increasing liquidity supply
Policy instruments	– Long-term repurchase operations to facilitate certificate of deposit and commercial paper market transactions – Treasury bond purchases – Adding bank debentures, etc, to securities eligible for open market operations	– Supporting bond market stabilisation fund	– Raising aggregate credit ceiling – Paying interest on reserves – Supporting recapitalisation funds – Increasing scope of lending collateral	– Monetary stabilisation bond redemptions prior to maturity – Increasing scope of financial institutions eligible for open market operations – Easing reserve management

Source: Bank of Korea.

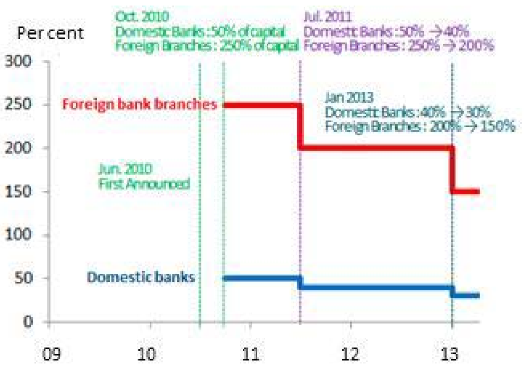
Aside from keeping its macrofinancial fundamentals in sound condition, Korea empowered its monetary policy with macroprudential and credit policies during the later phase of the global financial crisis. As part of its FX-related macroprudential tools, leverage caps on the FX derivatives positions of banks and a bank levy on non-core FX liabilities were introduced in 2010 and 2011, respectively, and since then have been adjusted flexibly in line with market conditions. Although it may be premature to assess the effectiveness of these two measures, preliminary evaluation[4] suggests that they have been effective in reducing the currency and maturity mismatches on bank balance sheets (Figures 9–10). To be specific, short-term external debt as a share of total external debt and foreign reserves has fallen markedly over the past few years (Figure 11).

[4] Choi (2013).

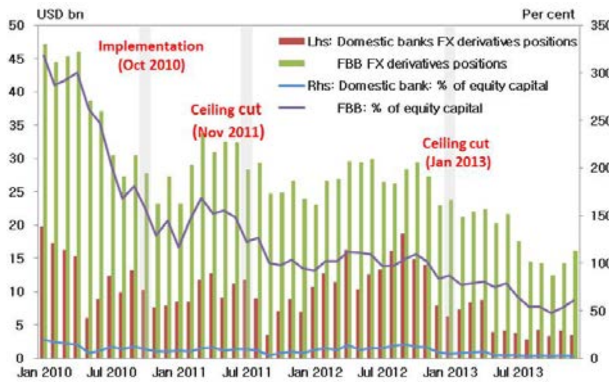
Macroprudential policy measures: Korea

Figure 9

Cap on banks' FX derivatives positions
(as a percentage of equity capital)



Banks' FX derivatives positions

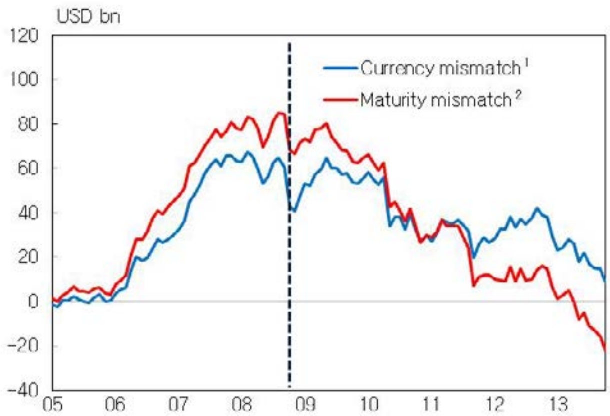


FBB = foreign bank branches.

Source: Bank of Korea.

Currency and maturity mismatches of domestic banks

Figure 10

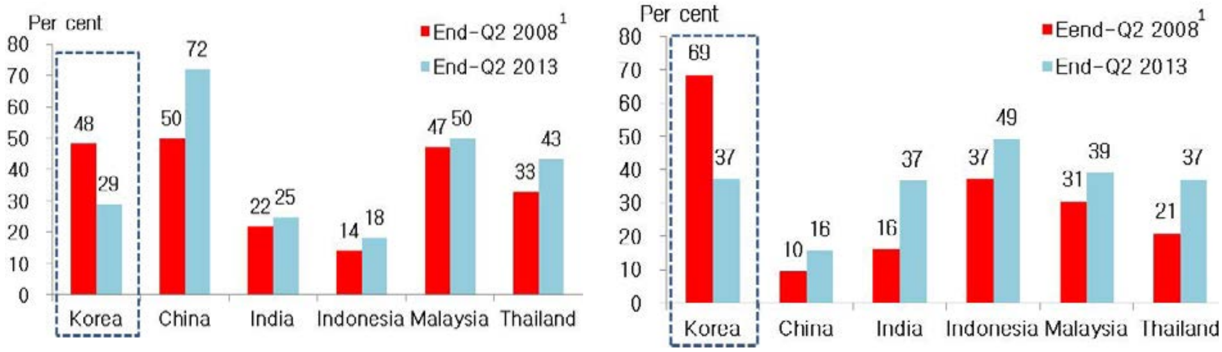


[1] FX liabilities minus FX assets. [2] Short-term FX liabilities minus short-term FX assets.

Source: Bank of Korea staff calculations.

External debt: selected Asian EMEs — Figure 11

Ratio of short-term external debt to total external debt	Ratio of short-term external debt to foreign exchange reserves



[1] For China, end-Q4 2008.

Sources: Bank of Korea staff calculations; IMF, *International Financial Statistics* and Special Data Dissemination Standard.

Policy challenges

From now on, the monetary policies of EMEs will continue to face challenges related to financial spillovers and the global transition to a "new normal". The key challenges for Korea and other financially open EMEs can be summarised as follows.

First, unsynchronised exits by major advanced economies from their extraordinary monetary easing would be likely to create exchange rate volatility among key reserve currencies, which would in turn have significant implications for international trade and investment. A continued and large depreciation of the Japanese yen could harm Korea's competitiveness in global markets. Higher exchange rate volatility among the key currencies would add more uncertainty to the investment decisions of firms. Last, but by no means least, the financial spillovers from US monetary tightening – ie hikes in the federal fund rates – could be far more adverse than those resulting from tapering. Monetary policy would therefore need to be well calibrated in order to strike the right balance between financial stability and economic recovery.

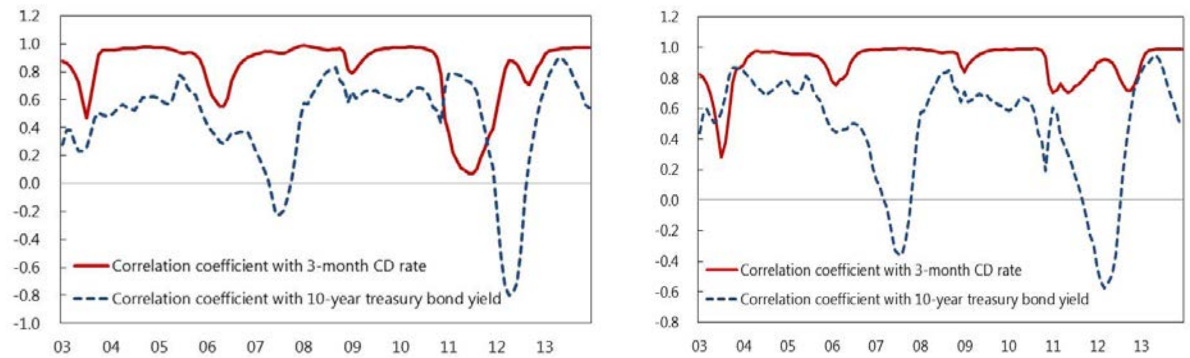
Second, EMEs operating under inflation targeting regimes may have to prepare for the risk of global secular stagnation and disinflation, if not deflation. Persistently lower global inflation will pass through to persistently lower domestic inflation. Under these circumstances, EME central banks may need to reconsider the suitability of their inflation targets. Similarly, the risk of secular stagnation would have profound implications for the natural rate of interest or the long-run equilibrium real interest rate. And even if the risk of secular stagnation is ruled out, there are good reasons to believe that the long-run equilibrium real interest rate will be at a lower level than in the past, eg owing to changes in prudential regulations and financial market infrastructure. If so, returning to the pre-crisis norm would be unduly contractionary.

Third, EME central banks may be forced to expand the scope of their monetary policies, thus risking their independence. Since the crisis, central bank mandates have in fact been expanded in many countries to include financial stability and/or growth and employment. Moreover, unconventional monetary policies and forward guidance have been used to manage virtually the entire yield curve, rather than just its short end. While extraordinary circumstances (eg hitting the zero lower bound or impairment of the monetary transmission channels) may offer some justification for such yield curve management, the information content of asset prices can be distorted or degraded as a result. Nevertheless, EME central banks may go beyond adjusting their policy rates and opt to manage the longer end of the yield curve as part of their policy responses to financial spillovers.

EME central banks may also be tempted to manage the yield curve because of the segmented corporate funding structure, whereby large firms fund mainly through capital markets, while small and medium-sized companies depend heavily on bank lending. In Korea, and perhaps many other Asian EMEs, short-term interest rates have accounted for an important part of monetary policy transmission to the real economy through their impact on bank lending rates. A large portion of the bank lending that goes to small and medium-sized firms and households has been offered at variable interest rates, and also at relatively short maturities (of, say, one year or less). Indeed, bank lending rates have tended to move in closer alignment with short-term (three-month) than with long-term (10-year) treasury bond rates (Figure 12). Moreover, short-term debt makes up a large share of total corporate debt (Figure 13).[5] Long-term interest rates, in contrast, matter more for large firms, whose primary sources of funding are capital markets. In consequence, the entire yield curve would probably become significant for corporate funding and investment.

Bank lending rates and market interest rates: correlations[1] Figure 12

Corporate lending rates Household lending rates



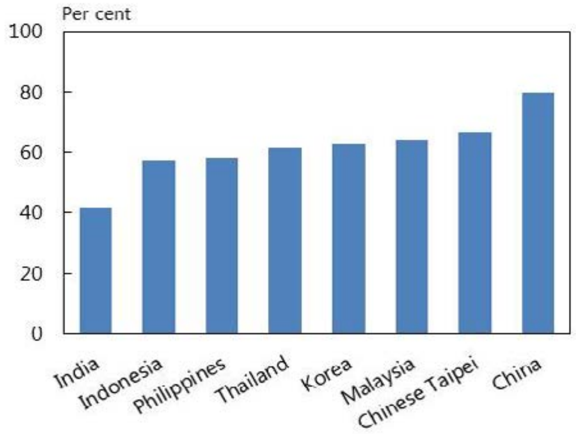
[1] Moving correlation coefficients over the preceding two years (24 months).

Source: Bank of Korea.

[5] IMF (2011).

Short-term corporate debt

As a percentage of total corporate debt Figure 13



Source: IMF (2011).

Lastly, but no less importantly, FX reserve management would pose increasingly more complex challenges to EME central banks. Total FX reserves have risen continuously since the global financial crisis, reaching US$ 7.5 trillion in June 2013, compared to US$ 4.9 trillion at end-2008. This is partly a result of the policy efforts of EME central banks to mitigate the complications arising from the surges in capital inflows associated with the unconventional monetary policies undertaken in advanced economies. On the central bank balance sheet, a large stockpile of FX reserves is typically matched by large domestic liabilities. This creates considerable currency mismatches and also causes great financial costs to central banks, given the positive domestic/overseas interest rate differentials. But large levels of FX reserves also bring financial benefits to the national economy as a whole, by offering greater financial stability and reducing the costs of external borrowing by the private sector. While the opportunity costs of holding large levels of FX reserves should therefore be compared to the financial stability benefits at the national level, central banks may assume most of these costs.

Easier and more predictable access to the global financial safety nets would probably be a short-term solution that could benefit both emerging and advanced market economies. An ultimate long-run solution would be the internationalization of EME currencies so that EMEs can borrow from global markets in their own currencies. To that end, EME central banks can act collectively to increase the global demand for their currencies for trade and investment purposes. Along this line of argument, the BOK has been active in arranging bilateral local currency swap facilities with other EME central banks. Such swap arrangements can be used to support trade settlement in local currencies and to help reduce excessive dependence on the US dollar.

References

Choi, C (2013): "Assessing the effects of macroprudential policy measures in Korea", *BOK Working Papers*, February.

International Monetary Fund (2011): *Regional Economic Outlook: Asia and Pacific*.

Spillovers from global monetary conditions: recent experience and policy responses in Malaysia

Sukhdave Singh[1]

Abstract

As a result of growing financial integration, domestic financial conditions are increasingly influenced by global financial conditions. This phenomenon has intensified after the advanced economies implemented their unconventional monetary policies, which have led to a surge in global liquidity. Both push and pull factors have accelerated the flow of capital into emerging market economies. In regard to Malaysia, the first point of impact has been on the exchange rate. There have also been price and quantity effects in the financial markets and on balance sheets. The capital inflows, and their subsequent reversal, have raised concerns over the risks to macroeconomic and financial stability. Given that these risks were assessed to exist only in specific segments of the financial system and the economy, macroprudential measures have been implemented over the past few years to address potential areas of vulnerability. Going forward, although volatility of financial flows and markets is likely to continue, the Malaysian financial system is expected to weather this volatility and remain resilient.

Keywords: Policy spillovers, capital flows management, macroprudential measures, Malaysia, monetary policy, financial imbalances

JEL classification: E44, E58, F62, F32

[1] Central Bank of Malaysia.

I. Introduction

As a result of growing financial integration, domestic financial conditions are increasingly influenced by global financial conditions. This phenomenon has intensified in recent years as the advanced economies (AEs) implemented their unconventional monetary policies (UMP), which have led to a surge in global liquidity. The associated capital inflows into emerging market economies (EMEs), and their reversal since May 2013, have raised concerns about the risks to macroeconomic and financial stability. This note focuses on Malaysia's recent experience, briefly highlighting trends in capital flows, before discussing the main channels of international monetary transmission, the ensuing impact on domestic financial conditions, and the policy implications.

II. Recent trends in capital flows

Along with other EMEs, Malaysia experienced a resurgence of capital inflows in the period following the 2008 global financial crisis (GFC) (see Chart 1). Cumulative net portfolio inflows over the period 2009–12 were more than twice the amount received over the period 2004–07.[2] Both push and pull factors played a role in capital flows to EMEs. This increase coincided with UMP in AEs, especially the three rounds of quantitative easing (QE) by the US Federal Reserve (Fed).[3] Higher interest rates and stronger growth in EMEs than in AEs acted as a "pull" factor for these flows. Using event studies and a global vector autoregressive (GVAR) model to examine the impact of QE[4] on domestic variables, Chua et al (2013) find that the QE episodes have had non-trivial effects particularly on exchange rates and asset prices for a group of EMEs, including Malaysia[5] (See Table 1 for developments in exchange rates and asset prices in selected Asian economies).

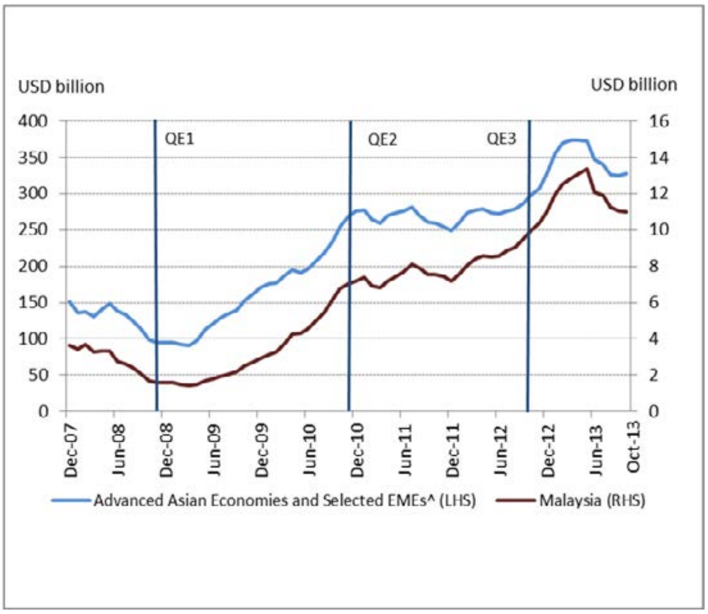
[2] Based on either Balance of Payments (Department of Statistics, Malaysia) statistics or EPFR Global data.

[3] For instance, in Ahmed and Zlate (2013) and Fratzscher et al (2012), the impact of UMP on capital inflows is analysed using panel data models whilst controlling for other potential determinants.

[4] US M2 growth is used as a proxy.

[5] This is corroborated by the Central Bank of Malaysia's internal estimation of factors affecting net portfolio inflows into Malaysia. Controlling for regional interest rate differentials and risk aversion, there appears to be a statistically significant positive effect from global liquidity.

Cumulative net portfolio inflows* into Malaysia and selected economies^ — Chart 1



* Sum of net equity and bond inflows, cumulated over time beginning January 2004. ^ Countries comprise China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand, Brazil, Chile, Colombia, Mexico and Peru.

Source: EPFR Global.

Asian currencies and asset prices performance during QE period
25 November 2008–21 May 2013 — Table 1

Countries	Exchange rate (% change against USD)^	Equity (% change)	10-yr government bond yield spread over policy rate (bps change)
Korea	34.0	104	-146
Singapore	20.9	113	-81*
Malaysia	20.2	109	-32
Thailand	18.7	326	60
Indonesia	27.0	355	-755
Philippines	20.7	307	-345

^ Positive values indicate appreciation. * Reflects only the change in 10-year government bond yield since Singapore does not have a policy interest rate.

Sources: Central Bank of Malaysia, Bloomberg, BNM staff calculations.

However, the subsequent period of volatility in international financial markets from May to September 2013, which was primarily due to expectations of the "tapering" of UMP[6] by the Fed, saw significant capital outflows from EMEs. Amidst heightened uncertainty and risk aversion, concerns about current account deficits and government debt positions in some EMEs increased significantly, amplifying capital outflows. In the case of Malaysia, about 40% of the portfolio inflows that had been received since the QE1 programme by the Fed reversed over a period of three months.[7] With substantial buffers in place, Malaysia was able to weather these reversals with minimal adverse effects on financial system stability and economic activity.[8] This episode underscored the importance of having strong economic fundamentals and understanding how capital inflows permeate the domestic financial system and create vulnerabilities.

III. Transmission channels and impact on domestic financial conditions

Post-GFC developments (November 2008–May 2013)

(i) Direct effects

The first point of impact for the transmission of global monetary conditions was on the exchange rate. In the period following QE1 by the Fed up to when the possibility of a tapering of Fed bond purchases was first raised, the Malaysian ringgit had appreciated by 20.2% against the US dollar (25 November 2008–21 May 2013). Since the floating of the ringgit in July 2005, foreign exchange intervention has become much less frequent. Operations have been focused primarily on ensuring smoothly functioning markets. On occasions when inflows or outflows had reached extreme levels, the central bank intervened in the foreign exchange market with the aim of mitigating volatility, maintaining orderly market functioning and reducing any destabilising effects on the real economy.[9] Intervention operations were

[6] See for instance, Koepke (2013), who finds that the capital flows retrenchment episode was primarily driven by a shift in market expectations towards an earlier tightening of Fed policy (increasing uncertainty and heightening risk aversion), rather than a markdown in expectations about EMEs' economic performance per se.

[7] May–August 2013. Source: BNM internal calculations.

[8] In general, internal and external imbalances financed by capital inflows are likely to exacerbate reversals, risking overcorrections in asset prices and balance sheets. Importantly, Malaysia has not been over-reliant on portfolio investments and external borrowings to either support the external position or to finance domestic activity. Instead, Malaysia's resilience has been supported by a robust level of international reserves (sufficient to finance 9.6 months of retained imports and 3.7 times the short-term external debt as at 31 December 2013), low external debt (32.1% of GNI at end-September 2013), and a strong and diversified financial system. Although lower than before, the current account balance continues to be in surplus. While the fiscal deficit position is of some concern (witness the Fitch sovereign rating outlook downgrade of Malaysia on 30 July 2013), it nevertheless had a relatively limited impact on capital outflows.

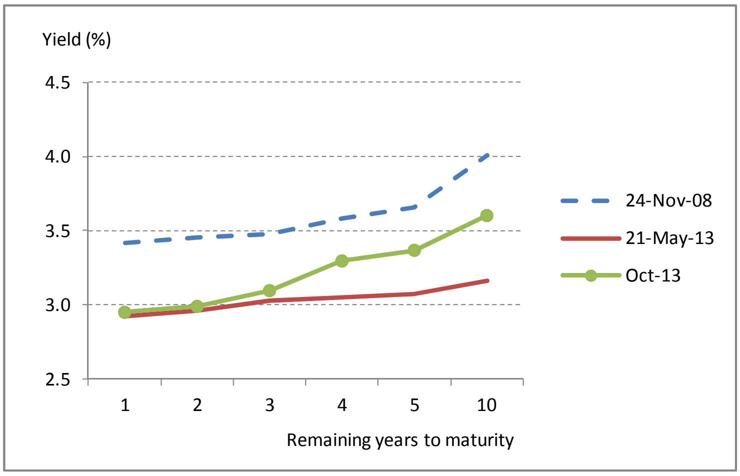
[9] While exchange rate appreciation has been broadly observed across EMEs in the past couple of years, overly rapid and sharp adjustments pose the risk of overshooting scenarios and misalignment, which may be detrimental to the real economy.

accompanied by sterilisation to maintain stable liquidity conditions in the interbank money market.[10]

As net capital inflows into Malaysia have mainly taken the form of portfolio investments rather than cross-border bank credit, the impact on financial markets, given foreign purchases of bonds and equities, has been more direct. This has the price effect of lowering yields and boosting equity prices, and also the quantity effect of expanding banks' balance sheets through the increase in external assets and bank deposits of the domestic non-bank sector.

Non-resident holdings of outstanding government securities[11] increased from about 12% on 25 November 2008 to 34% on 21 May 2013. Of the various government securities, non-resident demand was particularly pronounced in the case of Malaysian government securities (MGS), with holdings increasing from about 14% of outstanding MGS to approximately half over the same period. This resulted in a flattening of the yield curve (see Chart 2) with yields declining by between 22.9 and 56.6 bps.

MGS benchmark yield curve Chart 2



Source: Central Bank of Malaysia.

Capital inflows had a lesser impact on equity prices. Although the Kuala Lumpur Composite Index (KLCI) increased by 109% between late November 2008 and late May 2013, the share of non-resident holdings increased by only 4 percentage points to 25.8%. Similarly, in the case of yields on private debt securities (PDS), while some compression was observed, the share of non-resident holdings of PDS had in fact fallen to less than 5%. The impact of non-resident inflows on PDS yields has been indirect, coming through lower MGS yields and through increased demand for PDS among domestic investors following higher MGS prices.[12] PDS yields have also

[10] See Abdul Aziz (2013) for further details on foreign exchange intervention in Malaysia.

[11] Comprising Malaysian Government Securities, Government Investment Issues (GII), Malaysian Treasury Bills and Government Housing Sukuk.

[12] Controlling for other determinants, BNM's internal estimations suggest that non-resident holdings of MGS have a statistically significant effect on both MGS and PDS yields. Non-resident participation in the PDS market, however, is not a statistically significant determinant of PDS yields.

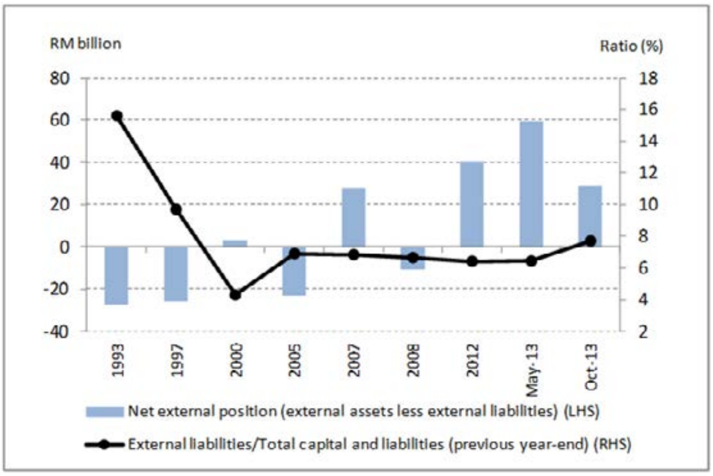
been driven by market-specific factors such as liquidity and changes to the credit outlook for corporates.

From a quantity point of view, as an indication of the impact net portfolio inflows might have had on the balance sheet of the banking system, non-residents effectively took up 61.4% of the increase (RM 203.7 billion) in outstanding government securities[13] from November 2008 to May 2013 (36.8% of RM 83.7 billion over 2004–07). The subsequent growth in domestic private sector deposits arising from government spending of these proceeds would have thus been indirectly driven by the external sector. Additionally, though of smaller magnitude, the net buying of equity by non-residents[14] would have also led to an increase in deposits of domestic agents.

Although domestic banks' external liabilities have increased in recent years, the international bank lending channel, via indirect credit (foreign banks' claims on domestic banks), has not been a particularly potent conduit in the transmission of global monetary conditions. The ratio of gross external liabilities to total liabilities of the banking system as a whole has remained relatively small and stable, notably lower than the levels observed during previous peaks in 1993 and 1997, when banks were net external borrowers (see Chart 3). Furthermore, the banking system's healthy net external assets position suggests that banks do not rely on external borrowing to fund their domestic lending activity. At the same time, although direct cross-border credit (foreign banks' claims on domestic non-banks) has increased, it remains small as a share of total financing. The Malaysian corporate sector's external debt[15] as a share of total corporate debt amounted to only 18.0% in September 2013 (end-2007: 22.4%; end-2005: 25.0%).

External position of the banking system

Chart 3



Source: Central Bank of Malaysia

[13] Comprised of MGS, GII, MTB and Government Housing Sukuk.

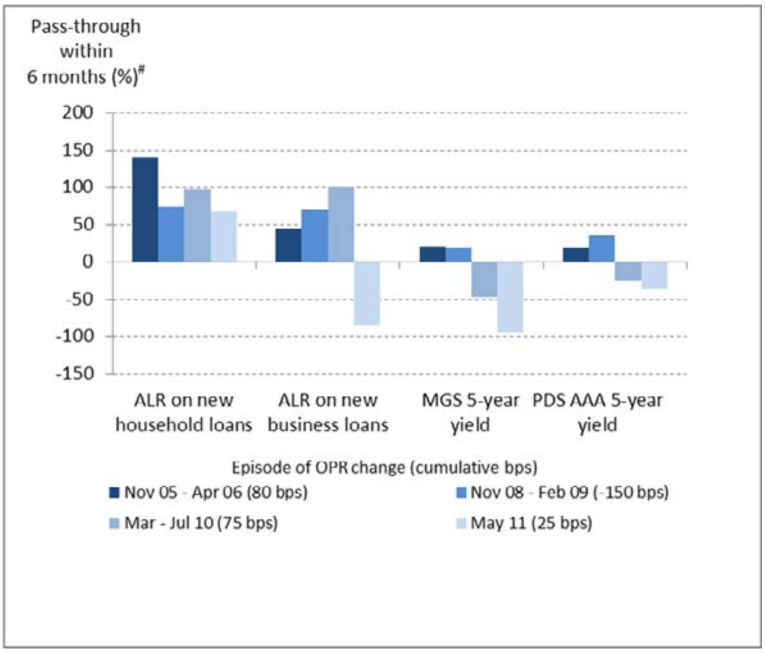
[14] Net buying of equity by non-residents amounted to RM 48.2 billion over January 2010–May 2013 (Source: Bursa Malaysia).

[15] External debt is measured as the foreign currency and ringgit debt owed to non-residents (ie the sum of loans and corporate bonds issued abroad in foreign currency, and non-residents' holding of domestic PDS).

(ii) Indirect effects

The international spillovers on financial markets and banks' balance sheets have also had indirect effects on the supply and cost of bank credit. Capital inflows increase private sector liquidity and banks' sources of funds. This provides an impetus for banks to match higher credit demand while competitively maintaining low or stable lending rates, as well as to increase their risk appetite. Lending rates on new loans to households have also declined. Generally, prices on all types of household loans have been affected by the ample liquidity and intense competition among banks, resulting in the compression of margins. This is notwithstanding different pricing structures across various types of loans. Fixed-rate loans (such as personal loans and hire purchase) are priced off interest rate swaps (IRS) and have a high correlation with MGS yields. Although floating-rate loans are predominantly priced off money market funds, which generally move with the overnight policy rate (OPR), the lending rates on these loans have also experienced downward pressure. Furthermore, the pass-through of policy rate changes to lending rates on new loans and bond yields has also declined slightly in the post-GFC period, particularly in the context of policy rate increases (see Chart 4).

Pass-through from OPR to average lending rates (ALRs) on new loans and bond yields — Chart 4



The pass-through is calculated as the six-month change in rates or yields after the cumulative change in the OPR. A negative value indicates that rates or yields moved in the opposite direction of the OPR.

Source: Central Bank of Malaysia.

A consequential policy concern is to pre-empt these developments from leading to a build-up of financial imbalances, particularly in the form of excessive credit growth and asset price misalignments. Internal assessments suggest that the risks of financial imbalances remain contained. Nevertheless, there are areas that have warranted close attention. In particular, loans to households and house prices have registered strong growth. Although the observed increases in credit to households and house prices have been broadly supported by fundamentals, pockets of vulnerabilities have required policy responses. These include high indebtedness among lower-income households, elements of over-investment and speculative activity in the housing market, as well as increased risk appetites and intense competition in the personal loans market. As a result, macroprudential measures have been implemented in stages since late 2010 to, among others, limit the maximum loan-to-value ratios on third and subsequent housing loans, increase the risk weights on some housing and personal loans, and reduce the maximum tenures on housing and personal loans. These measures have had positive effects. For instance, the growth rates of multiple housing loans and personal loans have both moderated (in the former case, from 15.4% in 2010 to 2.9% in September 2013, and in the latter case, from 20.5% in 2010 to 13.1% in September 2013).

The direct impact of capital inflows on the property market is estimated to be relatively limited. The participation rate of non-residents in the property market has remained relatively stable, averaging 5.5% of the total transactions involving properties valued at more than RM 500,000 from the period 2010–12. The effect of capital inflows is likely to be indirect via wealth effects and the easier availability of financing.

Volatility episode (May–September 2013)

The impact of capital outflows following market expectations of "tapering" by the Fed was confined to movements in the currency and bond yields. Also, the price discovery process remained orderly. Government bond yields, for instance, increased by less than in other countries, reflecting strong demand from domestic institutional investors.[16] The yield spread over the OPR for the five-year MGS increased by 55.6 bps, which was smaller than that experienced in other regional countries.[17] Despite the volatility, the MGS benchmark yield curve in October 2013 remained below those for various points in the past, particularly at the long-term tenures, while non-resident holdings of MGS remained relatively stable at 47% after the initial dip to 43% in September.

The financing needs of the economy were not compromised given the low reliance of banks on external funding[18] as well as their ability to meet any gaps that may have arisen from a possible curtailment of foreign bank lending to the domestic private sector, such as for trade financing. Retail lending rates were relatively unaffected and the ample liquidity situation in the banking system continued to prevail, as observed from the still large stock of liquidity absorbed by the Central Bank of Malaysia (BNM).

16 These domestic participants have sufficient capacity to step in and ease excessive volatility in the financial markets. The investible funds of the Employees Provident Fund, the Retirement Fund Incorporated, and insurance and takaful companies together amounted to RM 752.6 billion in 2012.

17 Average of 145.3 bps across Thailand, Philippines and Indonesia between 22 May and 28 August 2013.

18 The slight increase in US dollar funding costs by about 20–30 bps did not affect the availability of foreign currency financing.

IV. Policy implications and responses

The OPR remains the main policy lever used to affect aggregate demand in the pursuit of price stability and sustainable growth. While the direct impact of spillovers on the exchange rate and financial markets and the indirect impact on wider monetary and financial conditions complicate matters, the monetary policy stance continues to reflect domestic considerations, namely the outlook for inflation and growth. This is not to say that external factors do not matter for monetary policy – they certainly do, insofar as they affect broad domestic economic, monetary and financial conditions that are relevant for the policy rate decision. The OPR has not responded directly to changes in the monetary stance of AEs. Nor was the OPR used to support the exchange rate or to alleviate capital inflows or outflows that arose from interest rate differentials.

The ability to conduct independent monetary policy in this context is supported by the floating exchange rate regime, which provides more policy scope for managing capital flows, with the impact spread between the exchange rate and foreign exchange reserves. This, in turn, has increased the importance of foreign exchange reserves management and the availability of a range of sterilisation instruments. This is especially the case in an environment where changes in reserves reflect movements in capital flows that are highly dependent on risk sentiment and valuations, and are prone to quick reversals. BNM actively manages its investments, diversifying between short- and longer-term assets and between lower- and higher-rate fixed income assets based on market conditions and with a view to optimising the balance between risk and return. The greater international recognition of some EME currencies in this regard will allow for better optimisation of the trade-offs. Nevertheless, at this juncture, BNM's decisions to invest in other EME currency assets depend on country fundamentals, accessibility, regulatory impediments, financial market valuations and liquidity. On the liabilities side of the balance sheet, BNM relies on a wide range of sterilisation instruments for liquidity management, aimed at keeping the OPR stable and managing structural excess liquidity. The choice of instrument is based mainly on cost and duration considerations and the need for flexibility to manage intermittent liquidity creation and withdrawal. The use of BNM securities in particular has widened the pool of asset classes and allowed for liquidity to be absorbed directly from non-residents. This reduces the impact of capital inflows on other bond yields as well as on banks' balance sheets and excess liquidity, thus limiting, to some extent, the scope for credit expansion.[19]

The spillovers from global monetary conditions on some aspects of the domestic monetary transmission mechanism warrant continuous monitoring. Thus far, the ability of monetary policy to achieve inflation and output goals has not been compromised. In the near future, as global monetary policies become less accommodative, some normalisation in capital flows is likely, thus alleviating the earlier weakening of the pass-through from the policy rate to market interest rates. Given the interplay between economic and policy uncertainties in AEs, the volatility of capital flows will, nevertheless, be a feature of the financial landscape for the near

[19] Sterilisation using BNM securities with liquidity absorbed from non-residents limits the expansion not only in base money but also broad money. As at end-November 2013, non-resident holdings of outstanding BNM securities amounted to 72.2%.

future. How far these flows will affect the transmission mechanism will depend on factors such as their size and persistence, the variety and efficacy of available policy instruments, as well as the domestic financial system' structure and depth. The continuous integration and deepening of the financial markets, while increasing the sensitivity of yields and asset prices to external influences, will help strengthen the expectations channel. Regulatory changes will also play a role. For example, the recent introduction of risk-informed pricing guidelines in Malaysia, which addresses underpricing of risks in credit products, is likely to strengthen the transmission from policy rate changes to lending rates on new loans.

BNM has long recognised that different policy instruments may be required for different situations and objectives, depending on the nature of risks being confronted and taking into account the functioning of the economy and financial system. When domestic or cross-border risks to macroeconomic or financial stability are assessed to be specific, a targeted approach is required. Macroprudential measures implemented over the past few years have been aimed at addressing risks in specific segments of the financial system and the economy. Previously, in 1994 and following the Asian financial crisis (AFC) in 1998, capital flow management measures were used. These provided a similar targeted approach to address externally driven risks that were also hindering monetary policy autonomy and creating risks in the domestic financial system. Additionally, recognising the exceptional circumstances in the post-AFC recovery period, bank lending rates were linked directly to the then policy rate, the three-month intervention rate, to allow for faster transmission of changes in the policy rate. Funds for lending to small and medium enterprises (SMEs) and credit allocation targets were also used to influence the direction of credit extension. Unless in exceptional circumstances, however, the use of a broader policy toolkit does not reduce the importance of giving due consideration to the level of the policy interest rate since monetary conditions set the baseline conditions for risk-taking in the entire economy.

V. Conclusion

In the face of increasing financial globalisation, external factors such as abnormal cross-border capital flows due to UMP in AEs have exerted a stronger influence on the domestic financial conditions of many EMEs, including Malaysia, in recent years – despite the adoption of more flexible exchange rate regimes. In Malaysia's own experience, recent developments have reinforced the importance of the implementation aspects of monetary policy and the need for an expanded toolkit. The strong fundamentals, buffers and policy flexibility built up over the years have put the Malaysian economy on a good footing to meet the near-term challenges associated with adjustments to UMP in AEs. Although intermittent volatility is likely to be unavoidable, the financial system is expected to remain resilient, with the impact on financial markets cushioned by their depth and the liquidity support of domestic institutional investors. Most importantly, to ensure the continuity of sound fundamentals, precautionary measures have been implemented and continue to be taken to address potential areas of vulnerabilities. These have included macroprudential measures to address risks related to the property market and household indebtedness, and fiscal reforms to strengthen public finances and ensure fiscal sustainability.

Appendix: Developments in financial prices and quantities

	Cumulative Change		
	25 Nov 08 - 21 May 13[1]	22 May 13 - 31 Dec 13	25 Nov 08 - 31 Dec 13
Net portfolio inflows (USD billion) (Source: EPFR Global)	8.8	-2.2	6.7
MYR/USD (% change)	20.2	-8.2	10.3
MGS yields (bps change)			
3-year	-22.9	30.9	8.0
5-year	-35.3	58.9	23.6
10-year	-56.6	96.6	40.0
5-year PDS yields (bps change)			
AAA	-96.4	20.1	-76.3
AA	-110.1	18.5	-91.6
A	-31.1	7.0	-24.1
KLCI Index (% change)	109	4.5	118.3
	Nov 08 - May 13	**May 13 - Nov 13**	**Nov 08 - Nov 13**
ALRs on new loans (bps change)			
Households	-52	-2	-54
Businesses	-42	-19	-61
Lending to BNM by banks (RM billion)	13.5	-36.4	-22.9
	As at end		
	25-Nov-08	**22-May-13**	**31-Dec-13**
Non-resident holdings (% of total outstanding)			
MGS	14.1	50.3	44.9
Total Government Securities [2]	11.8	33.5	28.9
PDS	5.0	3.6	3.4
Equity	21.8	25.8	23.9

[1] Fed's QE1 announcement to market expectations of a scaling back of monetary accommodation.
[2] Includes Malaysian Government Securities (MGS), Government Investment Issues (GII), Malaysian Treasury Bills (MTB) and Government Housing Sukuk.

Source: Central Bank of Malaysia.

References

Abdul, A (2013): "Foreign Exchange Intervention in Malaysia", *BIS Papers*, no 73.

Ahmed, S and A Zlate (2013): "Capital flows to emerging market economies: a brave new world?", *International Finance Discussion Papers*, no 1081, Board of Governors of the Federal Reserve System, June.

Central Bank of Malaysia (2012): "Developments in the housing market and implications for financial stability", *Financial Stability and Payment Systems Report*.

Chua, W, N Endut, M Khadri and W Sim (2013): "Spillovers of global monetary easing and the available lines of defence for EMEs", *BNM Working Paper*, http://www.bnm.gov.my/files/working_papers/sim_et_al_FINAL_261213_JKK.pdf.

Fratzsher, M, M Lo Duca, and R Straub (2012): "A global monetary tsunami? On the spillovers of US quantitative easing", *Discussion Paper*, no 9195, Centre for Economic Policy and Research, October.

Koepke, R (2013): "Quantifying the Fed's impact on capital flows to EMs", *Research Note*, Institute of International Finance.

Global policy spillovers and Peru's monetary policy: inflation targeting, foreign exchange intervention and reserve requirements[1]

Renzo Rossini,[2] Adrián Armas[3] and Zenón Quispe[4]

Abstract

This paper provides an overview of the monetary policy actions undertaken by the Central Reserve Bank of Peru, combining its main inflation targeting framework with sterilised FX interventions and reserve requirement measures in order to overcome the spillover effects of global policies to counter the recessionary implications of the global financial crisis. We provide a rationale for the use of these instruments, as well as empirical evidence on their effectiveness. In general, the results show that sterilised FX interventions and reserve requirement changes have the desired effects in limiting spillover effects and smoothing out the interest rate and credit dynamics in a dual monetary economy such as Peru.

Keywords: Non-conventional policy, inflation targeting, foreign exchange intervention, reserve requirements

JEL classification: E51, E52, E58, F31

[1] The reserve requirement overview and evaluation is based on Armas et al (2014).

[2] General Manager, Central Reserve Bank of Peru.

[3] Manager of the Research Department, Central Reserve Bank of Peru.

[4] Head of Monetary Program, Monetary Policy Design Division, Central Reserve Bank of Peru.

1. Introduction

As a policy response to deal with the macroeconomic challenges brought about by financial dollarisation and its implications for financial vulnerability, the Central Reserve Bank of Peru (Banco Central de Reserva del Perú, BCRP) adopted an inflation targeting (IT) regime in 2002 and became the first monetary authority to implement this framework under a dual monetary system.

IT in Peru has a particular design. The BCRP actively intervenes in the FX market to smooth out exchange rate fluctuations and build international reserves as a self-insurance mechanism against negative external shocks. Since 2008, reserve requirements (RRs) have been used as an active monetary control tool to moderate the impact of capital flows on domestic credit conditions in both domestic and foreign currency. The BCRP has also set high RRs on foreign currency liabilities as a prudential tool to face liquidity and foreign currency credit risk. These additional policy tools have eased the trade-offs that the BCRP faces when implementing standard monetary measures within an IT regime that simultaneously takes into account financial dollarisation considerations.

The prompt use of RRs in Peru's monetary policy framework has allowed the BCRP to induce the necessary quantitative tightening (QT) required to face the domestic spillover effects of the unprecedented quantitative easing (QE) policies implemented by developed countries.

This paper describes the relevance of RRs as a complementary instrument for monetary policy based on this experience. The paper is organised as follows: Section 2 provides an overview of Peru's monetary framework, including the standard interest rate setting; Section 3 evaluates the general implications of the spillover effects of global quantitative monetary policy; Section 4 elaborates on the sterilised FX intervention; Section 5 discusses the use of RRs as a monetary policy tool, the transmission mechanism of RR changes and the control of financial dollarisation risks as well as liquidity risks; Section 6 performs the empirical evaluation of RR policies; and Section 7 concludes.

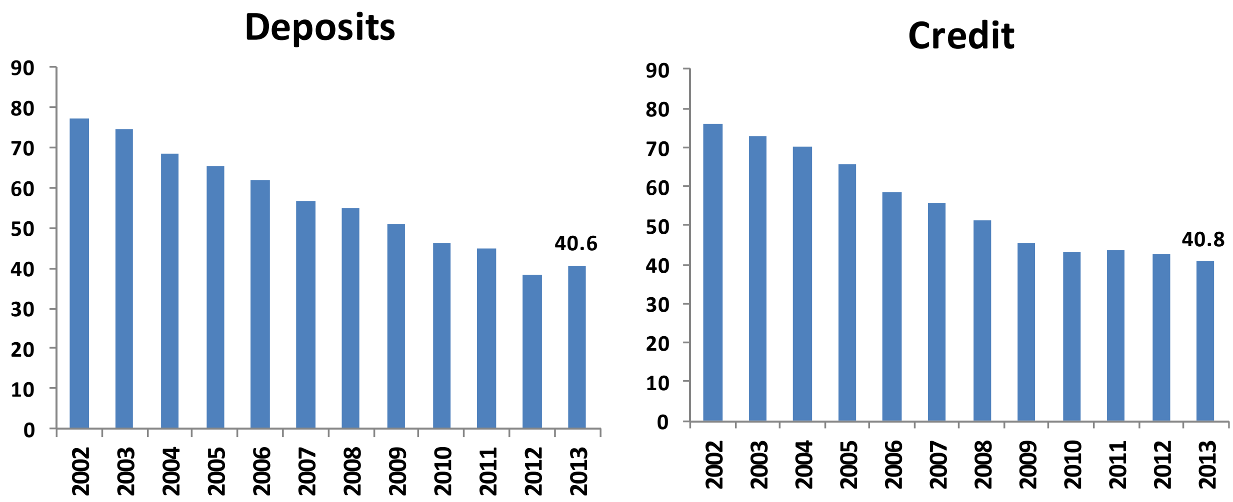
2. The monetary policy framework

In place since 2002, Peru's current monetary policy framework is best characterised as a full-fledged IT regime which explicitly takes into account the risks created by financial dollarisation (FD). Figure 1 shows Peru's high level of financial dollarisation. The inflation target is a 2% annual increase in the consumer price index, with a tolerance band ranging from 1 to 3%. Before the adoption of IT, monetary policy in Peru was implemented through a monetary target framework that used the annual growth rate of the monetary base as an intermediate target and also included instruments such as FX intervention and high RRs for deposits in foreign currency.

When IT was adopted, the aforementioned policy tools used to face FD risks remained in place (Figure 2 illustrates Peru's IT framework). Webb and Armas (2003) and Armas and Grippa (2005) defined the implementation of the IT framework in a financially dollarised economy as a combination of a standard interest rate rule setting plus the active use of other instruments to control financial risks.

Dollarisation ratios

(Percentage of total) Figure 1

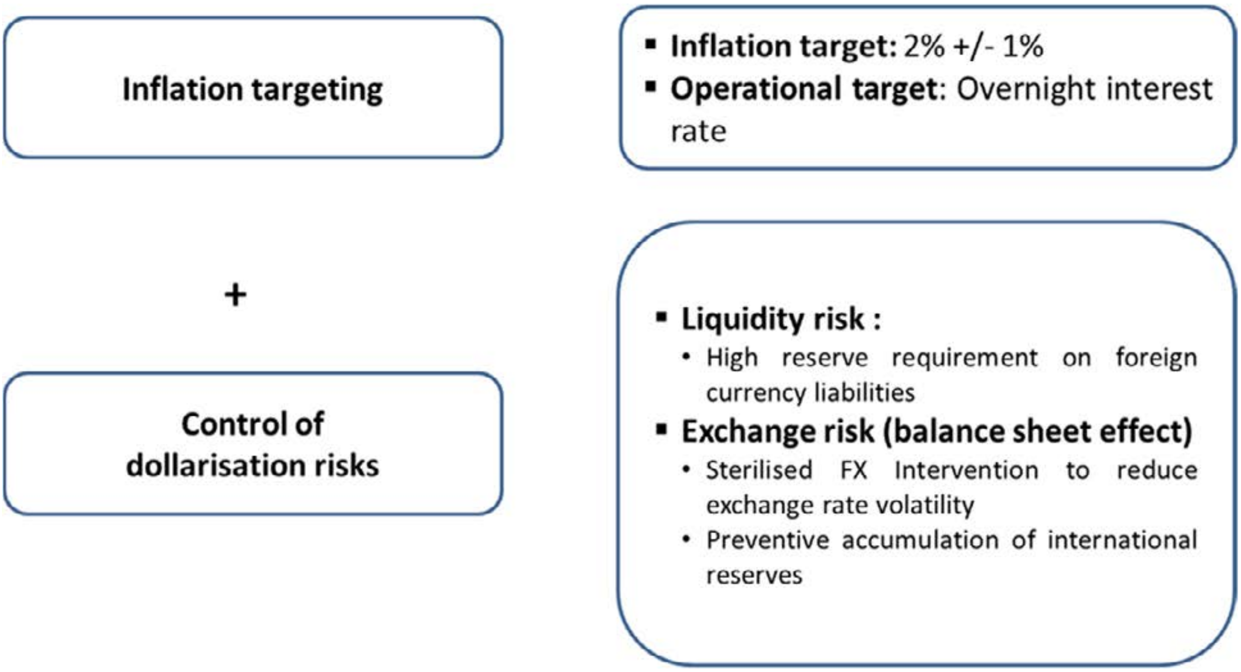


Since 2008, RRs have been changed frequently to complement changes in the policy interest rate. The main reason for this new role of RRs was the unprecedented expansionary monetary policies launched in developed economies, which triggered the zero lower bound for their policy interest rates and the implementation of QE. The central banks of emerging economies had to respond with different actions to deal with the spillover effects of these ultra-easy policies, mainly capital inflows and low international interest rates. Figure 3 summarises the different economic cycles and policy responses of both developed and emerging economies during the QE period.

Since 2008, changes in the marginal and average RR ratios have been used cyclically in tune with the challenges posed by the new international environment. RRs have been raised in response to capital inflow episodes, such as in Q1 2008, and later on since H2 2010, following the announcement of QE2. RRs were tightened with the aim of offsetting the impact of capital inflows on credit (particularly in dollars), which also gave the BCRP an increased capacity to inject foreign currency liquidity in case of a sudden capital flight. In spite of the country's high degree of FD, this policy framework has proven to be effective in dampening financial risks. In contrast to what happened during the Russian crisis, when a sudden stop in capital flows triggered a credit crunch, in 2008 the BCRP was better prepared: high international reserves and higher RRs allowed a massive injection of liquidity into the system and prevented another credit crunch.

The inflation targeting plus dollarisation risk control framework in Peru

Figure 2



Quantitative easing and quantitative tightening

Figure 3

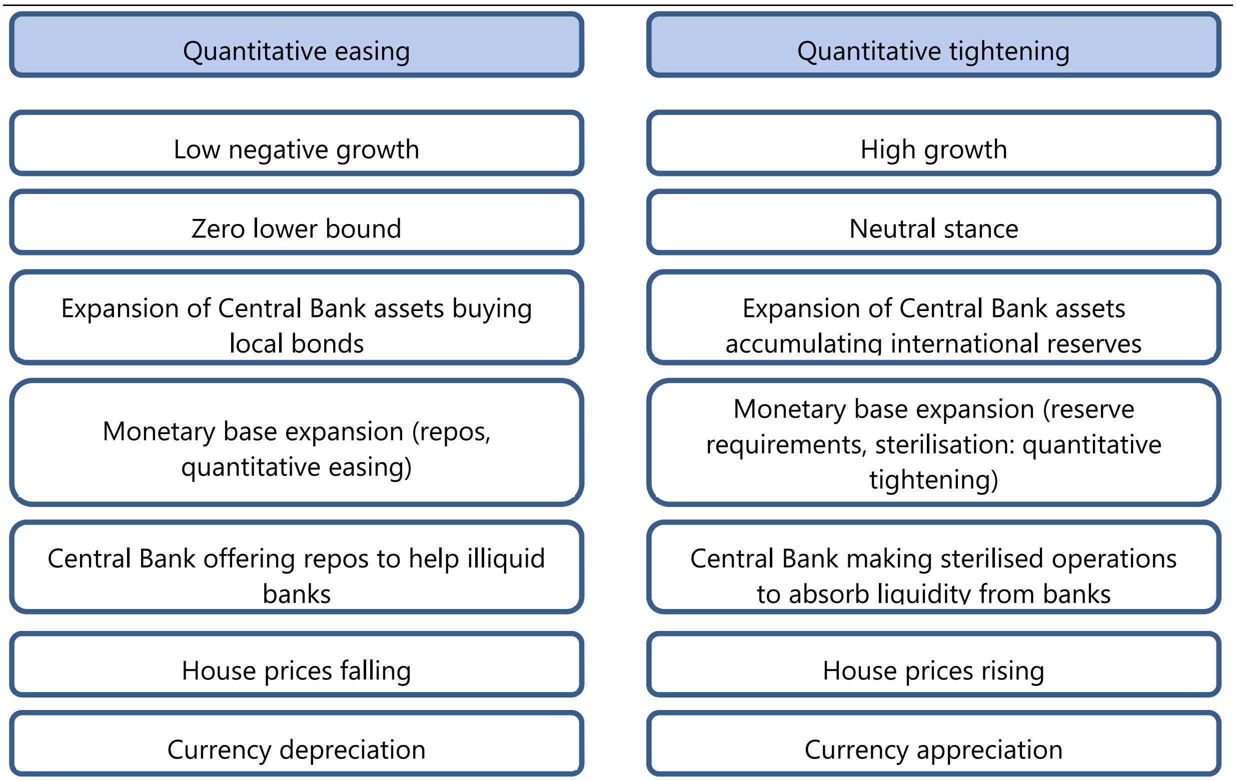
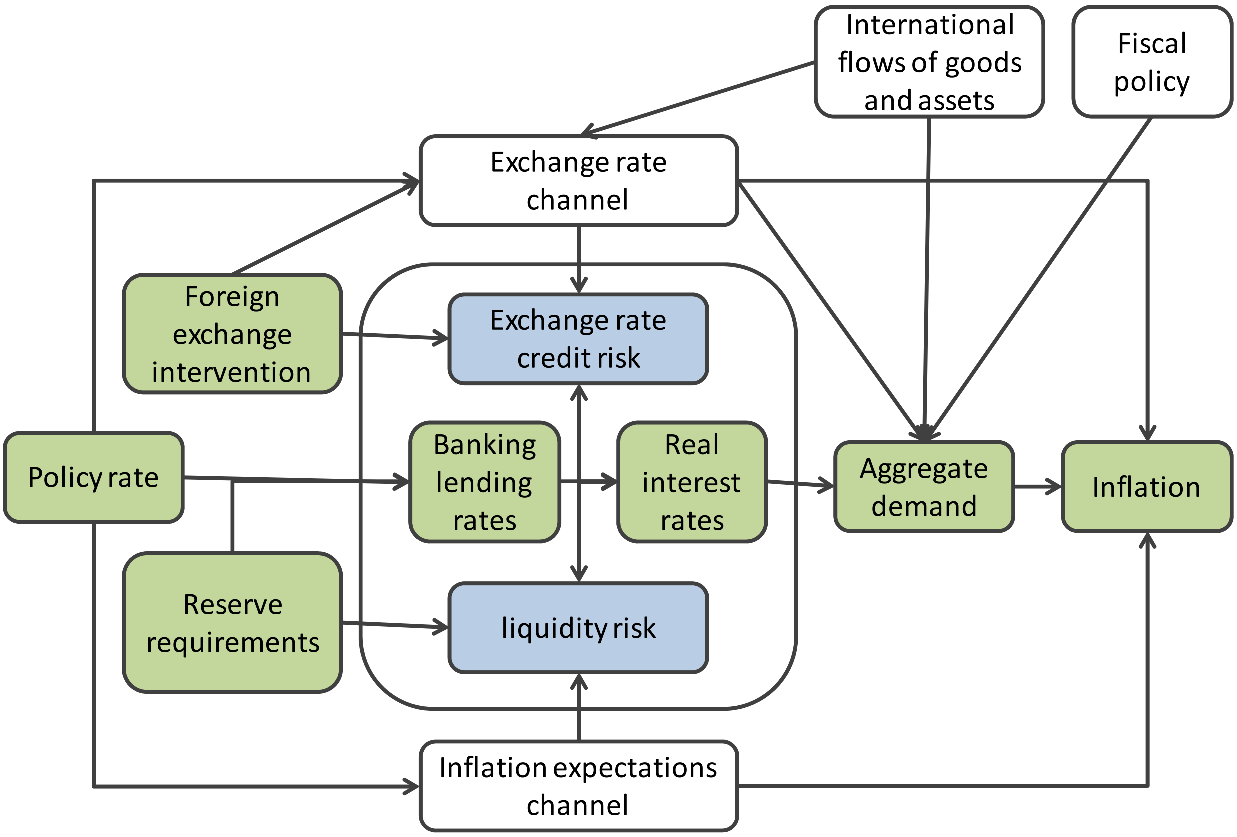


Figure 4 illustrates how the use of non-conventional monetary policy tools complements the use of the policy rate. Interventions in the foreign exchange market aimed at offsetting excessive exchange rate volatility reduce systemic risks associated with sharp exchange rate depreciations, whereas the use of high and cyclical RRs in foreign currency contributes to curbing systemic liquidity risks associated with FD.

Peru's monetary policy framework

Figure 4



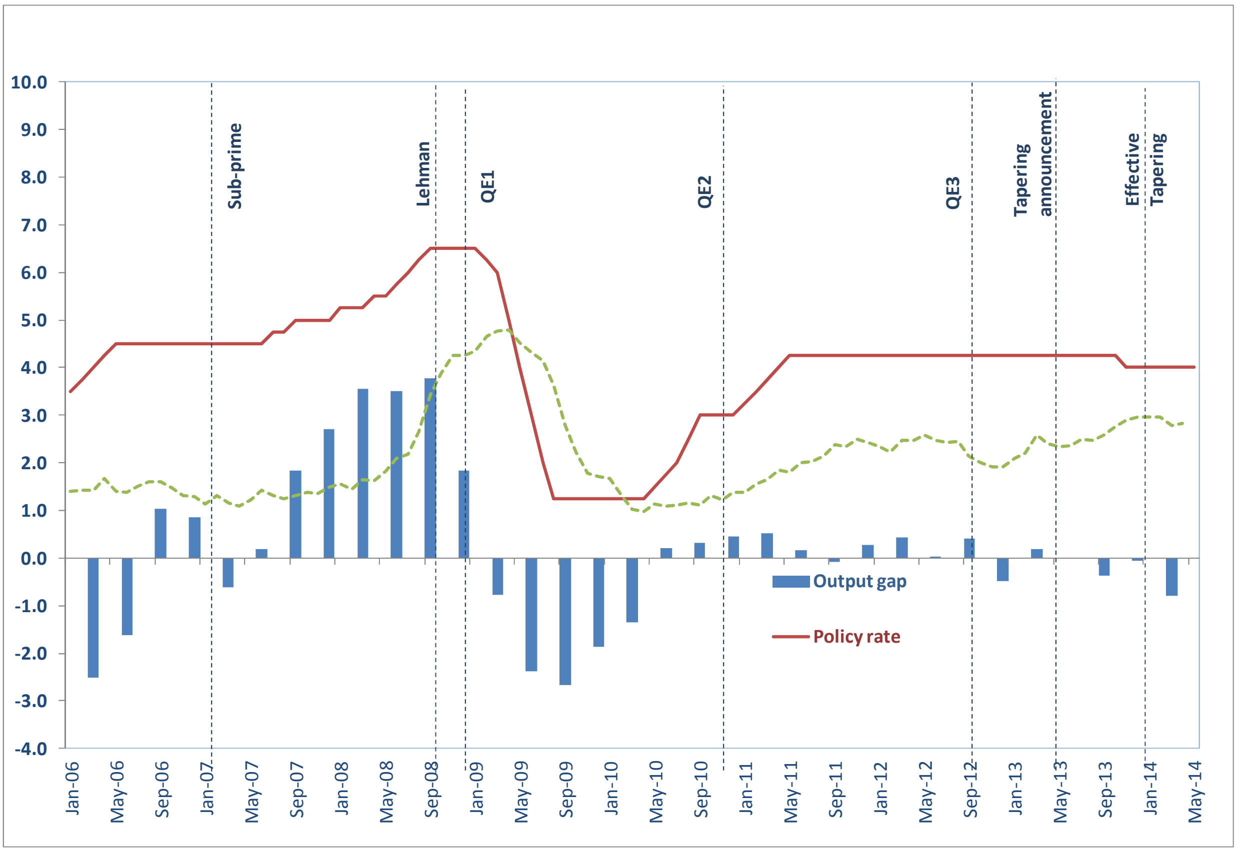
Standard interest rate setting under Peru's IT (2002–12)

The operational target of monetary policy is the short-term interest rate. Like any other central bank with an IT regime, the BCRP uses this operational target to deliver the monetary policy stance to the market. A central bank tends to increase its policy interest rate to fight inflationary pressures during periods of high inflation or output gap levels; conversely, when inflation is below the central bank's target and the output gap is negative, the central bank tends to cut its policy rate. However, in a financially dollarised economy, the interest rate setting also has to take into account how FD affects the transmission mechanism of monetary policy. The BCRP addresses this issue by using an inflation forecasting model (Modelo de Proyección Trimestral, MPT) that explicitly takes into account the impact of dollarisation on credit market conditions and on the dynamics of the exchange rate and inflation (Winkelried (2013)). In this model, dollarisation reduces the impact of monetary policy on inflation and the output gap, since a large depreciation not only typically generates a positive impact on exports, but also triggers a negative impact on the financial position of firms with currency mismatches. Thus, with FD, the typical expansionary effect of the exchange rate channel after the implementation of a policy easing measure is considerably reduced when there is a sharp depreciation. The expansionary net export effect will prevail over the balance sheet effect when depreciation is low. The MPT takes into account the impact of both RR changes and interventions in the foreign exchange market on the dynamics of interest rates and the exchange rate.

Figure 5 shows the evolution of the policy rate, the output gap and core inflation since 2004. As we can see, the policy rate has actively responded to the evolution of both inflation and the output gap. In particular, this has been the case in indicators such as core inflation and inflation expectations during episodes characterised by important changes. Estimations of the policy rule for 2002–09 show that it not only meets Taylor's principle, but also that the central bank gives more importance to reducing inflation volatility than output gap volatility. The estimations reported by Salas (2011) show that the interest rate response to inflation is close to 1.9 and the response to output is close to 0.5.

Evolution of the policy rate, output gap and core inflation

Figure 5



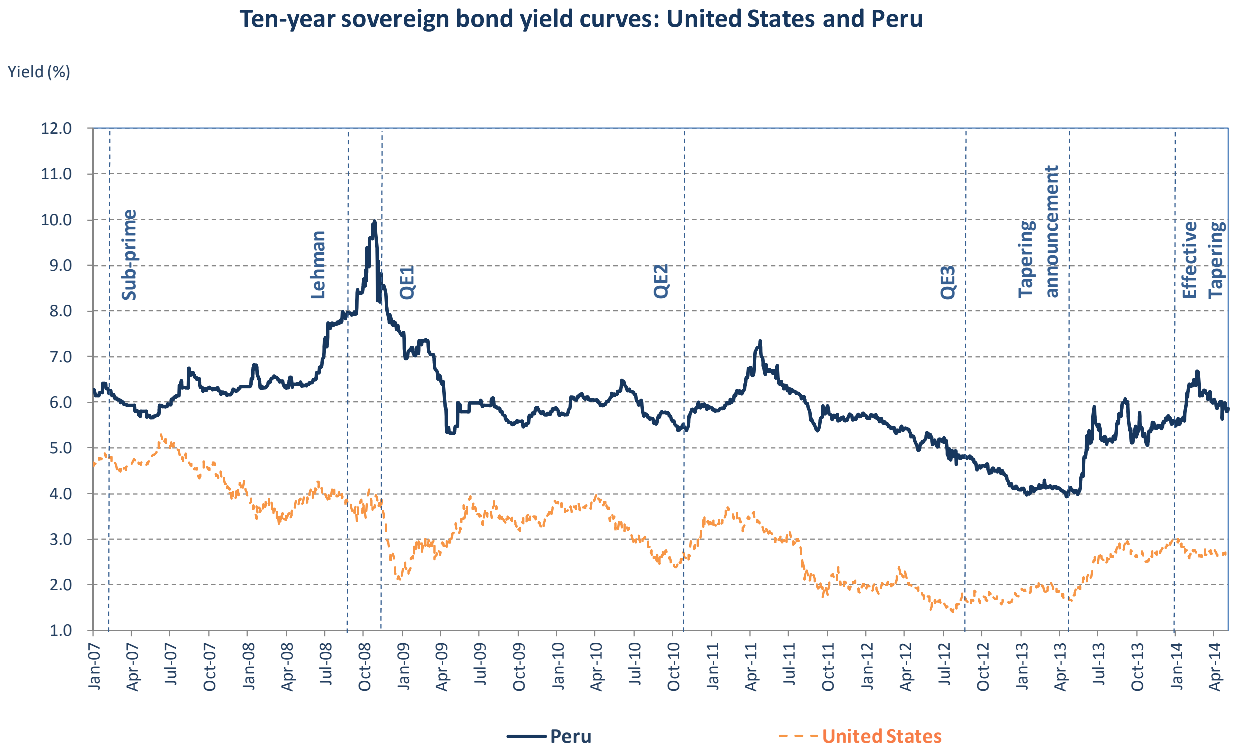
Two episodes highlight clearly the BCRP's active response to changes in the expected rates of inflation and the output gap. The first started in July 2007, when the central bank began to raise interest rates in response to a persistent rise in inflation. During that period, the BCRP increased its reference interest rate eight times, from 4.5% to 6.5% (a total of 200 basis points). The second episode followed the collapse of Lehman Brothers. The BCRP cut the policy rate aggressively, from 6.5% to 1.25% in six months. The policy rate cuts were effective in reducing interest rates not only in the money market, but also in the rest of the financial system. For example, the average interest rate on loans with maturities up to 360 days fell from 15.5% to 11.1% between January and December 2009.

3. Global policy spillovers and the Peruvian capital market

The collapse of Lehman Brothers ushered in the spreading of the subprime crisis to emerging economies, first through higher yields on emerging sovereign bonds, which in the case of Peru were around 10% for a few weeks (Figure 6). That was the first stress test for sovereign bonds, which began to develop in Peru simultaneously with the IT scheme.

The QE policy led by the US Federal Reserve in the developed world generated capital flows towards emerging economies, attracted by the nominal rates on domestic Treasury bonds. This trend was clear in Peru from October 2010, with the Fed's QE2, and then further enhanced by QE3 (Figure 7). For the first time in Peru's history, the majority of holders of Treasury bonds denominated in domestic currency were foreigners.

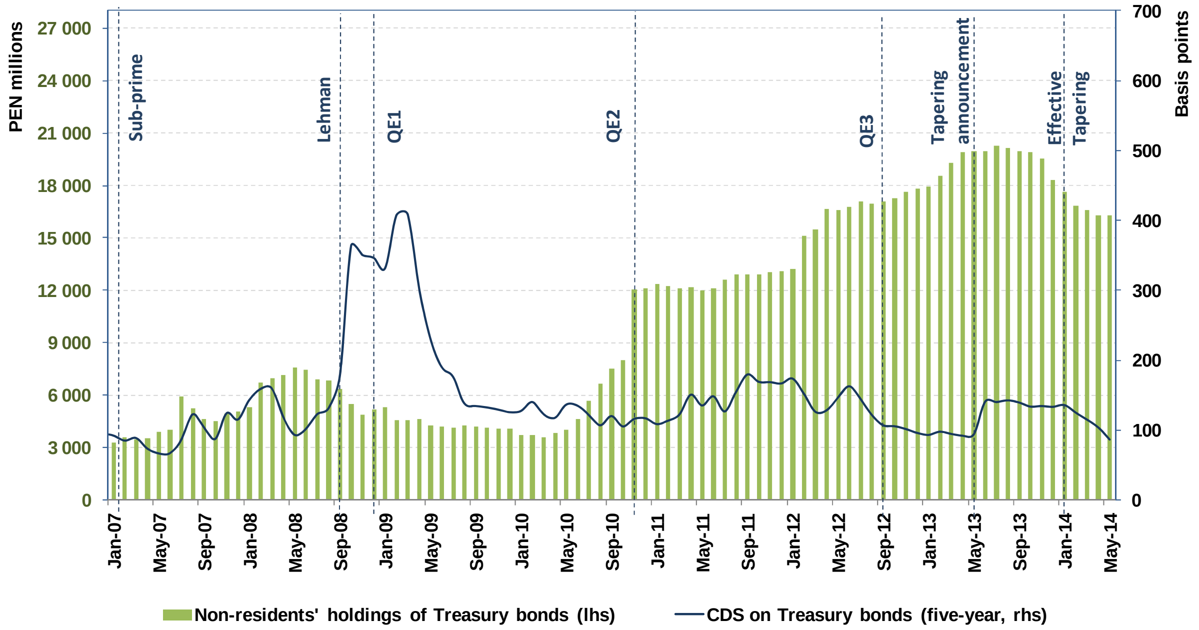
Sovereign bond yield curves | Figure 6



In May 2013, with Chairman Bernanke's hint that the Fed would start tapering its asset purchase programme, the yield on Peru's 10-year Treasury bonds jumped from around 4% to 6% (Figure 6), with no implications in terms of non-residents' holdings of Treasury bonds. However, after the tapering process started in January 2014, there were some outflows away from sovereign bonds despite the reduction of the corresponding CDS spreads (Figure 7).

Non-residents' holdings of Treasury bonds and CDS spreads

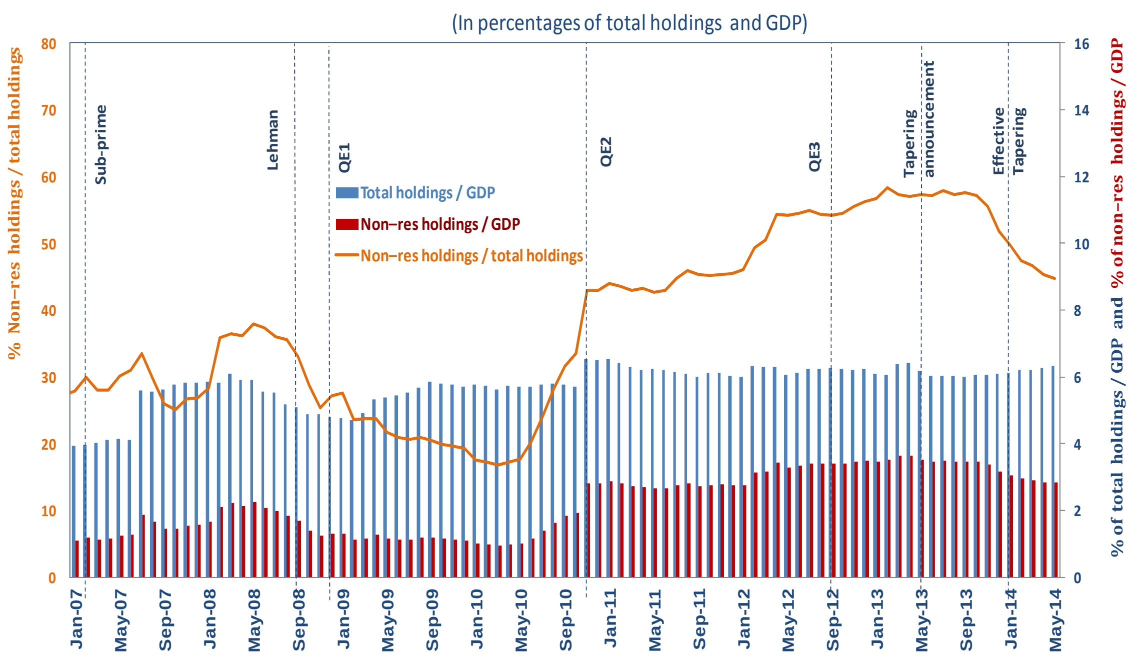
Figure 7



Non-residents' shift away from Peruvian Treasury bonds did not imply a higher risk for Peru's economy, as domestic institutional investors absorbed the remaining bonds and the fiscal position was sound (a fiscal surplus of 0.9% of GDP in 2013, the highest in Latin America) and very liquid (public sector deposits at the BCRP amounted to 12% of GDP). The government continued issuing Treasury bonds that were widely accepted by capital markets. The stock of Treasury bonds increased from 6% of GDP in June 2013 to 6.3% of GDP in May 2014 (Figure 8).

Non-residents' holdings of Treasury bonds

Figure 8



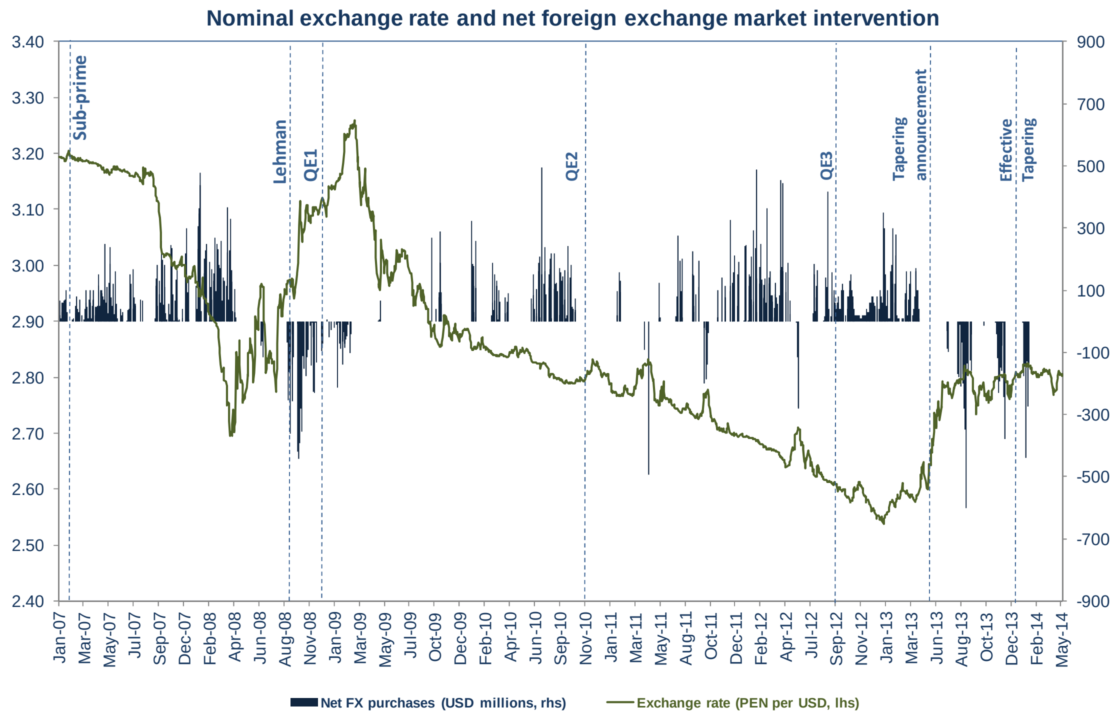
4. Sterilised foreign exchange interventions

In the case of Peru, the main purpose of foreign exchange intervention is to reduce exchange rate volatility and accumulate international reserves in order to prevent balance sheet effects, given the partially dollarised financial position of the domestic private sector. Dollarisation magnifies the reaction of financial intermediaries to sharp movements in their funding or 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 affecting the quality of the credit portfolio. Thus, dollarisation distorts the transmission mechanism of monetary policy and increases liquidity and solvency risks within the financial system.

Foreign exchange interventions are carried out avoiding any signalling regarding the level of, or a possible ceiling or floor for, the exchange rate. Since the beginning of the BCRP's interventions under a floating exchange rate system (1990), these operations have been carried out in a discretionary manner. This approach seems to serve Peru's economy well, as opposed to rules-based intervention.

Foreign exchange intervention

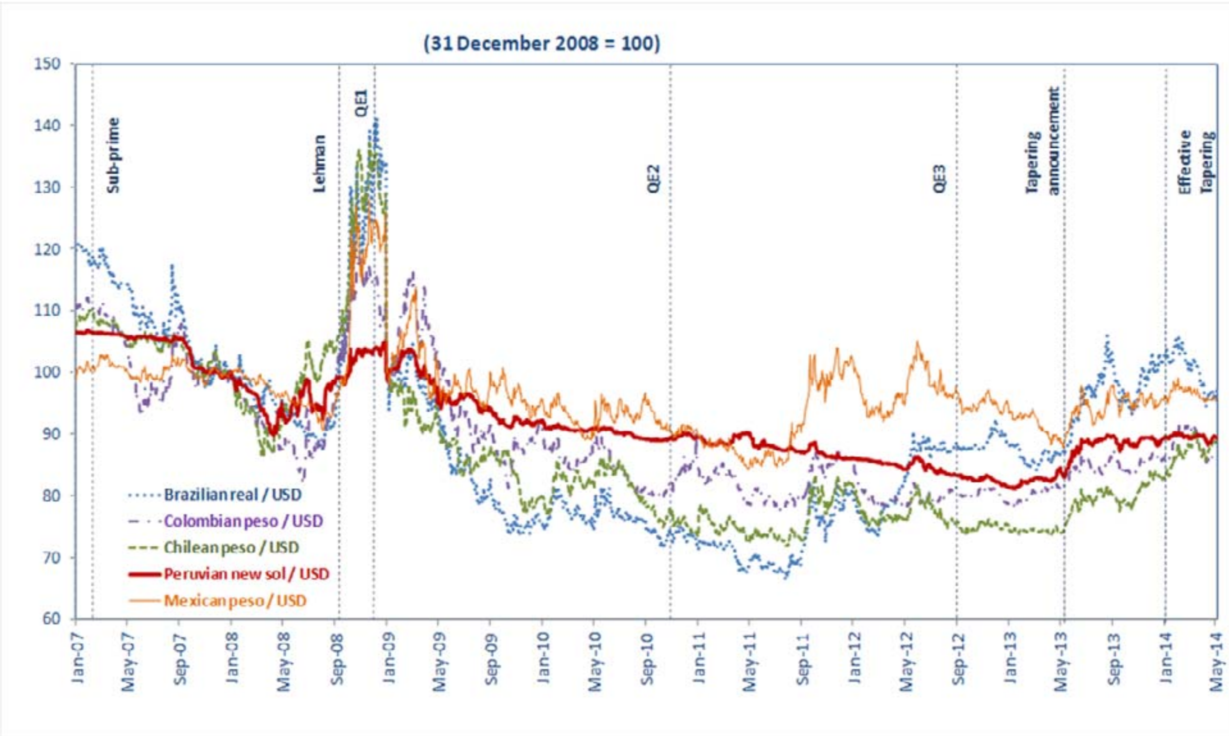
Figure 9



Interventions are implemented by purchasing or selling dollars in the spot market and by carrying out swaps and reverse swaps. Swaps and reverse swaps are used mainly when banks might be forced to translate pressures from the non-deliverable forward (NDF) market into the spot market. In this regard, a swap operation with the BCRP can provide temporary coverage against NDF market risks.

Latin American nominal exchange rate indices

Figure 10



In highly dollarised economies, it is convenient to build up international reserves to ring-fence the economy against risks associated with FD. Every economic crisis in Peru from the Great Depression and until 1990 was initiated by balance of payments problems. Given that historical background, international reserves as a self-insurance mechanism against international liquidity shortages are a key element of monetary policy design. These cases fall into the category of structural conditions for reserve accumulation. However, the recent need for reserve accumulation is partially associated with important short-term capital flows due to the very accommodative stance of monetary policy in the developed world, which in fact should be considered cyclical. International reserves help a country to preserve economic and financial stability, as they guarantee foreign currency availability in unusual situations, such as possible and significant withdrawals from the financial system or temporary external shocks which could generate imbalances in the real sector and feed back into expectations. Additionally, adequate foreign exchange reserves help to reduce country risk (and improve the associated credit ratings), thereby providing firms with better conditions to access international capital markets.

As shown in the BCRP balance sheet, international reserves are funded mainly by public sector deposits and RRs. BCRP securities and currency in circulation also fund the international reserve accumulation, but to a lesser degree**.** To sterilise the liquidity created by FX interventions, the BCRP issues its own Certificates, currently with maturities of up to 18 months, auctioned on a daily basis, which are complemented by banks' RRs and Treasury deposits. The following table shows a summary of the 2013 BCRP balance sheet in percentages of GDP, where 11.9% represents sterilisation through Treasury deposits (associated with a solid fiscal position); 11.0% is explained by RRs; BCRP Certificates explain 3.7% of the sources of net international reserves; and currency in circulation accounts for 5.1%.

Balance sheet of the BCRP as of December 2013

(as a percentage of GDP)

Table 1

Assets		Liabilities	
International reserves	**31.8**	**Treasury deposits**	**11.9**
		In domestic currency	6.7
		In foreign currency	5.3
		Reserve requirements	**11.0**
		In domestic currency	4.1
		In foreign currency	6.9
		Central bank instruments	**3.7**
		Currency in circulation	**5.1**

5. The use of RRs by the BCRP

The BCRP uses RRs mainly for: (a) monetary control, (b) limiting dollarisation risks and (c) increasing the maturity of banks' external leverage.

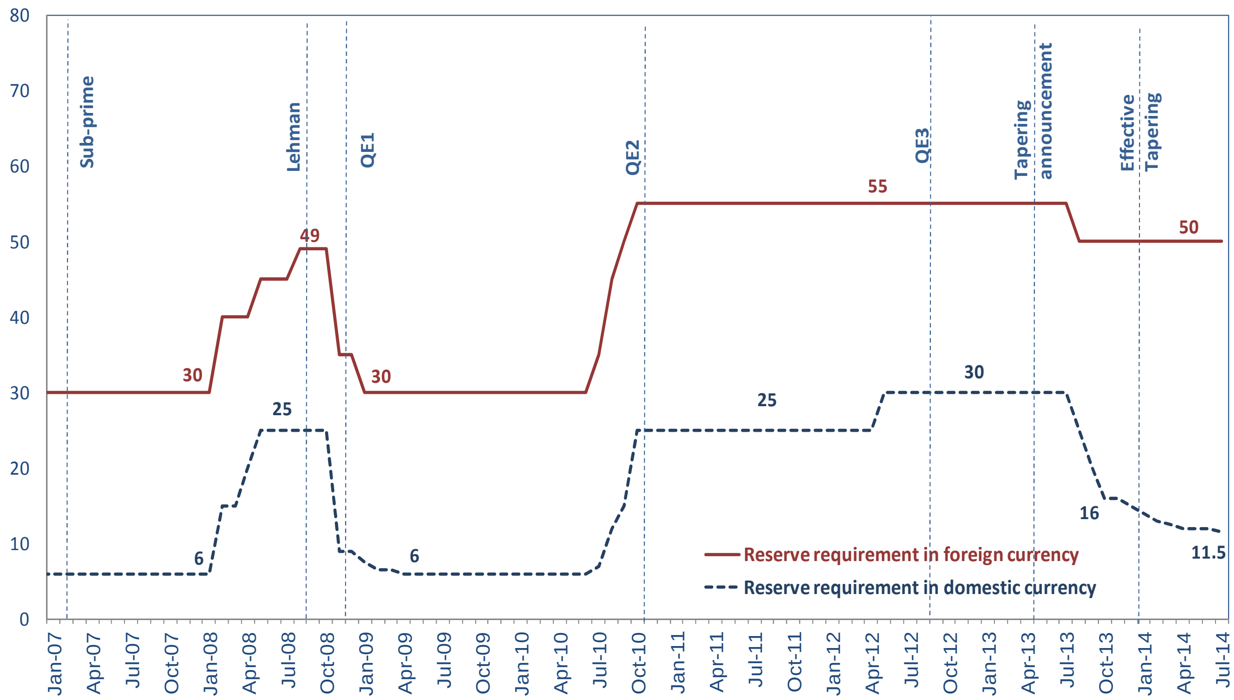
a. RRs as an active monetary control tool

Non-conventional instruments such as RRs have been used in Peru since the 1990s to preserve the transmission channels of monetary policy and prevent systemic risks associated mainly with exchange rate mismatches and liquidity risks created by FD. The scope and use of RRs have changed in recent years. Before the adoption of IT, and in response to high FD, RRs on foreign currency obligations were higher than on domestic currency obligations. Differential rates seek to encourage banks to internalise the risk of granting dollar-denominated loans to economic agents that do not generate dollar incomes; and to create a foreign exchange liquidity buffer to reduce systemic liquidity risks, given that the BCRP cannot act as lender of last resort (LOLR) in foreign currency. During this period, RRs were not used cyclically and only targeted domestic sources of bank funding.

In recent years, RRs have been used by the BCRP as complementary to its short-term interest rate. As such, they have helped to break the trade-off between macro and financial stability. In particular, the RR-induced QT dampened the expansionary effects of capital inflows on domestic credit conditions and, through this channel, also reduced the output gap and inflationary pressures. In the presence of RR policy, this QT effect on the output gap implies that the policy rate may not need to rise as much. Therefore, the use of QT under persistent capital inflows and a still underdeveloped local capital market is analogous to a fiscal policy tightening that also allows a lower policy rate and a less appreciated domestic currency; and, as such, introduces a new dimension in the policy mix space, one that must also take into account the relationship between RRs and policy rates.

Reserve requirements in domestic and foreign currency

(Percentage of total liabilities subject to reserve requirements) Figure 11



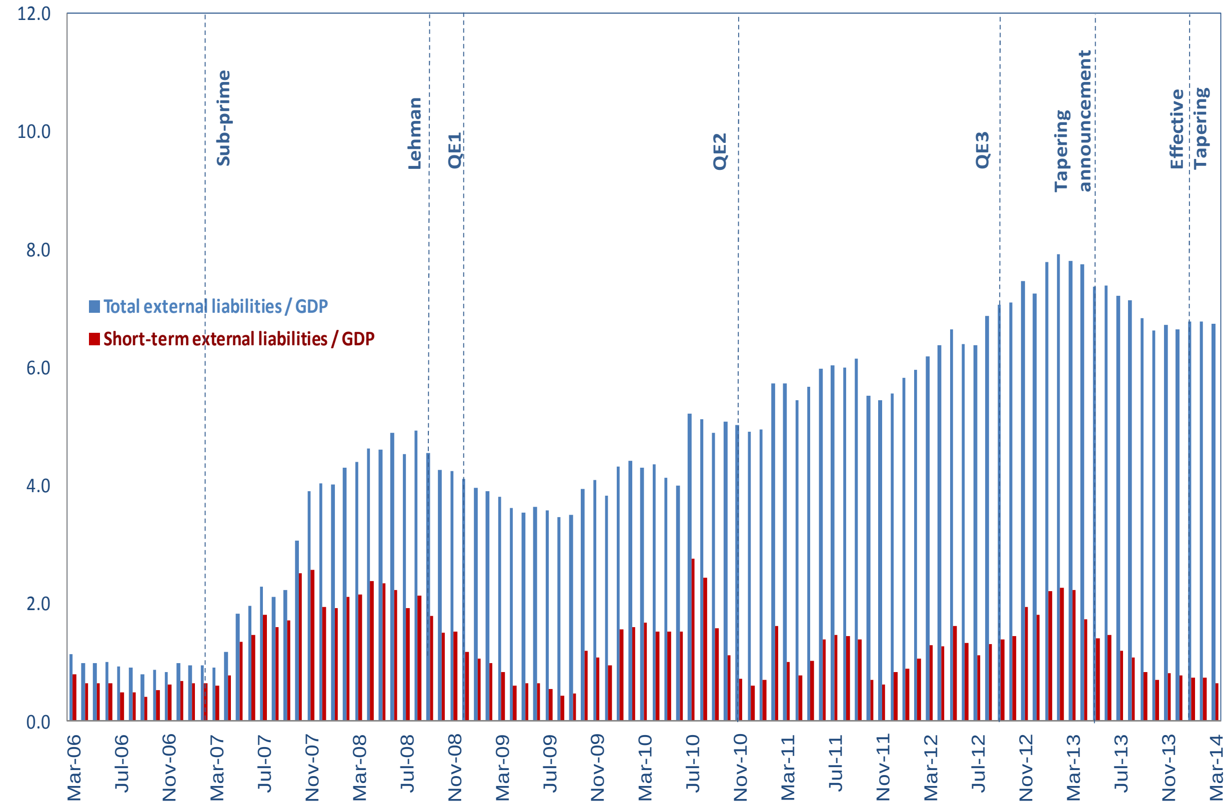
In addition, under massive capital inflows or very low international interest rates, FD strengthens the spillover from expansionary international monetary conditions to the domestic financial system, which weakens domestic monetary policy. This is so because the demand for credit switches towards foreign currency credit. Under these conditions, higher RRs on dollar liabilities contribute to moderating the spillover effect of international financial conditions on domestic markets, thereby strengthening the transmission of domestic interest rate policy. The use of RRs also contributes to monetary policy effectiveness. In credit market segments where the risk premium is high, lending rates are less sensitive to the policy rate, whereas changes in RRs, which operate through changes in financial intermediation margins, have a larger impact on lending rates.

Countercyclical RRs can help to offset credit expansions by reducing the amount of banks' loanable funds as a proportion of total bank assets. Massive capital inflows until April 2013 due to hitting the zero lower bound in the advanced world (QE, Operation Twist, massive injection of liquidity by the ECB at a rate of 1%, etc) brought about new macroeconomic and financial stability challenges. This time, the pre-emptive use of non-conventional tools by the BCRP helped to create a smoother credit cycle compared with the 2007–08 episode (see Figures 13 and 14). The use of non-conventional policy instruments such as RRs and FX market interventions not only helped to mitigate the foreign currency-induced credit and liquidity risks created by FD, but also contributed to breaking the trade-off between reducing domestic demand pressures and attracting capital flows. The trade-off takes place when the policy rate is increased to face domestic demand pressures amid episodes of strong capital flows.

Banking system foreign liabilities

(As a percentage of GDP)

Figure 12

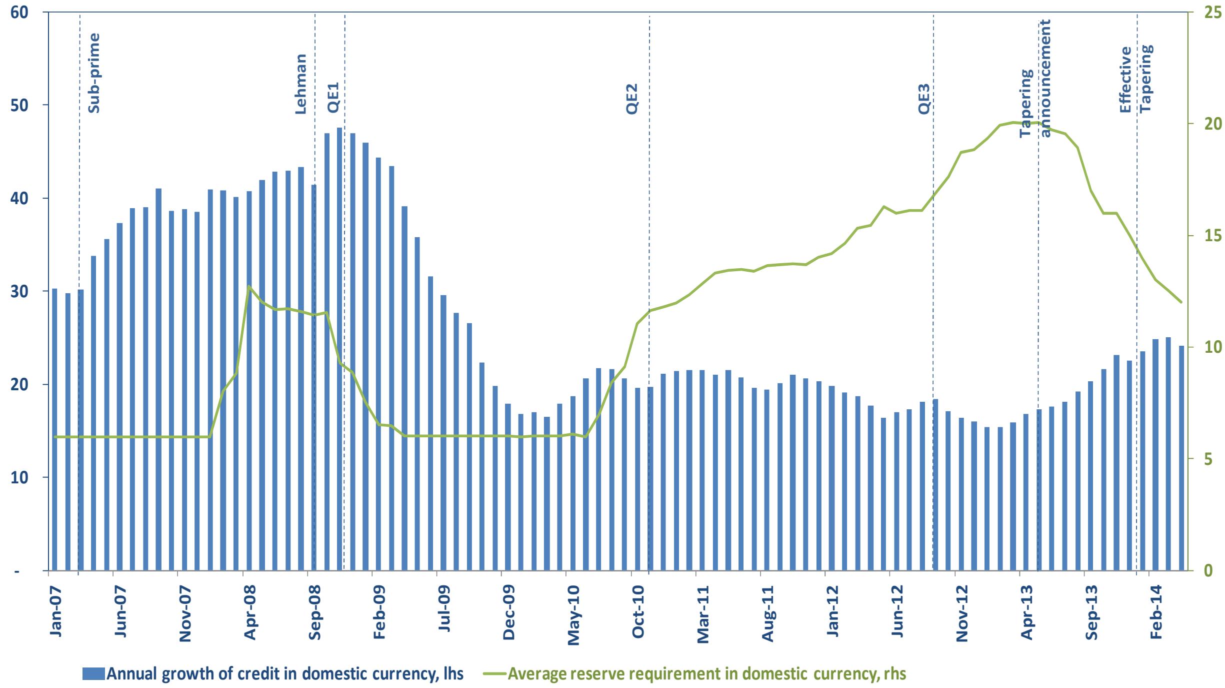


An increase in the RR ratio implies that banks must raise liquid assets to meet the new policy requirement. This tends to reduce credit growth, particularly when banks cannot replace liabilities subject to RRs with other sources of funding, like long-term foreign liabilities.[5] This is more likely the case for small-sized financial institutions with limited access to the international financial markets. Thus, by increasing RRs during episodes of capital inflows and credit expansions, the BCRP seeks to reduce the probability of liquidity stress scenarios in the financial system. Higher RRs induce private banks to increase their availability of liquid assets, which also reduces their capacity to expand credit, particularly in foreign currency. Hence, RRs generate buffer stocks of liquidity in both domestic and foreign currency.

[5] In Peru long-term foreign liabilities are not subject to reserve requirements up to a limit of 2.2 times the bank's net worth.

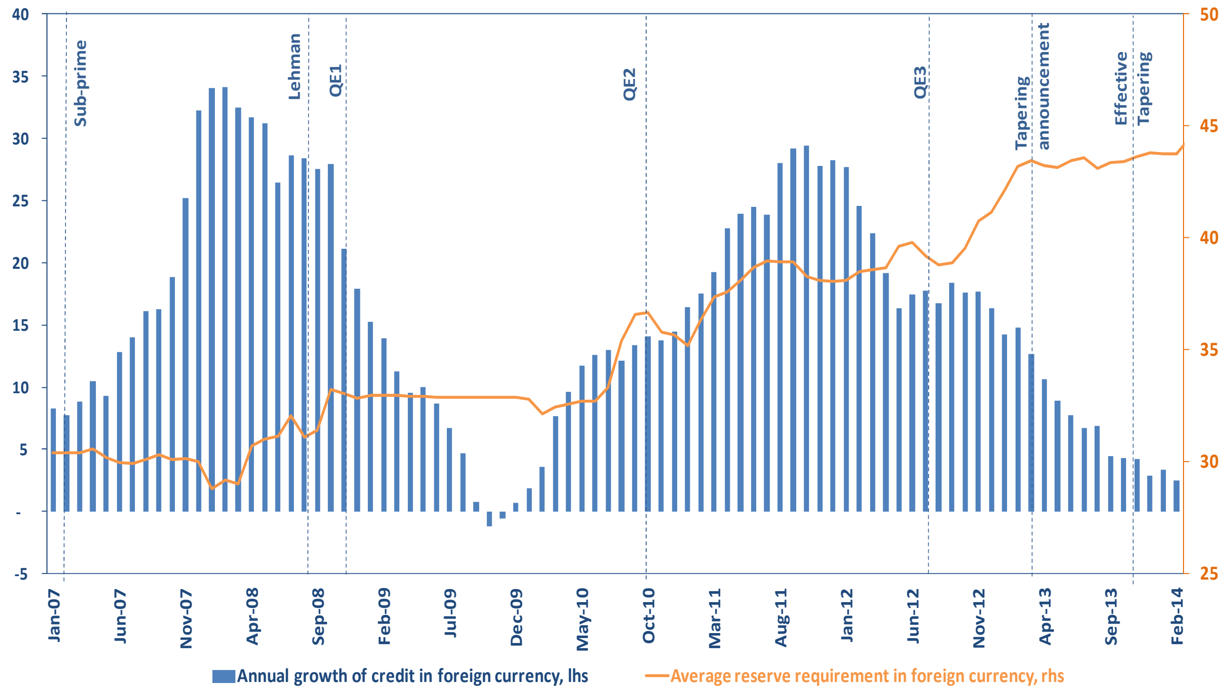
Banking system domestic currency credit to the private sector and average reserves

Figure 13



The quantitative effect of this mechanism depends both on the duration and intensity of RR increases and on the way this policy is implemented. Figure 8 also shows a different behaviour of credit and liquid assets during 2007 and 2008, when credit growth accelerated and liquid assets decreased in spite of the increase in RRs. During this period, the increase in RRs was much milder and shorter-lived than since 2010. The effectiveness of RRs was rather limited during this episode. Also during this period, the increase in RRs was implemented only through rises on marginal rates and not through increases in the average RR ratio. This distinction is important because an increase in the average RR has a stronger impact on banks' credit supply than an increase in the marginal rate, because the former is not contingent on the growth of bank deposits, as is the case for marginal RRs. Tovar et al (2011) provide empirical evidence on the effectiveness of average over marginal RRs. This implies that when the BCRP increases average RRs, banks must increase their liquid assets even when deposits are not increasing.

Banking system foreign currency credit to the private sector and average reserves Figure 14



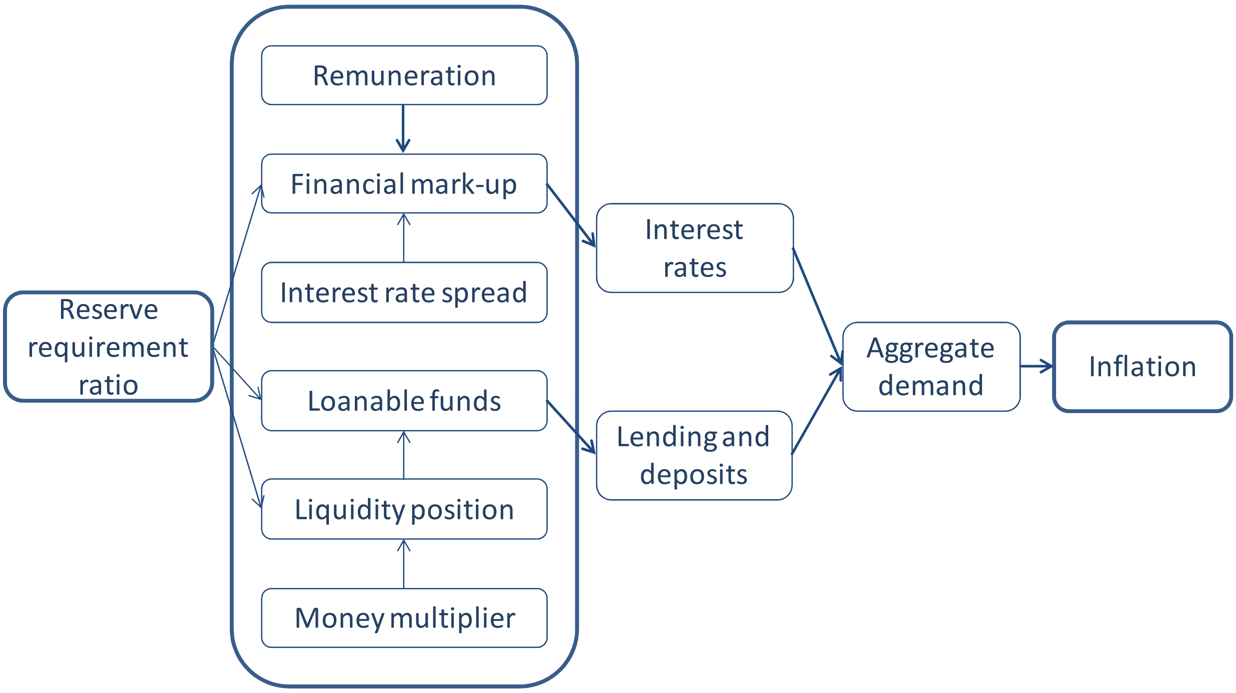
The transmission mechanism of RR changes

RRs affect money and credit conditions through a number of channels. A simple mechanism is described here. As figure 15 shows, RRs first aim at reducing financial entities' primary loanable funds. Lower loanable funds imply lower liquidity and credit, which in turn has an impact on aggregate expenditure and inflation. This mechanism is more effective when the balance of liquid assets held by financial entities is low.

Second, higher RRs reduce banks' financial margins. Banks will seek to preserve them by widening the spread between lending and deposit rates (León and Quispe (2010), Montoro and Moreno (2011)). They can achieve this by raising lending rates, reducing deposit rates, or both (Terrier et al (2011)). Higher market interest rates induce economic agents to reduce their expenditure, thereby attenuating inflationary pressures.

Regarding empirical evidence, there are virtually no references to Peru before 2008, given that RRs were not an active monetary policy tool. The initial approach when the BCRP started to use RRs actively was to calibrate their impact through an accounting procedure that operated through banks' financial margins (León and Quispe (2010)). In particular, the prior was that the demand for credit was relatively inelastic to changes in the interest rate, mainly for small and medium-sized firms.

The transmission mechanism of changes in reserve requirement ratios — Figure 15



It was also clear that the effectiveness of the RR tool would depend on the degree of liquid substitute assets or external funding from foreign financial institutions. Data for the 2008–12 events showed that this prior was not far from actual figures. The MPT assumes that changes in this instrument increase bank lending rates. The estimated impact of a 1% rise in the average RR ratio is about 0.3% on average domestic currency lending rates and 0.1% on foreign currency lending rates. The low pass-through from RRs to foreign currency lending rates is explained by the larger set of alternative sources of funding available to corporate firms in foreign currency.

In practice, the implementation of monetary policy within a dual currency economy not only requires forecasting of inflation conditional on the policy rate instrument, but also needs a continuous assessment of risks and vulnerabilities created by FD under the baseline scenario. Non-conventional policy instruments are then set to curb those risks. For instance, if the baseline scenario assumes a period of capital inflows and persistent low international interest rates, then two risks arise: (i) the risk of a rapid expansion of dollar-denominated loans; and (ii) a more intense use by local banks of short-term loans from foreign banks. In this case, a rise in RRs on foreign currency liabilities is also considered as a policy option in the baseline scenario.

b. Controlling dollarisation risks with RRs

The discussion on the relevance of non-conventional policies as tools to prevent systemic risks and preserve financial stability has become more intense as a result of the international financial crisis. In developed economies, financial asset prices, such as stocks and bonds, are an element in the policy transmission mechanism. In contrast, emerging economies' shallow capital markets limit the role of financial asset prices in the monetary policy transmission. In this group of economies the most important asset price is the exchange rate. This is the case of financially dollarised economies like Peru.

FD generates systemic risks on at least two crucial dimensions: first, by reducing the central bank's ability to act as lender of last resort, FD increases the likelihood of a liquidity shortage in the financial system; and second, since banks lend in foreign currency to non-tradable firms, FD also creates currency mismatches, which magnify foreign currency-induced credit risks. A common feature of these two additional sources of financial vulnerability implied by FD is that both generate negative externalities that justify policy intervention. They can also trigger potential non-linear dynamics with undesirable consequences for financial stability, which supports the introduction of precautionary policy measures. In this regard, the availability of adequate international reserves is key to providing liquidity to the markets during episodes of financial stress. As shown in the BCRP balance sheet (Table 1), the international reserves are funded by deposits from the public sector, RRs, central bank securities and currency in circulation.

The key externality at play with FD is a non-pecuniary one (but common before the creation of central banks in the continent). When banks intermediate in foreign currency, they do not take into account the fact that they are operating under a system without a LOLR in that currency. Banks assume that when they need foreign currency they will be able to obtain it from the interbank market (local or international) at the market interest rate (related of course to the policy rate of the foreign currency issuer). However, this may not be the case, particularly if all banks experience the same type of liquidity shortage.

Liquidity risk and LOLR in foreign currency

This was the case in Peru during the 1998 Russian crisis. This shock triggered a sudden stop and quickly damaged banks' foreign currency positions, particularly in those banks that took considerable short-term loans from the international financial system. During this episode, banks were not able to obtain foreign currency even at very high short-term interest rates. As a consequence, several banks had to abruptly curtail credit. The average local interbank rate in dollars was 8% in July 1998 (240 basis points over one-month Libor) and soared to 12.9% in October (760 basis points over one-month Libor).

The rationale for high RRs on foreign currency deposits, which strongly emphasises the need to provide adequate international liquidity to the financial system during periods of financial distress, was fundamental in diminishing the impact of the sudden stop during the late 1990s financial crisis. Thus, under FD, preventive policy is required because private banks hold too little foreign currency liquidity. Higher RRs on foreign currency liabilities, jointly with the accumulation of international foreign reserves, contribute to reducing the adverse impact of this externality. A historical reference of a financial system operating without a LOLR (like the FD case) was the 19th century and early 20th century, when bank run episodes were frequent across the world. In the United States, banks were required to keep a 25% reserve against deposits (National Bank Act of 1863). However, the role of RRs decreased over time after the creation of the Fed in 1913 (Goodfriend and Hargraves (1983)).

RRs on foreign currency liabilities have three desirable effects that help deal with financial distortions. First, RRs send a signal to financial intermediaries that foreign currency liabilities are riskier than their domestic currency counterparts and, thus, RRs help banks to internalise dollarisation risks. By setting higher RR ratios on foreign currency liabilities, the BCRP increases the cost of providing foreign currency loans, thereby reducing the incentives for banks to intermediate in foreign currency, particularly in those credit market segments where borrowers have few alternative sources of funding. Second, RRs reduce the likelihood of bank runs because economic agents realise that the banking system has a large pool of foreign currency-denominated liquid assets. RRs on foreign currency deposits amount to about 20% of total international reserves, 50% of total foreign currency credit and 44% of overall liabilities subject to RRs. And third, RR policy contributes to increasing the amount of international liquidity in the financial system when necessary. This level of liquidity allows the central bank to act as LOLR in foreign currency by providing it whenever it is needed. By cutting RRs, the central bank can inject liquidity to the financial system and reduce pressures on the interest rate.

Credit risk induced by currency mismatches

The existence of currency mismatches in the balance sheet of domestic agents generates an externality to the financial system, because agents either do not properly internalise the foreign currency-induced risk or engage in moral hazard behaviour. Even non-tradable firms which set prices in foreign currency do not realise that the nature of the mismatch is a real one. In other words, a negative shock to the economy that results in a depreciation of the real exchange rate increases the real debt of the non-tradable firm (net present value of cash in dollars will fall). There is also an externality that operates through the payments system: by taking dollar-denominated loans, an individual firm increases its default risk. However, it also increases the default risk of other firms, those that are linked to the first firm through the payments system. Banks do not properly internalise the complex degree of links between firms, and consequently do not charge the right risk premium when granting dollar-denominated loans to firms in the non-tradable sector. In this case, a sharp and unexpected depreciation of the exchange rate can trigger negative balance sheet effects that spill over across the payments system to a large set of firms, unduly affecting the credit quality of banks' assets.

It is worth mentioning that it is not only a sharp depreciation of the domestic currency that generates systemic risks in a financially dollarised economy, but also a strong and transitory appreciation. A persistent and sharp appreciation of the domestic currency reduces the real value of firms' debt and may also encourage further appreciation expectations. As a result, firms may perceive that borrowing in foreign currency is cheaper, leading them to increase their currency mismatches and, through this channel, the cost of a sudden exchange rate reversal. Policy measures such as additional provisioning for dollar-denominated loans, higher RRs for foreign currency liabilities and FX intervention to smooth out exchange rate fluctuations contribute to dampening this type of credit risk.

c. RRs as an instrument to increase maturities and moderate banks' external leverage

Higher RRs on both foreign currency short-term external liabilities and deposits not only increase the cost of dollar-denominated loans, but also induce banks to lengthen the maturity of their external liabilities and increase the availability of international liquidity. In 2007, the BCRP extended the use of RRs to banks' short-term foreign liabilities.[6] As a result, banks had the incentive to lengthen the maturities of their foreign currency liabilities, which reduced their vulnerability to sudden capital stops. Currently, a 50% special RR is in place for local banks' obligations to foreign banks with maturities of less than two years. Moreover, banks increased the average maturity of their foreign liabilities from two years in 2007 to four years in 2009. This special RR has also been used cyclically. The BCRP raises its level in periods of abundant capital inflows and reduces it in response to capital outflows.

Crucially, after the collapse of Lehman Brothers, the limited exposure of local banks to sudden stops of capital flows allowed banks to maintain their supply of credit, which limited the impact of this shock on the local financial system. More recently, as a result of greater international financial integration and historically low world interest rates, short-term capital flows[7] as well as firms' and banks' foreign liabilities, particularly bonds, have increased their share in the capital account. In order to limit over-borrowing, the BCRP set an additional RR (i) when the stock of long-term foreign liabilities and bonds exceeds 2.2 times a bank's net worth; and (ii) when credit growth in foreign currency exceeds a given limit established by the BCRP. Furthermore, in 2013, with the aim of reinforcing credit de-dollarisation, the BCRP introduced additional RRs for financial institutions that grant foreign currency loans above certain prudential limits.

6. Measuring the effects of RRs

In this section we present the effect of RR policy applied to both domestic and foreign currency bank liabilities on interest rates and credit. There has been an active stance in policies aimed at reducing currency and term mismatches in the public sector, as well as in the financial and non-financial private sector. In Table 2, different indicators of vulnerability to external capital account events show that active fiscal and central bank policies have aimed at reducing the impact of credit and exchange rate risks.

Econometric evaluation of policy is difficult due to the identification problem. The usual tool in the monetary policy literature is to identify monetary policy through structural VARs. The VAR procedure is sound in a conventional monetary policy setting where the policy rate dynamically interacts with inflation, economic activity and the exchange rate. In the analysis of unconventional monetary policy, it is important to account for episodes of policy interventions characterised by policy on-off situations. For those cases, Pesaran and Smith (2012) propose a policy evaluation exercise where the effectiveness of policy changes can be directly measured. The idea is to compare observed outcomes after a policy change against a counterfactual generated by an econometric forecast conditional on the policy not being implemented. Pesaran and Smith (2012) show that the conditional forecasts can be generated by a reduced-form equation linking outcomes to both policy and controls invariant to policy.

[6] The BCRP had extended the use of RRs to banks' foreign liabilities in 2004.

[7] NDF forward operations with non-resident investors and purchases of public debt instruments denominated in domestic currency.

Indicators of macro vulnerability						Table 2
			Unit	2003	2008	2013
Central bank	1	GDP / NIR	times	6.0	4.1	3.2
	2	M2 / NIR	times	1.0	0.9	1.2
	3	Short–term foreign liabilities + amortisation of external debt / NIR	%	13.6	27.0	12.7
Banking system	4	Dollarisation of banking credit	%	76.0	54.8	45.3
	5	Short–term foreign liabilities / banking credit	%	4.9	5.3	2.7
	6	Short–term liabilities (deposits + credit lines) / required reserves	times	3.1	2.5	1.7
Public sector	7	Dollarisation of public debt	%	84.9	62.5	44.5
	8	Non–residents' holdings of local public debt / public sector deposits in the CB	%	0.0	21.7	31.0
	9	Average maturity of the public debt	years	7.6	11.2	12.5

All that is required to follow Pesaran and Smith's (2012) policy assessment exercise is to define outcomes and instruments. The choice must have the special feature that the instrument needs to be "off" and then "on" for a reasonable amount of time. Three such episodes are identified by Armas et al (2014): (i) the increase in the marginal RR for domestic currency deposits from 6% to 25% since July 2010; (ii) the increase in the marginal RR for foreign currency deposits from 30% to 55% since July 2010;[8] and (iii) the increase in RRs on banks' short-term external debt from 30% to 60% since July 2010. According to Pesaran and Smith (2012), what is needed is a reduced-form equation such as:

$$y_t = \pi_1 x_t + \pi_2' W_t + v_{yt} \tag{1}$$

where y_t is an outcome variable, x_t is the policy instrument, and W_t is a vector of control variables invariant to ad hoc policy changes. The set of outcome variables is given by the levels of outstanding credit denominated in domestic and foreign currency, lending and deposit interest rates in both currencies, and the ratio of short- to long-term external debt of banks. Candidates for control variables include first a set of external variables including the US federal funds rate, the VIX, the trade-weighted US dollar index, the 10-year US Treasury bond yield and the slope of the US yield curve. A second set of control variables comprises variables affected mostly by external conditions (terms of trade, the EMBI, domestic primary output) or by the trend financial development (number of employees, number of branches). The key assumption is that these sets of control variables are invariant to policy. To make inferences, a mean effect quantity is constructed through the following equation:

8 There was a first tightening episode that started in February 2008 and spanned up to May 2008; however this tightening was quickly reversed after the Lehman collapse, and thus it cannot be used in this exercise.

$$\hat{d}_H = \hat{\pi}_1 \left[\frac{1}{H} \sum_{h=1}^{H} (x_{T+h} - x_{T+h}^0) \right] \tag{2}$$

where $\hat{\pi}_1$ is the estimated policy coefficient; H is the number of periods over which the specific level of policy tightening has been effective; x_{T+h} represents the observed policy trajectory from period T onwards; and x_{T+h}^0 is the counterfactual policy trajectory from period T onwards. The number of periods the policy stance lasted is H=22 months.

Next, Pesaran and Smith (2012) propose a policy-effectiveness test statistic given by

$$\mathcal{P}_H = \frac{\hat{d}_H}{\hat{\sigma}_{v_y}} \sim^a N(0,1) \tag{3}$$

where $\hat{\sigma}_{v_y}$ is the standard error of the policy reduced-form regression. Namely, if the mean effect $\hat{d}_H$ is relatively large compared to the standard error of the forecasting equation, then it is likely that the policy effect is significant.

Results

The main empirical results of Armas et al (2014) are presented in Table 3. In general, the effect of RR changes that took place in 2010 proved to have indeed increased lending interest rates and reduced deposit rates. The effect on bank interest rates implies that an increase in RRs induces bank interest rate spreads to widen, as described in Section 3 of this paper, and consistent with effects generally expected in the literature (eg Montoro and Moreno (2011), Terrier et al (2011)).

Pesaran-Smith (2012) policy effectiveness statistics — Table 3

	Mean effect ($\hat{d}_H$)	Policy-effectiveness statistic ($\mathcal{P}_H$)	p-value	Expected sign
Bank lending rates in domestic currency	0.001	6.47	0.00	yes
Bank lending rates in USD	0.006	1.57	0.06	yes
Bank deposit rates in USD	–0.009	–3.19	0.00	yes
Bank lending in PEN	–0.019	–0.57	0.28	yes
Bank lending in USD	–0.008	–0.49	0.31	yes
Bank's short-term external debt as a ratio of total external debt	–0.300	3.20	0.00	yes

Furthermore, there is evidence that the effect on credit works as expected. This is inconsistent with the results obtained by Pérez and Vega (2014), which show that a 1 percentage increase in the RR ratio has a 0.4 effect on credit growth within six months. The last empirical result presented here relates to the impact of an increase in RRs on banks' short-term external debt. The evidence provided here is that this policy produced a shift in banks' external debt towards long-term maturities and away from short-term ones.

Dynamic effects from a 1 percentage point reduction of RRs in domestic currency

Table 4

	3 months	6 months	9 months	12 months	18 months	24 months
Banking sector lending in DC	0.26***	0.4***	0.36	0.29	0.18	0.09
Interest rate spread	–0.07***	–0.14*	–0.14	–0.14	–0.11	–0.08

* (at 10%), ** (at 5%), *** (at 1%)

7. Conclusions

Non-conventional policy tools such as RRs are being used actively by many central banks in emerging market economies. The evidence provided by Peru's experience shows that this is an effective tool to reduce the trade-offs that expansionary monetary policies in developed economies are creating in emerging market financial systems. In particular, RRs can dampen the credit cycles in periods of capital inflows and reduce their expansionary effects on domestic aggregate demand. Also, when RRs are applied to foreign currency bank liabilities, they can contribute to increasing the availability of international liquidity in the financial system, and consequently help to reduce the impact of capital outflows on the domestic financial system.

The paper shows counterfactual exercises made by Armas et al (2014) and following Pesaran and Smith (2012) to quantify the effect of a marginal RR tightening over the period July 2010 to April 2012. The effects on interest rates and credit levels are measured. As with any other form of tax, RRs generate efficiency costs, which can affect the degree of financial development. However, when financial frictions pervade, these costs are of second-order magnitude compared to the benefits of an active use of RRs that reduces the probability of a financial crisis. In this regard, RR calibration needs to take into account these costs to define both the magnitude and the duration of this type of non-conventional policy instrument. In economies like Peru, where domestic capital markets are not well developed, RRs can also speed up the development of these markets by increasing the cost of financial intermediation through the banking system. However, they could also increase the incentives for firms to use more external funding.

The aforementioned costs can be reduced by spreading out the burden of prudential regulation among a larger set of instruments, for instance cyclical capital requirements and dynamic provisioning, and, in the case of financially dollarised economies, also additional capital requirements for loans in dollars. The central bank has to continuously assess the efficacy of RRs as prudential instruments and reverse them when necessary. For instance, RRs on short-term bank liabilities were reduced in 2012 for liabilities related to trade finance, so as to avoid a replacement of banking credit with offshore credit lines. Peru's experience also shows that central banks need to monitor closely the impact of this type of instrument in order to minimise its potential costs. A close coordination with the regulatory authority is also necessary, so as to complement RRs with the use of other instruments aimed at reducing systemic risks, such as countercyclical provisioning and capital requirements, as well as a higher capital requirement for foreign loans.

References

Armas, A, P Castillo and M Vega (2014): "Inflation targeting and quantitative tightening: effects of reserve requirements in Peru", *Working Paper* 003–014, Central Bank of Peru.

Armas, A and F Grippa (2005): "Targeting inflation in a dollarized economy: the Peruvian experience", *RES Working Papers* 4423, Inter-American Development Bank, Research Department.

Castillo, P and D Barco (2009): "Peru: a successful story of reserves management", in J Izquierdo and E Cavallo (eds), *Dealing with an International Credit Crunch. Policy Responses to Sudden Stops in Latin America*, IDB.

Céspedes, L F, R Chang and A Velasco (2004): "Balance sheets and exchange rate policy", *American Economic Review*, 94(4), pp 1183–93.

Goodfriend, M and M Hargraves (1987): "A historical assessment of the rationales and functions of reserve requirements", in M Goodfriend (ed), *Monetary Policy in Practice*, Federal Reserve Bank of Richmond.

Glocker, C and P Towbin (2012): "Reserve requirements for price and financial stability: when are they effective?" *International Journal of Central Banking*, 8(1), pp 65–114.

Montoro, C and R Moreno (2011): "The use of reserve requirements as a policy instrument in Latin America", *BIS Quarterly Review*, March.

León, D and Z Quispe (2010): "El encaje como instrumento no convencional de política monetaria", *Revista Moneda 143*, Banco Central de Reserva del Perú.

Mimir, Y, E Sunel and T Taskin (2013): "Required reserves as a credit policy tool", *The BE Journal of Macroeconomics*, 13(1), pp 823–80.

Moron, E and D Winkelried (2005): "Monetary policy rules for financially vulnerable economies", *Journal of Development Economics*, 76(1), pp 23–51.

Perez, F and M Vega (2014): "Efectos dinámicos de las tasas de encaje en el Perú", work in progress, Banco Central de Reserva del Perú.

Pesaran, M and R Smith (2012): "Counterfactual analysis in macroeconometrics: an empirical investigation into the effects of quantitative easing", mimeo, Cambridge University.

Terrier, G, R Valdes, C Tovar, J Chan-Lau, C Fernández-Valdovinos, M García-Escribano, C Medeiros, M-K Tang, M Vera-Martin and C Walker (2011): "Policy instruments to lean against the wind in Latin America", *IMF Working Paper* 11/159.

Tovar, C, M García-Escribano and M Vera-Martin (2012): "El crecimiento del crédito y la efectividad de los requerimientos de encaje y otros instrumentos macroprudenciales en América Latina", *Revista Estudios Económicos* 24, pp 45–64.

Rossini, R, Z Quispe and E Serrano (2013): "Foreign exchange intervention in Peru", *BIS Papers*, no 73, Bank for International Settlements.

Rossini, R, Z Quispe and D Rodríguez (2011): "Capital flows, monetary policy and forex intervention in Peru", *BIS Papers*, no 57, Bank for International Settlements.

Webb, R and A Armas (2003): "Monetary policy in a highly dollarized economy: the case of Peru", in P Ugolini, A Schaechter and M Stone (eds); *Challenges to Central Banking from Globalized Financial Systems*, International Monetary Fund.

Winkelried, D (2013): "Modelo de Proyección Trimestral del BCRP: actualización y novedades", BCRP, *Revista de Estudios Económicos* 26, pp 9–60.

What have emerging market central banks learned about the international transmission of monetary policy in recent years? The Philippine case[1]

Diwa C Gunigundo[2]

Abstract

An understanding of the transmission mechanism is essential to the appropriate design and implementation of monetary policy. Central banks must be alert to changes in the structure of the economy because they tend to alter the way in which a monetary policy change is transmitted to the economy. This concern applies as well to the international transmission of policy changes.

This study considers the mechanisms by which changes in policy rates in advanced economies are transmitted to the Philippine economy and finds that the exchange rate, risk-taking in global financial markets and inflation expectations have been significant channels of transmission. Moreover, changes in policy rates abroad have had an indirect influence on the Philippine policy rate, thereby affecting the outlook for Philippine inflation and growth.

Keywords: International monetary policy, monetary policy transmission mechanism, global financial crisis, Philippines

JEL classification: F42, F65, G15

[1] Prepared for the Meeting of Emerging Market Deputy Governors at the Bank for International Settlements, Basel, Switzerland, 6–7 March 2014.

[2] Deputy Governor, Monetary Stability Sector, Bangko Sentral ng Pilipinas.

1. Introduction

Over the past two decades, financial market behaviour and the conduct of monetary policy have changed significantly. The experience of most economies in reacting to the impacts of the global financial crisis in 2008–09 has underscored the importance of how monetary policy in one country can influence another country's monetary policy and thereby eventually affect its inflation and growth. These developments indicate that the monetary policy transmission mechanism may have changed since the global financial crisis.

Borio and Disyatat (2009) note that monetary policy before the global financial crisis was generally implemented with short-term interest rates. However, due to the subsequent flow of capital to emerging market economies (EMEs), most EME central banks have found it difficult to set monetary policy independently. This is because the increase in liquidity generated by the flows has posed upside risks to inflation, while a higher interest rate to address these pressures only risks stimulating further capital inflows. The measures adopted by recipient countries, including the Philippines, have included exchange rate flexibility, sterilisation and the accumulation of foreign exchange reserves.

An understanding of the transmission process in EMEs is essential to the appropriate design and implementation of monetary policy. Because changes in the structure of the economy – including changes in balance sheet positions, financial sector technology and institutions, or in expectations concerning future policy of advanced economies – tend to alter the economic effects of a given monetary policy change whether it originates abroad or domestically; central banks therefore must be alert to alterations in economic structure if they are to understand the current state of policy transmission.

This study examines the channels through which changes in policy rates in advanced economies are transmitted to the Philippine economy**.** The study finds that the exchange rate, risk-taking in global financial markets and inflation expectations have been significant as channels for transmitting the policy rate changes in advanced economies to the Philippine economy. Meanwhile, foreign policy rates have also had an indirect impact on the policy rate of the Bangko Sentral ng Pilipinas (BSP), to such an extent that changes in foreign monetary policy have affected the outlook for domestic inflation and growth.

The article highlights the increasing role of global factors in shaping domestic monetary policy outcomes (Section 2), details the various channels through which changes in international monetary policy are affecting the Philippine economy (Section 3), examines changes in the way the BSP conducts monetary policy (Section 4) and concludes with lessons for the formulation of monetary policy (Section 5).

2. Current context: global factors affecting domestic monetary policy outturn

Financial globalisation exposes EMEs to the volatility of international markets. In the literature on financial globalisation there is considerable discussion about the implications of large surges and volatility of capital flows, especially when they are routed through the financial system.[3] The global financial crisis in 2008 coincided with a surge of gross capital flows into emerging market economies, a real appreciation of their currencies, and an increase in the prices of their main commodities, stocks, and houses.

In the Philippines, the current account has been in surplus since 2003 (Figure 1) because of higher remittance transfers from overseas Filipinos (OF) and receipts from business process outsourcing (BPO). As a share of gross domestic product, the current account surplus rose from 1.8% in 2004 to 4.6% at the end of September 2013. As a result of the more robust current account position, the level of gross international reserves (GIR) rose similarly. The accumulation of foreign exchange reserves has been driven by both cyclical and structural factors**.** The cyclical factors relate to the surges in capital inflows – direct and portfolio investments – which may be explained by push factors (ie monetary and fiscal policies of advanced economies) and pull factors (ie real divergences between EMEs and advanced economies).

At the beginning of the global financial crisis, low interest rates in advanced economies and the risk appetite of global investors drove capital out of advanced economies into EMEs; the favourable growth prospects of EMEs reinforced these flows by attracting capital into their markets. Meanwhile, in the Philippines, the increase in GIR has also been driven by structural factors, in particular the current account—merchandise exports, BPO services receipts, and the remittances of OFs. Figure 2 shows the rapid rise of GIR in the Philippines starting in 2010; by end-December 2013, it stood at $83.2 billion.[4]

Meanwhile, the easing of foreign exchange regulations has helped mobilise foreign resources to finance the requirements of the domestic economy. As a result, financial market transactions have risen since 2007. The expanded domestic liquidity (M4) year-on-year growth in 2007 was 5.5%.[5] Meanwhile, the Philippine Stock Exchange Index has risen broadly since 2007. Likewise, led mainly by growth in the industrial, mining and oil, and holding firms sectors, stock market capitalisation rose, by 49.8% since year-end 2007 to reach PHP 11.9 trillion by year-end 2013.

The growth in capital flows has increased market volatility and amplified the transmission of shocks, with long-term interest rates increasingly determined globally. In the Philippines, the level and volatility of foreign portfolio investments with banks rose following the 2009 liberalisation of foreign exchange limits on foreign investments.[6] In both gross and net terms, portfolio investments have increased steadily since 2007, with larger flows recorded in the first and second quarters of 2008, the third and fourth quarters of 2009, and 2010. Between the third quarter of 2012 and year-end 2013, relatively large net portfolio investments were observed, largely in equities. In 2013, foreign portfolio investments registered a net

3 See Prasad et al (2003).

4 Revised. The level can adequately cover 12.1 months' worth of imports of goods and payments of services and income and is equivalent to 8.4 times the country's short-term external debt based on original maturity and 5.8 times based on residual maturity.

5 Before the imposition of Supervision and Regulation Fees (SRF). Expanded M3 (or M4) includes domestic liquidity and foreign currency deposits of residents. Data are taken from Selected Economic and Financial Indicators, BSP.

6 Based on Bayangos, Elloso and Hallig (2013).

inflow, owing mainly to net borrowings of residents from the rest of the world and to investments in equities, peso-denominated government securities and peso-denominated time deposits. In particular, registered portfolio investments surged by 53.7% from 2012 to $28.4 billion, the highest level since 1999.

Where did these flows originate? The 2013 volatility in portfolio flows in the Philippines was influenced by push factors in the US economy. In that year, net outflows were registered during March, May, June and August. The net outflow during May and June were due to uncertainties following the Federal Reserve's May announcement about unwinding its QE measures. The net outflow during August was due mainly to the possibility that the Federal Reserve would scale down its QE programme. The increase in inflows for the rest of 2013 was a result of pull factors, such as the country's sound macroeconomic fundamentals and the investment grade ratings given to the country by three international rating agencies (Fitch, Standard & Poor's and Moody's), which helped sustain investor confidence in the Philippines.

Meanwhile, the channel through which movements in US 10-year bond yields impact Philippine 10-year bond yields has become relevant in recent years following the rise in foreign investment in bond markets,[7] which has pushed down the Philippine 10-year bond yield.[8] Using a vector autoregressive (VAR) model, the present study extended the time period covered by Moore et al (2013) and added the Philippines to the sample.[9] The results show that the degree of pass-through from the US 10-year bond to the Philippine 10-year bond became significant between 2008 and 2013 relative to the pre-crisis period of 2003–2007 (Appendix A).[10]

For the pre-crisis period of 22 July 2003–31 December 2007, a 1 percentage point increase in the US 10-year yield (sustained for three consecutive days) was associated with a 0.03 percentage point increase in the current Philippine 10-year bond yield. For the more recent period of 1 January 2008–26 November 2013, the correlation changes to a 0.16 percentage point decline in the current Philippine 10-year bond yield (with a lag of one day and significant at the 5% level).

7 As indicated in Table C1 in the BIS questionnaire, local currency government bonds held by non-residents relative to total market capitalisation stood at about 10.3% in 2012.

8 Shin (2013) calls the period from 2010 to the present the Second Phase of Global Liquidity. In this second phase, the main stage is the bond market, especially the market for emerging market debt securities that are open to international investors. By contrast, the first phase, from 2003 until the 2008 global financial crisis, had global banks at the centre, and the main focus was the transmission of looser financial conditions across borders through the acceleration of banking sector capital flows.

9 Using a VAR model of daily data for the period July 2007–November 2011, Moore et al (2013) examined whether large-scale asset purchases (LSAPs) by the Federal Reserve influenced capital flows from the United States to EMEs; they also analysed the degree of pass-through from yields on long-term US government bonds to yields on long-term EME bonds. The EMEs in the analysis were the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Malaysia, Mexico, Poland, Singapore, South Africa, South Korea and Thailand. In the modification carried out by the present study, the period covered by daily data was extended back to 22 July 2003 and forward to 26 November 2013 and applied to all but five of the EMEs in the Moore et al (2013) sample plus the Philippines – because of data limitations, the Czech Republic, Hungary, Mexico and Singapore were dropped.

10 With a lag of one day at the 5% level of significance. However, the impulse response to the euro area's 10-year bond yield was significant at the 5% level of significance.

The ongoing accumulation of foreign exchange reserves pushed up the liabilities of the BSP by 29.9%, 20.6% and 7.2% in 2010, 2011 and 2012, respectively. This growth mainly took the form of increased deposits, reflecting continued liquidity management operations by the BSP. A significant share of the growth came from accrued interest payables in the Special Deposit Accounts (SDA) – PHP 1.2 trillion for 2010 and PHP 1.6 trillion for both 2011 and 2012[11] In 2013, outstanding balance of SDA dropped to PHP 1.4 billion. However, the accumulation of reserves has also caused the BSP to incur losses, which it has now done since the net loss of PHP 59.0 billion in 2010. The 2012 net loss of PHP 95.4 billion was nearly three times the 2011 net loss of PHP 33.7 billion. The loss declined for the first 10 months of 2013 (PHP 21.6 billion, 73% lower than for the year-earlier period).

The developments so far suggest that global factors are playing an increasingly important role in determining domestic outcomes. A closer look at the way in which changes in policy rates in advanced economies are transmitted to the Philippine economy may shed further light on the state of the relationship between monetary policy and global monetary conditions.

3. Channels of transmission of policy rate changes in major currency areas to the Philippine economy

Developments in the global economy continue to feed through to the behaviour of the nominal peso-dollar exchange rate. Since the BSP adopted inflation targeting as its framework for monetary policy in 2002, the behaviour of the peso-US dollar exchange rate has been broadly consistent with the direction and magnitude of foreign exchange flows**.** This was most evident after the Federal Reserve in May 2013 signalled the possibility of tapering its asset purchases in the ensuing months. Prompting concerns of tighter liquidity conditions and higher interest rates, the signal stoked uncertainty in global financial markets. As investors sought relatively safer assets, EME currencies, including the peso, started to depreciate.

Several BSP studies have documented the influence of foreign exchange flows on the peso-dollar rate in the 2000s:

- Covering quarterly data for the years 2002 to 2010, a BSP study showed that surges in capital flows have driven the nominal peso-dollar rate and have also had a significant impact on both the BSP overnight borrowing rate and long-term Treasury bond rates.[12] Such surges have lessened the strength of the transmission from the policy rate to market interest rates.
- Simulation results for March 2001–March 2012 from a macroeconometric model built for the Philippines indicate that a significant increase in remittances has also curbed the transmission mechanism of policy: while the policy rate

[11] SRF-based.

[12] See Elloso and Redoblado (2012a).

continues to be effective in influencing market interest rates, the pass-through is lessened when the impact of large remittance flows are taken into account.[13]

- Movements in the Philippines' Exchange Market Pressure Index (EMPI) reinforce the finding that there was lower depreciation pressure on the peso-dollar rate from January 2008 to December 2013 – a period of substantial foreign exchange inflows – than from December 2002 to December 2007.[14]

Importantly, data also support the conclusion that structural factors have changed the trend and behaviour of the peso-dollar rate. Figure 3 shows that the trend of the nominal peso-dollar rate has changed since 2007. Employing the Bai-Perron test for structural break on the peso-dollar rate shows that there is a break in 2006, particularly in September.[15] In 2012, the peso averaged PHP 42.2/USD 1, appreciating by 8.6% from the PHP 46.2/USD 1 average in 2007 and by 18.2% from the PHP 51.6/USD 1 average in 2002. The peso was slightly weaker during 2013 at PHP 42.4/USD 1. The sustained inflow of foreign exchange from overseas Filipino remittances, export receipts, portfolio investments and foreign direct investments remained the fundamental drivers of the peso's strength. The peso was likewise anchored by the country's sustained economic growth and sound macroeconomic fundamentals.

The risk-taking channel of international monetary policy transmission became more prominent after 2008, when policy rates in advanced economies reached near zero and prompted fund holders to seek higher returns elsewhere. Low policy rates and the significant asset purchases implemented in advanced economies have boosted the confidence of investors, increasing their appetite for relatively higher-yielding (and riskier) EME assets, especially equities, but also government and corporate bonds and credit default swaps (CDS).[16] According to the April 2013 *Global Financial Stability Report* (IMF, 2013b), external factors accounted for two-thirds of the local currency yield compression in EMEs in 2008, with domestic improvements explaining the remainder.[17] These developments are considered to have raised concerns over financial stability.

There were large swings in the entry and exit of registered foreign portfolio investments in 2013 and early 2014. Inflows started on a high of $2.8 billion for January 2013 but dropped to $1 billion in August 2013. In January 2014, foreign registered portfolio investments rose slightly, to $1.5 billion. Meanwhile, outflows were on an uptrend, reaching $2.9 billion in June 2013 – a reflection of the market reaction to the Federal Reserve's announcement about the unwinding of its stimulus

13 See Bayangos (2012).

14 The Philippine EMPI is computed as the sum of the monthly percentage change in nominal exchange rates and the negative of the monthly percentage change in gross international reserves scaled by the ratio of the standard deviations of the monthly percentage change in exchange rates to that of the monthly percentage change in gross international reserves. From December 2002 to December 2013, the EMPI averaged –0.275 versus –0.75 from December 2002 to December 2007.

15 The apparent structural break in the peso-dollar rate behaviour reflects the impact of the easing of foreign exchange regulations that started in 2007 and the consequent surge in OF remittances. See Bayangos, Elloso and Hallig (2013).

16 See International Monetary Fund (2013a).

17 See International Monetary Fund (2013b).

programme. With the start of that unwinding in January 2014, outflows rose to $3.1 billion.

According to the BSP *Annual Report* for 2013 (p 25):

The volatility in foreign portfolio investment took a toll on the stock market, as foreign investors became more cautious, despite the positive news of a robust Philippine GDP growth for all quarters and credit rating upgrades throughout 2013. Although foreign investors were net buyers of PhP 20.9 billion worth of stocks in 2013, it was down by almost 81 percent compared to net purchases in 2012. Foreign transactions as a proportion of total value traded reached 51.7 percent, higher than the 44.9 percent posted in 2012, highlighting the significant role played by foreign investors in the movement of the local market.

The BSP study mentioned in the previous section (Elloso and Redoblado 2012a and 2012b) provides evidence of the significance of the asset price channel in transmitting the international monetary policy stance. Five vector autoregressive (VAR) models were constructed to examine the effects of monetary policy shocks on asset bubbles and the impact of policy and market interest rates on portfolio flows for five asset classes – the composite equity price index, financial stocks, property stocks, the housing market and the foreign exchange market – from the full period 2001–11.[18] Looking closely at the variation in portfolio investments, the study finds that shocks in the peso-US dollar exchange rate contribute significantly to such variation, followed by shocks in the policy rate. Moreover, policy rates influence portfolio flows indirectly through their influence on market interest rates.[19]

The role of the expectations channel in transmitting international monetary policy to the Philippine economy has become significant. The enhanced transparency and accountability associated with the shift to inflation targeting in 2002 have served to increase the BSP's awareness of the importance of the expectations channel in the conduct of monetary policy.[20] The results in another BSP study provide some evidence of the importance of inflation expectations in the monetary policy transmission mechanism in the Philippines.[21] Using a reduced-form equation model of survey-based expectations, the study found that the inflation target, actual inflation, fiscal policy indicators and the monetary policy stance were important drivers of the behaviour of inflation expectations from March 2002-June 2008 (pre-global financial crisis). This finding indicates that private agents assess the credibility of the BSP and base their expectations on what they have learned at the end of the current period and also that they are interested in the declining medium-

18 Elloso and Redoblado (2012b). A longer series was also used to take into account the effects of the Asian financial crisis in 1997.

19 It should be noted that monetary policy shocks in the study refer to unanticipated shocks to monetary policy. For a long time, it has been held that for monetary policy to be effective in affecting aggregate demand, policy shocks should be unanticipated. That is, the basis for policy action should be information not available to the public. Otherwise, changes to policy are anticipated and the policy will not be effective. However, analysis of the effects of anticipated shocks to monetary policy would require a more complicated and encompassing model, such as a dynamic stochastic general equilibrium (DSGE) model, to account for information frictions.

20 See Fermo and Silva (2012). In broader terms, the finding is consistent with the observation that the BSP's transparency and communication practices are aligned with the core principles of international code and practices.

21 Bayangos et al (2010).

term path of the inflation target announced by the monetary authorities. In addition, the finding reinforces the view that current monetary policy actions are effective tools for sending a clear signal about the central bank's future actions.

To assess the relevance of the expectations channel in recent years, we compare the behaviour of private sector inflation forecasts and the BSP's inflation forecasts from January 2009 to November 2013. Figure 4 shows that there seems to be some convergence between the two series, suggesting that inflation expectations continue to be well anchored. From January 2009 to November 2013, the inflation forecasts of the private sector have been broadly in line with the BSP's inflation forecasts, except in the period from June to October 2009.[22] The average variance between private sector forecasts and the BSP's monthly inflation forecast dropped from 4.3 percentage points in 2009 to 0.3 percentage points in 2011, and further to 0.1 percentage points in the January to November 2013 period. The relatively high variance in 2009 could be attributed to the uncertainty in financial markets following the impact of the global financial crisis in 2008–09.[23]

Overall, this convergence may reflect the positive response of the private sector to the BSP's communication strategy of announcing its inflation forecasts as well as its policy intentions over the medium term. In the past few years, the BSP has responded to inflationary pressures with gradual changes in the policy rate as a means of managing inflation expectations, avoiding policy surprises and signalling the BSP's commitment to its price stability mandate. Under its inflation targeting framework, the BSP recognises the importance of transparency and communication, which serve as key components for effective and credible monetary policy. This allows the BSP to carry out its mandate and policy decisions with greater information, predictability and accountability.

Meanwhile, changes in foreign monetary policy rates have had an indirect impact on the BSP's policy rate sufficient to affect the outlook for domestic inflation and growth. A change in foreign monetary policy rates alters the movement of capital from one country to another. For example, the decline in foreign policy rates in advanced economies in reaction to the global financial crisis translated into large capital flows into EMEs, including the Philippines.[24] There are indications that changes in foreign policy rates may have affected movements in the BSP policy rate. The preliminary results of a Granger causality test between monthly changes in the BSP's overnight reverse repurchase agreement (RRP) rate and the Federal Reserve's federal funds rate from January 2002 to January 2014 show that changes in the US rate (Granger) cause changes in the BSP rate.

[22] The BSP's inflation forecasts are its monthly publicly announced forecasts. The private sector inflation forecasts are based on the BSP Private Sector Economists' Survey of inflation forecasts from selected banks, fund managers, some private research institutions and the academic world. The variance is the difference between the private sector forecasts and the BSP forecasts. A positive variance indicates that the private sector forecasts are higher than the BSP's.

[23] See BSP *Annual Report*, 2008 and 2009.

[24] See He and McCauley (2013).

4. The conduct of monetary policy in the Philippines in recent years

Under the BSP's inflation targeting framework, interest rate decisions are based on an assessment of the inflation environment, given inflation expectations and growth prospects**.** The BSP uses quantitative macroeconomic models to forecast inflation over a policy horizon of two years and to conduct policy simulations and analysis. A dynamic stochastic general equilibrium (DSGE) model had been in use to complement the Bank's workhorse models, the Single-Equation Model (SEM) and the Multiple-Equation Model (MEM).To capture the fundamental interlinkages amoung various sectors of the economy and to improve forecasting and policy simulations, the BSP utilized in 2012 the Macroeconomic Model for the Philippines (MMPH) to complete the SEM and MEM in lieu of the DSGE model[25]

Mindful that no single model can address every issue confronting policymakers, the BSP considers all available data. It incorporates trends in aggregate supply and demand in its assessment of economic activity. It also takes note of developments in the financial markets and uses data on consumer and business sentiment as a gauge of market confidence and expectations.

Given the extent of interconnectedness of countries in the global market, the BSP also considers international economic and financial data (such as foreign policy rates, global long-term rates, exchange rates and risk-taking in global financial markets), especially those in the Asia region and in other countries with extensive economic and financial linkages with the Philippines. The BSP uses the following models and indicators to measure the significance of these developments:

- Philippine Financial Stress Index (PFSI): measures the degree of stress in the financial system through indicators such as, the two-year RP Treasury bond yield-to-maturity, JP Morgan Emerging Bond Index (EMBI)+ Philippines Sovereign spread, Philippine Credit Default Swap (Senior 5-year) spread, Philippine Stock Exchange Composite index, Philippine Interbank Call Loan rate, Chicago Board Options Exchange Volatility Index (VIX), Overnight Reverse Repurchase rate, Philippine Corporate Ba3-rated bond versus 10-year RP Treasury bond spread, spread of 3-month Philippine Interbank Reference (PHIREF) over 3-month London Interbank Offering Rate (LIBOR), spread of overnight PHIREF rate and overnight RRP rate, and nominal peso-dollar rate.
- Asset Price Bubble Index: uses indicators such as nominal peso-dollar rate, composite stock price index, property stock price index, financial stock price index, price of luxury residential units and house price index to measure the development of asset price bubbles.
- Bank Distress Index: uses indicators such as the proportion of financial assistance and liabilities of closed banks to the country's GDP in evaluating the possible occurrence of a banking crisis to evaluate the risk of a banking crisis.

[25] The MMPH is a semi-structural gap model that provides an organising framework for producing coherent forecast scenarios and policy analysis. The principle of the MMPH framework is to lay the building blocks that reflect key relationships for understanding the monetary transmission mechanism based on forward-looking agents and a central bank that reacts to the output gap as well to the deviation of inflation forecasts from target.

- Network Analysis: identifies major triggers and channels of contagion by measuring the financial interconnectedness of banks and corporates
- Stress Testing: measures the vulnerability of the banking system's capital adequacy ratio to changes in credit, market and liquidity risk
- Early Warning System: measures the probability of a currency crisis using indicators from the external, monetary, financial, real, fiscal and global economy

The BSP manages short-term interest rates with a view to influencing long-term rates, thereby managing expectations.[26] However, faced with the implications of the surges in capital inflows, in particular the wide swings in the exchange value of the peso, the increase in domestic liquidity and the heightened risks to financial stability, the BSP has resorted to other measures:

- *Participation in the foreign exchange market and accumulation of foreign exchange reserves.* The BSP participated in the foreign exchange market to dampen exchange rate movements. As a consequence, there was a considerable increase in the Philippines' gross international reserves (GIR), which grew at an average annual rate of 23.4% during the period 2005–12 (from $18.5 billion in 2005 to $83.8 billion in 2012). By year-end 2013, the country's GIR stood at a revised level of $83.2 billion.
- *Rationalisation of reserve requirement policies.* The BSP made regulatory changes in reserve requirements as befit market conditions. The reserve requirement was lowered in 2008 to address potential credit tightening from heightened global risk aversion. In 2011, reserve requirements were increased to address rising domestic liquidity and the potential upside risk to inflation. In February 2012, operational adjustments were introduced to increase the effectiveness of reserve requirements as a monetary policy tool and simplify their implementation. The adjustments included the unification of the statutory reserve requirement and liquidity reserve requirement into a single set of reserve requirements and the non-remuneration of the unified reserve requirement. In March 2014, the BSP announced a 1 percentage point increase in banks' reserve requirement, effective April 2014, to address continued strong in liquidity and credit.
- *Changes in budget for the peso rediscounting facility.* The budget was increased in 2008 to allow banks to obtain loans from the BSP for short-term liquidity needs. In 2013, the BSP rediscounting facilities were restructured to align them with the market-based monetary operations framework and with the international central banking practice of scaling down directed credit operations.
- *Revisions of policies on the use of BSP fixed-term deposits.* The BSP introduced the SDA facility in November 1998 to expand its toolkit for liquidity management. In April 2007, access to the SDA facility was extended to trust entities to manage liquidity in the face of strong foreign exchange inflows. In 2011, the interest rate for the SDA was increased because of rising inflation pressures. Due to declining inflation pressures, the SDA rate was lowered to 2.0% in April 2012. On 1 January 2014, placements of trust entities in the SDA

[26] See Dacio, Robleza and Bayangos (2012).

facility became limited to funds from trust accounts allowed under existing regulations.

- *Role of communication*. The BSP ensured timely and clear communication with financial institutions and market participants. A clear public explanation of policy goals and strategies is crucial in guiding market expectations, particularly in times of frequent and large changes in policies and measures.

Meanwhile, some non-monetary policy measures have proved particularly helpful in maintaining monetary policy independence. The BSP monitors developments in various asset markets, particularly for indicators signalling the possible formation of asset price bubbles. Given the large amount of information required to identify bubble formation, the BSP relies more on supervisory and regulatory measures to manage these potential risks.

To restrain credit growth in the real estate sector, in February 2008 the BSP imposed a 20% limit on the lending of universal and commercial banks to the real estate sector (through BSP Circular No. 600). The coverage of the definition of real estate exposure was also expanded to include investments in debt and equity securities used to finance a broad range of real estate activities, including ancillary services like buying and selling, and rental and management of properties. In turn, year-on-year growth in total private sector credit declined from 16.8% in 2008 to 15.7% in 2011 and to 14.7% in December 2013.[27]

To manage capital flows, the BSP enforces certain administrative requirements for foreign investments and foreign loans. For foreign investments, no prior authorisation is required but there are registration mechanisms to allow foreign investors to use their peso divestment proceeds to buy another currency through BSP-authorised agent banks. However, if peso divestment proceeds are to be converted to another currency through non BSP-authorised banks or through foreign exchange corporations, registration is optional. Non-residents are not allowed to invest, directly or indirectly, in the BSP's SDA facility.

For foreign loans, all public and publicly guaranteed private sector obligations require prior BSP approval. BSP registration is also required for publicly guaranteed loans of the private sector.

To liberalise foreign exchange outflows, the BSP has allowed for the full repatriation of capital, dividends, profits and earnings of inward foreign investments registered with the BSP (or a duly designated custodian bank). The BSP has reduced the administrative requirements for certain outward investments of residents, and prepayments of private sector loans.

Certain further measures could be taken to address the implications of capital flows on the balance sheet of the BSP. These measures, however, would require amendment of the BSP Charter:

- *Higher capitalisation*. As the monetary authority, the BSP needs a higher level of capitalisation to meet the needs of the expanding economy and the growing complexity and sophistication of the financial system. Many of the important policy actions that the BSP needs to undertake in support of its mandate and core functions (such as engaging in open market operations, foreign exchange

[27] Pre-SRF-based data.

market intervention, acting as lender of last resort) may generate losses and weaken its capital position. As such, adequate capitalisation would allow the BSP to cope with fluctuations in its income stream.

- *Authority to issue own negotiable debt securities*. The restoration of the BSP's ability to issue its own debt securities would provide the BSP with greater flexibility in the timing and magnitude of monetary operations on its own initiative and would allow it to pursue its policy objectives more effectively. The use of the BSP's own debt securities to conduct open market operations would allow the BSP to better calibrate the size of its monetary operations to bring money market rates in line with its policy interest rate and better influence liquidity in the financial system.
- *Tax exemption from taxes, fees, charges and assessments relating to the BSP's core functions*. The operations of the BSP are guided by its mandate to maintain price stability and should thus be differentiated from the ordinary borrowing and lending operations of banks, which are in business for profit. Notwithstanding the attendant costs of a prolonged accumulation of foreign exchange reserves, EMEs, including the Philippines, have an incentive to keep readily available foreign reserves on hand as a precautionary measure.[28] Doing so creates a buffer to mitigate current- or capital-account shocks and could lessen the likelihood and impact of a sudden stop in capital inflows or of a rapid rise in outflows.
- *Allowances for foreign exchange and doubtful loans.* The establishment of adequate loss allowances and the creation of reserve buffers would allow the BSP to mitigate the risks and contingencies inherent in carrying out its mandated functions as the monetary authority. They would also ensure the availability of adequate resources so that the BSP can effectively respond to inflation pressures through policy actions. Such allowances and buffers are also common features of operations by other central banks in the region, helping them sustain operations and ensure financial soundness even during adverse economic conditions.

5. Conclusion: lessons on the international transmission of monetary policy

This study highlights the crucial role played by global factors in shaping domestic monetary policy outturns. In the Philippines, the level and volatility of capital flows have increased significantly since the global financial crisis of 2008–09. The exchange rate, risk-taking in global financial markets and inflation expectations have served as the main channels of international monetary policy transmission. Meanwhile, foreign policy rates have also had an indirect effect on the BSP's policy rate, to such an extent that changes in foreign monetary policy affect the outlook for domestic inflation and growth.

[28] See Ghosh, Ostry and Tsangarides (2012).

Overall, the BSP's sustained flexible conduct of inflation targeting has been useful in promoting price stability amid surges in capital flows. However, there are important lessons for the future conduct of monetary policy .

First, monetary policy may need to lean against potential credit-driven bubbles; yet there is an interaction between monetary policy and macroprudential policy whereby tighter macroprudential policy would require easier monetary policy and vice versa. However, the empirical evidence in this area remains thin and reflects the difficulty in specifying the relevant mechanisms involved in the interaction between monetary policy and macroprudential policy. In the case of the BSP, macroprudential measures are a necessary complement to more conventional monetary tools.

Second, shocks from global financial markets may imply the need for the BSP to continue developing a formal framework to cope with potential financial disruptions. Such disruptions interfere with the flow of information in financial markets and thus prevent them from doing their job of allocating capital to productive investment opportunities (Mishkin 2013). The finding that movements in US 10-year bond yields have influenced Philippine 10-year bond yields in recent years suggests that the influence of globalised finance may continue to spread and deepen in the Philippines. Understanding the dynamics of globalised finance will undoubtedly improve the BSP's capacity to manage and mitigate potential shocks coming from the financial sector in the future.

Lam and Yetman (2013) point to some evidence of continued strong links between Asia-Pacific economies, including the Philippines, and advanced economies. Thus, it is highly unlikely that the Asia-Pacific region will decouple from developments elsewhere in the near future. Conditional on underlying macroeconomic volatility, advanced economies outside the Asia-Pacific region are likely to continue having large effects on the economies in the region.

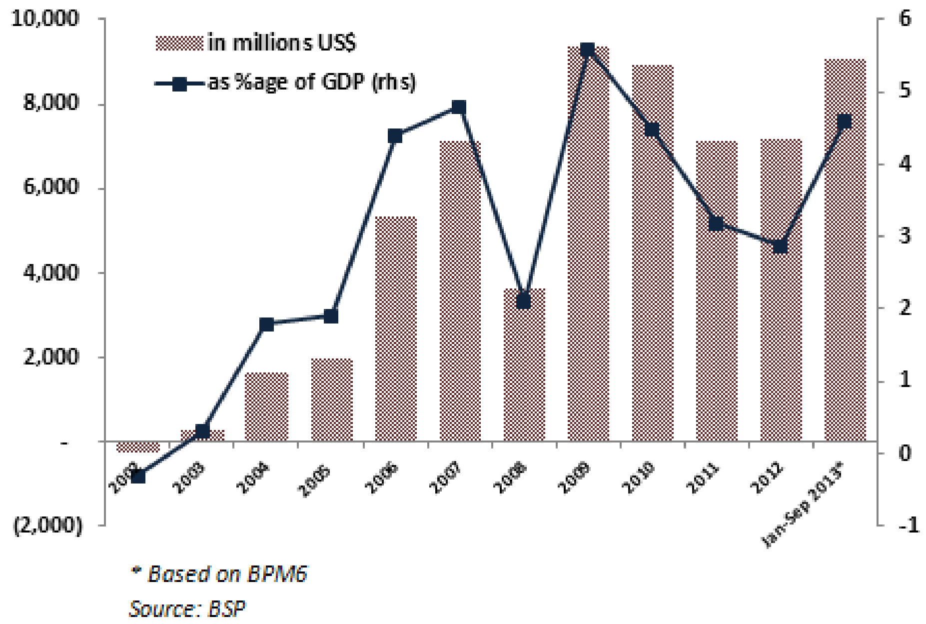
Third, the role of communication in managing private sector expectations is crucial for stabilising the economy, especially in the face of large adjustments in policy and its measures. Short-run panic in markets resulting from an unanticipated increase in the policy rate may have unwarranted effects; hence, it is essential to communicate to market participants the nature of a problem, the policy responses and the basis for the decision.

Fourth, there is no substitute for disciplined macroeconomic policies. To be effective, monetary policy may need to be complemented by appropriate macroprudential, fiscal, and financial sector policies; and be supported by strong supervision, a sound regulatory framework and effective enforcement.

The bottom line for the BSP is that it has to be prepared for greater challenges in its conduct of monetary policy. The course of policy following the global financial crisis has shown the importance of understanding the various aspects of the monetary transmission mechanism further. Policy transmission channels have changed in several important ways since the BSP adopted inflation targeting as a framework for monetary policy. Because the channels of transmission will continue to change as economies evolve, the BSP needs to remain alert to the implications of such changes as they calibrate their policy reaction to macroeconomic developments.

Current account position of the Philippines (2002–Sep 2013)

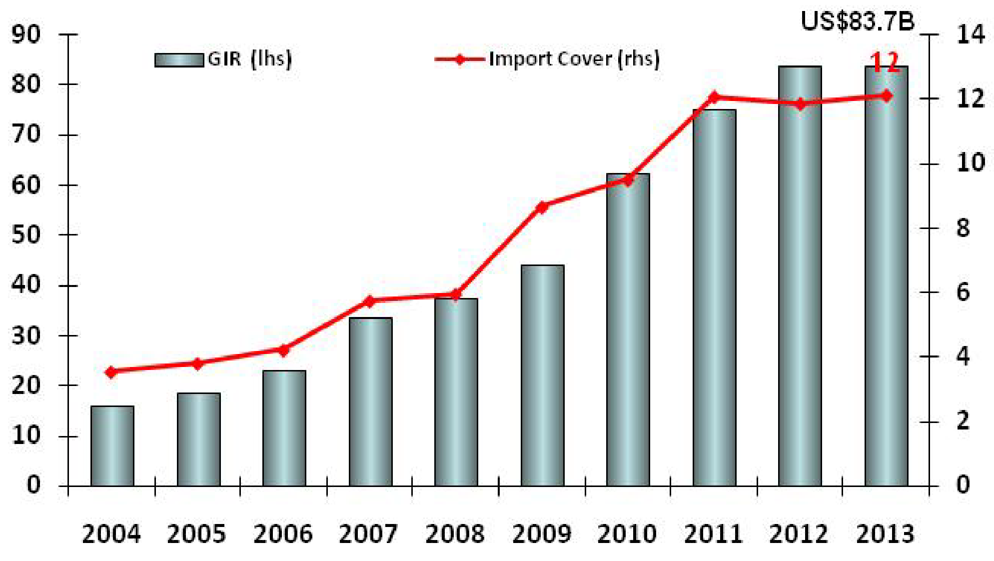
Figure 1



Source: Bangko Sentral ng Pilipinas.

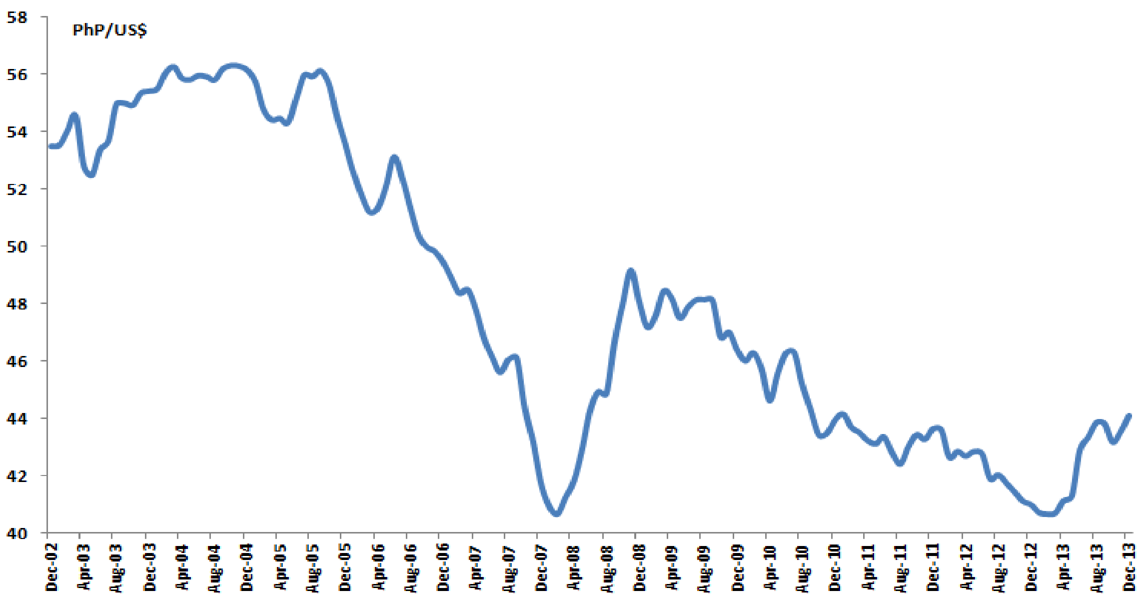
Gross international reserves, 2004–13, USD billion

Figure 2



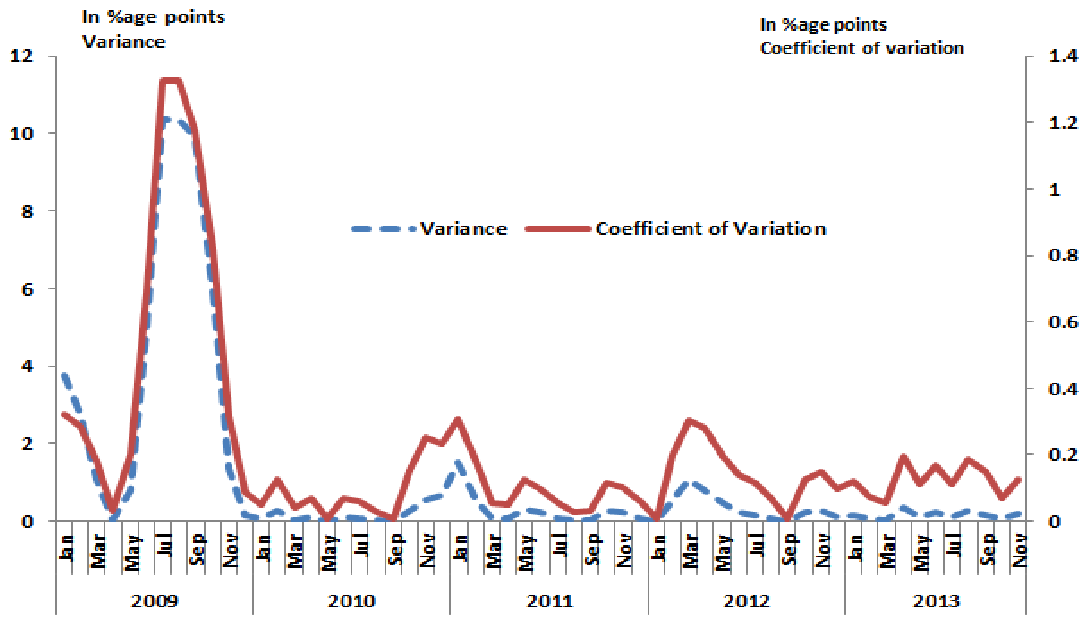
Source: Bangko Sentral ng Pilipinas.

Nominal peso-dollar exchange rate (average, December 2002–December 2013) Figure 3



Source: Bangko Sentral ng Pilipinas.

Difference in inflation forecasts of the BSP and the private sector (2009–13) Figure 4



Source: Bangko Sentral ng Pilipinas, staff estimates.

Appendix A

Moore et al (2013) examined whether large-scale asset purchases (LSAPs) by the Federal Reserve influenced capital flows out of the United States and into emerging market economies (EMEs). They also analysed the degree of pass-through from long-term US government bond yields to long-term EME bond yields. Using panel data from a broad array of EMEs, the empirical estimates suggest that a 10-basis-point reduction in long-term US Treasury yields results in a 0.4 percentage point increase in the foreign ownership share of emerging market debt. This, in turn, is estimated to reduce government bond yields in EMEs by approximately 1.7 basis points.

The quantification of these spillovers may assist in the calibration of short-term interest rate policies in developing economies. To this end, we conduct an empirical study of the impact of changes in longer-term US Treasury yields and LSAP announcements on 10 EMEs for which data on foreign investment in their government bond markets are available. Given separate estimates of the impact of US LSAPs on longer-term US yields, we can then infer the impact of US LSAPs on foreign investment and government bonds yields in EMEs. A vector autoregression (VAR) framework was employed in the analysis using two time series (the US 10-year Treasury bond yield and the Philippine 10-year government bond yield) and two time series (22 July 2003–31 December 2007 and 1 January 2008–26 November 2013). Since the Bank of England and European Central Bank were also employing bond purchase programmes over the same period, the euro- and pound-denominated 10-year yields were included as exogenous control variables in both VAR equations. All data were first differenced and five lags were used for US and Philippine bond yields. The following were estimated:

$$\Delta y_{(t)US} = \sum_{i=1}^{5} \beta_i \Delta y_{(t-i)US} + \sum_{i=1}^{5} \gamma_i \Delta y_{(t-i)PH} + \sum_{i=1}^{2} \delta_i \Delta y_{(t-i)UK} + \sum_{i=1}^{2} \theta_i \Delta y_{(t-i)Euro} + \varepsilon_t \quad (1)$$

$$\Delta y_{(t)PH} = \sum_{i=1}^{5} \beta_i \Delta y_{(t-i)US} + \sum_{i=1}^{5} \gamma_i \Delta y_{(t-i)PH} + \sum_{i=1}^{2} \delta i \;\; \Delta y_{(t-i)UK} + \sum_{i=1}^{2} \theta_i \Delta y_{(t-i)Euro} + \varepsilon_t \quad (2)$$

where:

y = government bond yields

US = United States

PH = Philippines

UK = United Kingdom

Euro = Euro area

t = time

The VAR results are as follows:

Sample: 22 July 2003–31 December 2007			No. of obs	=	1,157
Log likelihood	=	2978.982	AIC	=	–5.118379
FPE	=	.0000205	HQIC	=	–5.08871
Det(Sigma_ml)	=	.0000199	SBIC	=	–5.039758

Equation		**Parms**	**RMSE**	**R-sq**	**chi2**	**P>chi2**	
Dph		15	.107473	0.0739	92.31771	0.0000	
Dus		15	.041837	0.3687	675.8577	0.0000	
		Coef.	**Std. Err.**	**Z**	**P>|z|**	**[95% Conf. Interval]**	
dph							
	dph						
	Lag 1.	.2339817	.0293952	7.96	0.000	.1763683	.2915952
	Lag2.	.0792232	.0300716	2.63	0.008	.0202839	.1381625
	Lag 3.	–.0247032	.0293764	–0.84	0.400	–.0822798	.0328735
	dus						
	Lag 1.	–.0191164	.0612204	–0.31	0.755	–.1391061	.1008734
	Lag 2.	.0432546	.0603144	0.72	0.473	–.0749594	.1614685
	Lag 3.	.0028543	.0604158	0.05	0.962	–.1155586	.1212671
	deu	–.3567874	.1773313	–2.01	0.044	.7043503	–.009224
	dph	.2895174	.162362	1.78	0.075	–.0287063	.6077412
	_cons	–.0028817	.0031519	–0.91	0.361	–.0090594	.0032959

Sample: 1 January 2008–26 November 2013			No. of obs	=	1,540
Log likelihood		= 3307.203	AIC	=	–4.271693
FPE		= .0000478	HQIC	=	–4.248473
Det(Sigma_ml)		= .0000467	SBIC	=	–4.209283

Equation		**Parms**	**RMSE**	**R-sq**	**chi2**	**P>chi2**	
dph		9	.121554	0.0178	27.86295	0.0005	
dus		9	.056608	0.3463	815.7798	0.0000	
		Coef.	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
dph							
	dph						
	Lag 1.	–.668681	.0255469	–2.62	0.009	–.116939	–.016797
	Lag 2.	.0747992	.0255381	2.93	0.003	.0247453	.124853
	Lag3.	.0068614	.0254616	0.27	0.788	–.0430424	.0567653
	dus						
	Lag 1.	–.15843	.0458598	–3.45	0.001	–.2483136	–.068546
	Lag 2.	–.0260011	.0447076	–0.58	0.561	–.1136263	.0616241
	Lag 3.	.0000482	.0445514	0.00	0.999	–.087271	.0873674
	deu	.0336096	.0991807	0.34	0.735	–.1607811	.2280002
	duk	–.0046432	.0886156	–0.05	0.958	–.1783265	.1690402
	_cons	–.0019994	.0030919	–0.65	0.518	–.0080594	.0040606

References

Bangko Sentral ng Pilipinas: *Annual Report* (for 2008, 2009, 2013).

Bayangos, V (2012): "Going with remittances", *BSP Working Paper Series*, no. 2012–01, July.

Bayangos, V, L Elloso and J M Hallig (2013): "The impact of foreign exchange liberalization reforms on the Philippine economy: a preliminary assessment", BSP, unpublished, July.

Bayangos, V, D Floro, J Basilio and E Glindro (2010): "Quantifying the inflation expectations channel in the Philippines: some preliminary results", BSP, unpublished.

Borio, C and P Disyatat (2009): "Unconventional monetary policies: an appraisal", *BIS Working Papers*, no. 292, November.

Dacio, J, E J Robleza and V Bayangos (2012): "A note on the use of the BSP overnight policy rate as the major instrument of monetary policy", *BSP Economic Newsletter*, no. 12–03, May–June.

Elloso, L and J E Redoblado (2012a): "How effective is Philippine monetary policy in the face of large capital flows?", BSP, unpublished.

Elloso, L and J E Redoblado (2012b): "interest rates and portfolio investments", BSP, unpublished, October.

Fermo, L and R Silva (2012): "An assessment of the transparency and communication practices in monetary policy of the Bangko Sentral ng Pilipinas", *Bangko Sentral Review* Vol XIV pp 31–48.

Filardo, A and J Yetman (2012): "The expansion of central bank balance sheets in emerging Asia: what are the risks?", *BIS Quarterly Review*, June.

Ghosh, A, J Ostry and C Tsangarides (2012): "Shifting motives: explaining the buildup in official reserves in emerging markets since the 1980s", *IMF Working Paper* 12/34.

He, D and R McCauley (2013): "Transmitting global liquidity to East Asia: policy rates, bond yields, currencies and dollar credit", *BIS Working Papers*, no. 431, October.

International Monetary Fund (2013a): "Global impact and challenges of unconventional monetary policies", *IMF Policy Paper*, October.

——— (2013b): *Global Financial Stability Report*, April.

Kraft, E and T Galac (2011): "Macroprudential regulation of credit booms and busts: the case of Croatia", World Bank, *Policy Research Working Paper*, WPS5772.

Lam, L and J Yetman (2013): "Asia's decoupling: fact, forecast or fiction?", *BIS Working Papers*, no. 438.

Mishkin, F (2013): "Central banking after the crisis", Central Bank of Chile, *Working Paper*, no 714, December.

Moore, J, S Nam, M Suh and A Tepper (2013): "Estimating the impacts of U.S. LSAP on emerging market economies' local currency bond markets", *Federal Reserve Bank of New York Staff Reports*, no 595, January.

Prasad, E, K Rogoff, S Wei and M A Kose (2003): "Effects of financial globalization on developing countries: some empirical evidence", IMF, *Occasional Paper*, no 220, September 9.

Shin, H S (2013): "The Second Phase of Global Liquidity and its impact on emerging economies", keynote address at the Asia Economic Policy Conference, Federal Reserve Bank of San Francisco, 3–5 November.

Changing patterns in the dependence of long-term rates between Poland and major financial centres

Michał Adam,[1] Witold Koziński[2] and Michał Markun[3]

Abstract

The accommodative monetary policy of major central banks has resulted in strong capital inflows into emerging economies. We investigate the extreme dependence – effectively, contagion – between long-term interest rates in core markets and those of Poland in recent years. The issue is particularly important from a financial stability standpoint. Using a copula framework, we demonstrate that the dependence of extreme events has actually eased in recent years as the structure of foreign investment holdings in Poland has become more stable. Given the elevated risk of contagion, however, these developments should not lull one into a false sense of security. The propensity of bond yields to crash in synchrony should be closely monitored, especially in turbulent periods.

Keywords: Copulas, dependence, contagion, long-term interest rates, Poland

JEL classification: C58, G15

[1] Senior Economist, National Bank of Poland.

[2] Vice President, National Bank of Poland.

[3] Analyst, National Bank of Poland.

The authors would like to acknowledge Janusz Zieliński for his comments on market developments in Poland and emerging market economies as well as on international capital flows.

1. Introduction

The recent financial and economic crisis was followed by an unprecedented monetary policy response. The major central banks adopted a highly accommodative monetary policy stance, cutting their policy interest rates to near zero. Then, as the zero bound on nominal interest rates is a significant constraint on central bank action, further stimulus was provided by large-scale bond purchases or other unorthodox tools. Although the four major central banks adopted different forms of quantitative easing, all these programmes led to a massive expansion of their balance sheets and hence the monetary base.

Many indicators for global liquidity conditions can be devised (Eickmeier, Gambacorta and Hofmann (2013)), but a rise in the monetary base in the major developed countries serves as a good proxy. Based on this indicator, it needs to be stressed that major central bank policies, both standard and unconventional, have had a huge impact on global liquidity expansion, as it was termed by the IMF (2010). It became increasingly easy for investors to access funding at historically low costs during 2009–13. The environment of low funding costs and ample global liquidity was identified by many authors as the basic channel by which accommodative monetary conditions were transmitted from the industrialised countries to emerging market economies (EMEs). The large spillover effects experienced by EMEs resulted from sizeable portfolio capital flows to local equity and debt markets, which put exchange rates under significant appreciation pressure in some countries. Thus, even if the major central bank actions did not initially result in a much-feared inflation, they may have contributed to the potential build-up of imbalances that pose a threat to a wider economic stability.

In this paper we deal with the relationship between long-term rates in major financial centres and Poland in recent years. This is an important issue for central banks. Decisions by foreign central banks may interfere with the local monetary policy by putting pressure on the spreads between the two markets. This can in turn affect the spending decisions of local consumers and enterprises. While the overall dependence of Polish long-term rates may have increased in recent years, ordered flows to and from Poland do not pose a problem. In the context of excessive global liquidity expansion, however, it is worth noting that there is some evidence in the literature that a large proportion of activity by non-residents in government bond markets can induce higher volatility in local bond prices. Large changes in rates abroad, if transmitted to local markets, may be hazardous to the country's financial stability. Thus, the question of how far domestic long-term rates are dependent on large movements in foreign long-term rates is a central concern for any central bank. The contribution of the present study is the evidence that in Poland this sensitivity to extreme events has actually eased over the period of rapid capital inflows, possibly due to an improvement in the structure of foreign holdings. Nevertheless, further results suggest that, even if contagion has generally diminished in recent years, in some periods it returns with a force that needs to be treated as a warning signal.

The structure of the paper is as follows. In the next section, we present some stylised facts on portfolio inflows during the recent financial crisis. In the third section, we introduce the main tool used to investigate the propensity of markets to boom or crash together, the so-called copula function. Copulas were used in an earlier study executed at the National Bank of Poland (Adam, Bańbuła and Markun

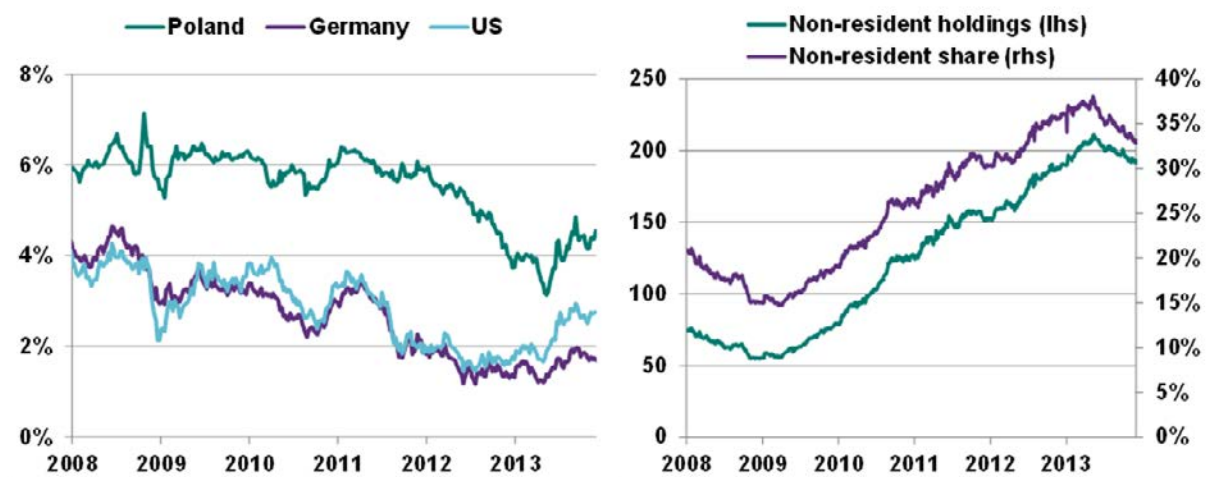
(2013), henceforth ABM). We present their main findings and explain how the methodology can be adapted to answer the current question. Finally, in the fourth section we conclude.

2. Foreign portfolio investment in Polish government debt in 2009–13

During 2009–12, several EMEs saw average net foreign portfolio inflows into debt instruments of more than 3% per year. As Polish government debt market was a favourite destination for this type of foreign portfolio investment, non-residents' holdings of the country's domestic sovereign debt surged to 38% before the May–June 2013 turmoil in EME financial markets. In principle, a country receiving large inflows benefits from a strong compression of yields and/or a reduction in CDS premia. And large capital inflows, together with short term interest rates that were falling towards historical lows, did indeed lead to a significant compression of yields on Polish long-term government bonds (Figure 1). But capital flows started to reverse to some extent on the Fed's announcement of a possible "tapering" in its quantitative easing.

Yields on Polish and core market sovereign bonds and non-resident holdings of Polish government debt

Figure 1



Notes: Left-hand panel plots the yields on Polish, German and US government 10-year debt. Right-hand panel plots non-resident holdings both in absolute terms (PLN bn), as well as relative to the whole stock of Polish government debt (%).

Sources: Bloomberg, Central Securities Depository of Poland.

Andritzky (2012) argues that, in general, a heavy presence of non-residents in government bond markets leads to lower yields on domestic debt, but at the same time it may induce higher volatility in local bond prices. This is due to the tendency of non-residents to respond to greater range of variables than domestic investors. Such variables may include, for example, exchange rates, global market sentiment or a change in funding costs in developed markets. That said, the Polish case shows that additional factors may come into play that counteract these effects. We argue that the stability of the investment holding structure also matters because it can mitigate the negative externalities arising from the increased presence of non-residents in government bond markets. The Polish experience shows that, if long-term investors predominate, then a stable base of investors can act as an important buffer against global headwinds, serving to mitigate the transmission of global volatility into domestic financial assets.

Between the fourth quarter of 2008 and the EM turmoil, non-residents' holdings of Polish government bonds increased by about PLN 150 billion. This translated into large gains in the market share of non-residents, which has risen by about 23 percentage points over the last five years. At the same time, the structure of foreign investors' holdings changed significantly. The holdings of foreign banks fell by about 10 percentage points to 15%, and were replaced by portfolio investments made by non-banking financial institutions, whose market share now amounts to about 80%. From the financial stability standpoint, the most important question concerns the characteristics of this group. The category is far from homogenous as it includes long-term investors, often called real money accounts, as well as hedge funds and the rest of the "leverage community". The former group seems to be welcomed by local authorities as the most stable type of investor, while the latter group poses the biggest potential risk to financial system stability. Based on historical precedents such as the large portfolio outflows from the Polish debt market in 2008, we estimate the share of leveraged funds at 6% of outstanding foreign investment in Polish government debt. This is clearly hot money, which is liable to overreact to changes in global investment sentiment. However, it should be stressed that foreign banks may also induce volatility on the debt market as their investments are often motivated by the expectation of capital gains. Foreign banks have been especially active during the monetary policy easing cycle. However, this category of investors, as already highlighted, appears to have lost some of its importance, with its share of total marketable fixed rate government debt now falling below 5%.

In 2013, Poland and other EMEs experienced capital outflows from their debt markets (Figure 1) following the Fed's announcement of possible tapering. The increase in global risk aversion led to the reversal of portfolio flows driven by the search for yield. Between May and June, yields on Polish longer-term government bonds rose by about 110 bps as foreign investors sold off government bonds worth about PLN 5.3 billion.[4] In the aftermath of the May–June turmoil, capital outflows tended to persist, although on a much smaller scale. Compared to the end of April 2013, non-residents reduced their long positions in the government bond market by PLN 13.9 billion, reversing almost all the inflows recorded in the first four months of 2013. As a result their share in total marketable government debt fell by 3.7 percentage points between May and December, easing to 33.6% at the 2013 year-end. Despite continuing capital outflows after the May–June turmoil, the yields on long-term government bonds behaved in a more stable way, moving in a wide range of 4.1–4.5%. This suggests that, while ordered capital outflows need pose no threat to the stability of government bond market, rapid and massive outflows can lead to the violent adjustment of local interest rates, with possibly damaging implications for the real economy.

[4] However, portfolio flows suggest that foreign capital may not have left the country in its entirety, a conclusion that is further reinforced by the broadly stable exchange rate.

3. Copulas and tail dependence to assess extreme events

We next investigate more formally and from a financial stability standpoint the recent changes in the way that developments in global markets are transmitted to the situation in Poland. We ask ourselves how likely it is that large changes in a given foreign market translate to a large change in the respective market in Poland. We employ and extend the ABM methodology based on the *copula* functions.

It is now well known that the simple measure of Pearson correlation is inadequate description of the dependence between financial assets. On the other hand, Sklar's theorem says that any multivariate distribution can be decomposed into marginal distributions of the variables among which the dependence is being investigated and a dependence itself, captured fully by a function called a copula. This is succinctly summarised by the following equation:

$$H(x_1, \dots, x_n) = C\big(F_1(x_1), \dots, F_n(x_n)\big), \qquad (1)$$

where H is an n-dimensional distribution function with marginal distributions $F_1,\dots,F_n$, and C is a copula function. To analyse dependence between Polish and foreign financial assets, ABM implement a thorough specification search of both marginal (conditional heteroscedasticity models) and copula distribution functions (nine parametric families), based on information criteria as well as state-of-the-art bootstrap goodness-of-fit tests for copulas, to choose the best among the wide range of parametric models for further inference. It turns out that a useful measure can be derived from a copula, the so-called (lower or upper) *tail dependence coefficient* (hereinafter TDC). The coefficients[5] describe the propensity of markets to crash or boom together, ie they measure the dependence between extreme outcomes of the analysed variables, a phenomenon which is often dubbed a *contagion*. For comparison, if correlation is a measure of total dependence between two variables, TDCs describe dependence during stress periods only. Importantly, for the copulas considered in this paper the TDCs are simple functions of copula parameters.[6]

ABM analyse daily data from 1 March 2000 to 30 June 2012 on roughly the same data as we do in the present study to identify the sectors of the Polish financial market that are particularly vulnerable to contagion. Two conclusions are especially relevant. First, for the pairs of variables among which dependence is measured in the present work, the symmetrised Joe-Clayton (SJC) copula is admissible and often the optimal. The SJC copula is very attractive as it allows us to model the dependence in the times of booms and crashes independently. Second, asset classes differ greatly in their susceptibility to contagion, and the responses to upturns and downturns in global markets are often asymmetric: equities and the currency appear prone to contagion from all international markets under

[5] Formally, the upper (lower) TDC is a limiting probability of one variable exceeding (falling behind) a high-order (low-order) quantile, given that the other variable exceeds (falls behind) the same quantile.

[6] It is important to remember that the choice of a particular copula may in some cases restrict admissible asymptotic dependence, eg Gaussian copula implies asymptotic independence, t-Student's copula implies that upper and lower asymptotic dependence have the same strength.

consideration, while Polish bonds exhibit rather limited contagion from foreign markets (two-year bonds do not seem to be affected by any of the external factors considered; for 10-year bonds, the contagion is visible, though relatively weak compared with other asset classes).

It has to be acknowledged that the cited analysis, although based on a very sound methodology, is limited in at least one important respect. As it is static, it does not allow us to analyse the dynamics of the dependence, and thus, to assess if the influence of long-term rates in major financial centres has changed in recent years. A straightforward solution implemented here, broadly preserving the methodological rigour, is to split the sample into two subperiods – pre-crisis and crisis. We divide the data on 15 September 2008 (Lehman Brothers bankruptcy), then fit the marginal models as well as the SJC copulas into subsamples. Finally we compute TDCs.

Since time variation in the conditional first and second moments of economic time series has been widely reported, it seems natural to assess if there exists time variation in the tail dependence between Polish and foreign economic variables as well. To this end, we consider the conditional copula in a version first presented by Patton (2006), the time-varying SJC copula[7]. We assume that the functional form of the copula remains fixed over the sample whereas the parameters vary according to the following evolution equation for the conditional upper and lower TDCs:

$$\tau_t^U = \Lambda\left(\omega_U + \beta_U \tau_{t-1}^U + \alpha_U \frac{1}{10}\sum_{j=1}^{10}\left|u_{t-j} - v_{t-j}\right|\right) \tag{2}$$

where U stands for upper TDC, $\Lambda(x) \equiv (1+e^{-x})^{-1}$ is the logistic transformation, used to keep τ^U and τ^L in (0,1) at all times (for the equation for lower TDC substitute U with L). The right-hand side of the model for the tail dependence evolution equation contains an autoregressive term, $\beta_U \tau_{t-1}^U$, and a forcing variable (mean absolute difference between u_t and v_t over the previous 10 observations). Since there are separate equations for τ^U and τ^L, the SJC copula allows for asymmetric dependence and includes symmetric dependence as a special case. In contrast to the static copula, here we do not use goodness-of-fit tests of the copula function and there are two reasons for this. First, the other time-varying copula introduced by Patton (2006) does not allow for asymmetric tail dependence behaviour. Second, a consensus does not seem to exist in the literature as to which goodness-of-fit test should be used in case of dynamic copulas; the tests that are used appear underdeveloped and to have low power. For this reason we believe that the static copula results should be treated as more robust, while the dynamic copula results can contribute useful supplementary information.

[7] There are other methods of introducing dynamics into the specification of the copula, see eg Rodriguez (2003).

4. Changing pattern of extreme dependence between Polish and core markets

The data set at our disposal comprises foreign and Polish variables. The foreign variables include stock index and sovereign bond yields in the United States (S&P 500, US2Y, US10Y), Germany (DAX, DE2Y, DE10Y) and the CBOE Market Volatility Index (VIX), which measures the implied volatility of the S&P 500 index options and is commonly used as a market-based risk-aversion and uncertainty indicator. The Polish variables include the main stock market index (WIG), short- and long-term sovereign bond yields (PL2Y, PL10Y) and the main foreign exchange rate, quoted as the Polish zloty price of the euro (EUR/PLN). We use daily data from 1 March 2000 to 29 November 2013 obtained from Reuters (PL10Y) and Bloomberg (other variables). We transform the original data in levels into changes in yields (all sovereign bonds, percentage points) or into rates of return between two consecutive trading days as appropriate, obtaining 3,245 observations. We also use weekly data in the dynamic part of the study. Here the changes (or rates of return) are defined between Friday and the previous week's Friday, which accounts for 714 observations in total. To characterise our data set, we present descriptive statistics in Table 1. All variables exhibit high kurtosis accompanied by often high absolute skewness, which leads to strong rejections of normality of the univariate distributions (Jarque-Bera tests). ARCH effects are present in all of the variables and all but one exhibit strong autocorrelation. These characteristics motivate the use of ARMA-GARCH models for marginal distributions.

Descriptive statistics — Table 1

	Mean	Min	Max	Std. dev.	Skewness	Kurtosis	ARCH(10)	Q(20)	J-B
EURPLN	1,40E-05	–0,038	0,054	0,007	0,47	8,31	441*	54*	3935*
PL2Y	–0,0043	–1,420	0,987	0,101	–0,68	31,19	352*	112*	107670*
PL10Y	–0,002	–0,844	0,865	0,085	–0,01	22,37	417*	111*	50709*
WIG	0,0003	–0,102	0,061	0,014	–0,41	6,59	261*	37*	1834*
VIX	–0,0002	–0,437	0,496	0,065	0,60	7,41	194*	94*	2820*
DE2Y	–0,0013	–0,390	0,331	0,049	0,07	8,71	165*	49*	4411*
US2Y	–0,0019	–0,565	0,473	0,062	–0,25	10,87	327*	68*	8411*
DE10Y	–0,0012	–0,226	0,228	0,047	0,14	4,56	199*	22	341*
US10Y	–0,0011	–0,473	0,428	0,067	0,18	5,55	156*	53*	893*
DAX	5,88E-05	–0,098	0,135	0,016	0,07	8,60	538*	59*	4244*
SP500	8,33E-05	–0,095	0,104	0,014	–0,13	10,58	894*	104*	7770*

Notes: The table displays sample statistics for daily returns or changes in yields (bonds) between 1 March 2000 and 29 November 2013, spanning 3,244 observations for each series. ARCH(10), Q(20) and J-B are the Lagrange multiplier tests of no ARCH effects up to 10 lags, the Ljung-Box statistics of no serial correlation up to 20 lags and the Jarque-Bera test for normality of distribution. *, ** and *** denote statistical significance at 1%, 5% and 10% level, respectively.

Table 2 below shows the results of the estimation of TDCs in subsamples, thus reporting our assessment of the likelihood that extreme changes in asset prices have coincided in Poland and abroad. Meanwhile, Figure 2 depicts how this assessment changes as we move from the pre-crisis to the crisis period.[8] What becomes evident is that for variables other than bond yields the tail dependence, both lower and upper, increases, sometimes significantly so. The upper tail dependence between Polish and German or US bond yields, most interestingly from the viewpoint of the central bank, is generally low. The susceptibility of Polish long rates to large moves in foreign bond yields decreases in the second subsample. This is somehow contrary to the results reported by Miyajima, Mohanty and Chan (2012) of a high degree of co-movement between the yields since 2008. Note however, that what tail dependence measures is the dependence between large changes, and the reported inflow of real-money investors in the crisis period into the sovereign bonds market in Poland, believed by the investors to have strong fundamentals, may in fact have dampened the tail dependence and brought more stabilisation to the market instead. Our finding does not therefore deny that the overall dependence may have increased as a result of a stronger integration of the Polish bonds with core markets, or following the recent change in the status of Polish debt (now described as a regional safe haven). It refers to the probability of contagion only, and it shows that this probability has eased on average since September 2008, as compared to the period March 2000–July 2008.

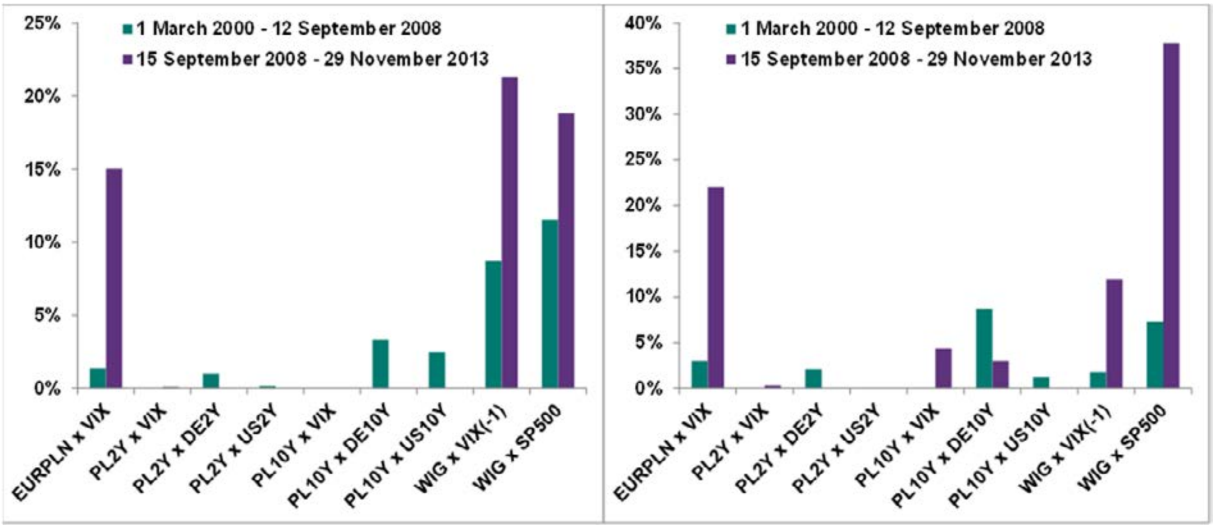
Estimates of extreme dependence in subsamples — Table 2

		1 March 2000–12 September 2008				15 September 2008–29 November 2013			
Poland	Foreign	τ^L	s.e.	τ^U	s.e.	τ^L	s.e.	τ^U	s.e.
EURPLN	VIX	1,4%	2,17E-02	3,0%	1,65E-02	15,0%	4,83E-02	22,0%	3,20E-02
PL2Y	VIX	0,0%	9,85E-05	0,0%	1,57E-06	0,1%	8,08E-03	0,3%	7,71E-03
PL2Y	DE2Y	1,0%	1,47E-02	2,1%	1,78E-02	0,0%	4,87E-06	0,0%	2,35E-06
PL2Y	US2Y	0,2%	4,82E-03	0,0%	3,84E-04	0,0%	9,71E-06	0,0%	1,97E-06
PL10Y	VIX	0,0%	5,95E-06	0,0%	1,49E-05	0,0%	1,99E-03	4,4%	2,64E-02
PL10Y	DE10Y	3,3%	2,31E-02	8,7%	2,71E-02	0,0%	3,89E-08	3,0%	2,25E-02
PL10Y	US10Y	2,4%	2,07E-02	1,2%	1,40E-02	0,0%	9,60E-07	0,0%	2,68E-05
WIG	VIX(-1)	8,7%	2,47E-02	1,7%	2,14E-02	21,3%	3,04E-02	12,0%	4,89E-02
WIG	SP500	11,5%	2,73E-02	7,3%	2,84E-02	18,8%	3,63E-02	37,8%	3,01E-02

Notes: The table displays the static upper and lower tail dependence coefficients and their standard errors, estimated over the two subperiods for the respective Polish-foreign pairs of assets. Nine pairs of the most representative financial instruments were chosen.

8 The results of the marginal distributions modelling as well as other non-reported results in this study are available upon request.

Estimates of extreme dependence in subsamples | Figure 2



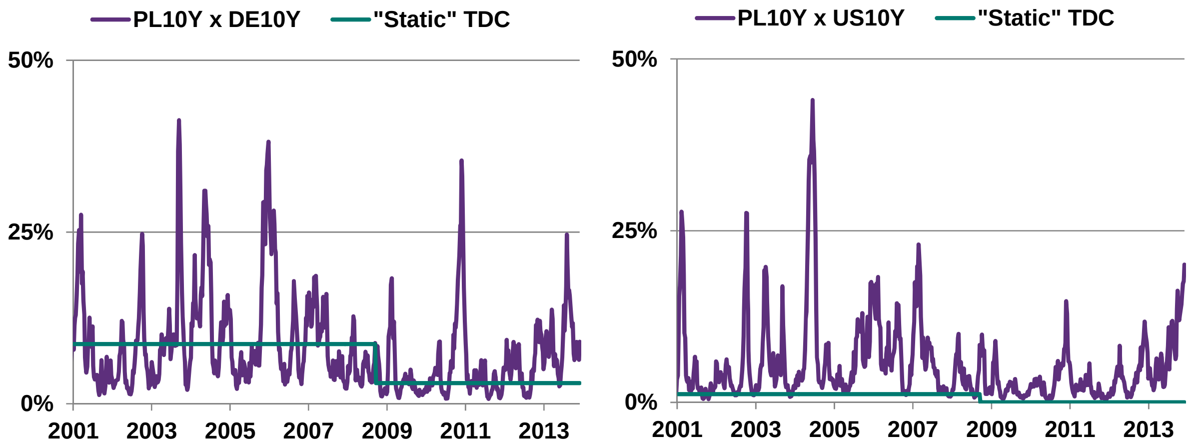
Notes: The figure plots the changes of static ("average") tail dependence coefficients over two subperiods for the respective Polish-foreign pairs of assets. The left-hand panel presents lower TDCs (propensity of two markets to boom together), while right-hand panel presents upper TDCs (propensity to crash together). See Table 1 for numerical values and standard errors.

The method based on splitting the sample into pre-crisis and crisis periods maintains some of the methodological rigour of ABM, but it cannot be applied to the recent period, marked by a rise of long-term rates caused by expectations for QE tapering. The reason is that the relevant period, from May 2013 until the present, would be too short to reliably fit the static models and make inferences. Here the time-varying copulas come to the rescue by providing the contagion estimates at every period in our sample ending in November 2013. We decided to focus on the upper tail dependence between Polish and core market (US and German) long-term yields because large yield surges, which do not originate in a change in a country's fundamentals, pose a bigger threat to the stability of local debt than large yield decreases. If sizeable increases in yields are not reversed, they may prompt overreactions among foreign investors. Bearing in mind that self-fulfilling expectations may arise in financial markets, this may increase borrowing costs for the government, as well as lead to problems with debt financing and even to default.

Figure 3 presents the propensity to crash from the estimation of conditional copulas. Several striking observations can be made when analysing the results. To start with, the importance of using methods which allow the tail dependence to vary over time is clearly demonstrated. TDCs fluctuate between virtually zero to as much as 44% in some periods. Our conditional copula results also cast light on the puzzle of decreased estimates between subsamples. The average dynamic estimate in the periods corresponding to subsamples from the unconditional part of the study also shows a visible decrease in the second period. In particular the average dynamic estimate decreases from 9.4% to 5.9% in the Polish-German copula, and from 6.3% to 5.9% in the Polish-US copula[9].

Dynamic propensity to crash together between Polish and core markets' 10Y yields

Figure 3



Notes: The figure plots upper tail dependence coefficients between 10Y Polish government bond yields and German bund yields, as well as between 10Y Polish government bond yields and US Treasury yields from dynamic SJC copulas (purple lines). For comparison are added upper TDCs from the estimation of unconditional SJC copulas in subsamples (green "step" lines, compare Figure 2, right-hand panel).

More importantly, however, if dynamic copulas were not applied, no strong contagion at several points in time would be detected. If limited to the latest financial crisis period only (starting from 2008), it appears that the most visible spikes in the extreme dependence between Polish and German yields coincide with the culmination of the sovereign debt crisis in the euro zone in November 2010 (Ireland became the second country to be bailed out), and during mid-2013, when speculation about the Fed's QE tapering mounted. The last period is even more pronounced when extreme dependence between Polish and US yields is taken into account. As a matter of fact, it surges to the highest level since the onset of the global financial crisis. This result requires special attention. It turns out that, regardless of the fact that the structure of Polish government non-resident investors has arguably "improved" (become more stable) in recent years, contagion during stress periods still occurs. This is clearly evident in the crisis periods, triggered by events that changed market perception of risk (credit risk in particular), as well as in the periods which signal a shift in the monetary policy stance of globally important countries, which may be followed by hot money portfolio outflows. From the policy viewpoint it underscores the importance of proper communication with the market to avoid policy-induced shocks that translate into abrupt changes in prices.

9 It should be pointed out, though, that SJC copula is not closed under temporal aggregation, so if the conditional copula is SJC, the unconditional copula does not need to be SJC in general. Moreover, the use of different frequencies also explains part of this problem.

5. Conclusions

Following sizeable liquidity injections undertaken by the major central banks since the onset of global financial crisis, the emerging debt markets have experienced large portfolio inflows. The inflows to Poland were significant compared to those received by other EMEs. In this study we argue that the stability perspective merits particular attention as possible consequences resulting from a disorderly outflow of a large base of foreign portfolio capital may be very damaging to the local economy. We employ the copula method which allows us to account for the dependence between financial assets better than the traditional Pearson correlation. More specifically, we use tail dependence coefficients, derived from the copulas, to examine the tendency of two markets to crash together, often interpreted in the literature as contagion, and focus on the pairs of Polish and core market 10-year sovereign bond yields. The results show that in the second subsample (September 2008 onwards) the extreme dependence has declined on average. Specifically, the propensity of the Polish 10-year yields to crash together with core market yields has decreased. We also note that the structure of non-residents investing in Polish government bonds has changed considerably. Stable investors have increased their share at the expense of speculative capital. Furthermore, the investor base has become visibly more stable. The recent outflows from the debt market beginning in May 2013 were more limited. It transpires that a stable structure of non-residents acted as a stabiliser and reduced extreme dependence on average. Such developments improve financial stability, sparing the country even bigger problems. Capital inflows may thus, under some conditions, turn out to be positive for a country, rather than a danger as often emphasised in the literature. It also underscores the need to efficiently manage the flows.

As always, the authorities should not be led into a false sense of security, as the current state of stability may sow the seeds of a future crisis. Indeed, a closer look at our additional results highlights the facts that there are still periods, often short-lived, during which Polish yields experience significantly more contagion from core yields, and that these periods are most pronounced when global markets come under stress. Specifically, the mid-2013 speculation about the start of QE tapering manifested itself in another large bout of contagion. In this regard, the extreme dependence estimates send a warning signal – to the effect that there is still a possibility of spillovers into a country identified as relatively safe in the region. On the policy front, our results confirm that the central bank needs to communicate carefully with the market to avoid policy-induced shocks that could translate into abrupt changes in the financial markets.

References

Adam, M, P Bańbuła and M Markun (2013): "Dependence and contagion between asset prices in Poland and abroad: A copula approach", National Bank of Poland, working paper, no 169.

Andritzky, J (2012): "Government bonds and their investors: what are the facts and do they matter?", IMF, working paper, no 12/158.

Eickmeier, S, L Gambacorta and B Hofmann (2013): “Understanding global liquidity”, *BIS Paper*, January 2013.

IMF (2013): “The recent sell-off in emerging market assets: what was most impacted and why”, internal note, IMF, July 2013.

IMF (2010): *Global Financial Stability Report*, April 2010.

Miyajima, K, M Mohanty and T Chan (2012): “Emerging market local currency bonds: diversification and stability”, *BIS Working Papers*, no 391, November 2012.

Patton, A (2006): “Modelling asymmetric exchange rate dependence”, *International Economic Review*, vol 47, no 2.

Rodriguez, J (2007): “Measuring financial contagion: A copula approach”, *Journal of Empirical Finance*, vol 14.

Monetary policy in Russia: Recent challenges and changes

Central Bank of the Russian Federation (Bank of Russia)

Abstract

Increasing trade and financial flows between the world's countries has been a double-edged sword for emerging market economies (EMEs). On the one hand, it has given EMEs ample opportunities to benefit from world economic growth and from the significant financial resources accumulated by developed countries. On the other hand, EMEs have become more vulnerable to shocks in global financial markets, the origins, scope and size of which are often beyond the control of EME governments and monetary authorities. This paper describes the specific set of external and internal conditions the Bank of Russia has had to take into account, as well as some features of its monetary policy and the way these have evolved in recent years to cope with the challenges posed by a changing external environment.

Keywords: Money supply, liquidity, intervention, Russia

JEL classification: E58, E52, E51, F31

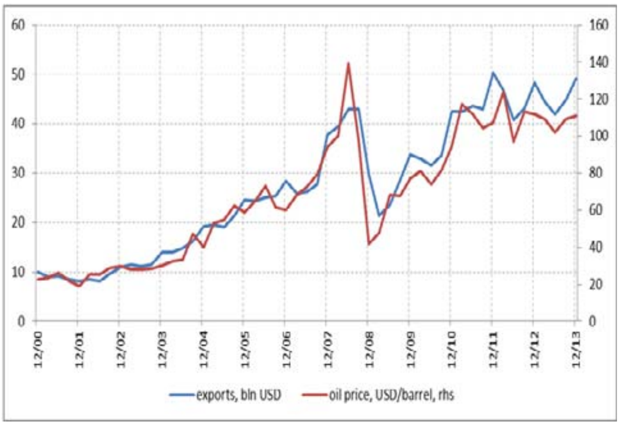
Policymakers in emerging market economy (EME) central banks are facing difficult choices. The world economy is becoming more and more integrated, with cross-border trade and financial flows increasing rapidly in volume. On the one hand, this gives EMEs many opportunities to benefit from world economic growth and from the vast financial resources of developed nations. However, on the other hand, as EMEs become increasingly integrated into the world economy and thus more dependent on external demand and financing, they become more vulnerable to external shocks. Most EMEs are quite small, especially compared to the volumes seen in the world financial market, and fluctuations that are more or less manageable by the central banks of the world's largest economies are much harder to control with the tools available to an average EME central bank.

Furthermore, many EMEs are undergoing structural changes. Their economic and financial conditions are subject to sudden and quite significant shifts even without external influence, and local central banks often have to focus on specific functions that at best are of secondary importance among the priorities of a "textbook" central bank. Some policy tools might be unavailable to them, while others may not be that efficient due to the specifics of the local economies or financial markets. Monetary policy itself becomes somewhat path-dependent, determined by past economic developments and policy responses, which greatly complicates the process of adopting central banking best practice.

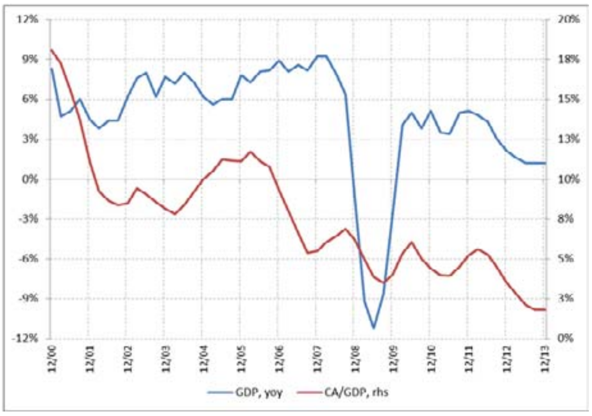
That said, the beginning of the 2000s was undeniably a prosperous time for most EMEs. Economic growth in these countries was much faster than the world average (6.7% per year in 2001–07 compared with 4.2% for the world economy). Global investors were happy to buy EME assets, fuelling a rally in the countries' stock and commodity markets.

Russia was one of the main beneficiaries of this favourable global environment. Commodity prices boomed during the period, with oil prices alone growing by about 350% in 2001–07. As oil accounts for over 50% of Russian exports – and oil and other commodities making up more than 70% – the sharp rise in oil prices fuelled a threefold increase in Russia's export volumes over the period. Meanwhile, the current account balance exceeded 10% of GDP in 2005–06, and economic growth accelerated as well, with GDP growing faster than 9% year-on-year by 2007.

Oil price and exports



GDP and external balance

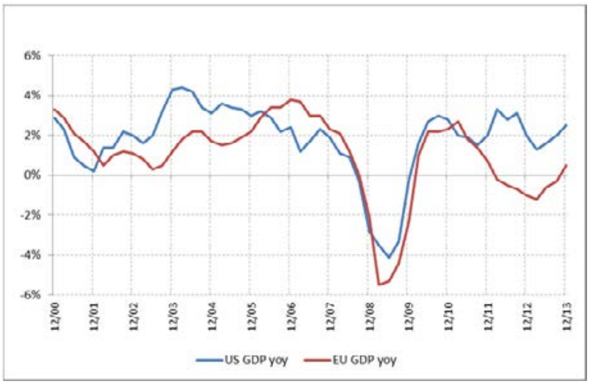


Source: Federal State Statistics Service, Bloomberg

Of course, the boom was not restricted to commodity markets. Risk appetite was high in all segments of the world financial system, and leverage ratios were rising, as were the prices of risky assets and the capital flows to EMEs. Such an extreme (though still favourable) set of external conditions was at least partly caused by the monetary policy stance of the world's major central banks. The Federal Reserve and the ECB were conducting loose monetary policies; the real policy rate in the United States was significantly negative during 2002–05, reaching –2%, while in the euro zone the real policy rate fell below zero as well, though not as much. Historically, these levels were very low, especially given the relatively high world economic growth rates during the period.

Real key rates

GDP growth rates, yoy



Source: Bloomberg

One can argue about the extent to which the loose monetary policies of major central banks were responsible for the accumulation of the imbalances in developed economies that finally resolved themselves in the 2008 financial crisis. However, for a relatively small EME central bank such a set of external conditions was obviously too much to handle. For Russia, rapid commodity price growth and an increase in the external trade surplus, given no restrictions on cross-border capital flows, caused significant upward pressure on the rouble, with demand for local currency greatly exceeding supply throughout most of the pre-crisis period.

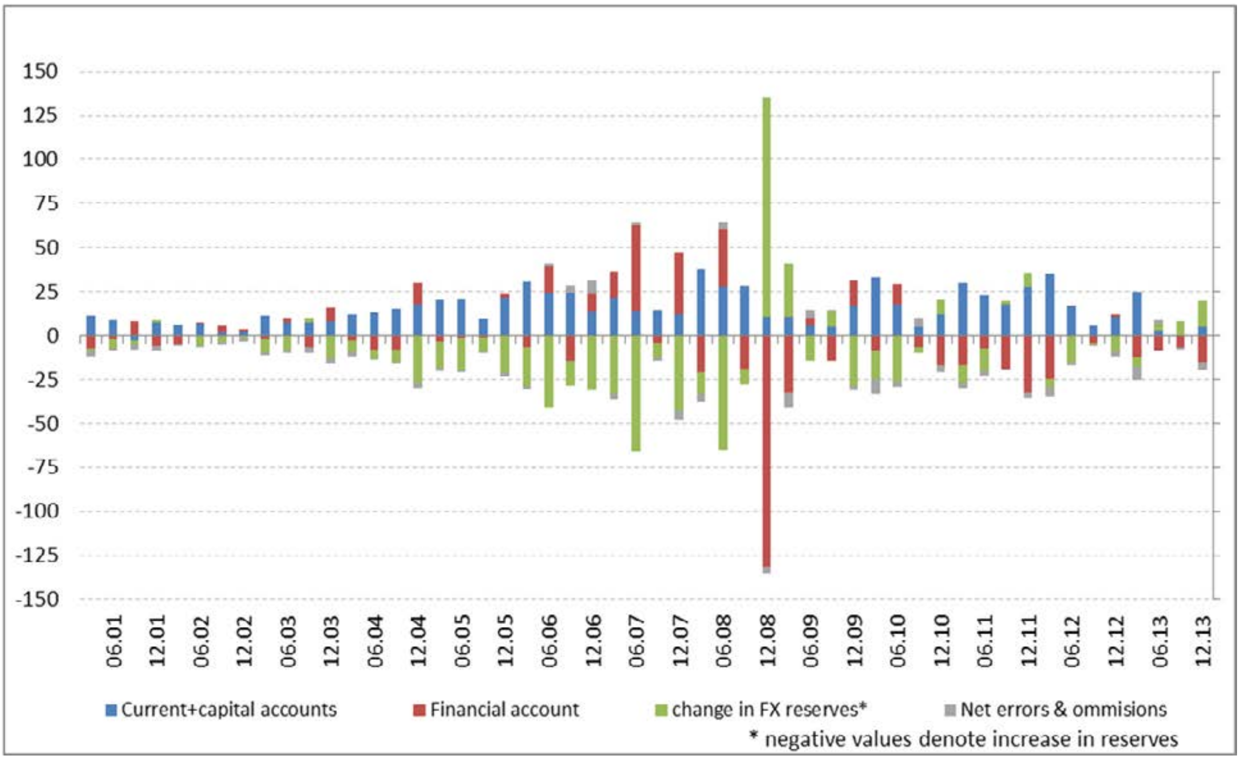
Were the exchange rate to be determined by private market participants alone, the rouble would have appreciated sharply, making for a perfect example of "Dutch disease". In this scenario, upward pressure on the exchange rate, caused by a temporary rise in world demand for a product in one sector of the economy, drives the exchange rate high enough to make other sectors of the economy uncompetitive, with no positive implications for the economy as a whole.

However, exchange rate stability means a lot for Russia's economy and population. Not so long ago, the country had passed through another major currency crisis, with foreign exchange, the USD in particular, widely used for household savings. In addition, exports and imports are quite high relative to the country's GDP, and foreign lending is an important source of funding for investments. So, the Bank of Russia obviously cannot ignore exchange rate dynamics; in fact, exchange rate stability is stated first in the Bank of Russia's mandate, as set out in "The Law of the Central Bank of the Russian Federation".

Consequently, the Bank of Russia had to try to counter the threat of "Dutch disease". Given the absence of capital controls, the one effective instrument the

Bank could use to combat excessive rouble appreciation was FX intervention in the domestic market. And intervene it did – quite considerably – with FX reserves increasing from less than USD 40 billion in 2001 to over USD 400 billion in 2007.

Balance of payments structure, bln USD



Source: Bank of Russia

The problem was that the external (upward) pressure on the rouble was so high that the Bank of Russia's goal of exchange rate stability (and its operations aimed at achieving it) started to conflict with, and even dominate, its other goals and instruments of policy. FX purchases in the domestic market injected vast amounts of liquidity into the financial sector, but local financial markets were fragmented and not deep enough for the Bank of Russia to be able to sterilise these interventions via liquidity-absorbing operations. Large-scale FX purchases created a structural liquidity surplus in the local financial sector. Virtually the entire increase in the money supply during the pre-crisis period was due to FX interventions. The Bank's liquidity instruments were not used much, and the relationship between market interest rates and the rates on the Bank's instruments was vague at best.

This was a good example of the classic "impossible trinity" of the central bank: of three possible policy options—free international capital flows, a managed exchange rate and independent monetary policy—the central bank is able to achieve only two simultaneously.

In Russia's case, the measures aimed at achieving exchange rate stability (FX interventions), the volume of which was actually determined by external, uncontrolled factors (world oil prices, demand for risk in world financial markets), outweighed any other instrument the Bank of Russia had to control the money supply and the interest rate level. As a result, under the given policy mix, the Bank had fairly limited potential to use the interest rate channel of monetary policy to influence the situation in local financial markets. The volume of liquidity and the price of money were determined to a much higher degree by external conditions than by the Bank's own operations.

And while the Bank of Russia was coping quite well with ensuring nominal exchange rate stability, the rapid growth in the money supply at least partially resulted in higher inflation rates. Persistently higher price growth in Russia than in its main trading partners led to rouble appreciation in real terms, gradually eroding the competitiveness of local producers.

However, the risks of such a situation were clearly visible, and the Bank of Russia moved steadily towards resolving them. The general course of action for the Bank, outlined in the Guidelines for the Single State Monetary Policy for 2004, was to shift gradually from a focus on exchange rate targeting to inflation targeting, to increase the role of interest rate instruments and to gradually move towards a freely floating exchange rate. Unfortunately, the world financial crisis in 2008 and the need to take emergency measures to mitigate its effect on the Russian economy forced a delay in this transition, but, on the other hand, it highlighted the drawbacks of the current monetary policy stance. After the crisis, work on the transition to inflation targeting was intensified.

During the post-crisis period, Russia's external conditions changed considerably. After a brief period of rapid growth, oil prices stabilised and have remained at approximately the same level since the second quarter of 2011. The rouble appreciated sharply in real terms, leading to faster growth in imports than in exports. The upward pressure on the rouble was gone, and automatic FX interventions were no longer the primary source of money growth. Better ways and better instruments of monetary policy were needed, and changes followed.

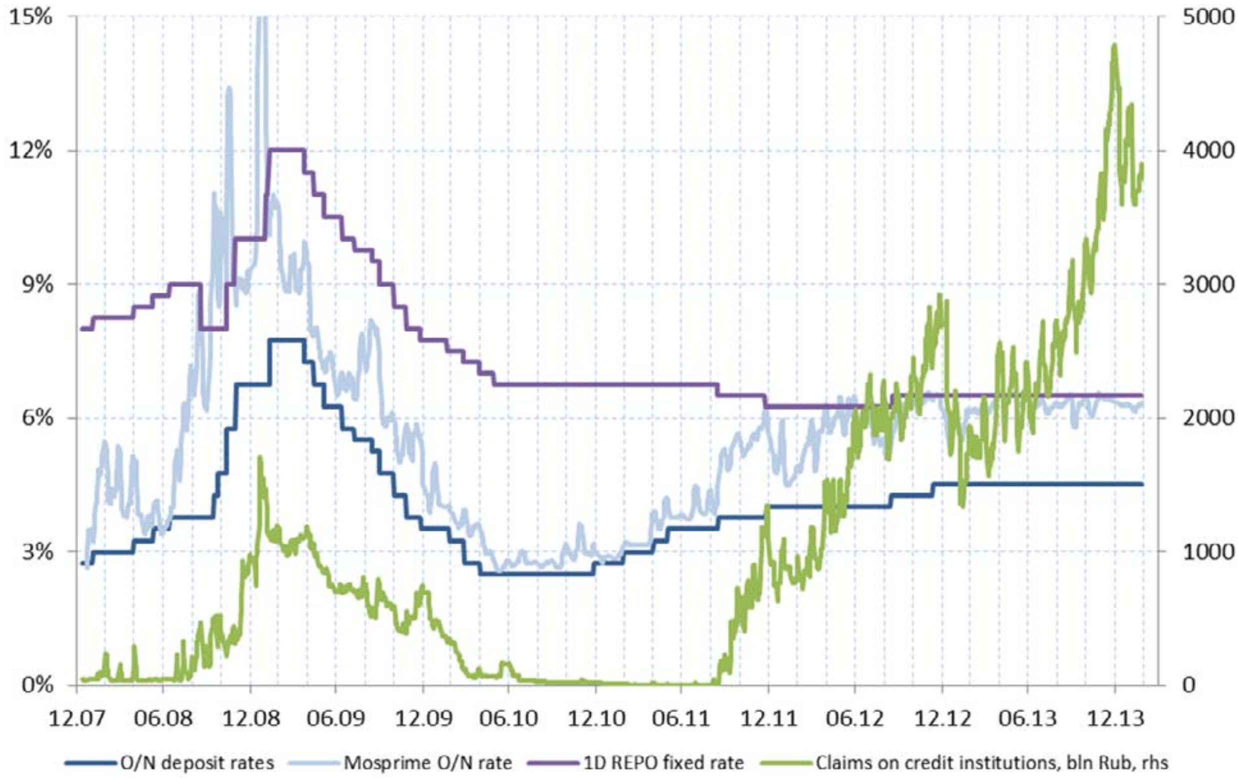
First of all, important changes were introduced to the mechanism of FX intervention, aimed at allowing for greater flexibility in the rouble exchange rate and reducing the amount of interventions needed to smooth excessive exchange rate volatility. Fixed bands for the rouble value of the dual-currency basket were abandoned in favour of the floating operational band, the boundaries of which are automatically adjusted depending on the amount of FX interventions. The current mechanism for smoothing exchange rate volatility allows purchases or sales of FX currency not only on the boundaries of the bands, but also inside the bands. The parameters of the Bank of Russia's FX operations in the domestic market are determined by taking into account the goal of smoothing exchange rate volatility. As a result, the rouble exchange rate is now determined to a much greater extent by market forces than it was during the pre-crisis period.

The instruments of interest rate policy were also modified significantly. In order to enable interest rate policy to be effective, credit organisations should be using the policy instruments frequently, and the rates on these instruments should influence market exchange rates. This was not exactly the case during the pre-crisis period, when commercial banks used the Bank of Russia's liquidity facilities mainly during brief periods with liquidity deficits. In order to increase the significance and volume of the liquidity management operations, the rates on the Bank of Russia's instruments were brought closer to market rates, and the gap between the rates on the liquidity-absorbing and liquidity-providing operations was narrowed.

By 2011, the structural liquidity surplus was gone, the commercial banks started using the Bank of Russia's liquidity facilities on a regular basis, and the rates and volumes of the liquidity-providing/absorbing operations were having a direct effect on market conditions, making interest rate policy much more effective.

September 2013 saw the most recent changes to the Bank's system of monetary policy instruments. First, the Bank of Russia introduced its key rate – the interest rate on the Bank's one-week liquidity provision and absorption open market operations, including a maximum interest rate on one-week deposit auctions and a minimum interest rate on one-week repo auctions. Second, an interest rate band was established by setting rates on the standing liquidity-absorbing/providing facilities at 1% lower/higher than the key rate.

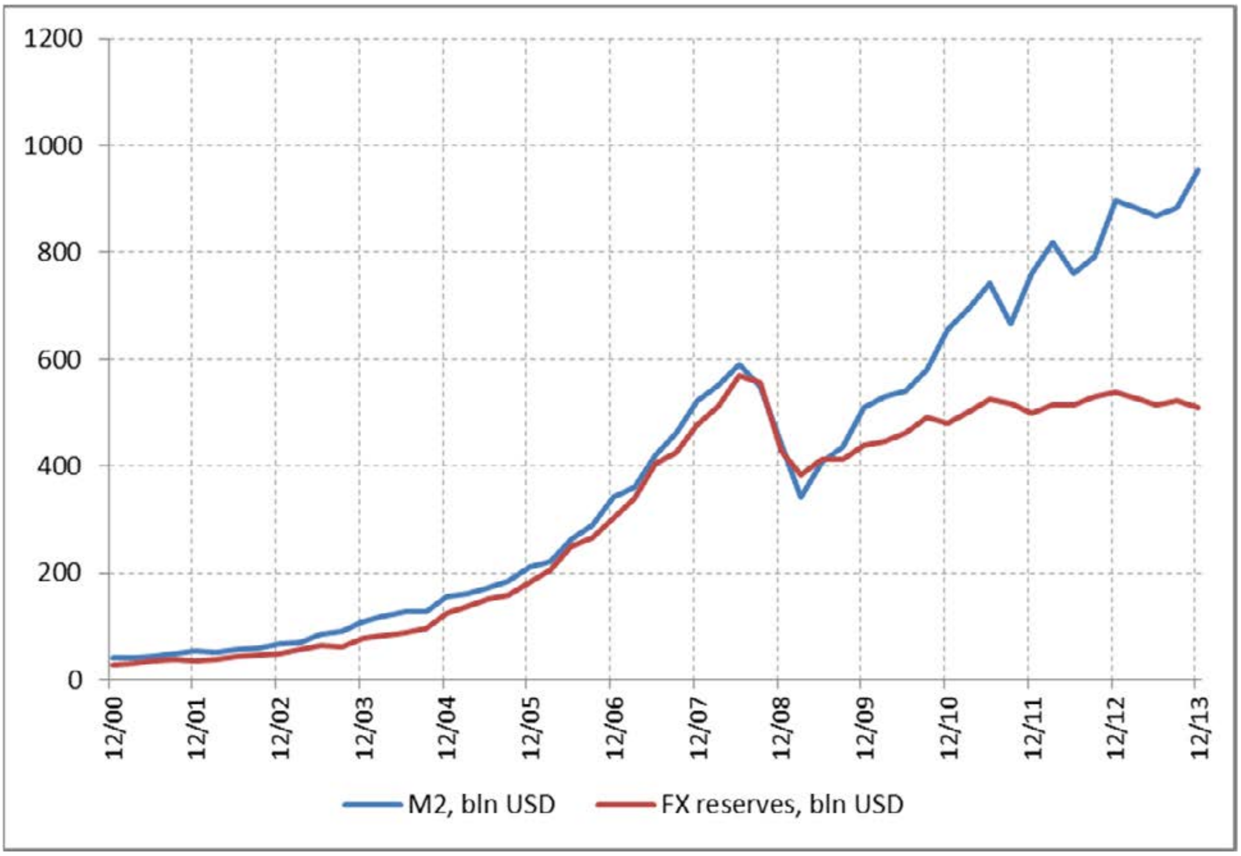
Interest rate instruments of the Bank of Russia



Source: Bank of Russia

To sum up, the Bank of Russia has modified its mix of policy instruments considerably in response to changes in macroeconomic and financial conditions during and after the world financial crisis. A transition was made from a policy that was primarily exchange-rate-stability-oriented, by which the money supply and interest rates were at least partially beyond the control of the Bank, to a policy by which the monetary aggregate dynamics are no longer tied to FX interventions by the central bank. The Bank of Russia now has much greater control of the money supply and interest rates via its interest rate policy instruments, while still maintaining the ability to smooth undesirable exchange rate fluctuations thanks to a more flexible FX intervention mechanism.

Money supply dynamics



Source: Bank of Russia

What have central banks from EMEs learnt about the international transmission of monetary policy in recent years?

Saudi Arabian Monetary Agency

Abstract

After the Fed adopted its unconventional monetary policy, countries with strong surpluses faced fewer challenges than did those with more open economies and strong financial linkages with developed economies. In the case of Saudi Arabia, fiscal policy remains dominant due to the structure of the economy and the country's exchange rate arrangements. As a result, Saudi Arabia did not have to engage in FX intervention to defend its currency or impose additional macroprudential measures to maintain the stability of the domestic financial system.

Keywords: Financial crises, Fed, unconventional monetary policy, EMEs, current account, exchange rate, and capital flows

JEL classification: E52, E58, F31, G01, E62

1. Introduction

The past two decades have witnessed a number of financial crises, but the latest one in 2008 was the most severe in modern history. Coordinated actions from many countries were needed to alleviate its impact on the global economy with significant pressures on central banks to restore financial stability and avert a potential deflationary spiral. Central banks in the advanced economies have resorted to unconventional policy tools, as lower-bound interest rates have reduced the effectiveness of monetary policy.

2. Impact of central bank actions on EMEs

The Fed has led other major central banks in pursuing unconventional monetary measures aggressively. Asset purchases have approximately quadrupled the size of the Fed's balance sheet since the beginning of crisis in a bid to keep mortgage rates low and help stabilise the financial system in the aftermath of the crisis. The Fed's policy triggered massive capital inflows into EMEs, putting undue upward pressure on their currencies and asset prices. Some countries have criticised QE as opening the way to currency wars and have been forced to introduce temporary capital controls. The flip side of this episode is that the Fed's exit strategy, initially by gradually withdrawing monetary stimulus via reduced asset purchases (so-called tapering), is also a matter of serious concern to EMEs as it has caused abrupt capital outflows and undermined their exchange rates.

The impact of policy transmission on EMEs varies according to their economic fundamentals. Countries with good current account surpluses were less vulnerable whereas those with more open economies and strong financial linkages with developed economies have suffered the most.

3. Saudi Arabia's experience

In Saudi Arabia, fiscal policy remains dominant due to the structure of the economy and the country's exchange rate arrangements. As for monetary policy transmission in Saudi Arabia, the most effective policy channel is the credit channel due to the constraints on interest rate policy under a fixed exchange rate regime.[1] Bank credit growth in Saudi Arabia reflects the economic activities stemming from fiscal operations (ie government spending on infrastructure projects). After a pause in 2009, bank credit growth has remained largely in line with overall economic activity. Unlike some other EME central banks, SAMA did not have to engage in FX intervention to defend the currency nor did it impose additional macroprudential measures to maintain the stability of the domestic financial system. This was largely

[1] Saudi Arabian Monetary Authority (SAMA) seeks to ensure that monetary and exchange rate policies are mutually consistent. In cases where speculation on the Saudi riyal is expected, SAMA either lets the interest rate differential widen to make speculation more expensive, or it intervenes in the FX market to mitigate any speculation-linked volatility in the rarely used forward market.

due to the resiliency of the Saudi banks, which derives from their strong balance sheets and prudent risk management together with sound supervision. Given that effective banking supervision lies at the core of financial stability, SAMA takes a proactive approach in supervising Saudi banks through rule-based as well as macroprudential measures. The bottom line is that Saudi banks' financial ratios speak for themselves, with regulatory capital well above the Basel II and III minimum requirements, while liquidity and leverage ratios are relatively conservative.

4. Lessons learnt about monetary policy transmission

- Owing to the nexus between monetary policy and capital flows, EMEs are more sensitive to any volatility in capital flows that may be triggered by major central bank policy actions.
- EMEs need to be better prepared to contain the impact of global crisis. Rather than adopting a bank-centric approach, this implies further developing their domestic capital markets with a view to making better use of domestic savings and improving their capacity to absorb capital flows from DMEs.
- Countries with structural issues need to introduce fiscal discipline in good times and to address supply-side shocks with the aim of reducing the volatility of their growth path.
- A sound and stable financial and banking system is the key to economic growth and to withstanding crisis-related effects.
- Capital controls should be the last resort and of short duration as they interfere with optimal asset allocation.

What have central banks from emerging market economies learnt about the international transmission of monetary policy in recent years?

Jacqueline Loh[1]

Abstract

Since 1981, monetary policy in Singapore has been centred on managing the trade-weighted nominal effective exchange rate, which has a powerful and predictable influence on domestic prices in a small, open economy. However, given Singapore's exchange rate-based monetary policy framework and financial openness, domestic interest rates have fallen in line with those in the world's advanced economies. With lending rates depressed, growth in credit to the domestic non-bank sector has accelerated, contributing to the fairly strong run-up in transaction volumes and prices in the housing market over 2010–12. In addition to posing risks to financial stability, this has exacerbated price pressures stemming from restructuring in the Singapore economy. In response, the MAS has calibrated its monetary policy stance and augmented the exchange rate framework with macroprudential tools and other targeted administrative measures, with a view to securing overall price and financial stability in the economy.

Keywords: Monetary policy, exchange-rate framework, price and financial stability, macroprudential policy

JEL classification: E440, E520, E580

[1] Deputy Managing Director, Monetary Authority of Singapore.

The views expressed here are solely those of the author and should not be attributed to the MAS.

1. Introduction

1.1 This note highlights the challenges to the conduct of Singapore's exchange-rate-centred monetary policy following the global financial crisis. The outline of the note is as follows. Section 2 outlines Singapore's exchange-rate-centred monetary policy framework. Section 3 highlights the channels through which advanced economies' monetary policies are transmitted to Singapore, as well as the associated challenges to the conduct of the country's monetary policy. Section 4 discusses the Monetary Authority of Singapore's (MAS) policy responses, while Section 5 concludes.

2. The exchange rate as the instrument of monetary policy

2.1 Since 1981, monetary policy in Singapore has been centred on managing the Singapore dollar nominal effective exchange rate (S$NEER). The MAS manages the S$NEER within a policy band. The slope and width of the exchange rate band, as well as the level at which the band is centred, are calibrated to attain the optimal monetary policy stance for the Singapore economy to ensure low and stable inflation over the medium term. The exchange rate represents an ideal intermediate target of monetary policy as Singapore is a small, open economy, and is highly dependent on imports for all its needs, including necessities such as food and energy. The economy's openness means that the exchange rate exhibits a stable and predictable relationship with price stability.

How the exchange rate affects the economy

- First, the exchange rate acts *directly* to dampen imported inflation. The import content of domestic consumption is high, with nearly 40 cents out of every dollar spent going to imports. Hence, domestic prices are very sensitive to world prices and exchange rate movements.
- Second, the exchange rate acts *indirectly* to tackle domestic sources of inflation. A stronger currency moderates the external demand for Singapore's goods and services, and hence the demand for domestic factor inputs. As a result, factor incomes would rise more modestly, which in turn reduces the domestic demand for goods and services and puts *downward* pressure on prices.

However, the choice of the exchange rate as the instrument of monetary policy implies that the MAS cedes control over domestic interest rates and the money supply, in the context of an open capital account. Singapore dollar interest rates are largely determined by foreign interest rates and investor expectations of the future movement in the Singapore dollar. The MAS monitors interest rates and the money supply closely to ensure sufficient liquidity in the system for regulatory and settlement purposes rather than for monetary policy objectives.

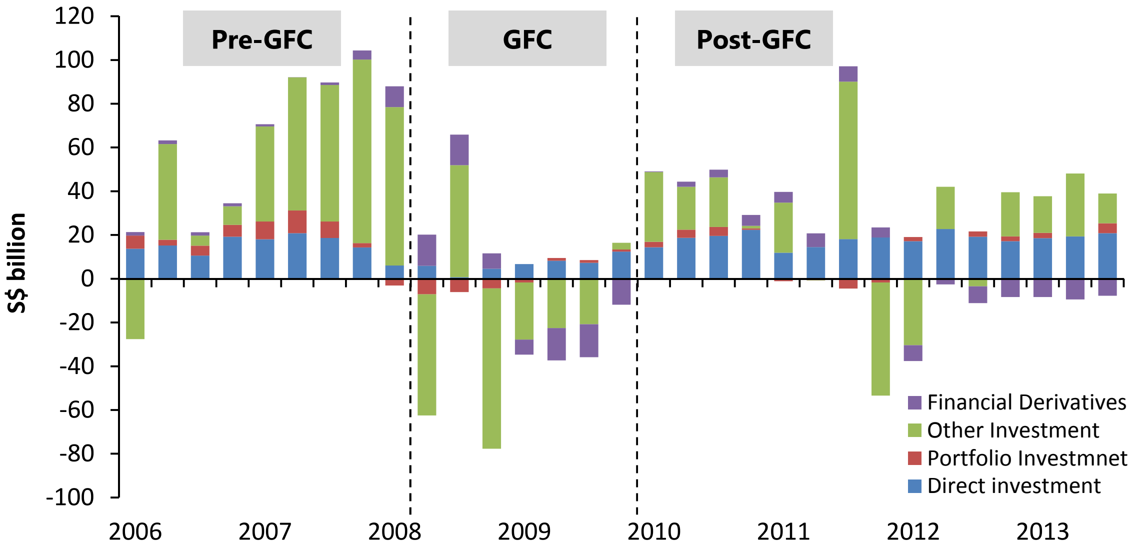
3. International transmission of monetary policy in the post-GFC environment

Post-crisis monetary policy and global capital flows

3.1 From the outset of the global financial crisis (GFC), policymakers in the advanced economies reduced policy rates to near zero and implemented successive rounds of unconventional monetary policies – initially to restore confidence in the financial markets, and later to support the still-fragile economic recovery. Near-zero policy rates and unconventional monetary policies have lowered returns on interest-bearing assets in the advanced economies and reduced global risk aversion. Consequently, this has encouraged portfolio rebalancing among global investors towards riskier assets, with capital flowing to emerging economies in the search for yield. Indeed, the global risk premium has shown to be a significant variable in predicting surges and stops in capital inflows (Forbes and Warnock 2011).

3.2 In developing Asia, after a sharp but short retrenchment during the GFC, gross capital inflows rebounded at a record pace, averaging some USD 212 billion per quarter between Q1 2010 and Q3 2013. The level of capital inflows slightly exceeded that seen in the pre-GFC period (USD 208 billion a quarter). In Singapore's case, capital inflows also recovered during the post-GFC period but were smaller, on average, than in the run-up to the GFC. This relatively smaller volume of flows was largely due to reduced gross "other investment" inflows, which are primarily flows into the banking sector (Chart 1 and Table 1). It is noteworthy that Singapore's banking system has ample liquidity domestically, and does not rely on foreign funding to support domestic lending.[2]

Gross capital inflows to Singapore | Chart 1



Source: Singapore Department of Statistics.

[2] MAS (2012): "Banking System Trends: Pre- and Post-Lehman," Box E, *Financial Stability Review,* pp. 39–42.

Gross capital inflows (quarterly average)		Table 1
Pre-GFC (Q2 2006-Q1 2008 avg.)	GFC (Q2 2008-Q4 2009 avg.)	Post-GFC (Q1 2010-Q3 2013 avg.)
S$70 billion	-S$17 billion	S$37 billion

Source: Singapore Department of Statistics.

Transmission to domestic credit and asset prices

3.3 In addition, deepening integration of the global financial system has amplified the international transmission of advanced economies' monetary policies through feedback loops, as banks and institutional investors increase leverage rapidly in response to an initial monetary policy impulse or changes in risk appetite[3] (Bruno and Shin 2012). Research by Helene Rey (2013) has also highlighted that advanced economies' monetary policies are part of a "common global financial factor" that can trigger excessive credit growth during periods of exuberance and, conversely, excessive retrenchment during the downswing. This can take place irrespective of the exchange rate regime. (Rey 2013)

3.4 Given Singapore's exchange rate policy regime and financial openness, domestic interest rates such as the S$ interbank offered rate (S$ SIBOR) have moved in tandem with foreign interest rates such as US$ LIBOR. (Chart 2a) In the post-GFC period, domestic interest rates have fallen in line with those in the advanced economies. The three-month S$ SIBOR declined from 3.4% at end-2006 to a historical low of around 0.4% following the GFC, and has remained almost unchanged since December 2011.

3.5 Loans in Singapore tend to be priced off short-term interest rates such as the S$ SIBOR and swap rates with tenors of less than one year. With short-term lending rates depressed, growth in credit to the domestic non-bank sector accelerated, from 4.5% year on year at the start of 2010 to 30% in December 2011 (Chart 2b). This was due in part to strong business lending, which rose by 41% in 2011 as economic activity across a broad swath of sectors recovered following the GFC. At the same time, consumer credit growth was also robust, as mortgage loan growth remained firm throughout the GFC and thereafter.

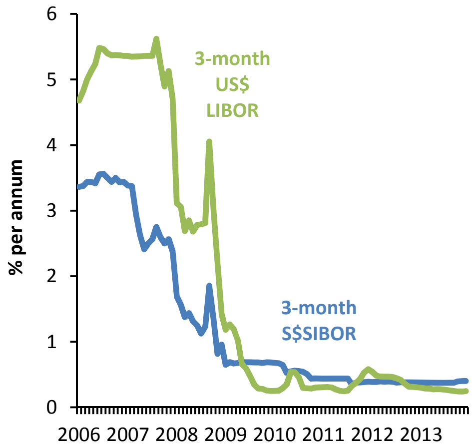
3.6 There were concerns that easy financing conditions would cause property prices to rise rapidly. This could destabilise the domestic housing market and compromise financial stability if sustained for an extended period. Housing loan growth rose from 14% year on year in Q1 2010 to 20% in Q2 2011, and, alongside these developments, the property market experienced a fairly strong run-up in transaction volumes and prices. For example, private property prices were 16%

[3] Bruno and Shin (2012) constructed a theoretical model to explain how global banks transmit financial conditions across borders. For example, a decrease in the Fed Funds rate would lower global banks' funding costs. This provides an initial impetus for greater risk-taking in cross-border lending, resulting in capital inflows and an initial appreciation of the local currency. In turn, this strengthens the balance sheet position of the borrowers, relaxing the funding constraints for global banks to lend even more to them. Thus, the initial monetary policy impulse is amplified through this feedback loop.

higher in Q2 2011 compared to the beginning of 2010, and had risen by more than 50% since their trough in Q2 2009. Nevertheless, following several rounds of property-cooling measures, property-related indicators, including housing loan growth, have moderated. The overall growth in credit to the domestic non-bank sector has also eased to 17% year on year as at end-2013.

Interest rates

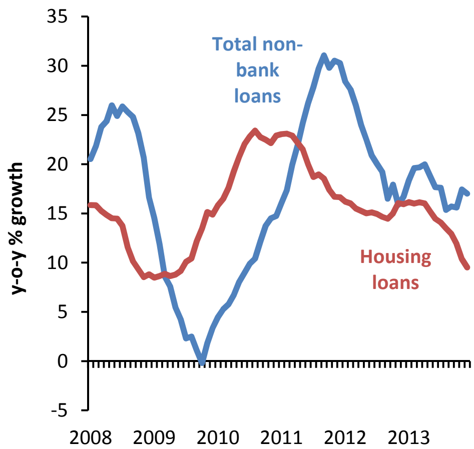
Chart 2a



Source: Bloomberg.

Domestic credit growth

Chart 2b



Source: Monetary Authority of Singapore.

4. Singapore's monetary policy response given the new international financial landscape and domestic restructuring[4]

4.1 Post-GFC, the MAS's conduct of monetary policy has been conditioned by an unprecedented confluence of factors, in particular the persistently low global interest rate environment described above, and restructuring in the domestic economy.

4.2 The Singapore economy has been undergoing restructuring against the backdrop of supply constraints, especially in the labour market. Singapore is facing a demographic challenge: the effects of low birth rates over the last two decades and the entry into retirement of the baby boom generation. In addition, it is not sustainable to continue to grow the foreign workforce at historical rates, given Singapore's physical land constraints. Over the longer term, growth in the Singapore economy will therefore have to rely less on increases in the labour force and more on productivity growth. Meanwhile, economic restructuring will result in some transitional costs. For example, the government has implemented labour force tightening measures, such as increasing the levy paid on foreign workers and reducing the dependency ratio ceilings, which cap the proportion of foreign to resident workers in different sectors. These tightening measures aim to reduce firms' reliance on low-cost foreign labour and prompt shifts in production and investment by inducing relative factor price adjustments. In the short term, however, wages and therefore price pressures will rise, as productivity-enhancing measures take time to bear fruit.

4.3 Taken together, this has meant strong credit growth and domestic demand at a time when supply is temporarily tight. Consequently, inflation has picked up, averaging 4.9% over 2011–12. This has been driven by increases in the cost of cars and accommodation in the CPI basket, as well as wage-cost pressures arising from a tight labour market feeding through to higher services fees (Chart 3).

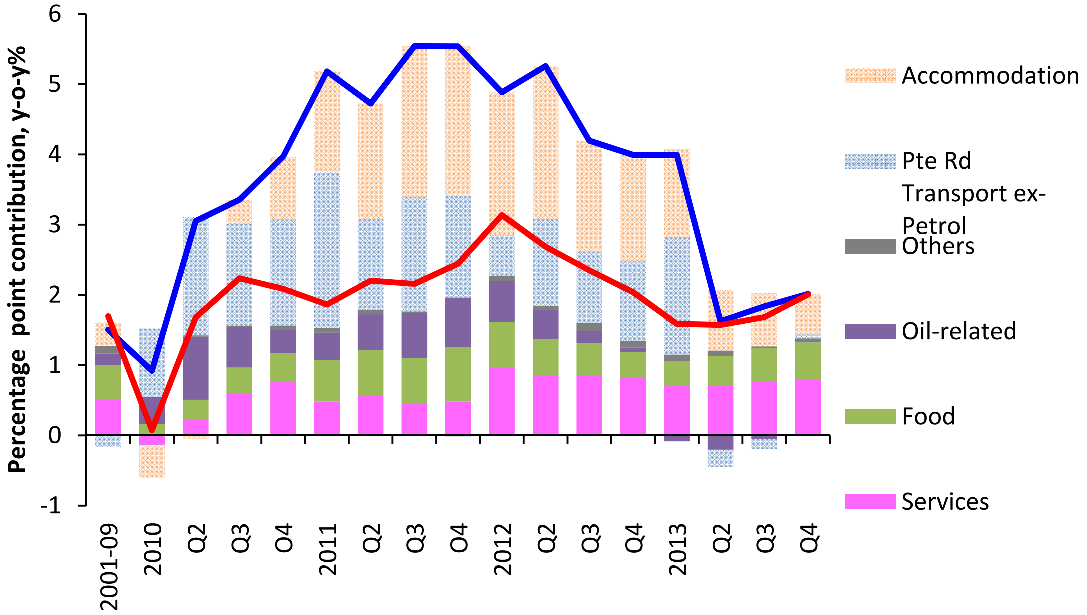
4.4 These developments have presented several issues for the formulation and conduct of Singapore's monetary policy in the recent period:

1. With the increase in importance of domestic sources of inflation, to what extent is the exchange rate still relevant as the instrument of monetary policy?
2. How should monetary policy be calibrated, given the interaction of global and domestic cyclical and structural factors?
3. What other instruments can the central bank use to secure overall macroeconomic stability?

[4] This section draws on a speech by MAS Managing Director, Mr Ravi Menon, at the Opening Gala Dinner for the Asian Bureau of Financial and Economic Research on 21 May 2013, entitled "Securing Price Stability as Singapore Restructures".

Contribution to CPI inflation

Chart 3



Note: MAS Core inflation excludes the cost of private road transport and accommodation.

Source: Singapore Department of Statistics.

Continued relevance of the exchange rate as the instrument of monetary policy

4.5 On the first issue, the MAS has emphasised that the exchange rate-based framework remains relevant and effective even during this period of low global interest rates and rising domestic sources of inflation stemming from economic restructuring.

4.6 The importance of the exchange rate in restraining price increases has not been undermined as the fundamental structure of the Singapore economy has not changed: external-oriented manufacturing and services sectors together account for about half of Singapore's GDP, while imports make up almost 40% of domestic consumption. As such, the exchange rate remains a key nominal anchor in household and business decisions. Since April 2010, the MAS has set monetary policy on a tightening path by allowing the S$NEER to appreciate at a modest and gradual pace. Up to December 2013, the S$NEER had appreciated by 11%. The appreciating bias of the trade-weighted exchange rate has dampened imported inflation and reduced the upward pressure on core inflation, which has moderated from a peak of 3.5% at the start of 2012 to 2% at end-2013.

Formulation of monetary policy responses

4.7 As regards the second issue, the MAS has had to establish the optimal monetary policy response under the extraordinary circumstances in the global and domestic economy. Restructuring will tend to generate temporary inflationary pressures if the supply-side adjustments take place amid sustained but modest growth in aggregate demand. If monetary policy settings were insufficiently tight, inflation expectations could become unhinged. This could arise if firms pass on wage increases to consumer prices in the near term, given that productivity gains would only bear fruit in the medium term. The resetting of a range of services fees could cause medium-term expectations of inflation to drift upwards.

4.8 Further, while property prices do not directly enter the computation of the CPI, their "visibility" implies that such prices are an important part of the information set on which expectations are formed. Monetary policy is primarily directed at ensuring price stability for the whole economy and, in many circumstances, is too blunt an instrument to directly temper increases in specific asset prices or to cool interest-rate-sensitive segments of the economy. While a tighter monetary policy could dampen asset prices, it would inflict significant collateral damage on the broader economy, leading to considerable output volatility. In addition, an excessively strong Singapore dollar could drive firms to exit the economy rather than make the necessary adjustments to their usage of capital and labour. This would hinder rather than facilitate the relative price changes that would stimulate the necessary resource reallocation in the economy.

4.9 Accordingly, the formulation of monetary policy has been guided by a number of practical considerations.

Calibrated response to temporary price increases

4.10 First, one of the guiding principles of monetary policy adopted by the MAS is to "temper, but not fully offset" price pressures in the economy. In the short term, higher labour costs due to permanent supply-side shifts are necessary to signal optimal resource reallocation – monetary policy should not (fully) offset these relative price adjustments. However, monetary policy must also react to guard against an increase in inflation expectations due to second-round effects on prices. Accordingly, the MAS has taken a judicious approach towards monetary policy formulation, targeting a modest and gradual appreciation path for the policy band of the S$NEER since April 2010. In effect, the MAS allowed a temporary increase in core inflation to accommodate some of the increases in relative prices, so as to signal the scarcity of resources and encourage the necessary behavioural shifts. Appendix 1 provides a graphical summary of the MAS's monetary policy responses since 2004.

Flexible implementation of monetary policy stance

4.11 Second, the MAS has also exercised flexibility in adjusting the parameters of the basket, band, and crawl system. For example, the MAS adjusted two policy levers in the tightening moves in April and October 2010, which is relatively rare.[5] These moves, deemed "pre-emptive" by the market, were necessary as the economy was recovering very rapidly from the GFC, and the negative output gap had turned positive and was widening. In April 2011, the MAS re-centred the policy band upward but "below [its] prevailing level", whereas it had previously always

[5] Typically, when monetary policy is in its tightening phase, only the slope of the policy band or the level at which it is centred is adjusted.

re-centred the band to the prevailing level. This calibration of the exchange rate policy band allowed the MAS to tighten monetary policy to anchor inflation expectations, while signalling that the pace of S$NEER appreciation should not be so rapid as to hinder restructuring.

Expanding policy toolkit to include macroprudential policies

4.12 Third, the MAS has always taken the position that asset prices matter for both economic and financial stability. In response to the potential risks associated with an environment of sustained low interest rates, the MAS has adopted an approach that augments the exchange rate-centred monetary policy framework with macroprudential tools and other targeted administrative measures. While monetary policy continues to be formulated on the basis of growth and inflation considerations, the use of macroprudential instruments is targeted at the specific areas of financial stability risks.

4.13 Although macroprudential tools have been used in Singapore as early as 1996 to help cool an overheated property market, they have been applied in a more concerted fashion since 2009.[6] Unlike monetary policy, there is no single macroprudential instrument that has a stable relationship with financial or asset price stability. Macroprudential policy has thus relied on a range of policy instruments, and has involved a coordinated approach across different government agencies including the MAS, the Ministry of Finance (MOF), and the Ministry of National Development (MND). For example, the MAS has progressively lowered the loan-to-value ratios on property loans and capped mortgage tenures at a maximum of 35 years. The MOF has successively raised taxes on property transactions, in the form of the Seller's Stamp Duty and the Additional Buyer's Stamp Duty. The MND has ramped up land sales for residential property developments, taking into account the medium-term housing needs of the population.

5. Summary

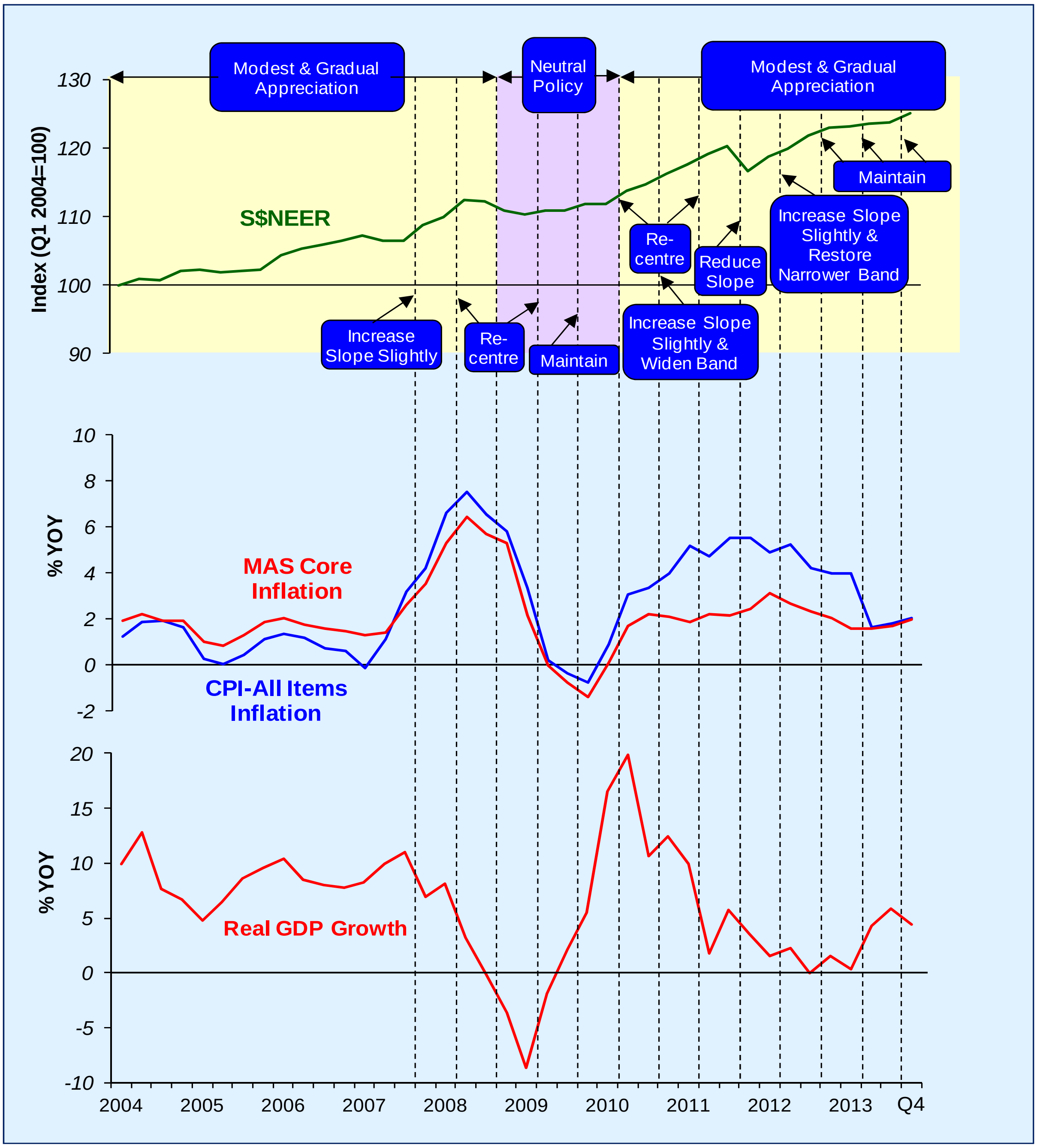
5.1 Since the GFC, Singapore's macroeconomic landscape has become more complex. Externally, exceptionally loose monetary policy in advanced economies had led to easy money with inflationary consequences for Singapore, exacerbating price pressures that stemmed from restructuring in the domestic economy. Singapore's monetary policy stance since 2010 has been calibrated and has begun to yield results: it has dampened imported inflation, restrained aggregate demand, and tempered domestic sources of inflation. Indeed, CPI-All Items inflation came in at 2.4% in 2013, a step-down from 5.2% in 2011 and 4.6% in 2012. MAS Core Inflation has also moderated, from 2.5% in 2012 to 1.7% in 2013. In addition, the coordinated series of macroprudential measures has succeeded in cooling the

[6] The MAS has introduced seven rounds of macroprudential policies since September 2009 to cool the property market and promote sustainable asset prices. In June 2013, the MAS also introduced a total debt-servicing ratio (TDSR) framework for all property loans granted by financial institutions to individuals. The TDSR framework is structural in nature and will help strengthen credit underwriting practices and serve to encourage financial prudence among borrowers.

property market. Property transaction volumes have eased, while the prices of private residential properties rose by 1.1% in 2013 from an average of 8.7% in 2010-12. The MAS continues to ensure that monetary policy is focused on keeping the economy on an even keel by bringing the path of GDP closer to its potential during this period of restructuring, even while specific areas of strong credit and asset price growth are dampened through targeted measures.

Appendix 1

Key macroeconomic variables and changes in the monetary policy stance



References

Bruno, V and H S Shin (2012): "Capital flows, cross-border banking and global liquidity", *NBER Working Paper*, no 19038.

Forbes, K and F Warnock (2011): "Capital flow waves: surges, stops, flight and retrenchment", *Journal of International Economics*, vol 88(2), pp 235–51.

Rey, H (2013): "Dilemma not trilemma: the global financial cycle and monetary policy independence", Paper prepared for the Jackson Hole Symposium, August 2013.

Menon, R (2013): "Securing price stability as Singapore restructures", Keynote Address at the Asian Bureau of Financial and Economics Research (ABFER) Opening Gala Dinner, Singapore, 21 May 2013.

The international transmission of monetary policy – lessons learnt in South Africa

South African Reserve Bank

Abstract

Changes in the monetary policies of major countries impact on the exchange rates and interest rates of emerging market (EM) countries, although the extent differs. Some EMs appear to be more exposed, owing to factors such as the size of current account deficits and low levels of foreign direct investment (FDI). As longer term bond flows to EMs increased, long-term rates in major financial centres have become more important since the global recession and particularly since talk of tapering initially began in May 2013. South African monetary policy, which is conducted in an inflation targeting framework, responds to changes in advanced economy (AE) monetary policies in an orthodox and therefore fairly well-understood manner.

Emerging markets reserves accumulation gathered pace following the global financial crisis. The SARB too has accumulated reserves in recent years, and follows a policy of sterilizing the liquidity. It has also recently announced some diversification of its reserves. Growing diversification of assets by international investors towards EM domestic currency bonds and equities for the international financial system should help to reduce concentration risk and achieve a more stable foreign investor base for EM issuers.

Keywords: Bond market, exchange rate, share market, current account, FDI, foreign exchange reserves, Fed, interest rates, monetary policy, stabilisation

JEL classification: G15; E52; E58; E59; F65

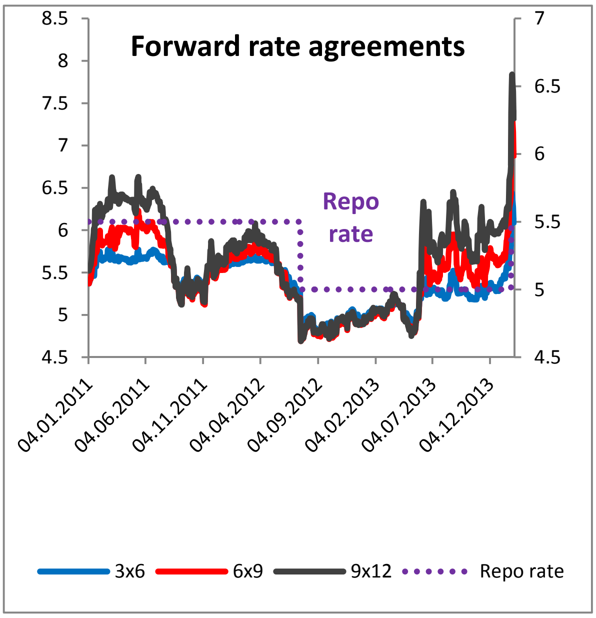
A. International financial spillovers

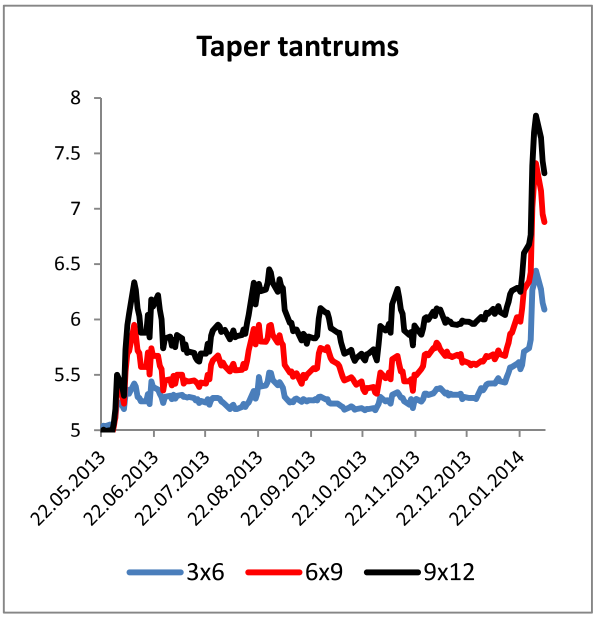
1. What are the channels of transmission of policy rates in major currency areas to EMEs? How does the impact on a particular EME depend on their current account positions and the structure of their gross cross-border positions (eg equity versus debt)?

Changes in the monetary policies of major countries often affect the **exchange rate** and the **yield curve**. The "taper tantrum" of May 2013 is a clear demonstration of these impacts as shown in Figures 1 and 2. Short-term rates jumped abruptly, signalling expectations of rate hikes, as markets initially interpreted tapering to including short-term interest rate normalisation. Similarly, the 10-year government bond rate rose 240 basis points (compared to 140 bps for the United States) and the rand – which had already depreciated in response to negative domestic news – fell even further. Emerging market economies' bonds were particularly vulnerable to expectations of QE tapering in the United States as investors' expectations were that it would reduce the "search for yield" among advanced economies (AE) investors, and in turn result in capital outflows from EMEs, which turned out to be the case, even before *actual* tapering began. Quantitative easing (QE) purchases had also resulted in a compression of term and risk premiums across a broad range of EME assets, and this trend began reversing in 2H 2013. Since late 2013, when the focus was increasingly on the timing and extent of short term interest rate normalisation, changes in these perceptions have resulted in volatile capital movements, with implications for the rand exchange rate.

Expectations for short-term rates in South Africa are clearly responding to developments in the United States

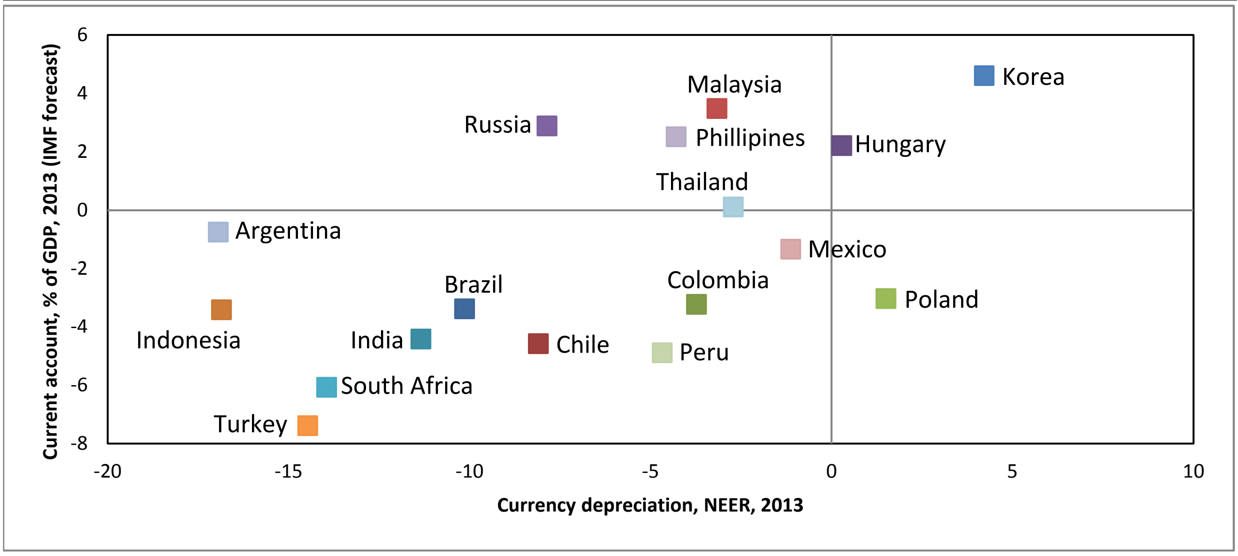
Figures 1 & 2





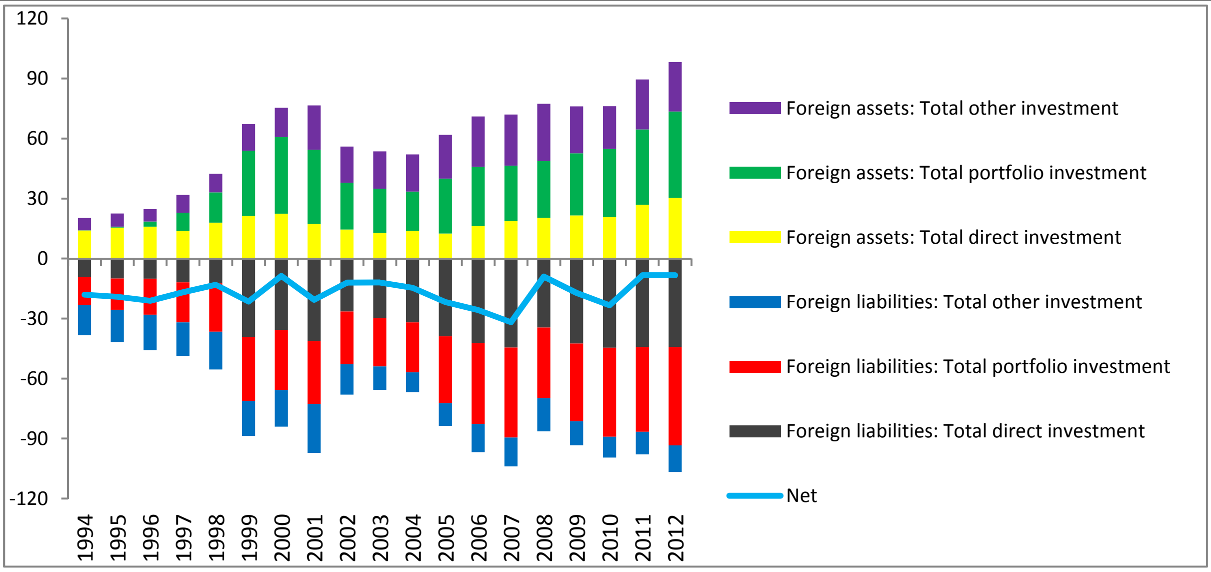
However, not all emerging markets have seen AE monetary shocks transmitted and magnified to the same extent. South Africa appears to be more exposed due to the size of its current account deficit – a characteristic it shares with certain other EMEs, (see figure 3.) and its relatively large and liquid financial markets which facilitate easier portfolio rebalancing by foreign investors.

The relationship between currency depreciation and current account deficits | Figure 3



It is more difficult to identify vulnerabilities arising from the structure of gross cross-border positions. Figure 4 illustrates the rise in gross flows and the large gap between net and gross positions, a consequence of South Africa's steady integration with world asset markets. The net external liabilities of South Africa remain relatively low relative to GDP and have been paradoxically aided by the depreciation of the rand in recent years (as most liabilities are rand-denominated while assets are FX-denominated).

Gross versus net capital stocks, % of GDP | Figure 4



The case for considering the *structure* of flows, and especially equity versus debt, rests on the premise that different kinds of inflows create different vulnerabilities. Foreign direct investment is widely deemed more stable and therefore more desirable, but a comparable logic has been attached to equity investment.[1] According to this theory, equity investors confronted by bad news (eg an economic downturn, a major strike or a bad data release) will face losses on their investments should they try to sell, and these losses will be exacerbated if the local currency is also depreciating. Therefore, they will resist selling. Creditors, by contrast, have no incentive to persist: they can simply refuse to roll over loans without suffering further losses. The consequence is that debt flows will be procyclical and debt dependence will exacerbate boom and bust cycles. An added hazard is that banks might rely on foreign debt to fund their lending activities, so that the boom/bust cycle will be magnified by large changes in credit extension, particularly in countries where banks provide the majority of firms' financing.

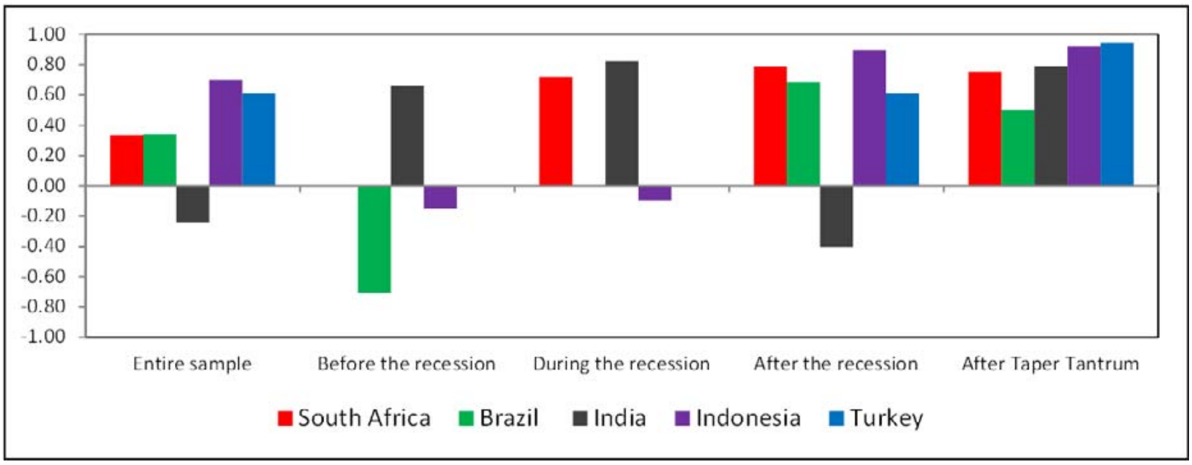
However, the majority of South Africa's external debt liabilities are in the form of bonds held by non-residents, and the argument made for equities (that investors will not sell so as not to realise a capital loss) can also be valid for bondholders. The denomination of the debt is also important: South Africa's private and public sector debt is mostly rand-denominated. Finally, South African banks are substantially reliant on short-term borrowing to fund their lending activities, but their greatest exposure is to domestic institutional investors. In conclusion, the type of debt is as important as the difference between equity and debt.

2. Has the influence of long-term rates in major financial centres on long-term rates in EMEs increased in recent years?

In the case of South Africa, long-term rates showed no correlation with AE rates before the great recession but this has since changed. Figure 5 illustrates this for South Africa, as well as certain other EMEs, using 10-year government bond rates as proxies for all long-term domestic rates, and the US 10-year Treasury bill for AE rates. This provides supporting evidence that long-term rates in major financial centres have become more important for EMEs since the recession and particularly since the "taper tantrum", at least for those EMEs with large current account deficits and corresponding foreign financing needs. In South Africa's case, this increased correlation with AE rates coincides with an increasing reliance on bond portfolio flows to finance the current account deficit (whereas prior to the recession, the deficit was mostly financed by equity inflows. Countries such as South Africa, India or Brazil, which have seen their potential growth estimates decline in the past few years, are now experiencing some challenges in attracting meaningful equity inflows and as a consequence, their currencies and local rates markets are more sensitive to the AE (and especially US) interest rate cycle.

[1] See M Brunnermeier et al, "Banks and cross-border capital flows: policy challenges and regulatory responses", Committee on International Economic Policy and Reform, November 2012, http://www.brookings.edu/~/media/research/files/reports/2012/9/ciepr/09%20ciepr%20banking%20capital%20flows.pdf.

Long-term rates in the BIITS have become closely correlated with US rates Figure 5



3. How do monetary and exchange rate policies in EMEs affect global monetary conditions, including the long-term rate?

South Africa's financial markets are relatively deep and liquid, but they are small in a global context, and are unlikely to affect global monetary conditions. Although SARB policy is extremely important for the sub-region, given that Lesotho, Swaziland and Namibia participate in a monetary union with South Africa and Botswana targets a basket of currencies in which the rand features strongly, outside this region South African monetary policy rarely shapes global monetary conditions.

This argument also broadly applies to other larger EM economies, apart from China, especially as their bond and equity markets remain smaller than those of AEs. Perversely, policies that lead to a sell-off in EM assets can be beneficial for markets in AEs, if investors in the latter decide to repatriate external assets (ie outflows from EM bonds and equities in 2H 2013 coincided with inflows into peripheral euro zone bonds, which significantly improved the financing conditions for these countries). Admittedly, a very large degree of stress in EMEs does tend to raise the risk premium on a broad range of assets, including AE assets). Developments in late January and early February 2014, for example, saw a re-correlation between AE and EME equities, although this joint sell-off has since abated and in some instances reversed.

4. What explains the recent increase in capital flow volatility?

EMEs such as South Africa have experienced considerable volatility for three interlinked reasons. Firstly, with the onset of the Great Recession, AE monetary policy became very loose. Widening interest rate differentials then pushed large quantities of liquidity to EMEs. Secondly, this permitted some EMEs, including South Africa to run large current account deficits, which meant that these countries' currencies would need to adjust when inflows slowed down or reversed. Thirdly, investors found it difficult to predict the course of AE monetary policy (chiefly from the US Federal Reserve), leading to significant changes in monetary policyexpectations as new information emerged (especially the taper tantrum).

Furthermore, changes in global risk perceptions (so-called "risk-on" and "risk-off" scenarios), also impact on the volatility of global capital flows. Predicting the market consequences of policy unwinding has been made even more difficult by the fact that both the scale of accommodation and the tools utilised were largely unprecedented, so that empirical models are of limited use in this exercise. The combination of perceived domestic vulnerabilities and fast-changing expectations for US monetary policy has been a significant cause of volatility.

B. Policy responses and coordination

5. How do EM monetary authorities take account of changes in advanced economies' monetary policy in their own interest rate decisions?

South Africa, as an inflation targeting country, responds to changes in advanced economy monetary policies in an orthodox and therefore fairly well understood manner. The Monetary Policy Committee (MPC) targets an inflation band of 3–6%. Should inflation diverge from this band for a prolonged period or inflation expectations become unhinged, then the MPC will respond with short-term policy rate adjustments. There are several connections between domestic inflation and AE rates. The most important is the interest differential, which will affect capital flows and therefore the exchange rate. However, the link is not automatic and depends in part on the degree to which exchange rate changes are passed through to consumer prices. A further significant factor will be the growth outlook in advanced economies, which would feed through to South Africa in the form of changes in demand and inflation. The MPC, therefore, does not respond directly to changes in AE monetary policy, but instead monitors these developments and their impact on domestic variables.

6. Should the focus of monetary policymaking be solely on managing the short-term rate?

The MPC uses the repo rate, a short-term rate, as the main instrument for achieving its monetary policy goals. The SARB currently also uses communication strategies to reinforce its interest rate actions. For example MPC statements have recently been used to strongly affirm the Bank's commitment to its inflation target, with the aim of influencing inflation expectations and changing public expectations of the timing and extent of repo rate adjustments.

There are two obvious subjects for alternative policies: longer-term rates and the exchange rate. Longer-term rates have become increasingly prominent in the monetary policies of some AE central banks, which have tried to influence them through asset purchases (eg the US Fed's quantitative easing) and forward guidance. However, there are several compelling arguments against the use of such policies, particularly in an economic environment like South Africa's. The first and most important is that South Africa, like all EMEs, is some distance from the zero lower bound (ZLB). The AE central banks which have adopted these unconventional policies have done so to effect monetary easing once short-term rates approached the ZLB. Above this point, however, further monetary easing, if desired, is simply achieved by lowering the conventional short-term policy rate. Secondly, these measures present their own set of challenges and the ability to directly determine the longer term interest rate is limited. It is not clear how effective forward guidance would be as effective in steering long-term interest rates in an open EME such as South Africa, where domestic bond yields are influenced by global rate differentials, global risk appetite and cross-border capital flows, as well as the policy signals of the domestic central bank.

When it comes to exchange rate intervention, South Africa does not target an exchange rate level or attempt to manipulate the exchange rate for monetary policy purposes. The exchange rate is generally market–determined, apart from purchases related to reserve accumulation. Such flexibility lightens the burden of the SARB regarding the extent to which it needs to accumulate exchange reserves. A further benefit of a flexible currency is that it helps to maintain external competitiveness even if other prices are downwardly rigid.

7. Is the recent accumulation of forex reserves cyclical (eg a response to low global interest rates) or structural (eg an increase in the optimal level of reserves)? How do EM central banks manage the increase in domestic liabilities associated with the prolonged accumulation of foreign assets?

In global perspective, foreign reserves serve two main goals: security and competitiveness. Reserves achieve security by providing insurance against sudden outflows. The Asian Crisis of 1998 should probably be treated as the decisive inflection point for reserve accumulation amongst EMEs because it convinced many policymakers that sudden outflows were a major threat. As Table 1 shows, the decade between 1997 and 2007 saw substantial increases in EMEs reserves – a demonstration of a structural increase in what is regarded as optimal reserve levels.

Some EMEs, however, have more reserves than can be justified by a straightforward security argument. For these countries, it is necessary to consider the role of reserve accumulation in dampening exchange rate appreciation and therefore bolstering competitiveness.

Changing reserve strategies

Table 1

	TOTAL RESERVES (% of GDP)			IMPORT RATIO (% Annual imports)		
	1997	2007	2012	1997	2007	2012
World	**4.0**	**10.0**	**13.3**	**0.3**	**0.5**	**0.6**
Brazil	5.8	13.1	16.4	0.9	1.5	1.7
China	15.0	44.0	40.7	1.0	1.6	1.8
India	5.9	22.9	14.8	0.6	1.2	0.6
Indonesia	6.7	12.7	12.4	0.4	0.7	0.6
South Korea	3.8	25.0	28.6	0.1	0.7	0.6
South Africa	3.2	10.3	11.5	0.2	0.4	0.4
Thailand	16.7	34.2	47.3	0.4	0.6	0.7
Turkey	7.1	11.3	12.7	0.4	0.4	0.4
Developing countries	**11.2**	**29.7**	**30.9**	**0.5**	**1.0**	**1.0**
Middle income countries	**11.0**	**29.4**	**30.6**	**0.5**	**1.0**	**1.1**

South Africa has accumulated significant foreign exchange reserves, with the goal of achieving security but not in an attempt to manage the exchange rate. In just under two decades, the SARB's reserves have expanded from a net negative position (US$25 billion) to around US$50 billion. The SARB's *strategy* is to hold reserves adequate for security whilst remaining cognisant of their cost. At current levels, the SARB's reserves are regarded as being at the low end of the IMF's reserve-adequacy metric, and the policy remains to continue to build reserves in a prudent manner as circumstances allow.

It is probable that low global rates will coincide with rand strength as foreign investors search for yield. This connection, however, has broken down over the past couple of years owing to both domestic and external factors.

The SARB follows a policy of sterilising the liquidity created through reserve accumulation, for which purpose it uses mainly SARB debentures, as well as government deposits, foreign exchange swaps and reverse repos. Owing to the interest rate differential between South Africa and the issuers of reserve assets, South Africa makes a loss on its reserve holdings. The Bank is also exposed to interest rate risk. (These problems are qualified by the fact that SA's reserves have yielded large *profits,* in rand terms, given fluctuations in the exchange rate, but these profits are unrealised).

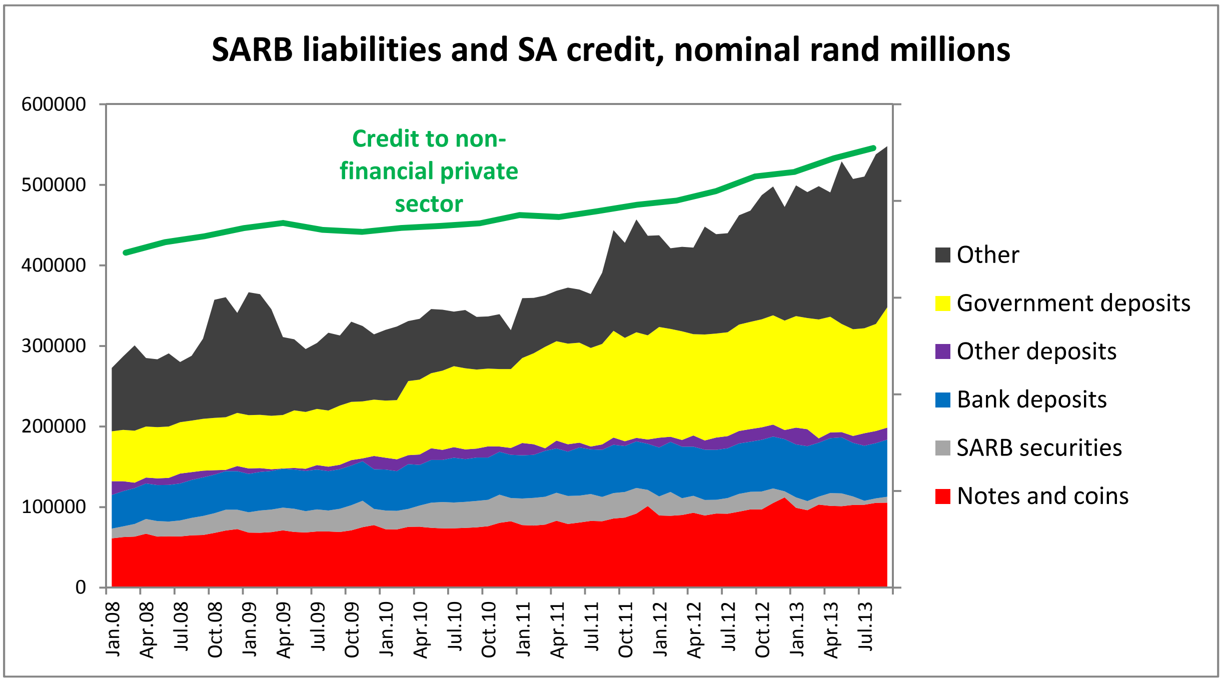
8. How effective have policies aimed at influencing the structure of central bank liabilities been in limiting bank credit expansion?

This question seems to have limited relevance for South Africa as it has not used such policies, and credit extension to the private sector is still quite far below the pre-crisis peak, measured as a share of GDP.

Figure 6 illustrates the structure of the central bank's liabilities and non-financial sector credit extension (the latter using BIS data). It shows relatively smooth and consistent changes in the structure of SARB liabilities, roughly in line with growth and inflation.

SARB liabilities and SA credit, nominal rand millions

Figure 6



9. What non-monetary policy measures have proved particularly effective in maintaining monetary policy independence?

"Monetary policy independence" is here understood as one of the three potential goals that make up the trilemma (the other two are free capital movements and a fixed exchange rate). South Africa's choice has been clear: monetary policy independence is the top priority, capital controls are generally limited and the currency is free to adjust. The floating rand is a crucial shock absorber for the economy and an important element of monetary policy. By protecting monetary policy independence, the MPC has been able to maintain low interest rates to stimulate economic activity despite significant currency depreciation.

C. Internationalisation of EM currencies

10. What are the implications of growing diversification of assets by international investors towards EM domestic currency bonds and equities for the international financial system?

Ultimately, the international financial system should benefit from greater diversification. If investors hold more balanced portfolios, which include larger portions of EME stocks and bonds, they will achieve reduced concentration risk. Furthermore, in the run-up to the Great Recession investors overstated the risk-reward profiles of AEs and have since come to appreciate that EMEs are relatively more attractive than previously thought, prompting a necessary rebalancing. Diversification of assets can also imply a more stable foreign investor base for EME issuers, as institutional real-money flows are generally less volatile than hedge fund flows, which in the 1990s were often the major drivers of capital flows into EMEs. In South Africa, for instance, this may have helped reduce the sensitivity of bond yields to exchange rate movements compared to the currency crises of the late 1990s. However, the switch from AEs to EMEs had its own challenges and there are risks of disruptive corrections arising particularly from the procyclicality of international capital flows, with a worst case scenario of sudden stops in emerging markets that have attracted significant inflows. The appropriate responses for policymakers in vulnerable EMEs are to let currencies float, minimise risk-multipliers like foreign-denominated debt and maintain adequate reserves.

11. How do official investors in emerging economies (sovereign wealth funds or central banks) select which other EMEs to invest in?

The three standard objectives for reserve management are: (1) capital preservation, (2) liquidity; and (3) returns, in that order. However, this framework has been challenged by the extremely low returns available on traditional reserve assets, the interest rate risk presented by the prospect of monetary tightening from AE central banks and the reduced availability of AAA-rated assets. This has not changed the ranking of objectives but it has increased the weighting given to returns. South Africa has therefore recently announced some diversification of its reserves into Chinese renminbi, as well as plans to use Australian dollarsand Korean won. The attractiveness of the renminbi is that it offers great liquidity, through a bond market that is already the world's fifth largest and growing, as well as relatively attractive returns. The other currencies mentioned also offer higher returns at low risk (policy rates in Australia, New Zealand and Korea are all 2.5% at present, compared to <0.25% in the US).

12. Which EM currencies are likely to play an international role in the future?

The most obvious EME candidate for reserve currency status is the renminbi, especially as China has taken some gradual steps towards the internationalisation of its currency, which appears to be a long-term policy goal. As mentioned above, South Africa has already diversified a portion of its reserve holdings into the Chinese currency, attracted by the liquidity of a large and growing bond market and the higher returns available on these assets. Because China is South Africa's single biggest trading partner, its currency is also an important reference point. The other emerging market currency South Africa plans to use for its reserve holdings is the Korean won. Although South Korea is of course a far smaller market than China, with a correspondingly smaller trade share and bond market, it shares with China a high credit rating.

13. What are the benefits and risks to an EME from growing international use of its own currency?

The issuers of international currencies, especially reserve currencies, enjoy seigniorage revenues, as well as lower borrowing costs, including some immunity to sudden outflows. But these benefits must be weighed against the advantages of an undervalued or overvalued currency, especially for industrial policy.

In a sense, the potential EM issuers of reserve currencies face a problem akin to the Triffin Dilemma: if other countries are to accumulate their assets, then they need to run current account deficits. However, the more they run such deficits the less desirable their currencies will be as reserve assets. The dilemma has an interesting twist for those countries that have built up their own reserves not simply as insurance against outflows but to achieve a competitive currency and therefore a dynamic export sector which generates current account surpluses – such as China and South Korea. It is likely that, as EMEs develop and move up the value chain, appreciated currencies will be more tolerable. However, even wealthy societies with large manufacturing sectors may still at times feel the need to resist currency appreciation, for instance if they are experiencing deflation or to protect the competitiveness of their industries. This dilemma is likely to repeat itself as EMEs with large manufacturing export sectors confront greater international appetites for their currencies.

Over time, EMEs generally witness real currency appreciation as their economies converge towards AE levels of developments and income levels. Nonetheless, in the event that demand for their currencies result in an appreciation of the said currencies that is faster than justified by this convergence, this development path itself can become jeopardised.

The rand is not likely to become a global reserve currency in the near future, but it is still widely used internationally. Because South Africa has highly developed financial markets and a largely non-interventionist philosophy regarding the exchange rate, the rand is widely traded, often as a proxy for emerging markets and volatility in equity prices (note the correlation between the Rand and the VIX). This sometimes has unsettling consequences, for instance when the rand's value adjusts abruptly because of non-South African factors, but open capital markets do bring along benefits as they generally lower borrowing costs.

The international transmission of monetary policy in recent years: Thailand's perspectives

Don Nakornthab*

Abstract

Owing to the extraordinarily accommodative monetary policy of advanced economy central banks, those of emerging market economies have entered uncharted territory. This note reviews the experience of Thailand, a small economy highly exposed to international trade and capital flows, in dealing with monetary policy spillovers during the various phases of the US Fed's QE programmes. The Monetary Policy Committee's policy responses and their rationale highlight the difficult trade-offs faced by monetary policymakers as they seek to maintain economic and financial stability.

Keywords: Thailand, unconventional monetary policies, spillovers, financial stability, policy responses

JEL classification: E44, E52, E58, F30

* Director of Macroeconomic Policy Office, Bank of Thailand.

Introduction

The post-crisis global financial environment represents uncharted territory for central banks in emerging market economies (EMEs). After unconventional monetary policies were implemented in the major advanced economies (AEs), international monetary policy transmission would no longer depend simply on the interest rate differential between AEs and EMEs. Global liquidity and global risk aversion as a result of major central banks' actions now play an equally important role in the transmission of monetary policy from AEs to EMEs. For many EMEs, particularly those relatively exposed to global financial flows, the changing nature of international monetary policy transmission presents an added complication for domestic monetary policy and exchange rate management.

This note reviews the experience of the Bank of Thailand in dealing with the spillovers from major AEs during the QE1, QE2, QE3, and QE tapering periods. In each episode, special attention is paid to the policy responses and their rationale, highlighting the constraints and trade-offs facing the Bank's Monetary Policy Committee at the time of the relevant policy decisions.

The Bank of Thailand's monetary policy framework

Since May 2000, the Bank of Thailand has conducted its monetary policy under a flexible inflation targeting framework with a managed floating exchange rate. Under this framework, the Monetary Policy Committee takes into consideration not only inflation but also economic growth and financial market conditions, as well as the financial status of households, businesses, and financial institutions. With regard to the exchange rate, the Bank of Thailand has neither level nor trend targets for the Thai baht but, in accordance with its inflation targeting mandate, stands ready to intervene in the case of excess volatility, particularly if this should result from speculative capital flows.

The Thai economy is very open to trade and financial flows. The recovery from the 1997 financial crisis was led by exports of goods and services that in 2013 accounted for nearly three quarters of GDP in nominal terms. The country is also relatively open to international capital flows, with some restrictions on outflows but virtually no restrictions on inflows. Due to its open nature, the economy suffered greatly from the global downturn in 2008–09. The Thai economy, however, managed to recover quickly along with the rest of Asia, as its predominantly bank-based financial sector did not suffer balance-sheet problems as in the West. For this reason, the country was considered among the most attractive destinations by international investors.

Policy responses to international financial spillovers and consequences

Episode 1: QE1 and QE2, December 2008–December 2012[1]

The severity of the economic downturn following the global financial crisis prompted major AE central banks to cut their policy rates to near zero. As interest rate policies were soon found insufficient to counter the large negative aggregate demand shocks, the major central banks turned to a set of unconventional monetary policy measures. Of those measures, a series of quantitative (credit) easing or QE rounds by the US Federal Reserve has taken centre stage. Most of the liquidity injected by the Federal Reserve via its QE programmes have remained in the US banking system in the form of excess reserves. However, some did migrate abroad, and with the resulting yield compression, global investors suddenly found themselves in search of higher returns elsewhere. These factors contributed to excess global liquidity that gravitated towards attractive investment opportunities, quickly withdrawing during periods of instability.

Although the QE programmes started in November 2008, the US monetary policy action did not initially complicate the Bank of Thailand's policy. In the early stages, Thailand's monetary policy was geared towards shoring up its economy, which was hurt by the collapse in global trade. At the end of 2008 and early 2009, the Bank of Thailand cut its policy rate four times for a total of 250 basis points to a record low of 1.25% per annum. During this stage, the baht also fell in value and acted as an automatic stabiliser for the economy. Only when it became clear in the second half of 2009 that Thailand, like the rest of Asia, would emerge as a winner in the new global environment did the excess global liquidity start to interfere with domestic policy decisions.

The changing view of global investors amidst abundant global liquidity prompted the return of capital inflows to Thailand. In 2010, net capital inflows registered a record surplus of nearly USD 25 billion. As a result of both the country's strong growth prospects and the capital inflows, the baht appreciated from around USD/33 baht at the beginning of the year to around USD/30 baht at the end of the year. Monetary policy decisions during this episode appeared immune to these developments. As the Thai economy showed signs of firm recovery, the Monetary Policy Committee began normalising the policy rate in July 2010. Amidst some political and industry opposition that the widening interest rate differential would induce capital inflows and that the resulting baht appreciation would hurt the export sector, the interest rate up-cycle went on almost continuously, peaking at 3.50% per annum. This was just 25 basis points below the level before the global financial crisis had taken a toll on the economy. In fact, it was the severe flooding that almost paralysed the economy in the last quarter of 2011 that halted the Bank of Thailand's hiking cycle.

Instead, the policy response to the surge in capital inflows took the form of massive foreign exchange intervention. Net foreign reserves rose from

[1] This period also included Operation Twist which came after QE2 had ended. See Appendix A for the Fed's QE chronology and details of each operation.

USD 118 billion at the end of 2008 to USD 192 billion at the end of 2010. For much of 2011, net foreign reserves continued to rise, reaching USD 215 billion at the end of August. Although part of this almost doubling in net foreign reserves was due to valuation changes, by and large they came from foreign exchange intervention by the Bank of Thailand.

The rationale for the massive foreign exchange intervention was clear. Judging that too rapid an appreciation of the baht would be detrimental to the recovering economy, the Bank of Thailand decided to intervene in the foreign exchange market. The Bank also hoped that a series of further capital account liberalisation measures, starting with the removal of restrictions on foreign direct investment by Thai companies in October 2010, would relieve pressure on the baht and hence lessen the need to intervene later on. To a certain extent, the Bank was right, as the surge in foreign direct and portfolio investment abroad did balance out the capital account in 2011. The problem, however, was that by the end of 2011, the Bank of Thailand had already amassed a large amount of foreign exchange reserves.

Episode 2: QE3, September 2012–May 2013[2]

In September 2012, the Federal Reserve began the third and final round of QE, also known at the time as QE infinity due to its open-ended nature as opposed to the first two QE rounds. The timing of QE3 coincided with the Thai economy's recovery from the flooding disaster. Boosted by repair and reconstruction demand as well as the government's short-term stimulus (most notably, the tax rebate programme for first-time car buyers, which provided an extraordinary short-term boost to private consumption), the Thai economy recorded a 6.5% growth rate in 2012. Adding to this impressive performance was the prospect of a seven-year, 2 trillion-baht infrastructure investment project. Not surprisingly, foreign capital inflows surged, outweighing the continuously strong foreign investment abroad, and the baht once again came under appreciation pressure.

This time, the Bank of Thailand's response was different. While monetary policy decisions continued to be independent of the baht movement (the interest rate cut in October 2012 was motivated by concerns about the global economy), the Monetary Policy Committee shied away from foreign exchange intervention and allowed the baht to surpass its 2010 level. Although the Monetary Policy Committee eventually became concerned about the pace of appreciation, they seemed to prefer other means as reflected in the 30 April 2013 statement: "The MPC expressed concern over recent volatility and rapid appreciation of the baht, which, at times, has not been justified by economic fundamentals. The committee therefore agreed on the need for a timely implementation of appropriate policy mix as warranted by circumstances, in close coordination with the Ministry of Finance and other agencies." The coordinated policy tool referred to in the statement was understood to be the use of some form of capital flow management measure.

Behind the change of attitude towards foreign exchange intervention was the realisation that the intervention during the QE1–QE2 period, while necessary to buy time for exporters to adjust, was overdone to the point that the mounting costs

[2] Officially, QE3 has not yet ended. For the purpose of this note, we take QE tapering talk as the beginning of the next episode, as it drastically changed the pattern of global capital flows.

were no longer justified. As a result of its sterilised foreign exchange purchases, the Bank of Thailand had to absorb a large amount of liquidity along with significant negative carries. Concerns over the Bank of Thailand's balance sheet losses fed into a public debate, which also made the prospect of additional intervention less appealing. In fact, a board-commissioned study on the Bank's balance sheet improvement released in 2013 had as one of its recommendations the downsizing of the Bank's holdings of foreign reserves.

Returning to the monetary policy front, while policy decisions during this episode were still divorced from exchange rate and balance sheet concerns, they were nonetheless indirectly complicated by the US QE actions through financial stability concerns. It was in the 2012–13 period that the Monetary Policy Committee expressed serious concerns about private credit growth and rising household debt. Beginning in the second half of 2010, private credit registered double-digit growth, and household debt rose sharply to nearly 80% of GDP by the first half of 2013. While these developments were driven largely by post-flood capital replacement and fiscal stimulus packages for domestic consumption, excess global liquidity was also an important contributory factor.

It may not be initially obvious how excess global liquidity could have influenced Thailand's credit boom. After all, foreign funding made up less than 10% of the banking sector's total liabilities and the sector's fast-growing external borrowings were used mainly to finance the hedging needs of exporters and part of Thailand's direct investment abroad. The rise in banks' short-term external borrowings could be explained by the rise in hedging demand, while the rise in banks' long-term external borrowings could be explained by the rise in investment abroad demand. This was different from the case of the pre-1997 credit boom, which was driven by the on-lending of foreign funds by local financial institutions.

The excess global liquidity deriving from QE and other major central banks' unconventional monetary policy measures contributed to Thailand's latest credit boom via three indirect channels. First, the surge in capital inflows led to a large liquidity surplus in the banking system. Sterilised intervention by the Bank of Thailand led to an enlargement of the banking sector's bond holdings, which could be liquidated at will to meet loan demand. Second, the QE operations have depressed long-term yields in the United States, which along with the fact that much of the QE-induced portfolio inflows went into bonds, put downward pressure on long-term bond yields in Thailand. This was positive for local bond issuance by large corporates, including banks. The first and the second channels both enabled banks to source funds at low cost with ease and thus may be considered supply-side channels. The third channel worked through the demand side. The surge in exporters' hedging needs was, in fact, a response to the baht's appreciation. The stronger baht also made foreign assets more attractive for Thai firms investing abroad and hence further increased the demand for foreign currency funds.

Episode 3: QE tapering, May 2013–present

On 22 May 2013, less than a month after the Monetary Policy Committee released the statement on the exchange rate management framework, talk of the Fed's QE tapering surfaced and capital flows reversed their direction. Although actual QE tapering started in December, capital outflows had already commenced. The capital and financial account ended the year less than USD 1 billion in surplus, compared with a surplus totalling USD 9.3 billion from January to May. The baht also weakened and ended the year at USD/32.86 baht after reaching a record 28.61 in April. In addition, QE tapering talk has led to an increase in the US long-term yields, which in turn has caused the corresponding yields to increase in Thailand. The increase in long-term yields together with the depreciation of the baht has inevitably resulted in higher external funding costs for the Thai economy.

It is important to note, however, that the capital outflows and the weakening baht were not due entirely to the reversal in the pattern of global capital flows following the tapering talk. Thailand's weakening economic prospects also contributed. As the year 2013 progressed, it became increasingly clear that the Thai economy had lost its growth momentum. The economy, which started the year on a high note, with many observers expecting 5% or higher growth for the whole year, ended up with a disappointing 2.9%. For the current year, many forecasters are projecting a growth rate of even less. This reversal of fortune was due to the expiration of temporary government stimulus measures along with the failure of merchandise exports to take advantage of the AE's economic recovery. The political turmoil that began in the last quarter of 2013 was an additional negative factor.

The baht's depreciation removed the incentive to build up any further foreign exchange reserves or to put in place capital flow management measures. This time, it is monetary policy that is complicated by the Fed's monetary policy action. Given the current prospects of the Thai economy, the continuation of accommodative monetary policy is critical. The policy choices in the short to medium term are either to hold or to cut the policy rate. The Monetary Policy Committee minutes for the 22 January 2014 meeting, in which the committee voted four to three to maintain the policy rate, starkly reveals the committee's concern over international financial spillovers. Specifically, the majority view is reflected in the following quotation: "Against the backdrop of higher global financial market volatility stemming from QE tapering and market concerns about the emerging markets, financial stability should be given a high priority in monetary policy considerations, as it would provide a foundation for a sustainable recovery in the period ahead." And it is not that the other three members were not concerned. They just deemed that the risk was manageable because of the "high level of international reserves to cushion potential capital outflows".

Concluding remarks

By reviewing the experience of Thailand in dealing with international financial spillovers, this note highlights the complications generated by the AE's post-crisis monetary policy actions for the monetary policy of EMEs and their exchange rate management. As the Thai experience demonstrates, these complications can at times be difficult to deal with. In the first episode, the Monetary Policy Committee was faced with a difficult policy task, ie determining how far it should intervene, in dealing with the surge in foreign capital inflows and the resultant impact on the baht. The vast amount of accumulated reserves became a policy constraint in the second episode. And, in the final episode, the risk of financial spillovers has interfered directly with monetary policy. In fact, if the Thai economy were to need a substantial rate cut at the time when the Federal Reserve starts its hiking cycle, the financial stability risk for Thailand could become a significant constraint.

In retrospect, what could the Bank of Thailand have done differently? An important policy lesson from this note is that policymakers should take a long-term view and explore a set of policy alternatives along with the short-term and long-term consequences. Admittedly, this is easier said than done. But going in this direction should help policymakers establish a better formulated policy mix with fewer unintended consequences.

Appendix A. Fed's QE chronology

Fed's QE chronology

	Period	Length	First Hint / Note	Size	Period
QE1	16 Dec 2008 – 31 Mar 2009	16 months	25 Nov 2008 FOMC statement	600 bn	500: Agency MBS 100: Agency debts
	18 Mar 2009 – 31 Mar 2010		18 Mar 2009 FOMC statement	1,150 bn (additional)	750: Agency MBS 100: Agency debts 300: Treasury
QE2	3 Nov 2010 – 30 Jun 2011	8 months	Hint: 27 Aug 2010 Bernanke's speech at Jackson Hole	600 bn (75 bn a month)	600: Long-term Treasury
Operation twist (OT)	21 Sep 2011 – End 2012	16 months	1) 21 Sep 2011 – Jun 2012 2) 20 Jun 2012 – end 2012 (ext) *Formerly used in 1961	400 bn 267 bn (extension)	buy long-term Treasury (maturity 6-30 yrs) and sell short-term Treasury (maturity <3 yrs) at the equal amounts
QE3 / QE3+	13 Sep 2012 – present	Open-ended	Hint: 1) 22 Aug 2012 FOMC Minute revise down GDP and weak activity 2) 31 Aug 2012 Bernanke's speech at Jackson Hole *QE3+ 12 Dec 2012	Open-ended (85 bn a month)* State-contingent: 1) Unemployment 6.5% 2) Inflation expectation 2-2.5%	40: Agency MBS 45: Treasury

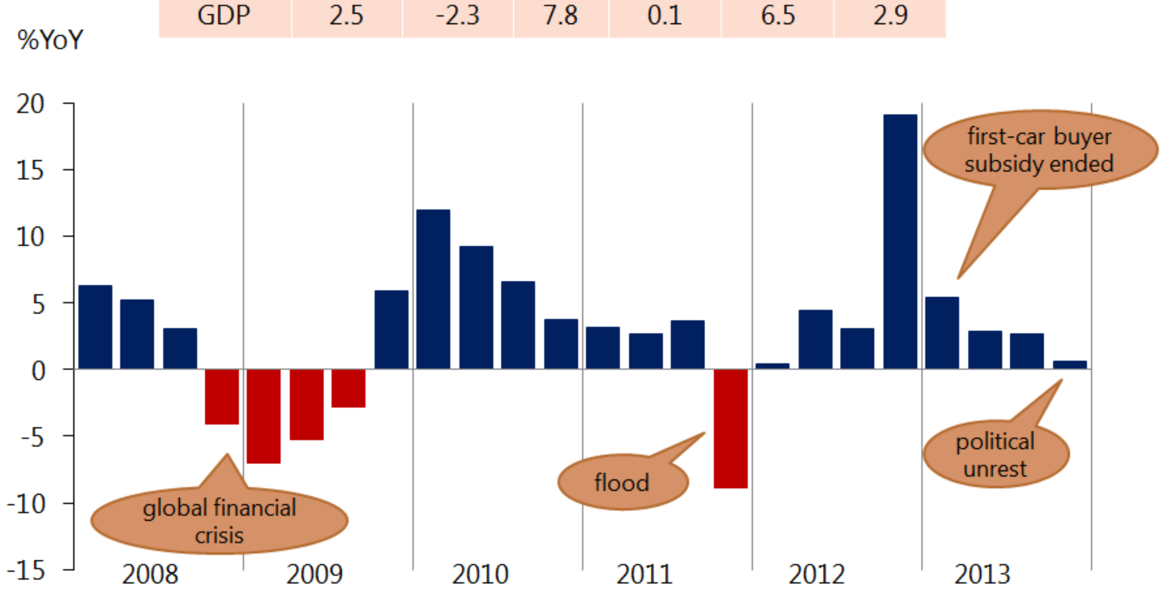
* Size of asset purchases was cut to USD 75 bn and 65 bn, in Jan and Feb 2014, respectively

Appendix B. Development of selected macroeconomic and financial variables

GDP growth

Figure 1

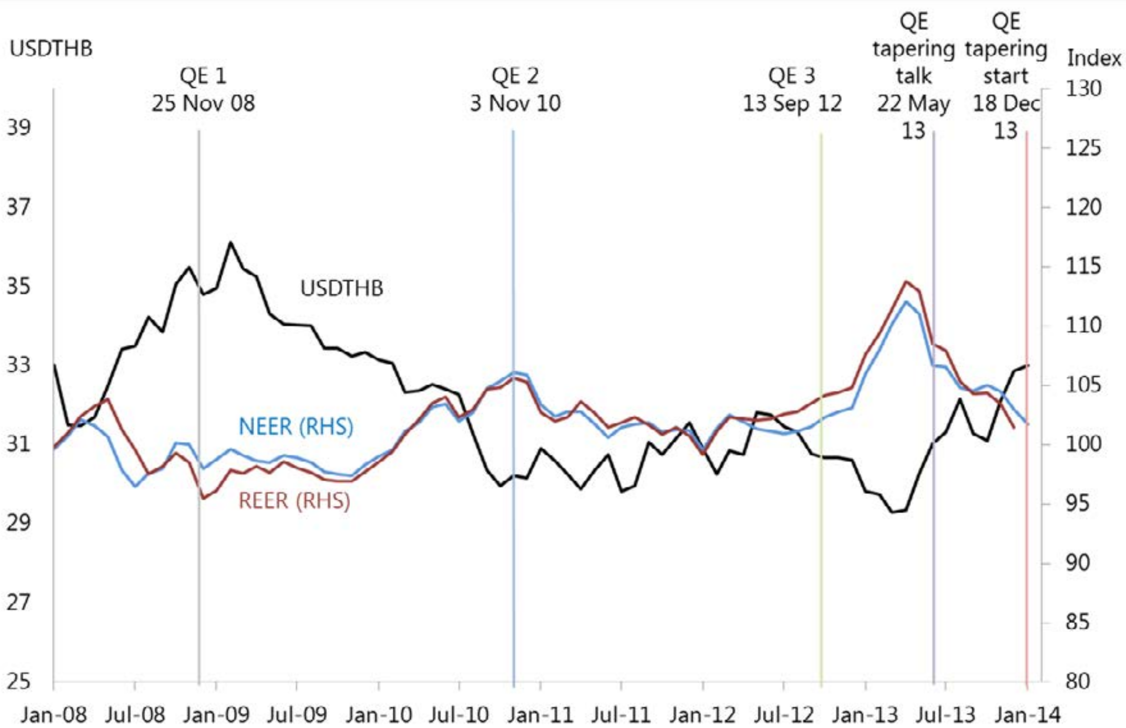
%YoY	2008	2009	2010	2011	2012	2013
GDP	2.5	-2.3	7.8	0.1	6.5	2.9



Source: NESDB

Exchange rates

Figure 2

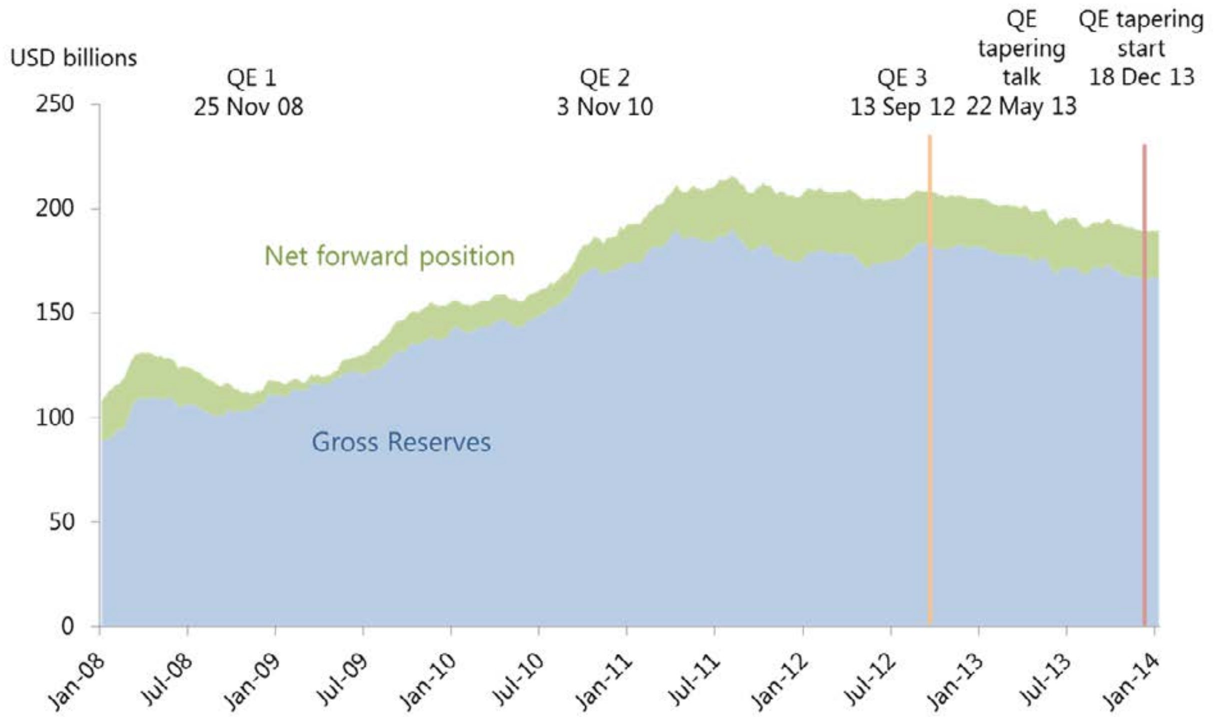


Note: *USDTHB is end of period data.

Source: Bank of Thailand and FOMC Press statement

Foreign exchange reserves

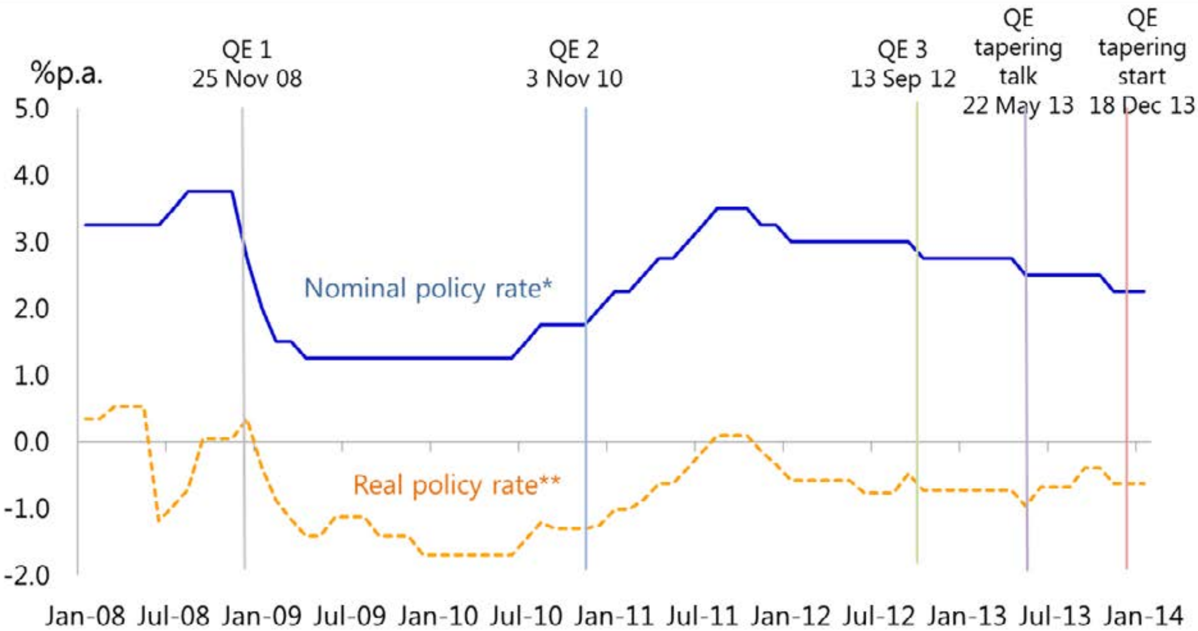
Figure 3



Source: Bank of Thailand and FOMC Press statement

Nominal and real policy rates

Figure 4

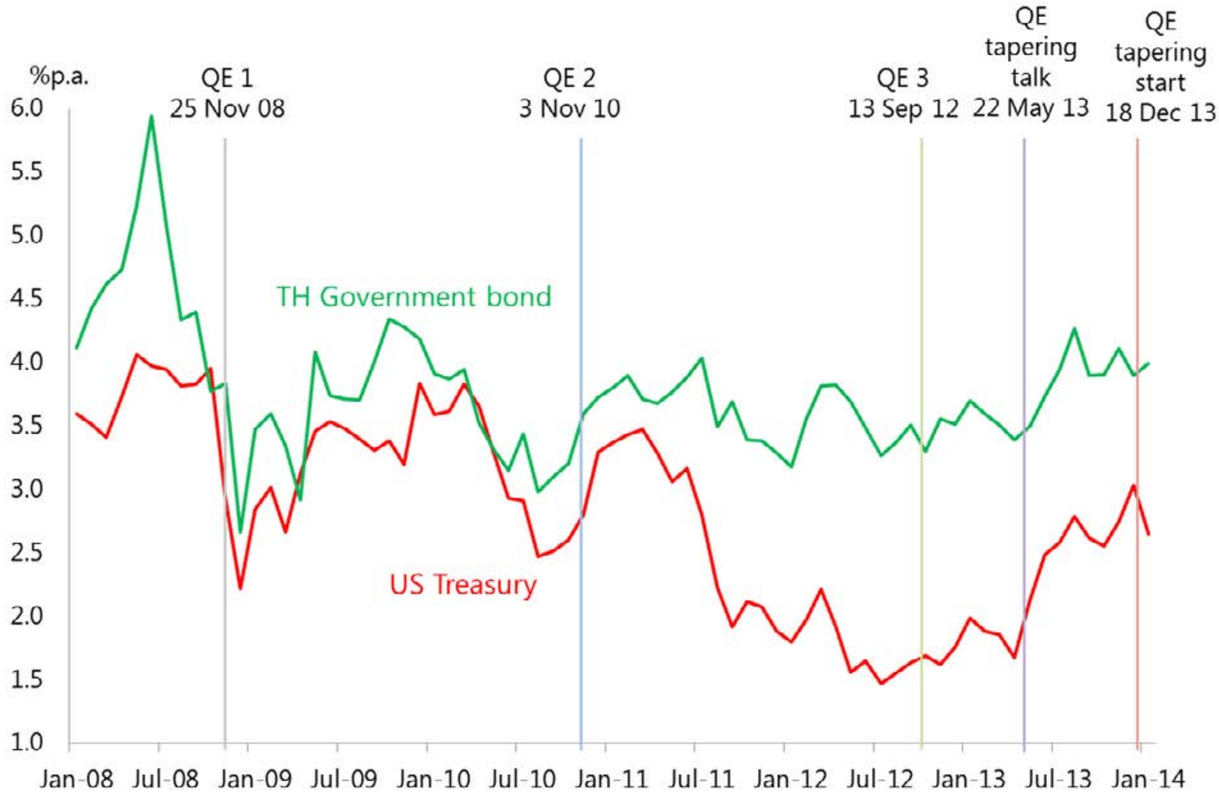


Note: * Nominal policy rate (end-period data) ** Real policy rate is adjusted by estimate of headline inflation 1 year ahead (inflation forecast from Consensus Forecasts)

Source: Bank of Thailand (BOT), Consensus Forecasts and calculated by BOT's staff

10-year US Treasury vs. Thai government bond yields

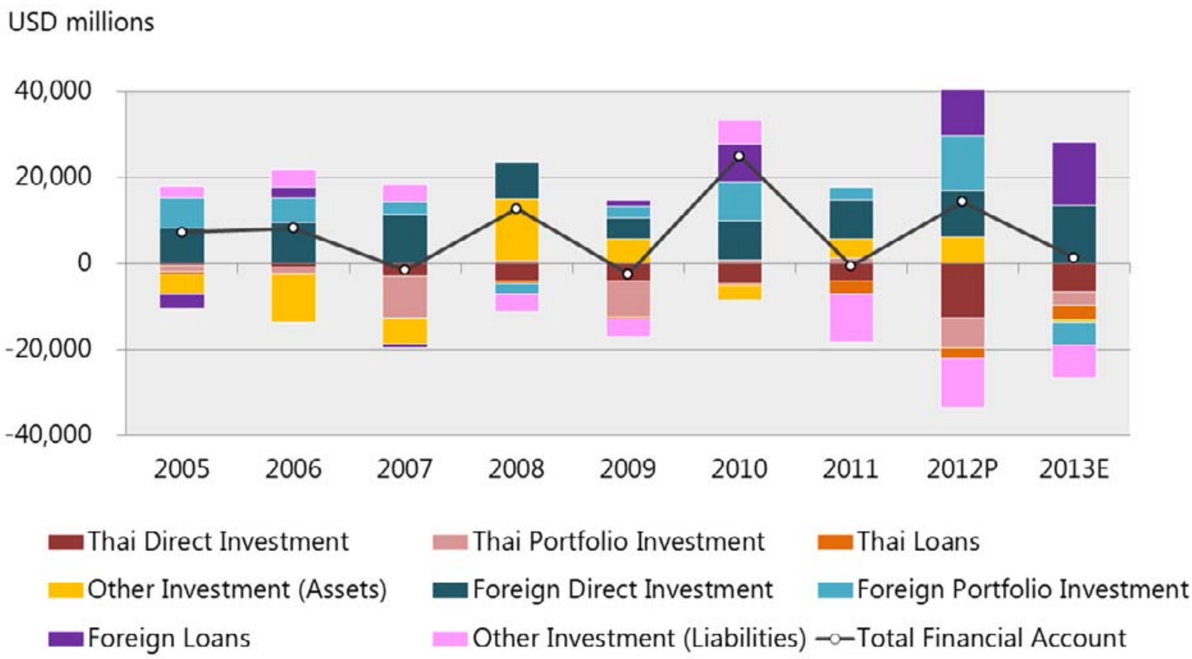
Figure 5



Source: Bloomberg

Net capital flows and components

Figure 6

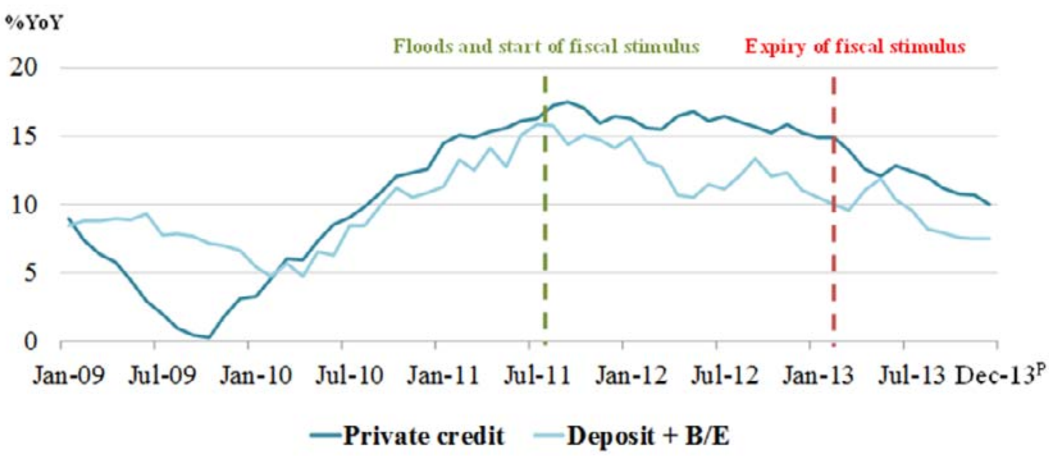


Note: P = Preliminary E = Estimated

Source: Bank of Thailand

Private credit growth

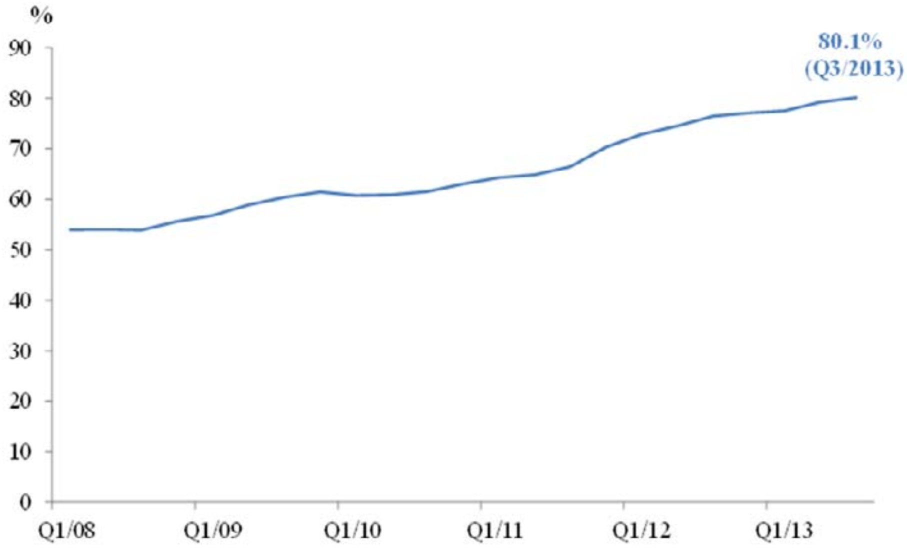
Figure 7



Source: Bank of Thailand

Household debt to GDP

Figure 8



Note: *Loans to households from financial institutions

Source: Bank of Thailand

Cross-border portfolio flows and the role of macroprudential policies: experiences from Turkey

Salih Fendoğlu, Mustafa Kılınç and Mehmet Yörükoğlu[1]

Abstract

The last three decades have been marked by financial market globalisation and a higher degree of integration of emerging markets into the world economy. One distinct feature of this integration has been a sharp increase in portfolio flows between advanced and emerging market countries. Since the global financial crisis of 2008–09, these flows have become very sensitive to the monetary policy stance, interest rates and central bank balance sheets of advanced economies. Coupled with prevailing policy uncertainties, this has made global portfolio flows highly volatile, and accordingly has given rise to serious challenges for emerging market countries. To contain the potentially undesirable effects of these flows on their domestic real and financial cycles, emerging market countries have implemented a battery of macroprudential policies. Turkey has been proactive in devising an augmented policy framework to limit such undesirable effects, using policy tools such as reserve requirements, the Reserve Option Mechanism and the interest rate corridor. This note uses a cross-country data set covering 2005–12, and shows that the policy framework in Turkey has been effective in decreasing the sensitivity of portfolio flows to global risk factors.

Keywords: Portfolio flows, risk-taking channel, macroprudential policies, Turkey

JEL classification: E44; E52; E58

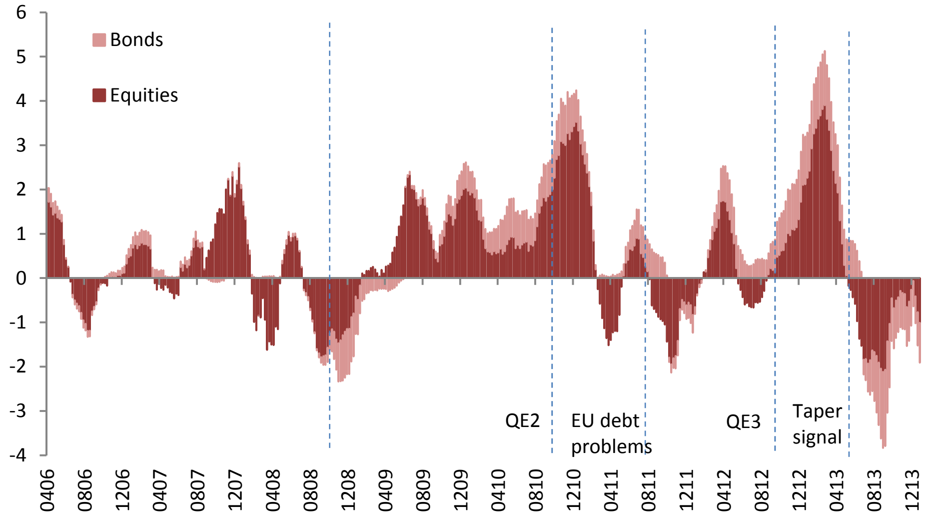
[1] Central Bank of the Republic of Turkey (CBRT).

1. Introduction

Over the last three decades, financial markets have become increasingly globalised as emerging markets have integrated themselves into the world economy. Given this higher integration of the world's economies, spillovers among countries have also become important. Accordingly, news of a fiscal problem, of a change in the monetary policy stance or of a real slowdown in individual countries becomes a major event for the world economy as a whole. As a result, policymakers in each country need to take into account any positive or negative economic developments in the rest of the world when making their decisions.

One major consequence of the higher integration in the world economy has been an increase in financial flows between countries. One particular kind of financial flow that requires close attention is the portfolio flows from advanced economies to emerging economies. These flows are mostly considered to be short term in nature and highly sensitive to economic developments. Figure 1 shows portfolio flows of bonds and equities towards emerging economies. After the global financial crisis of 2008–09, portfolio flows became larger, and also remained highly volatile. Especially during this period of significant quantitative easing (QE) in advanced economies, financial markets were flooded with short-term liquidity, which induced strong flows towards emerging economies. However, these flows were also very sensitive to risk perception in the world economy. For example, as the fiscal problems in advanced economies intensified, these portfolio inflows quickly turned into outflows.

Portfolio flows to emerging economies (13-week moving average, USD billions) Figure 1



Source: EPFR.

So, as a result of financial integration, the global portfolio market can be considered to be a single market. In this market, global investors decide on the distribution of funds across countries depending on the associated risks and returns. Monetary policies and especially the QE policies of advanced economies have been important factors in this market. Due to the low interest rates and abundant liquidity provided by advanced economy central banks, investors searched for higher yields, creating a kind of risk-taking channel. Subsequently, emerging economies with higher growth outcomes/prospects and higher nominal yields became preferable destinations for investors' portfolio flows. However, as the risks surrounding the fiscal policies, monetary policies and the pace of economic growth emerged, these flows behaved in a very volatile fashion.

Being on the receiving end of these volatile flows, policymakers in emerging economies devised and extensively used several tools to contain the possible adverse effects.[2] Turkey also devised a number of new tools, such as the interest rate corridor and the Reserve Option Mechanism (ROM). These tools were designed to smooth the effects of volatile capital flows on the economy and to contain any possible financial cycles.

Section 2 of this paper explains these tools and their effects on the capital flows into Turkey[3]. Section 3 constructs a large cross-country data set covering the period Q1 2005–Q4 2012 to test the hypothesis of the paper. First, it is shown that portfolio flows are sensitive to the risk perception in financial markets, as measured by the VIX. Also, this sensitivity has arguably increased since 2010. Subsequently, it is shown that emerging economies as well as Turkey have historically been more sensitive to fluctuations in international risk appetite. Finally, we show that the policy tools implemented in Turkey to contain the adverse effects of capital flows have led to a significant reduction in the sensitivity of portfolio flows to risk perception since 2010. Section 4 concludes.

2. Turkish experiences of the recent volatile capital flows

Turkey liberalised its trade account in the early 1980s, its financial account in the late 1980s and became a trade member of the European Union in the mid-1990s. As a result, the country has become a more open and integrated economy, but these developments have not been without significant challenges. Especially as regards capital flows, the country's financial liberalisation was followed by a number of difficult problems. For example, Turkey experienced two crises in 1994 and 2001 related to its capital account, although the main determinants of these crises were domestic in nature, such as fiscal sustainability issues and banking concerns. After the 2001 crisis, Turkey implemented significant reforms in several areas including the fiscal, monetary and banking domains. These reforms strengthened the country's fundamentals and supported its convergence with the advanced economies.

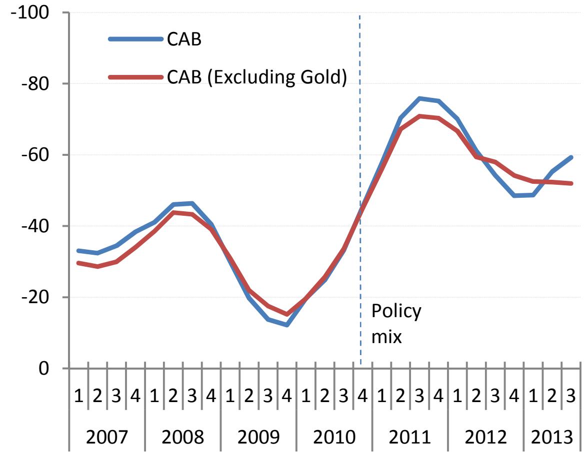
In the 2000s, with strong fundamentals and in the midst of its convergence process, Turkey was running current account deficits (Figure 2). Before the global financial crisis, a large portion of this current account deficit was financed by foreign direct investment and long-term flows (Figure 3). After the crisis, however, concerns grew as the current account deficit became excessive and the financing of the deficit shifted to mostly portfolio and short-term capital flows.

2 See IMF (2013a,b,c) for an overview of these policies.

3 For an overview of the CBRT's new policy framework, see Başçı and Kara (2011), and Alper, Kara and Yörükoğlu (2013).

Current account balance (CAB) (12-month cumulative, USD billions)

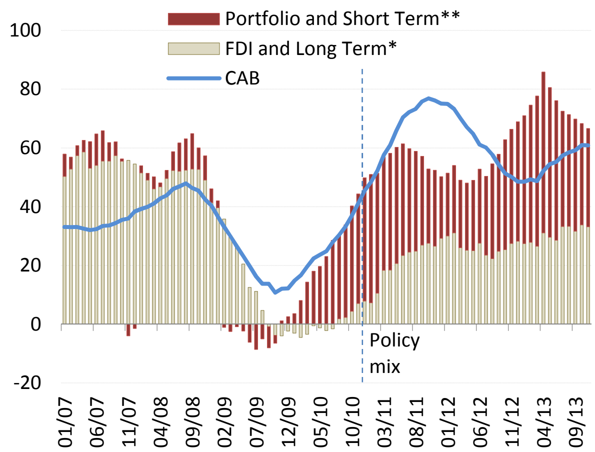
Figure 2



Source: CBRT.

Financing of current account balance (12-month cumulative, USD billions)

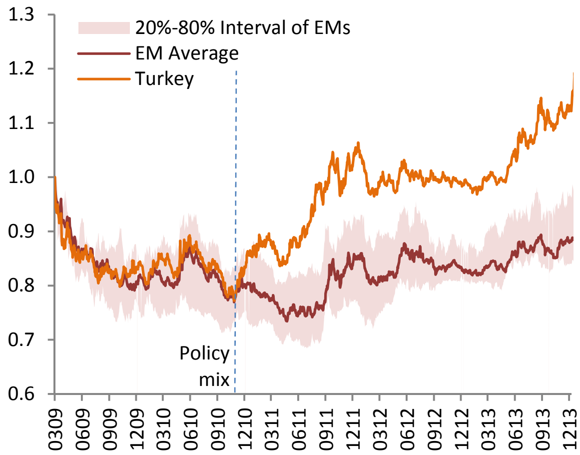
Figure 3



Source: CBRT.

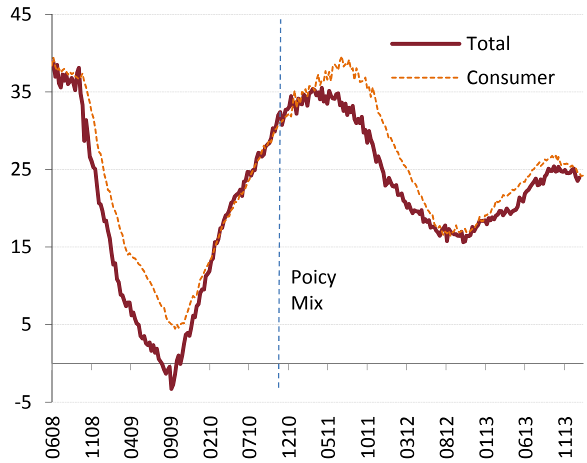
Other concerns that emerged due to the strong inflows of portfolio and short-term capital were related to the exchange rate and credit growth. During this inflow period, the Turkish lira appreciated sharply but so did other emerging market currencies, indicating that the developments were not specific to Turkey, but more part of a global financial cycle (Figure 4). Additionally, credit growth in Turkey reached around 35% (Figure 5). This high level of credit growth along with an overvalued currency and strong portfolio flows were potential symptoms of a nascent financial boom. Therefore, the CBRT devised a new policy mix to contain the possible adverse effects of this financial cycle.

Turkish lira and other EM currencies versus the USD (9 March 2009=1) Figure 4



Source: CBRT, Bloomberg.

Growth rates in total and consumer loans (adjusted for the exchange rate effect, annual change, per cent) Figure 5

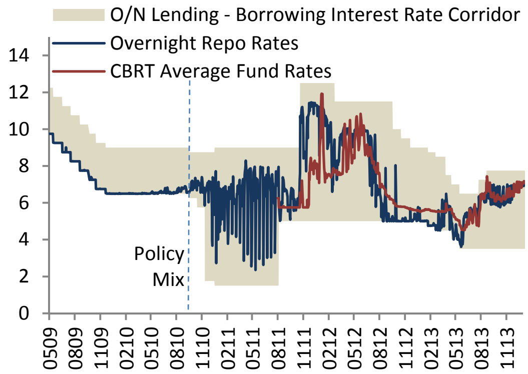


Source: BRSA, CBRT.

In its policy mix, the CBRT used two new tools: the interest rate corridor and the Reserve Option Mechanism (ROM). In pursuit of the interest rate corridor policy, the central bank overnight borrowing rates were lowered significantly while the lending rates were stable at the end of 2010 (Figure 6). In addition, the CBRT allowed its overnight repo rates to fluctuate within this asymmetric corridor, creating a downward bias in short-term interest rates. In effect, this policy reduced the risk-adjusted return for foreign investors by increasing the volatility of the returns. This policy succeeded in limiting some portfolio and short-term capital flows. Moreover, the CBRT increased its reserve requirement ratios significantly and terminated the remuneration on those reserves.

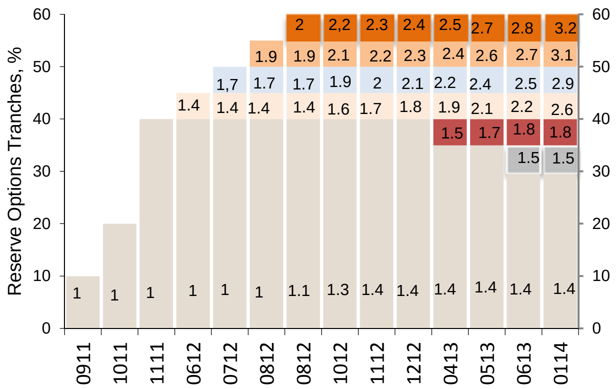
As a result of these policies, the Turkish lira immediately started to depreciate at the end of 2010, while credit growth and the share of short-term flows in the financing of the current account started to decrease in 2011. Following the onset of the European debt problems in the third quarter of 2011, the Turkish lira depreciated further. This time, to contain the volatility in exchange rates, the CBRT shifted the asymmetry of the interest rate corridor upwards by increasing the lending rate. This upward-biased interest rate corridor basically increased the risk-adjusted return for foreign investors. However, this policy also created a funding rate risk for domestic banks at a time of still-high credit growth. Later on, when euro area concerns eased, the width and asymmetry of the corridor decreased.

Interest rate corridor (per cent) — Figure 6



Source: CBRT.

FX reserve option coefficients in Reserve Option Mechanism (ROM) — Figure 7

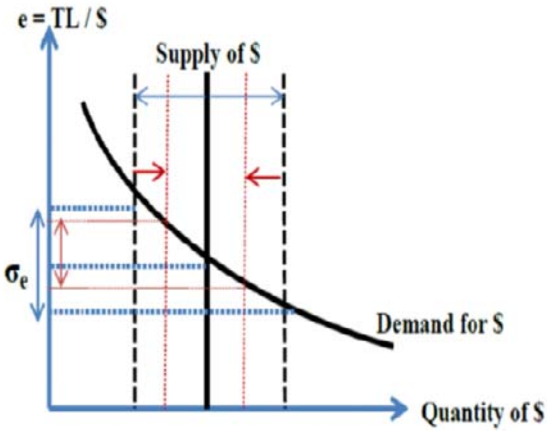


Source: CBRT.

The second tool, which was devised at the end of 2011 and used more actively later on by the CBRT, was the ROM. In this mechanism, banks are given the option of holding some percentage (reserve option tranches) of their required Turkish lira (TL) reserves as foreign exchange and/or gold (Figure 7). For each tranche, there is a coefficient, called the reserve option coefficient, which specifies the amount of foreign exchange or gold that can be held per unit of TL-required reserves. If banks want to use a particular tranche, they have to hold the tranche's TL-coefficient equivalent in foreign exchange. Banks use the option even if the coefficient is larger than 1 because they have access to foreign funds and the cost of foreign exchange is lower compared with the Turkish lira. However, as the coefficient gets larger, banks will approach an indifference point for using the option. So, as international funding conditions fluctuate and the relative cost of foreign funding changes, banks can decide on their optimal level of usage.

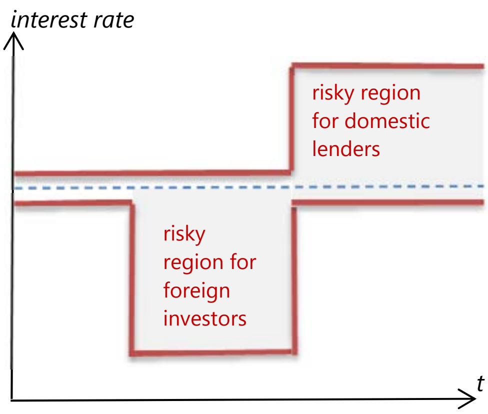
The ROM is a market-friendly mechanism and works as an automatic stabiliser. If there is a decrease in the availability of foreign funding or an increase in its cost, banks curtail their use of the mechanism and reduce their reserves at the CBRT. On the other hand, if the availability of foreign funds increases or its cost decreases, banks deposit more available funds as reserves at the CBRT. In this way, the mechanism smoothes the volatility in the exchange rate to some extent. During the second half of 2012 and the first part of 2013, when the portfolio and short-term capital flows to emerging market countries and to Turkey accelerated again (Figures 1 and 3), this mechanism was able to channel a sizeable portion of the flows into the CBRT's reserves and limit the possible adverse effects on the exchange rate and the economy.

Smoothing role of interest rate corridor | Figure 8



Source: Authors' calculations

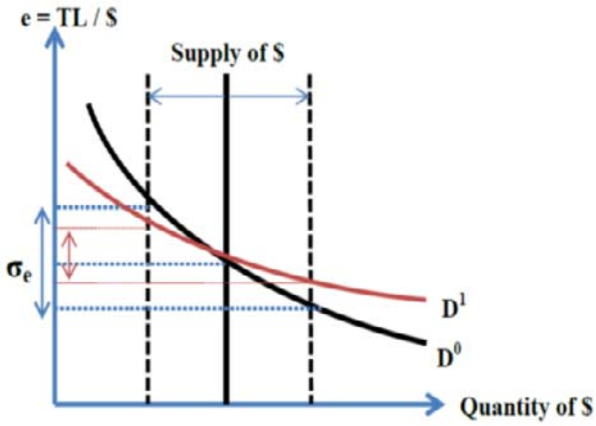
The corridor and its asymmetric effect on domestic/global lenders | Figure 9



Source: Authors' calculations

Regarding the functioning of these tools, one can consider a simple framework in terms of the supply and demand for foreign exchange (Figure 8). In this framework, the supply of foreign exchange can be taken as inelastic, for reasons of simplicity, and so the supply will be affected only by developments in the global financial markets and risk perception. Thus, the asymmetric use of the interest rate corridor can be considered to lessen the impact of the volatility in short-term capital flows.[4] When risk perception is overly optimistic and there are strong inflows, decreasing the lower part of the corridor creates uncertainty over the returns for foreign investors and limits the inflows to some extent (Figure 9). In effect, this lower part of the corridor will take away some of the increase in the inflows (Figure 8). In the case of overly pessimistic risk perception and capital outflows, the upper part of the corridor will provide a return assurance, with an upward bias in the returns, for foreign investors. Also, the upper part of the corridor will create uncertainty over the funding costs for domestic banks, thereby limiting credit growth (Figure 9).

Smoothing role of Reserve Option Mechanism (ROM) — Figure 10



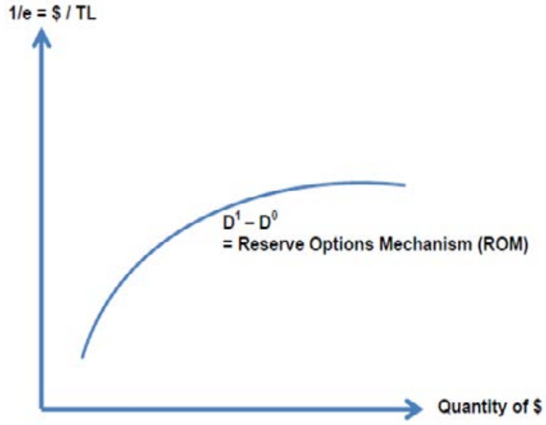
Source: Authors' calculations

In the simple demand and supply framework, the ROM can be considered a way of decreasing the sensitivity of demand to supply shifts. So, when there is an increase in the supply, instead of putting extra foreign exchange into the economy, the mechanism steers some into the central bank reserves, and vice versa (Figure 10). Thus, in effect, the ROM creates a less steep demand curve D^0 compared with the original curve D^1, the difference between the two demand curves being the amount of foreign exchange reserves in the mechanism (Figure 11). This mechanism is very similar to the standard reserve policy of emerging market countries, but the ROM is a market-friendly mechanism that can be used frequently by banks according to aggregate economic conditions or in times of abnormal bank conditions.

4 For a more general discussion of possible uses of the asymmetric interest rate corridor, see Goodhart (2013).

Reserve option mechanism and FX reserves

Figure 11



Source: Authors' calculations

3. Cross-country evidence regarding the Turkish case

This section tests the hypothesis that, after 2010, portfolio flows overall became more sensitive to risk perception on the back of low yields and the QE policies of advanced countries. We also test whether macroprudential policies in Turkey have lessened the country's sensitivity in this regard. To conduct these tests, we construct a quarterly data set of 44 countries covering 2005–12.[5] Our theoretical underpinnings and empirical strategy are similar to Bruno and Shin (2013, 2014), who analyse an environment with global banks and centralised funding, and show that cross-border bank flows are driven by the operations of global banks. The authors then propose an empirical methodology whereby cross-border flows are determined by the inter-office assets of foreign banks in the US as a source of wholesale funding, risk perception as measured by VIX, and a number of controls including recipient-country variables.

Here, we consider portfolio flows to be similar to bank flows. In addition, the distribution of portfolio flows is determined in a highly integrated financial market in which investors may switch easily among different markets. Consequently, global liquidity conditions and risk perception will be important drivers of the portfolio flows, along with the fundamentals in the recipient countries. This enables us to propose an equation similar to the one used in Bruno and Shin (2014), where

5 The data are collected from the IFS-IMF, the Fed and the World Bank. Portfolio inflow is taken as non-residents' net purchases of domestic assets, and is normalised by seasonally adjusted GDP. ΔDebt/GDP is provided at an annual frequency (World Bank), and is linearly interpolated to convert the series into a quarterly frequency. The sample countries are similar to those in Bruno and Shin (2014): Argentina, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Malaysia, Mexico, the Netherlands, Norway, Philippines, Poland, Portugal, Romania, the Russian Federation, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, the United Kingdom and Uruguay.

portfolio flows to a country (*Portfolio Flows/GDP*) are determined by the level and the change in VIX, the US money supply (*ΔUS M2*), changes in real exchange rates, and the real GDP and debt-to-GDP ratios (*ΔRER, ΔGDP, and ΔDebt/GDP,* respectively) for each country *i*.[6]

$$Portfolio\ Flows/GDP_{\ it} = \beta_0 + \beta_1 VIX_{t-1} + \beta_2\, \Delta VIX_{t-1} + \beta_3\, \Delta US\ M2_{t-1} + \beta_4\, \Delta RER_{it-1} + \beta_5\, \Delta GDP_{it-1} + \beta_6\, \Delta Debt/GDP_{it-1} + \varepsilon_{it} \qquad (1)$$

The first column of Table 1 presents the results for all countries for the period 2005–12. The results show that a reduction in international risk appetite (an increase in *Δ*VIX) leads to a decrease in portfolio flows, and as a domestic factor, an increase in the use of net debt (*ΔDebt/GDP*) decreases portfolio flows (both significantly).[7] In the second column, we study whether the sensitivity of portfolio flows to risk perception has changed since 2010.[8] On average for all the countries, the results show that the sensitivity has increased since 2010, albeit insignificantly: δ_2 is estimated negative and implies a higher sensitivity, but it is estimated to be statistically insignificant. Moreover, it appears that the flows are sensitive to the change in, rather than the level of, VIX (while $\delta_1 + \delta_2 = 0$ is rejected at a p-value of .02, $\beta_1 + \beta_2 = 0$ at a p-value of .73).

The third column studies whether emerging market economies are more sensitive to international risk perception for the whole period.[9] Here, the increase in *Δ*VIX implies a sharper decrease in portfolio flows for this group of countries compared with the other countries (δ_3 is negative and significant). Similarly, while the flows are estimated to be more sensitive in magnitude to changes in international risk appetite after 2010, the effect is found to be statistically insignificant.

A similar conclusion can be drawn for Turkey (the fourth column). On average, Turkey appears to be more sensitive to fluctuations in international risk appetite compared to other economies (δ_4 is negative and significant).

In the fifth column, we show the main specifications for testing the effectiveness of macroprudential policies implemented in Turkey after 2010. While Turkey historically has been more sensitive to movements in international risk appetite (δ_4 is negative and significant), the country has become significantly less sensitive compared to other economies after the implementation of its new policy framework in 2010 (δ_5 is positive and significant).[10]

6 All independent variables are lagged by one quarter to ease potential endogeneity in the estimation.

7 A lagged level of VIX appears to have a predicted positive effect on portfolio flows, yet is statistically insignificant and small in magnitude.

8 We specify the dummy variable 2010 to take a value of 1 from Q4 2010 (the quarter in which Turkey started implementing its new macroprudential framework), and 0 otherwise.

9 Emerging market countries, for which the dummy variable EM takes a value of 1, are Argentina, Brazil, Bulgaria, Chile, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Indonesia, Israel, Latvia, Lithuania, Malaysia, Mexico, Philippines, Poland, Romania, the Russian Federation, Slovakia, Slovenia, South Korea, Thailand, Turkey, Ukraine, and Uruguay.

10 Moreover, we test the sensitivity of portfolio flows to Turkey (as a percentage of GDP) to ΔVIX after 2010. The results suggest that Turkey has welcomed lower portfolio flows, due to an increase in ΔVIX ($\delta 1+\delta 2+\delta 4+\delta 5$ is negative, and significant at a p-value of .02) compared with other economies ($\delta 1+ \delta 2$ is negative, yet milder, and significant at a p-value of .02). Hence, while Turkey

This empirical exercise provides a straightforward way of testing the effectiveness of macroprudential variables in decreasing the sensitivity of portfolio flows to global risk perception. Other robustness checks on these results are possible, such as comparing different groups of countries and adding the related global liquidity indicators for portfolio flows. Also, other related questions remain, such as whether the possible adverse effects of portfolio flows on domestic variables are contained enough,[11] whether the macroprudential policies entail economic costs that might outweigh the benefits, or whether there are potential benefits to be had from central bank coordination regarding capital flows.

4. Conclusion

Global financial markets and the world economy have become more integrated in the last three decades. Along with this integration, the size of cross-border capital flows, including portfolio flows, has increased significantly. One important feature of portfolio flows since the global financial crisis of 2008–09 is that they have become very volatile and that their sensitivity to global risk perception has increased. This higher volatility and sensitivity to risk factors has confronted emerging market countries with difficult challenges. Most countries have used different kinds of macroprudential policies to contain the adverse effects of the volatile short-term capital flows. Turkey has also devised and used a number of new tools, such as the interest rate corridor and the Reserve Option Mechanism. These tools appear to have been effective in decreasing the sensitivity of portfolio flows in Turkey to global risk perception.

has a lower sensitivity to international risk appetite after 2010 compared with the previous period, the strength of its sensitivity is still high compared to the average.

11 For studies on the effects of the new policy mix in Turkey, see Aysan, Fendoğlu and Kılınç (2013), Binici et al (2013), Oduncu, Akçelik and Ermişoğlu (2013), and Değerli and Fendoğlu (2013 a,b).

Determinants of portfolio flows and effectiveness of macroprudential policies in Turkey

Dependent variable: Portfolio flows/GDP

Table 1

Coeff.	Independent variables	(1)	(2)	(3)	(4)	(5)
β_1	VIX_{t-1}	0.003	0.004	–0.100	0.004	0.004
		(0.006)	(0.007)	(0.008)	(0.007)	(0.007)
β_2	VIX_{t-1} * 2010		–0.002**	–0.002**	–0.002**	–0.002**
			(0.001)	(0.001)	(0.001)	(0.001)
β_3	VIX_{t-1} * EM			0.026**		
				(0.012)		
β_4	VIX_{t-1} * TR				0.015**	0.012*
					(0.006)	(0.007)
β_5	VIX_{t-1} * 2010 * TR					0.025***
						(0.009)
δ_1	ΔVIX_{t-1}	–0.014*	–0.016**	–0.016**	–0.016**	–0.016**
		(0.008)	(0.008)	(0.008)	(0.007)	(0.008)
δ_2	ΔVIX_{t-1} * 2010		–0.004	–0.006	–0.004	–0.005
			(0.004)	(0.005)	(0.004)	(0.004)
δ_3	ΔVIX_{t-1} * EM			–0.024*		
				(0.012)		
δ_4	ΔVIX_{t-1} * TR				–0.018**	–0.030**
					(0.007)	(0.01)
δ_5	ΔVIX_{t-1} * 2010 * TR					0.013**
						(0.006)
γ_1	ΔUS $M2_{t-1}$	0.0457	0.143	0.160	0.144	0.146
		(0.081)	(0.118)	(0.119)	(0.118)	(0.119)
γ_2	ΔRER_{it-1}	–0.017	–0.016	0.002	–0.015	–0.014
		(0.028)	(0.029)	(0.029)	(0.029)	(0.029)
γ_3	ΔGDP_{it-1}	0.053	0.065	0.076	0.066	0.066
		(0.05)	(0.051)	(0.055)	(0.052)	(0.052)
γ_4	$\Delta Debt/GDP_{it-1}$	–0.390**	–0.375**	–0.348**	–0.374**	–0.374**
		(0.186)	(0.188)	(0.174)	(0.188)	(0.189)
γ_5	2010 * TR					–0.072**
						(0.030)
γ_0	Constant	0.012	0.008	0.006	0.008	0.008
		(0.014)	(0.015)	(0.017)	(0.015)	(0.59)
	Number of obs.	1425	1425	1425	1425	1425
	Within R^2	0.115	0.118	0.129	0.119	0.119
	Number of countries	44	44	44	44	44
	Fixed effects	Yes	Yes	Yes	Yes	Yes

* and ** shows significance at the 10% and 5% levels. Errors are the cluster-robust standard errors. P-values are in brackets.

Source: IMF, World Bank, Fed and CBRT

References

Alper, K, H Kara and M Yörükoğlu (2013): "Reserve options mechanism", *CBT Central Bank Review*, no 1.

Aysan, A, S Fendoğlu and M Kılınç (forthcoming): "Macroprudential policies as buffer against volatile cross-border capital flows", *Singapore Economic Review*.

Başçı, E and H Kara (2011): "Financial stability and monetary policy", *CBT Working Papers*, no 8.

Binici, M, H Erol, P Özlü and D Ünalmış (2013b): "Interest rate corridor: a new macroprudential policy tool", *CBT Research Notes in Economics*, no 20, (in Turkish).

Bruno, V and H S Shin (2013): "Capital flows, cross-border banking and global liquidity", *Princeton University CEPS Working Papers*, no 237a.

——— (2014): "Assessing macroprudential policies: case of South Korea", *Scandinavian Journal of Economics*, vol 116, no 1, pp 128–57.

Değerli, A and S Fendoğlu (2013a): "Exchange rate expectations and CBRT monetary policy", *CBT Research Notes in Economics*, no 2, (in Turkish).

——— (2013b): "Reserve option mechanism as a stabilizing policy tool: evidence from exchange rate expectations", *CBT Working Papers*, no 28.

Goodhart, C (2013): "The potential instruments of monetary policy", *CBT Central Bank Review*, no 2.

International Monetary Fund (2013a): "Unconventional monetary policies – recent experience and prospects", *IMF Staff Report*.

——— (2013b): "Global impact and challenges of unconventional monetary policies", *IMF Policy Paper*.

Oduncu, A, Y Akçelik and E Ermişoğlu (2013): "Reserve options mechanism: a new macroprudential tool to limit the adverse effects of capital flow volatility", *CBT Central Bank Review*, no 3.

The transmission of US monetary policy shocks to EMEs: an empirical analysis

Manuel Ramos-Francia and Santiago García-Verdú[1]

Abstract

We consider the extent to which three channels that transmit US monetary policy shocks to emerging market economies (EMEs) may have changed in importance and relative strength – ie structurally changed – since the third quarter of 2008. We run linear regression models and estimate a factor-augmented vector autoregression (FAVAR) for the United States and each EME in our database, using macroeconomic variables from each economy. We find that the possibility of structural change in the policy rate, exchange rate, and long-term interest rate channels generally depends on the EME in question. Also, in the case of some tests, accounting for unconventional monetary policy (UMP) does seem to make a difference in this result. However, EMEs seem to have experienced some structural changes more uniformly in what can be interpreted as (i) second-round effects in the channels or, more likely, (ii) as changes in channels that we have not explicitly modelled but that are nonetheless being captured. Such changes highlight the potential for a renewed interdependence between the monetary policies in most EMEs and US monetary policy above and beyond the unprecedented stance of the latter. They also underscore the importance for most EMEs of taking appropriate policy measures, in particular as the United States begins tightening its monetary stance. Our results should be interpreted with some caution given the limited length of the time series.

Keywords: Monetary policy, central banking

JEL classification: E4, E5

1 Bank of Mexico.

The opinions expressed in this paper are exclusively the responsibility of the authors and do not necessarily reflect the point of view of the Bank of Mexico.

Introduction

It is well understood that during recent decades the world's economies and financial systems have grown more integrated through a relentless globalization process (eg Friedman (2005)). However, what is perhaps less well understood is the extent to which the process has made monetary policy more globally integrated, thereby tightening the mechanisms by which monetary policy shocks are transmitted internationally.

Despite some significant efforts towards understanding this topic in general (eg Galí and Gertler (2009)) as well as with regard to emerging market economies (EMEs) (eg Kim and Yang (2009)), the issues pertaining to EMEs have received relatively little attention. In this context, several relevant questions arise: What is the nature of the mechanism by which US monetary policy effects are transmitted to EMEs? What is the strength and relative importance of the transmission channels? Have these channels changed after the recent financial crisis and, if so, to what extent? What are the implications, if any, for EME economic policies?

Against this backdrop, we undertake two studies. First, we quantitatively explore the policy rate, exchange rate, and long-term interest rate channels by which US monetary policy shocks are transmitted to EMEs.[2] Of course, these are but three among other channels present in the transmission mechanism. Second, we assess the extent to which the strength and relative importance of these channels might have changed since recent global financial crisis; we hereafter refer to such changes as structural changes. We apply these enquiries to a set of 15 EMEs (sometimes fewer, depending on data availability) that have varying exchange rate arrangements, monetary regimes, degrees of financial openness, and policy responses (the Appendix includes the list of EMEs along with descriptions of their exchange arrangements and monetary regimes).[3]

We estimate a set of linear regression models and a factor-augmented vector autoregression (FAVAR) for the United States and each EME in our database, using macroeconomic variables from each economy. This allows us to incorporate a wide range of time series data in our estimation. We assess the extent to which such channels might have changed beginning with the third quarter of 2008. To do so, we run a set of regressions with data for the 22 quarters preceding the crisis (Q1 2003 to Q2 2008) and, in a separate estimation, with data for the 22 subsequent quarters (Q3 2008 to Q4 2013). We use an auxiliary dummy variable to account for possible changes in the coefficients measuring the impact of the US policy rate (ie the federal funds rate) on relevant macroeconomic variables. Accordingly, we run a

[2] For a specific emerging market economy, we explore these channels by examining how changes in the US policy rate affect (i) the EME's policy rate; (ii) the EME's exchange rate; and (iii) the EME's long-term interest rates. As the transmission effect is not limited to these three variables, we aim to capture other effects through a vector autoregression.

[3] One might divide the EMEs in our database into the following groups: (i) South American EMEs, most of which have benefited from the commodities super cycle and the significant increase in demand, in particular from China; (ii) Asian EMEs, characterized by an efficient industrial block; (iii) eastern European EMEs, whose situation is greatly affected by the EU; (iv) Mexico, which is closely related to the US economy; and (v) others. Specific patterns within these groups do not appear in our exercises.

battery of statistical tests on the relevant coefficients. It is important to clarify that while in the regressions we use data from the quarters preceding the crisis and, in a separate estimation, we use data from the subsequent quarters; in the case of the FAVAR models we use the whole sample. The key difference is that in one FAVAR we allow for a structural change in some coefficients, while in the other FAVAR we do not allow for a structural change, as later explained in detail in the text.

In this context, a natural challenge is to measure the US monetary policy stance once the US federal funds rate reaches the zero lower bound. At that point, we sidestep the issue by using the rate proposed by Wu and Xia (2013) (hereafter, the Wu and Xia rate). That rate essentially coincides with the US federal funds rate as long as the policy rate is positive; but once the policy rate hits the zero lower bound, the Wu and Xia rate can become negative. When negative, its distance from zero is a quantitative measure of the effectiveness of unconventional monetary policy.

Having a better understanding of the international transmission mechanism of monetary policy is relevant for many reasons. Monetary policy in advanced economies has played an essential role in the recovery from the global financial crisis. In fact, it has been referred to as the "only game in town" (Rajan (2013)).[4] Also, it is crucial for investors and policymakers alike to understand the implications of global monetary policy for EMEs, where capital flows can be directly influenced by changes in the monetary policy stance in advanced economies. A better understanding of the international transmission of US monetary policy can therefore provide critical assistance to policy planning within EMEs.

Our main findings are as follows. We obtain initial evidence that the existence of a structural change in the policy rate, exchange rate, and long-term interest rate channels depends on the EME in question.[5] However, EMEs seem to have experienced some structural changes more uniformly. These changes can be thought of as second-round effects of the three channels modelled; but we believe they are more likely to be arising from other channels that our model is implicitly capturing.

Here, we will discuss our results in a broader perspective. Much of the attention given to the international transmission mechanisms of US monetary policy started with the global financial crisis. In responding to that crisis, the US central bank lowered the policy rate esentially to the zero lower bound, after which it began implementing unconventional monetary policies. Under those measures, significant capital flows swiftly entered and exited EMEs, depending to a great extent on diverse episodes and situations in the advanced economies. Moreover, there are possibly several factors influencing each of the three channels we study here.

For *the policy rate channel*, we could hardly have expected uniform results since: (i) the initial conditions of each EME before the global financial crisis differed substantially; (ii) we have observed diversity among EMEs in their management and policy responses to unconventional monetary policies; and (iii) except for the worst

4 Moreover, some researchers have cautioned about its limits and risks (eg Eichengreen et al (2011)).

5 As will be discussed shortly, structural change in the long-term interest rate channel appears to be more uniform across EMEs if the linear regression models account for unconventional monetary policies in the United States.

part of the crisis, very few EMEs have shared the same business cycle phase with the main advanced economies, in particular the United States. Moreover, business cycles have not been synchronized even among EMEs. Our mixed results are in line with the significant differences among EMEs in the factors considered above.

For *the exchange rate channel*, the results depend on the specific EME as well. Yet, arguably, there is less evidence of possible structural changes in this channel across the battery of tests. We could have expected this for two reasons. These EMEs have, for a relatively long time now, maintained a stationary inflationary process (Noriega, Capistrán and Ramos-Francia (2013)). Indeed, they have not monetized their fiscal deficits, ending fiscal dominance. This has produced a much lower pass-through.

Finally, *the long-run interest rate channel* also offers mixed evidence. Yet, a specific set of exercises (the linear regression models) give some evidence of a more generalized change when one accounts for unconventional monetary policies. We believe that there are several factors behind these results, some of which are above and beyond the global financial crisis. On the one hand, the secular decrease in long-term rates in the United States that began in the early 1980s accelerated, given the search-for-yield phenomenon, and was further supported by elements such as US demographic dynamics and the implementation of unconventional monetary policies. In fact, the fall in the long-term rates in EMEs has been faster than their corresponding individual deflationary processes.

In addition, these US factors have played a reinforcing role abroad. For example, the aggressive search for yield has certainly affected the interest rates in EMEs. In this context, a key question is what would be the scenario once normalization of the US federal funds rate starts. We believe that, although some bouts of volatility will quite possibly take place given the secular decrease in US long-term rates, the fierce competition among asset management companies for the highest yields in EMEs will continue. In the long-run rate channel, other factors have surely played a role as well and thus have led to differing results among EMEs. For instance, some of these economies have implemented capital controls, established macroprudential policies, allowed credit booms, or had more flexibility in their fiscal policies. All in all, it would have been a surprise to observe uniform results for the long-term interest rate channel.

However, joint tests (ie tests jointly assessing a structural change in various channels) tend to reject the null hypothesis of no structural change. We believe there are channels that may have changed but that we are not explicitly modelling. For instance, the global financial crisis and the associated financial regulatory response have significantly affected the balance sheets of banks and, to an extent, also of the so-called shadow banks. As is well known, their aim has been to improve their risk pricing. These factors are likely to have affected other channels, for instance, the credit channel. In sum, we find more uniform evidence of a structural change in channels we do not observe but that we think our models are capturing.

A caveat about our results is that only a few years have passed since the global financial crisis. Thus, the post-crisis period offers a relatively small number of observations for each time series, which makes statistical relationships difficult to detect. In addition, the relatively short time series limit the number of model specifications we can entertain. Thus, our results represent an exploration rather than robust statistical findings.

In the following sections we describe our data, model, and estimations, discuss our main results and offer some concluding remarks.

Data, model and estimations

As one would expect, there are more time series available for the United States than for any EME. In addition, data are not uniform across EMEs. Prominently, for some EMEs we do not have the time series of the long-term interest rate, which in those cases prevents us from studying that channel. Nonetheless, we have tried to keep databases as uniform as possible.

All time series have been transformed to a quarterly frequency and rendered stationary, the latter a needed condition for VAR model estimation. Let z_t be a generic variable. In general, except for interest rates, the percentage growth is taken (ie $\log(z_t)-\log(z_{t-1})$). Nonetheless, if a time series has negative values, then the difference is taken (ie $z_t - z_{t-1}$). To obtain evidence on stationarity, a stability test is performed on each of the VARs we estimate.[6] These tests are assessed but not reported.

Data

US data

We use a relatively large number of time series for the United States. The US federal funds rate is an indicator of the US monetary policy stance. To account for changes in the use of unconventional monetary policies or, equivalently, for those periods in which the US federal funds rate essentially hits the zero lower bound, we use the Wu and Xia rate in separate estimations. That rate coincides with the US federal funds rate if the latter is nonnegative. If the US federal funds rate hits the zero lower bound, the Wu and Xia rate can turn negative, and its distance from zero is a measure of the effectiveness of unconventional monetary policy.[7]

The following list shows each of the US variables we have used and their units of measure.[8] For convenience, we have divided them into three groups – financial, monetary and real – with no direct implications for our models.

Financial

- 3-month US interest rate (percentage);
- 10-year US interest rate (percentage);
- Morgan Stanley Capital International Index (MSCI) (percentage growth);
- Dow Jones 30 Industrial (percentage growth); and

[6] This test verifies that all of the norms of the matrix eigenvalues are strictly less than 1.

[7] Wu and Xia (2013) show that their model can be used to convey the macroeconomic effects of unconventional monetary policy at the zero lower bound.

[8] The source for each series is Haver Analytics except as otherwise noted.

- mortgage rate (percentage).

Monetary

- US federal funds rate (percentage);
- Wu and Xia rate (percentage);
- monetary base (percentage growth);
- M1 (percentage growth);
- M2 (percentage growth);
- currency in circulation (percentage growth);
- Federal Reserve balance sheet assets (percentage growth); and
- Federal Reserve balance sheet liabilities (percentage growth).

Real

- real GDP, seasonally adjusted (SA), billions of chained (2009) dollars (percentage growth);
- current account (per cent of GDP) (difference);
- exports (percentage growth);
- imports (percentage growth);
- consumer credit (percentage growth);
- micro-finance industry lending to private sector (percentage growth);
- private sector credit, over GDP (difference);
- central government budget, over GDP (difference);
- debt outstanding:
  - domestic economy, over SA GDP (difference);
  - households and non-profit institutions serving households, over quarterly GDP at a seasonally adjusted annual rate (SAAR) (difference);
  - non-financial corporations, over quarterly SAAR GDP (difference);
  - US financial corporations/institutions, over quarterly SAAR GDP (difference);
- gross capital formation (percentage growth);
- corporate gross operation surplus (percentage growth);
- gross disposable income (percentage growth);
- gross savings (percentage growth);
- earnings (percentage growth);
- manufacturing (percentage growth);
- manufacturing, excluding construction (percentage growth);
- housing prices (percentage growth);

- housing starts (percentage growth);
- housing permits (percentage growth);
- housing completions (percentage growth);
- shipments (percentage growth);
- retail value (percentage growth);
- wholesale (percentage growth);
- consumer confidence (percentage growth);
- consumer expectations (percentage growth);
- capacity (percentage growth);
- employment (percentage growth);
- labour force (percentage growth); and
- unit labour cost (percentage growth).

EME data

We divided the EME time series into the same three groups. We have taken as given the policy rate status provided by our main data source, Haver Analytics. The variables and units of measure are as follows.

Financial

- exchange rate (percentage growth);
- Morgan Stanley Capital International, MSCI (percentage growth);
- 3-month interest rate (percentage); and
- long-run (10-year) interest rate (percentage).

Monetary

- policy interest rate (percentage);
- M1 (percentage growth);
- M2 (percentage growth); and
- M3 (percentage growth).

Real

- real GDP (quarter percentage growth);
- current account, over GDP (difference);
- manufacturing (percentage growth);
- trade balance, over GDP (difference);
- private consumption expenditure (percentage growth);
- public consumption expenditure (percentage growth); and
- gross capital formation (percentage growth).

Exchange rate arrangements, monetary policy frameworks and financial openness

Each economy varies in the way it sets and conducts its exchange rate and monetary policies. In a broader context, it is relevant to understand the policy framework being implemented in the EME of interest, including its monetary and fiscal policies, capital flow management, and macro-prudential policies. Presumably, the state of these policies is partially captured by the macroeconomic variables we have incorporated into our VAR models. Yet, it is plausible that some aspects not captured explicitly may nonetheless be relevant in interpreting our results.

In this context, we first provide an IMF (2013) classification of the de facto exchange rate arrangements and monetary policy framework for each of the economies in our database (Table 1). We have omitted those classifications in which none of our economies appear. Hong Kong SAR is at one end of the exchange rate arrangements, having a currency board. At the other end, we find countries, such as Chile and Mexico, with an independently floating regime. For the monetary policy framework, Hong Kong SAR is again distinctive, having the US dollar as its anchor; most EMEs in our database maintain an inflation-targeting regime.

IMF de facto exchange rate arrangements and monetary policy regimes[1] — Table 1

	Monetary policy framework		
Exchange rate arrangement	Exchange rate anchor USD	Inflation targeting framework	Other
Currency board arrangement	Hong Kong SAR		
Other conventional fixed peg arrangement			
Crawling peg	China		
Managed floating with no pre-determined path for the exchange rate		Colombia Indonesia Peru Thailand	India
Independently floating		Brazil Chile Czech Republic Israel South Korea Mexico Poland South Africa	

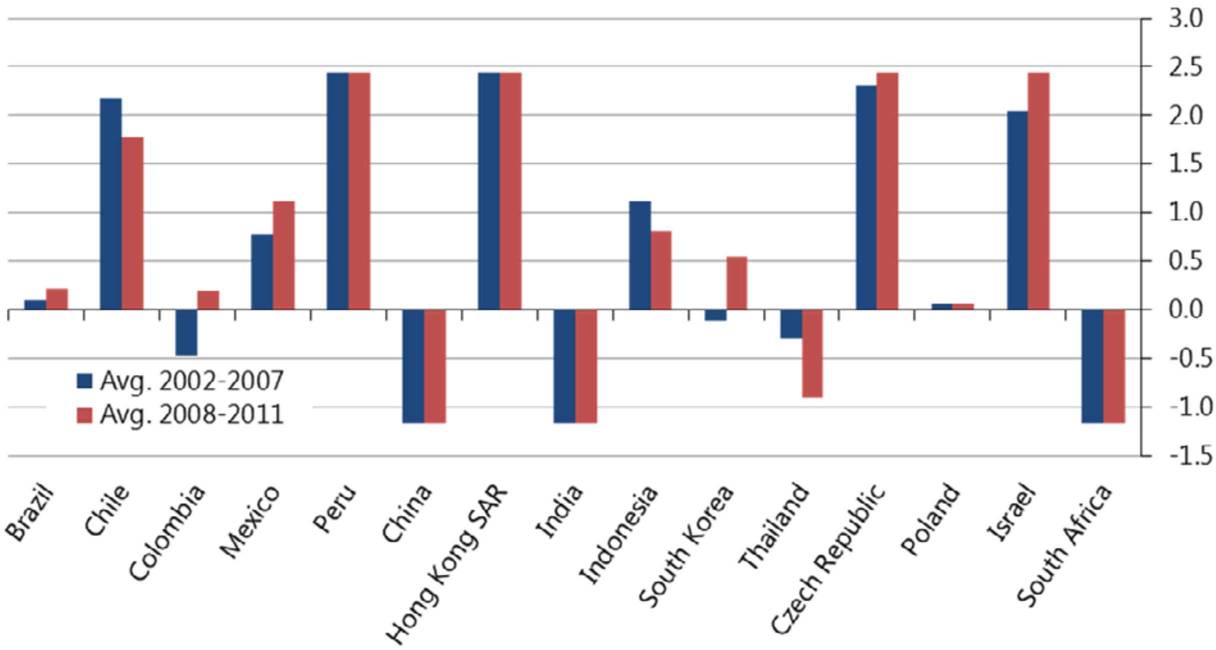
[1] See the Appendix for a more detailed explanation of the monetary policy regimes.

Source: IMF (2013).

Second, we present the Chinn and Ito index (2006) for each country (Figure 1). This index is a *de jure* measurement of the financial openness in an economy. We are interested in knowing the level of financial openness in each EME and whether it has changed in the sample period. Notable cases of an increase in financial openness are Colombia and Korea, whereas Thailand is a case in which financial openness diminished. In general, however, economies that began the sample period either financially open, such as Hong Kong SAR and Israel, or relatively closed, such as China and India, have remained that way.

Chinn-Ito index[1]

Figure 1



[1] Averages for the 2002–07 and 2008–11 periods. The index is a de jure measure of financial openness. A larger and positive (negative) value means greater (lesser) financial openness. Values based on the restrictions on cross-border financial transactions in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*.

Source: Chinn and Ito (2006).

Third, in the Appendix, we provide the IMF's definitions of de facto exchange arrangements shown in Table 1 as well as brief descriptions of exchange arrangements and monetary regimes, as contained in HSBC (2011), for the EMEs in our database. The HSBC information complements, although in some respects does not exactly coincide with, the IMF's classifications.

In sum, a thorough assessment of our results requires an understanding of these arrangements and regimes. As noted, we do not include this information in the model; they are for interpretation purposes only.

Model

We implement an approach similar to that in Bernanke et al (2005) and Boivin et al (2009) by using a factor-augmented VAR (FAVAR). There are at least three important aspects to their approach. First, monetary policy decisions involve the analysis of large amounts of information. The use of principal component analysis (PCA) allows for a systematic use of a wide range of data. Second, some of the variables on which monetary policy depends are unobservable to agents, eg potential output growth. Presumably, the use of PCA partially captures latent variables. Third, we could have attempted to calibrate, say, a dynamic stochastic general equilibrium (DSGE) model. Indeed, there are close relationships between

DSGE and VAR models (eg Fernandez-Villaverde et al (2007)). However, DSGE models require strong identifying restrictions. Moreover, although the VAR approach has not been free of criticism, it provides enough flexibility and has few identification assumptions.

There are several steps to our model's estimation. The first one entails the extraction of the main principal components from our time series set. On one hand, consider x_t, an $nx1$ vector that contains all of the time series (at time t) in the EME database of interest, except for the variables in question, such as the policy rate and exchange rate of the EME at hand. On the other hand, consider x_t^{US}, an $nx1$ vector containing all the time series (at time t) in the US database, except for the federal funds rate.

Next, consider the following approximations:

$$x_t \cong E(x_t) + \upsilon' c_t$$
$$x_t^{us} \cong E(x_t^{us}) + \upsilon'^{us} c_t^{us}$$

where c_t is an $mx1$ vector with the m^{th} first principal components at time t associated with the PCA decomposition of x_t, with $m << n$. Similarly, c_t^{us} is an $mx1$ vector with the $(m^{us})^{th}$ first principal components associated with the PCA decomposition of the time series x_t^{us}, with $m^{us} << n^{us}$.[9] The vector $\upsilon(\upsilon^{us})$ contains the factor loadings associated with the PCA decomposition of the time series in $x_t(x_t^{us})$.

Second, once the c_t^{us} and c_t time series have been obtained, the following vector is constructed by stacking the vectors obtained above along with the economic variables of interest, specifically:

$$y_t = \left[c_t^{US} \; ff_t \; c_t \; lri_i \; i_t \; dfx_t \right]',$$

where we have the $(m^{us})^{th}$ and m^{th} first principal components (c_t^{US} and c_t), the percentage change in the foreign exchange rate (dfx_t), the EME's long-run interest rate (lri_t) and its policy rate (i_t), and the US federal funds rate (ff_t). The long-run rate is not available for all the economies in our database. In a different exercise, we substitute the US federal funds rate for the Wu and Xia rate. Thus, the VAR model for y_t is posited as:

$$y_t = \psi(L) y_{t-1} + \varepsilon_t \tag{1}$$

where $\psi(L)$ is a lag polynomial, and ε_t has mean 0 and variance-covariance matrix Σ.

Third, the VAR model is estimated under some identifying assumptions, for which we provide more details in the next subsection.

9 If m equals n, then $x_t - E(x_t) = \upsilon' c_t$. Similarly, if m^{us} equals n^{us}, then $x_t^{us} - E(x_t^{us}) = \upsilon'^{us} c_t^{us}$.

Our main tests are based on the following extension of model (1):

$$\tilde{y}_t = \tilde{\psi}(L)\,\tilde{y}_{t-1} + u_t \qquad (2)$$

where $\tilde{y}_t = [y_t \;\; ff_t \times d_t]'$ and d_t is a dummy variable defined as follows:

$$d_t = \begin{cases} 0 & \text{if } t < 3Q.2008 \\ 1 & \text{if } t \geq 3Q.2008 \end{cases}$$

Similarly, $\tilde{\psi}(L)$ is a lag polynomial that accommodates the coefficients associated with the $ff_t \times d_t$ variable. The error term u_t has mean 0 and variance-covariance matrix Ω.

To see how the dummy captures a possible structural change in our original VAR model (1), consider the following simplified version of the model. In it, we have included only the variation in the exchange rate (dfx_t), the EME policy rate (i_t), and the US federal funds rate (ff_t). The fourth variable is an auxiliary $(ff_t \times d_t)$, as defined above. Hence, we have:

$$\begin{aligned} dfx_t &= a_{11}dfx_{t-1} + a_{12}i_{t-1} + a_{13}ff_{t-1} + a_{14}ff_{t-1} \times d_{t-1} + u_{1,t} \\ i_t &= a_{21}dfx_{t-1} + a_{22}i_{t-1} + a_{23}ff_{t-1} + a_{24}ff_{t-1} \times d_{t-1} + u_{2,t} \\ ff_t &= a_{31}dfx_{t-1} + a_{32}i_{t-1} + a_{33}ff_{t-1} + a_{34}ff_{t-1} \times d_{t-1} + u_{3,t} \\ ff_t \times d_{t-1} &= a_{41}dfx_{t-1} + a_{42}i_{t-1} + a_{43}ff_{t-1} + a_{44}ff_{t-1} \times d_{t-1} + \varepsilon_{4,t}, \end{aligned}$$

which can be rewritten as:

$$\begin{aligned} dfx_t &= a_{11}dfx_{t-1} + a_{12}i_{t-1} + (a_{13} + a_{14} \times d_{t-1})\, ff_{t-1} + u_{1,t} \\ i_t &= a_{21}dfx_{t-1} + a_{22}i_{t-1} + (a_{23} + a_{24} \times d_{t-1})\, ff_{t-1} + u_{2,t} \\ ff_t &= a_{31}dfx_{t-1} + a_{32}i_{t-1} + (a_{33} + a_{34} \times d_{t-1})\, ff_{t-1} + u_{3,t}n \\ ff_t \times d_{t-1} &= a_{41}dfx_{t-1} + a_{42}i_{t-1} + (a_{43} + a_{44} \times d_{t-1})\, ff_{t-1} + u_{4,t}. \end{aligned}$$

Our first test considers whether the coefficient a_{24} is statistically significantly different from zero. If so, that would provide us with some evidence that the policy rate channel had a structural change after the third quarter of 2008.[10] That is, the coefficient, which measures the contemporaneous effect of ff_t on i_t, would have changed from a_{23} to $a_{23} + a_{24}$. This happens provided that a_{24} is statistically different from zero. Thus, we posit as a null hypothesis that $a_{24} = 0$.

Similarly we can test for a structural change in the exchange rate channel by statistically assessing whether $a_{14} = 0$. In addition, we can jointly test whether there has been a change in both channels by considering the null hypothesis: $a_{14} = a_{24} = 0$.

10 An underlying assumption is that we know a priori the period in which the structural change could have taken place.

In sum, we perform each of these tests as linear restrictions on the following system:[11]

$$\tilde{y}_t = \tilde{\psi}(L)\,\tilde{y}_{t-1} + u_t .$$

As an important exercise, we plot the impulse-response functions (IRFs) given a 25 basis point orthogonal shock to the US federal funds rate under model (1) and again under model (2). This allows for a visual comparison of, on one hand, the IRFs from the model in which it is assumed that there has been no structural change in the channels, with, on the other hand, the IRFs from the model that allows for a possible structural change between the Q1 2003–Q2 2008 period and the Q3 2008–Q4 2013 period.[12] Compared with the linear tests, the IRFs depend on the specific Cholesky decomposition considered.

An underlying assumption is that the rest of the coefficients do not go through a structural change. Although it would be desirable to consider a more general hypothesis in order to capture a possible structural change in all of $\psi(L)$, this exercise is limited by the relatively short length of the time series.[13]

Estimation

For estimation purposes, we first divide our database into two sets, as suggested by our notation. In one set, we have the US time series, except for the US federal funds rate (or the Wu and Xia rate). The second set contains an EME's time series except for its policy rate, exchange rate, and long-term interest rate.

Second, by decomposing the US variables using PCA and also decomposing the EME's variables using PCA, we obtain a pair of sets of principal components. The components associated with the US data are denoted by c_t^{US}, and those associated with the EME's data by c_t.

Third, we construct the vector $y_t = [c_t^{US} \;\; ff_t \;\; c_t \;\; lri_t \;\; i_t \;\; dfx_t]'$, having used the first three principal components from each set.[14] Accordingly, the c_t^{US} and c_t entries in y_t stand for vectors, and the rest stand for scalars for each t.

11 These linear restrictions, under the null hypothesis, follow an F distribution, with the number of restrictions (v_1), and the number of observations minus the number of parameters being estimated (v_2), as degrees of freedom; ie its distribution is $F(v_1, v_2)$.

12 We have estimated models (1) and (2) under the identifying assumptions of orthogonal shocks, as will be explained later.

13 In the VAR model, if one has n variables, $n + n^2 + n(n-1)/2$ parameters have to be estimated. Adding one more variable implies that such number increases by $4n-1$. Assessing a possible structural change in all of $\psi(L)$ calls for n^2 additional coefficients. Regime switching calls for n^2 additional coefficients plus the transition probabilities.

14 We normally choose three components, for the following reasons: (i) On average, three components explain more than 50% of the accumulated variance of the whole data set; in general, the increment of accumulated variance tended to markedly drop by the fourth component. And (ii) using the same number of lags for each EME has the advantage of maintaining a level of comparability across EMEs.

Fourth, we assess the number of lags by means of Schwartz's Bayesian information criterion (SBIC). In most cases, SBIC points to a lag of 1. This is reasonable given that we are using principal components, which can proxy the lagged variables' dynamics.[15] For those cases in which the SBIC indicates a greater lag, we instead increase the number of EME and US components until the test points to a lag of 1.[16]

Fifth, the systems $y_t = \psi(L) y_{t-1} + \varepsilon_t$ and $\tilde{y}_t = \tilde{\psi}(L) \tilde{y}_{t-1} + u_t$ are estimated. As a final step, tests and IRFs are calculated and assessed.

Also, we redo the steps above with the Wu and Xia rate instead of the US federal funds rate to allow the model to capture the effects of unconventional monetary policies.

A VAR estimation has some identifying restrictions. In particular, one has to make a choice regarding the identification of shocks. In our case, we assume orthogonal shocks by applying the Cholesky decomposition to the variance-covariance matrices. To this end, we order our VAR variables by their speed of adjustment, as suggested by our notation $y_t = [c_t^{US} \; ff_t \; c_t \; lri_t \; i_t \; dfx_t]'$. Thus, on impact, we have assumed that the adjustment of the exchange rate is followed by that of interest rates and then of the EME's components. Then the US federal funds rate adjusts, followed by the US components.[17] Thus, in general, the EME's variables respond on impact to changes in US variables but not the other way around.

For identification purposes, we could have estimated a structural VAR (SVAR). We have nonetheless preferred a Cholesky decomposition, for two reasons: (i) it is equivalent to a just-identified SVAR and thus generally implies a less restrictive scheme; and (ii) we find it more suitable, at least initially, as a SVAR would generally require stronger identification assumptions and consequently more a priori knowledge about the variables' relationships.

Results

To set the stage, we first consider the cross-correlations between the US federal funds rate and each of our three variables of interest for each EME – the policy rate (Figure 2), the exchange rate (Figure 3) and long-term interest rates (Figure 4) – for the Q1 2003–Q2 2008 and the Q3 2008–Q4 2013 periods. The autocorrelations have

15 In fact, Stock and Watson (1999) have referred to (1) as a dynamic model.

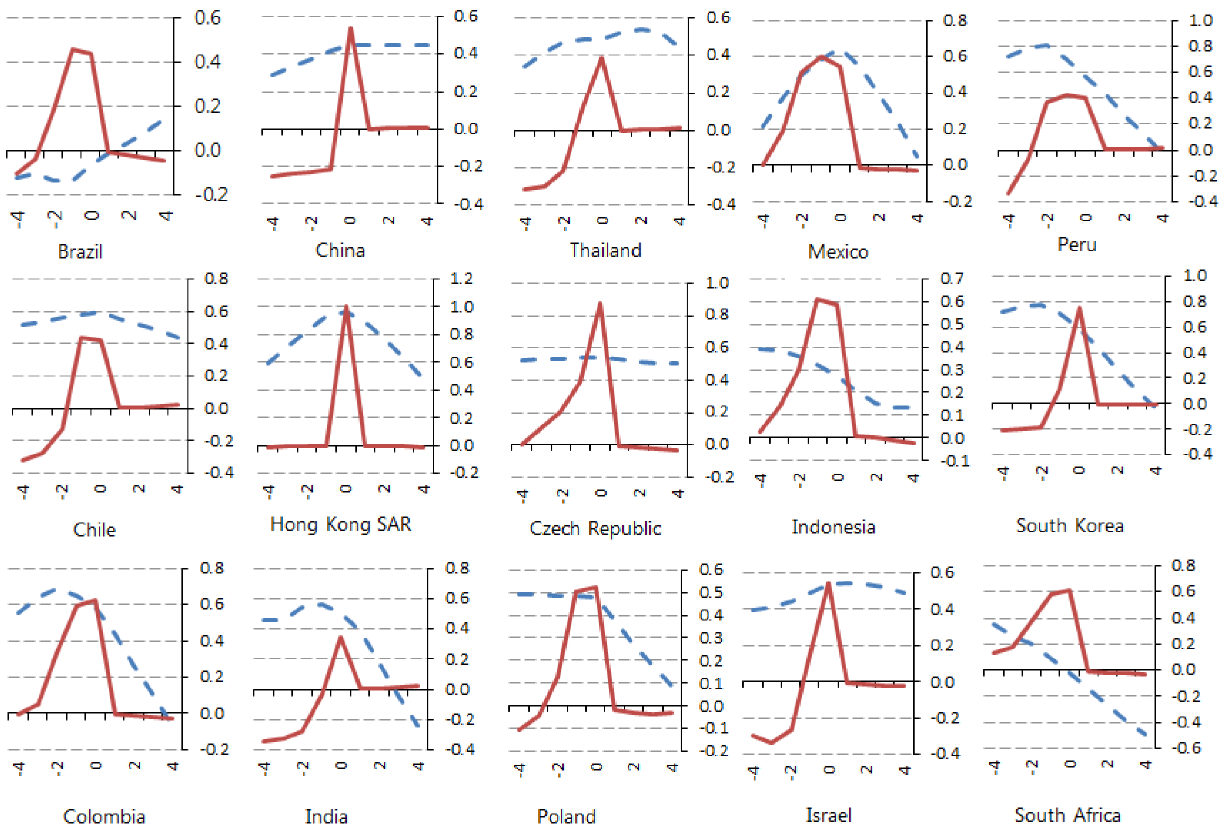
16 Specifically, for Chile, Peru and China, the SBIC calls for a lag greater that 1. The issue is that, given our time series' short length, increasing the lag might not be feasible because of the large number of coefficients that would need to be estimated. Adding lags makes estimated coefficients grow exponentially, and adding components makes them grow linearly; efficiency calls for the latter approach. Thus, to mitigate the problem, we increase the number of components, which tends to reduce the lag indicated by SBIC.

17 Such order might be better suited to some EMEs than others. We nonetheless keep the same order to maintain comparability across EMEs.

lags and leads of up to four quarters. These statistics provide us with initial clues on possible changes in the relationships between the variables.[18]

Autocorrelations of the US federal funds rate with each EME's policy rate[1]

Figure 2



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period.

First, the autocorrelations with the policy rates (which tend to peak when the lag is set to zero) suggest that some economies, including Brazil, could have experienced a change in such relationships between the two periods. Second, they also indicate that some economies, including Colombia and Mexico, might have maintained such relationships over the two periods.

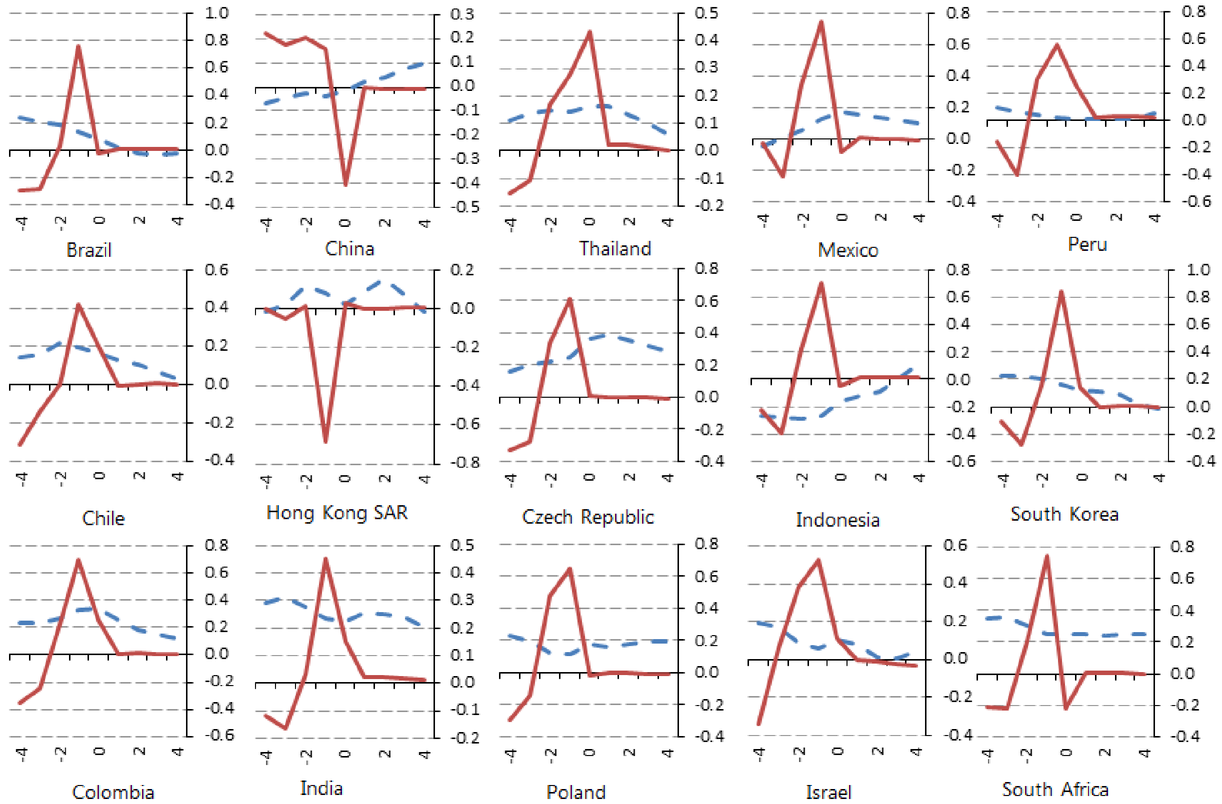
Second, the autocorrelations with the exchange rate are generally smaller in magnitude than those with policy rates. In the Q3 2008–Q4 2013 period, their values tended to be less stable through the leads and lags. Interestingly enough, some of the autocorrelations in this period share a similar pattern in several economies, peaking at around two lags and then dropping towards the zero lag mark.[19]

[18] They of course capture unconditional moments.

[19] This is notable for Chile, Colombia, Mexico and Peru; Indonesia and Thailand; the Czech Republic and Poland; and Israel and South Africa.

Autocorrelations of the US federal funds rate with variations in each EME's exchange rate[1]

Figure 3



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period.

Third, the autocorrelations with the long-term rates on average increased in the second period, eg for the Czech Republic, Indonesia, Korea, Mexico, Poland and South Africa. In contrast, two economies have seen these autocorrelations decrease: India and, except for the zero lag, Thailand.

As a next step, we analyse the autocorrelations between the Wu and Xia rate and the three variables: the policy rate (Figure 5), the exchange rate (Figure 6) and long-run interest rates (Figure 7). Note that for the first period, Q1 2003–Q2 2008, the autocorrelations coincide with those in our last exercise, as the US federal funds rate and the Wu and Xia rate are essentially the same during the period.

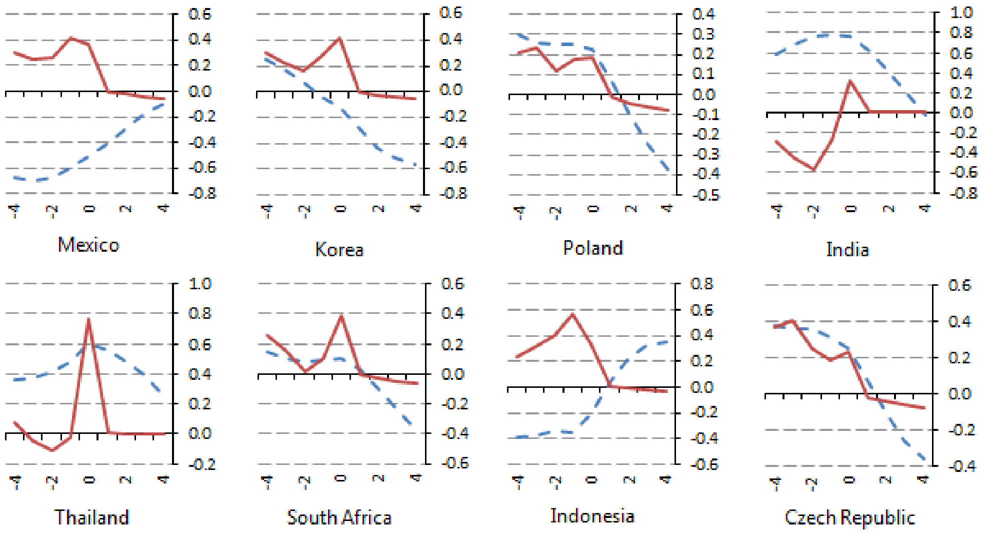
First, regarding the autocorrelations with the policy rates, those with the Wu and Xia rate have decreased in magnitude. This suggests that the policy rates channel could have lost some importance for the second period, Q3 2008–Q4 2013.

Second, the autocorrelations with the exchange rates do not have a stable pattern in the second period.

Third, the autocorrelations with the long-run rates show an overall increase in value, both for the leads and lags; the two exceptions are India and Thailand, which seem to have swapped signs. This result suggests that the long-run rate channel might have gained a greater role in the period after the crisis.

Autocorrelations of the US federal funds rate with each EME's long-run interest rate[1]

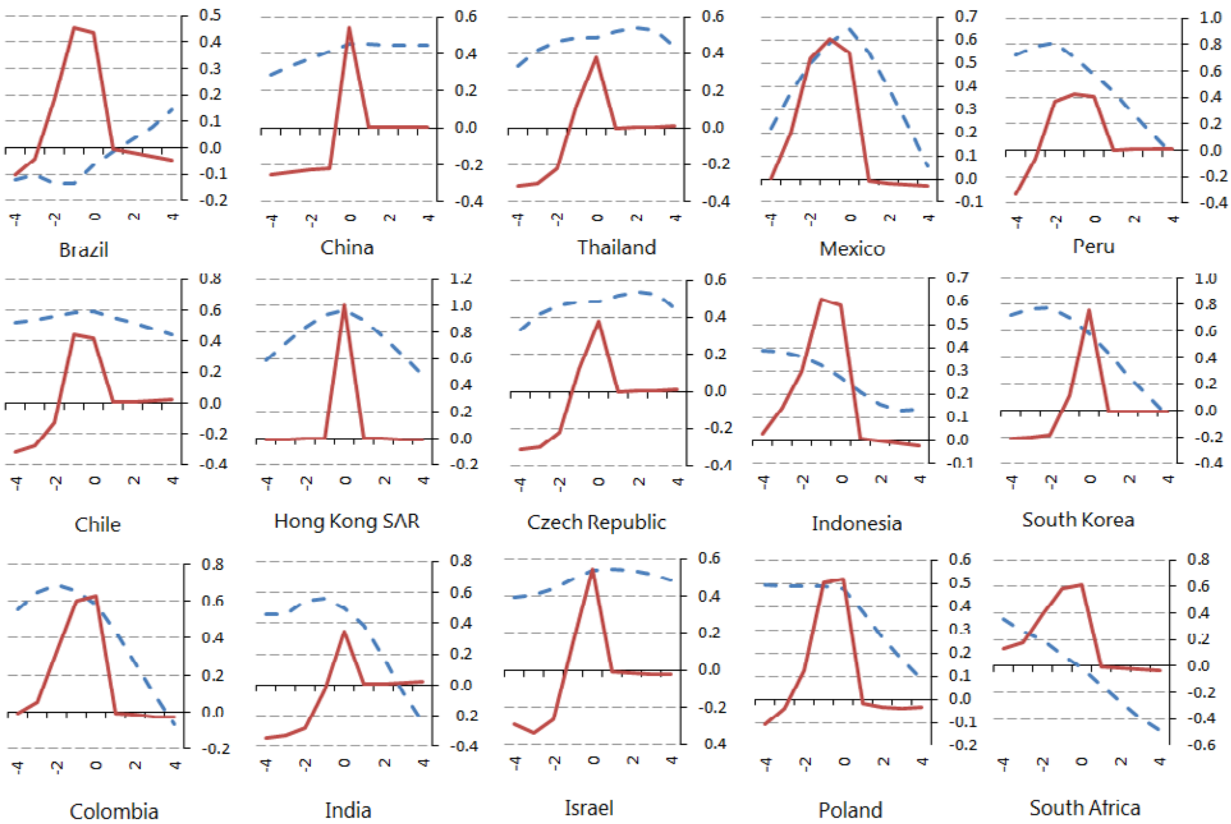
Figure 4



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period.

Autocorrelations of the Wu and Xia rate with each EME's policy rate[1]

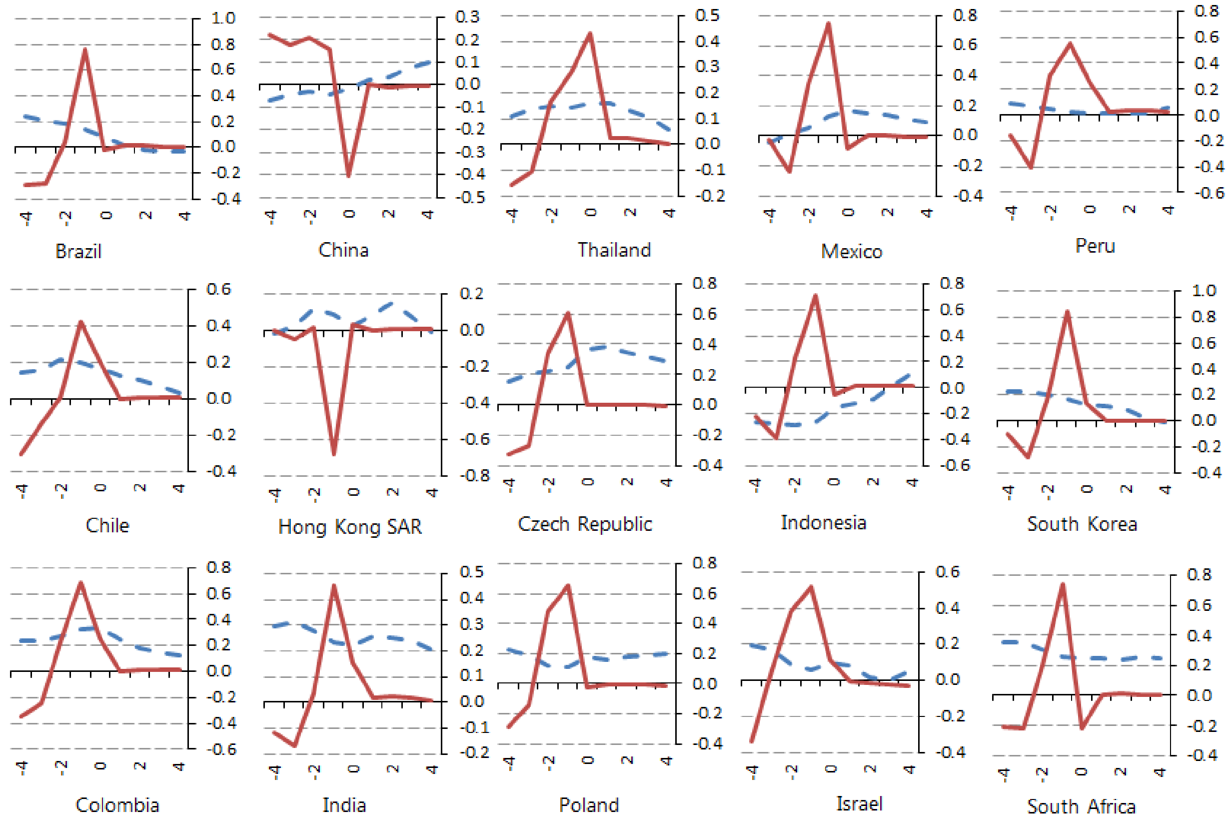
Figure 5



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period. See Wu and Xia (2013) for the Wu and Xia rate.

Autocorrelations of the Wu and Xia rate with variations in each EME's exchange rate[1]

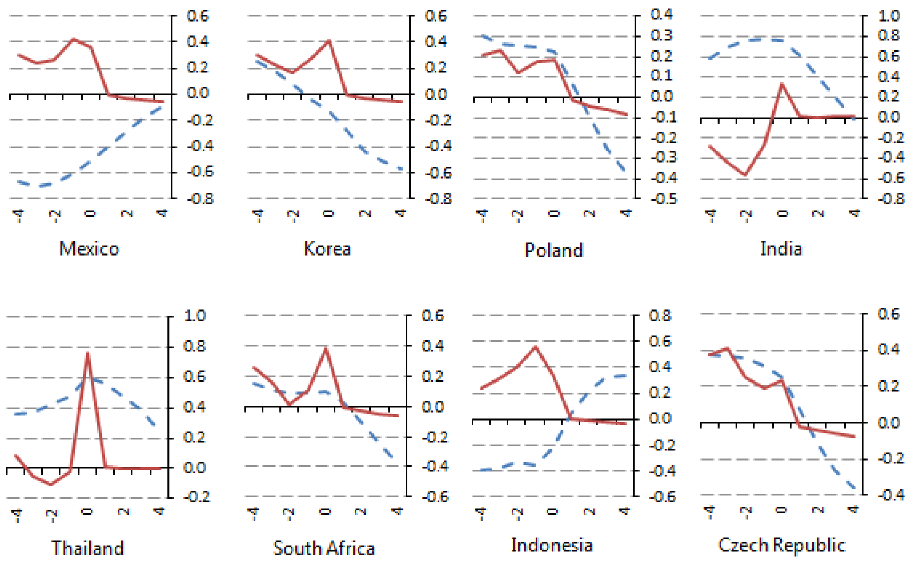
Figure 6



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period. See Wu and Xia (2013) for the Wu and Xia rate.

Autocorrelations of the Wu and Xia rate with each EME's long-run interest rate[1]

Figure 7



[1] The maximum lead and lag time is four quarters. The blue (dashed) lines correspond to the Q1 2003–Q2 2008 period, the red (solid) lines to the Q3 2008–Q4 2013 period. See Wu and Xia (2013) for the Wu and Xia rate.

In sum, although autocorrelations are only a first step, they provide some initial evidence that the eruption of the global financial crisis and the policy responses could have affected to some extent the channels by which US monetary policy shocks are transmitted to EMEs.

Linear regression models

As a next step, we assess the following linear regression models. Specifically, we posit the following three benchmark regressions for each of the corresponding economies:[20]

$$\begin{aligned} i_t &= \beta_{10} + \beta_{11} c_t + \beta_{12} ff_t + e_{1,t} \\ dfx_t &= \beta_{20} + \beta_{21} c_t + \beta_{22} ff_t + e_{2,t} \\ lri_t &= \beta_{30} + \beta_{31} c_t + \beta_{32} ff_t + e_{3,t} \end{aligned} \tag{3}$$

where, as above, c_t is a vector with the first three principal components of the EME's macroeconomic variables, ff_t is the US federal funds rate, $\beta_{.,0}$ are constants and $e_{.,t}$ are the error terms. We separately estimate them for Q1 2003–Q2 2008 and for Q3 2008–Q4 2013. Our focus is on the statistics of $\beta_{.,2}$ between those two periods, in particular analysing the associated *t*-statistics and R^2 (Table 2).

The first regression can be seen as a rule that is more general than the Taylor rule. We depart from the Taylor rule for two reasons. First, a given country may not strictly follow a Taylor rule to set its policy rate. Second, in the same vein, using principal components allows us to have a model that is similar across economies and the variables of interest, and thus allowing us to make closer comparisons.

For the policy rate, the results are as follows. For three EMEs, the coefficients lost their statistical significance; for four others, they attained statistical significance; for the rest, the coefficients maintained their status. Moreover, while the explained variance generally increased between periods, the *t*-statistics decreased on average. In sum, the relevance of the policy rate channel seems to depend on the economy in question.

Second, the coefficients associated with the exchange rate channel are in general not statistically significant in either period. The exceptions to this seem to be the coefficient for China, which maintained statistical significance; for Indonesia and Poland, which attained statistical significance; and for South Africa, which has swapped its sign. Hence, this test indicates that, in the majority of cases, the exchange rate channel does not seem to have had a structural change.

Third, for long-term rates, three economies (out of the eight EMEs for which we have the requisite rate data) have a significant coefficient in the first period – India, Mexico and Thailand. Mexico and India lose statistical significance in the second period, while Thailand maintains it. South Africa's coefficient attains statistical significance in the second period.

For the period in which the US federal funds rate hits the zero lower bound, we consider the following model:

[20] The long-term rate model is estimated only for the eight economies for which we have data on long-term rates.

$$\begin{aligned} i_t &= \gamma_{10} + \gamma_{11} c_t + \gamma_{12} xx_t + \varepsilon_{1,t} \\ dfx_t &= \gamma_{20} + \gamma_{21} c_t + \gamma_{22} xx_t + \varepsilon_{2,t} \\ lri_t &= \gamma_{30} + \gamma_{31} c_t + \gamma_{32} xx_t + \varepsilon_{3,t} \end{aligned} \tag{4}$$

where, instead of the US federal funds rate, we use the Wu and Xia rate, denoted by xx_t. Hence, our focus is now on estimates $\gamma_{.,2}$. We report the associated *t*-statistics and the R^2 in Table 3.

Coefficient statistics for the US federal funds rate[1] — Table 2

		EME macroeconomic variable and regression period					
		Policy Rate		Exchange Rate		Long-run interest rate	
		Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
Brazil	*t*	–1.815	**2.667**	1.409	0.141		
	R^2	0.767	0.570	0.434	0.803		
Chile	*t*	**4.130**	0.664	0.755	–0.010		
	R^2	0.743	0.564	0.052	0.218		
Colombia	*t*	**4.145**	**3.567**	0.257	1.328		
	R^2	0.443	0.576	0.148	0.381		
Mexico	*t*	**4.588**	**4.304**	–1.686	–1.381	**–2.470**	1.533
	R^2	0.528	0.855	0.284	0.696	0.334	0.246
Peru	*t*	**2.286**	1.784	1.799	0.296		
	R^2	0.734	0.790	0.223	0.404		
China	*t*	**2.872**	**4.096**	**–2.057**	**–2.391**		
	R^2	0.580	0.802	0.501	0.508		
Hong Kong SAR	*t*	**155.590**	–	1.500	0.073		
	R^2	0.999	1.000	0.098	0.627		
India	*t*	0.714	1.566	–0.934	0.513	**4.792**	1.468
	R^2	0.680	0.538	0.289	0.476	0.823	0.331
Indonesia	*t*	0.714	**2.822**	–0.578	**–2.451**	–1.110	1.415
	R^2	0.285	0.599	0.360	0.805	0.569	0.346
South Korea	*t*	**2.156**	**3.838**	0.366	0.253	–1.380	0.820
	R^2	0.453	0.722	0.156	0.835	0.387	0.317
Thailand	*t*	**2.746**	0.955	0.559	1.688	**2.684**	**4.297**
	R^2	0.412	0.325	0.222	0.443	0.429	0.606
Czech Republic	*t*	**2.444**	**9.227**	1.420	–1.041	1.464	1.045
	R^2	0.295	0.893	0.130	0.686	0.214	0.099
Poland	*t*	1.805	**2.711**	0.863	**–2.487**	1.000	0.093
	R^2	0.645	0.783	0.127	0.754	0.606	0.339
Israel	*t*	**2.895**	**3.646**	1.222	0.333		
	R^2	0.215	0.483	0.400	0.250		
South Africa	*t*	0.071	**3.445**	**2.375**	**–3.288**	1.129	**2.253**
	R^2	0.543	0.675	0.199	0.537	0.412	0.256

[1] For equation (3). Period 1 = Q1 2003–Q2 2008. Period 2 = Q3 2008–Q4 2013. *T*-statistics are for the coefficients $\beta_{.,2}$; those in bold are for statistically significant coefficients at a 90% confidence level.

For the policy rate channel, the coefficient for only two economies – Indonesia and South Africa – attained statistical significance. For the rest of the EMEs, the coefficient either lost or maintained significance.

Coefficient statistics for the Wu and Xia rate[1] Table 3

		Policy Rate		Exchange Rate		Long-run interest rate	
		Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
Brazil	t	**–1.996**	**2.381**	1.648	–0.371		
	R^2	0.771	0.541	0.445	0.805		
Chile	t	**5.411**	–0.633	0.412	0.808		
	R^2	0.811	0.563	0.028	0.249		
Colombia	t	**4.987**	**3.988**	0.266	**2.113**		
	R^2	0.523	0.618	0.148	0.463		
Mexico	t	**4.445**	**9.515**	–1.905	–0.984	**–3.108**	**5.768**
	R^2	0.515	0.953	0.295	0.679	0.409	0.720
Peru	t	**2.714**	–0.252	1.645	0.421		
	R^2	0.760	0.749	0.215	0.407		
China	t	**3.702**	**2.205**	**–2.693**	**–2.254**		
	R^2	0.645	0.689	0.555	0.493		
Hong Kong SAR	t	**38.444**	**3.118**	1.463	–0.202		
	R^2	0.981	0.510	0.095	0.627		
India	t	1.116	–1.044	–1.032	0.588	**5.793**	–1.478
	R^2	0.688	0.501	0.292	0.479	0.853	0.332
Indonesia	t	1.009	**5.719**	–0.640	–0.943	–1.395	**5.986**
	R^2	0.299	0.804	0.362	0.746	0.589	0.773
South Korea	t	**3.008**	0.383	0.845	0.907	–0.928	**4.254**
	R^2	0.521	0.472	0.174	0.842	0.361	0.666
Thailand	t	**2.414**	–1.383	0.646	0.594	**2.538**	**2.440**
	R^2	0.382	0.362	0.225	0.358	0.417	0.379
Czech Republic	t	**3.024**	**6.348**	1.085	–0.780	1.802	**4.147**
	R^2	0.357	0.808	0.105	0.677	0.243	0.549
Poland	t	**2.457**	1.551	0.751	–0.547	1.475	**2.314**
	R^2	0.675	0.724	0.121	0.665	0.622	0.505
Israel	t	**2.875**	1.203	0.826	1.126		
	R^2	0.212	0.132	0.387	0.301		
South Africa	t	0.093	**9.870**	**2.281**	–1.222	0.962	**4.350**
	R^2	0.543	0.920	0.194	0.290	0.405	0.551

EME macroeconomic variable and regression period (column group heading)

[1] For equation (4). Period 1 = Q1 2003–Q2 2008. Period 2 = Q3 2008–Q4 2013. *T*-statistics are for the coefficients $\gamma_{\cdot,2}$; those in bold are for statistically significant coefficients at a 90% confidence level. See Wu and Xia (2013) for the Wu and Xia rate.

For the exchange rate channel, only two EMEs have a statistically significant coefficient in the first period – China, which attained it, and Colombia, which maintained it. South Africa's coefficient lost its significance between the two periods.

In these exercises, the majority of EMEs do not present strong evidence of a structural change in the exchange rate channel.

For the long-term rate channel, five of the eight EMEs for which we have data gained a significant coefficient in the second period. This performance contrasts somewhat with the results obtained with the US federal funds rate. The result, however, does not strictly hold in the tests we perform, as discussed next.

Tests

The hypotheses we test are posited in terms of linear restrictions in (2), as follows:

1. $H_0 : a_{i_t, ff_t \times d_t} = 0$. A direct test of no structural change in the *policy rate channel*.
2. $H_0 : a_{dfx_t, ff_t \times d_t} = 0$. A direct test of no structural change in the *exchange rate channel*.
3. $H_0 : a_{lri_t, ff_t \times d_t} = 0$. A direct test of no structural change in the *long-term rate channel*.
4. $H_0 : a_{i_t, ff_t \times d_t} = 0$ and $a_{lri_t, ff_t \times d_t} = 0$. A joint direct test of no structural change in the policy rate, exchange rate, *and* long-run rate channels (the "joint all rates test").
5. $H_0 : a_{r, ff_t \times d_t} = 0$ for all rows r. An indirect test of no structural change in any channel (the "joint all variables test"). This test involves other channels whose mechanisms are, in our view, embedded in the principal components. By construction, tests 4 and 5 are more stringent than tests 1, 2 and 3.[21]

For the US policy rate, we run the tests using the US federal funds rate and, on a separate set of FAVARs, the Wu and Xia rate. The latter accounts for the possible effects of unconventional monetary policy and allows us to compare the effects of solely traditional monetary policy with those of unconventional policy. We present our estimates in that order.

The *p*-value results of our tests (Table 4) show that, first, eight EMEs reject null hypothesis 1 ($a_{i_t, ff_t \times d_t} = 0$), two at a 10% confidence level and six at a 5% confidence level, providing some evidence of a change in the policy rate channel.

Second, seven EMEs reject null hypothesis 2 ($a_{dfx_t, ff_t \times d_t} = 0$), one at a 10% confidence level and six at a 5% confidence level, which indicates a possible change in the exchange rate channel.

Third, for the long-run rate channel, four of eight EMEs reject null hypothesis 3 at a 5% confidence level.

[21] Under the null hypothesis, all of the them have an *F* distribution with (i) the number of restrictions and (ii) the number of observations minus the number of parameters being estimated as degrees of freedom. These tests are invariant to the specific Cholesky decomposition one opts to use.

Fourth, 11 EMEs reject null hypothesis 4 (the joint all rates test), one at a 10% confidence level and ten at a 5% confidence level.

Interestingly enough, some economies, including the Czech Republic and Indonesia, reject some individual tests but fail to reject the joint all rates test. Conversely, some others, including Poland, fail to reject rate tests 1, 2 and 3 but reject the joint all rates tests. These results are a consequence of the behaviour of the confidence regions in the joint tests compared with that of the confidence intervals in the individual tests.

P-values of test results for the US federal funds rate[1] — Table 4

	EME macroeconomic variable				
	Policy Rate	Exchange Rate	Long-run interest rate	Joint all rates	Joints all variables
Brazil	0.5602	0.0060		0.0184	0.0001
Chile	0.0005	0.1601		0.0007	0.0004
Colombia	0.0090	0.0129		0.0019	0.0000
Mexico	0.0016	0.1306	0.0353	0.0020	0.0002
Peru	0.0561	0.0164		0.0143	0.0004
China	0.0000	0.0086		0.0000	0.0000
Hong Kong SAR	0.0330	0.4491		0.0905	0.0008
India	0.6543	0.3749	0.0010	0.0090	0.0000
Indonesia	0.5389	0.0428	0.2984	0.2085	0.0000
South Korea	0.6157	0.0356	0.0010	0.0020	0.0000
Thailand	0.6602	0.7729	0.0020	0.0181	0.0000
Czech Republic	0.0273	0.5930	0.1953	0.1338	0.0000
Poland	0.0684	0.3806	0.2523	0.0302	0.0018
Israel	0.8682	0.0633		0.1351	0.0000
South Africa	0.4836	0.9771	0.1296	0.3308	0.0010

[1] For the *F*-tests of the linear restrictions set on each FAVAR, as in equation (2). Darkest shading indicates a *p*-value of less than 0.05; lighter shading, a *p*-value between 0.05 and 0.1.

Fifth, all EMEs reject null hypothesis 5 (the joint all variables test) at a 5% confidence level. Our presumption is that these tests capture other channels we are not measuring directly. Hence, we take these results as evidence of a possible structural change in channels we are not explicitly modelling but that we are nonetheless capturing.

In sum, whether an EME experienced a structural change in any of the three channels we are assessing depends on the EME in question.

We next consider the same battery of tests using the Wu and Xia rates in place of the US federal funds rate (Table 5). First, for the policy rate, five EMEs fail to reject null hypothesis 1, one at a 10% confidence level and four at a 5% confidence level. Thus, whether a policy rate channel changed or not depends on the EME in question.

Second, for the exchange rate, four EMEs reject null hypothesis 2, one at a 10% confidence level and three at a 5% confidence level. Here too, although less than one third of EMEs reject this test, it seems that a change in the channel generally depends on the specific economy being considered.

Third, of the eight EMEs tested for the long-run rate channel, three reject null hypothesis 3, one (Thailand) at a 10% confidence level and two (India and Korea) at a 5% confidence level. Again, these results indicate a country-dependent change.

P-values of test results for the Wu and Xia rate[1] Table 5

	EME macroeconomic variable				
	Policy Rate	Exchange Rate	Long-run interest rate	Joint all rates	Joints all variables
Brazil	0.0500	0.1344		0.0995	0.0019
Chile	0.0178	0.4308		0.0432	0.0081
Colombia	0.1117	0.3804		0.2132	0.0220
Mexico	0.0208	0.0263	0.4784	0.0600	0.0007
Peru	0.1269	0.1383		0.1351	0.0046
China	0.0001	0.0510		0.0003	0.0000
Hong Kong SAR	0.2982	0.1561		0.2691	0.0048
India	0.4301	0.3702	0.0064	0.0362	0.0000
Indonesia	0.6560	0.0067	0.8165	0.0128	0.0001
South Korea	0.7414	0.0240	0.0350	0.0294	0.0038
Thailand	0.4728	0.7515	0.0802	0.3104	0.0160
Czech Republic	0.0130	0.7368	0.7209	0.0334	0.0040
Poland	0.3420	0.5417	0.6867	0.6594	0.2394
Israel	0.9503	0.2702		0.5243	0.0304
South Africa	0.4235	0.6066	0.7384	0.8167	0.0660

[1] For the *F*-tests of the linear restrictions set on each FAVAR, as in equation (2). Darkest shading indicates a *p*-value of less than 0.05; lighter shading, a *p*-value between 0.05 and 0.1. See Wu and Xia (2013) for the Wu and Xia rate.

Fourth, for the joint all rates test, eight EMEs reject null hypothesis 4, two at a 10% confidence level and six at a 5% confidence level.

Fifth, for the joint all variables test, all EMEs except Poland reject null hypothesis 5. Again, this result underscores the possible structural changes in what we think are some of the channels we have not modelled explicitly.

In sum, our tests provide some evidence that a share of economies seem to have experienced a change in their policy rate, exchange rate, or long-run interest rate channels. Moreover, evidence of possible structural changes appears for channels that we are not explicitly modelling. Another plausible interpretation is that such changes are second-round effects of the respective channels. That is, variations in the US federal funds rate affect the US components, which in turn affect EMEs through one or more of the three channels we test.

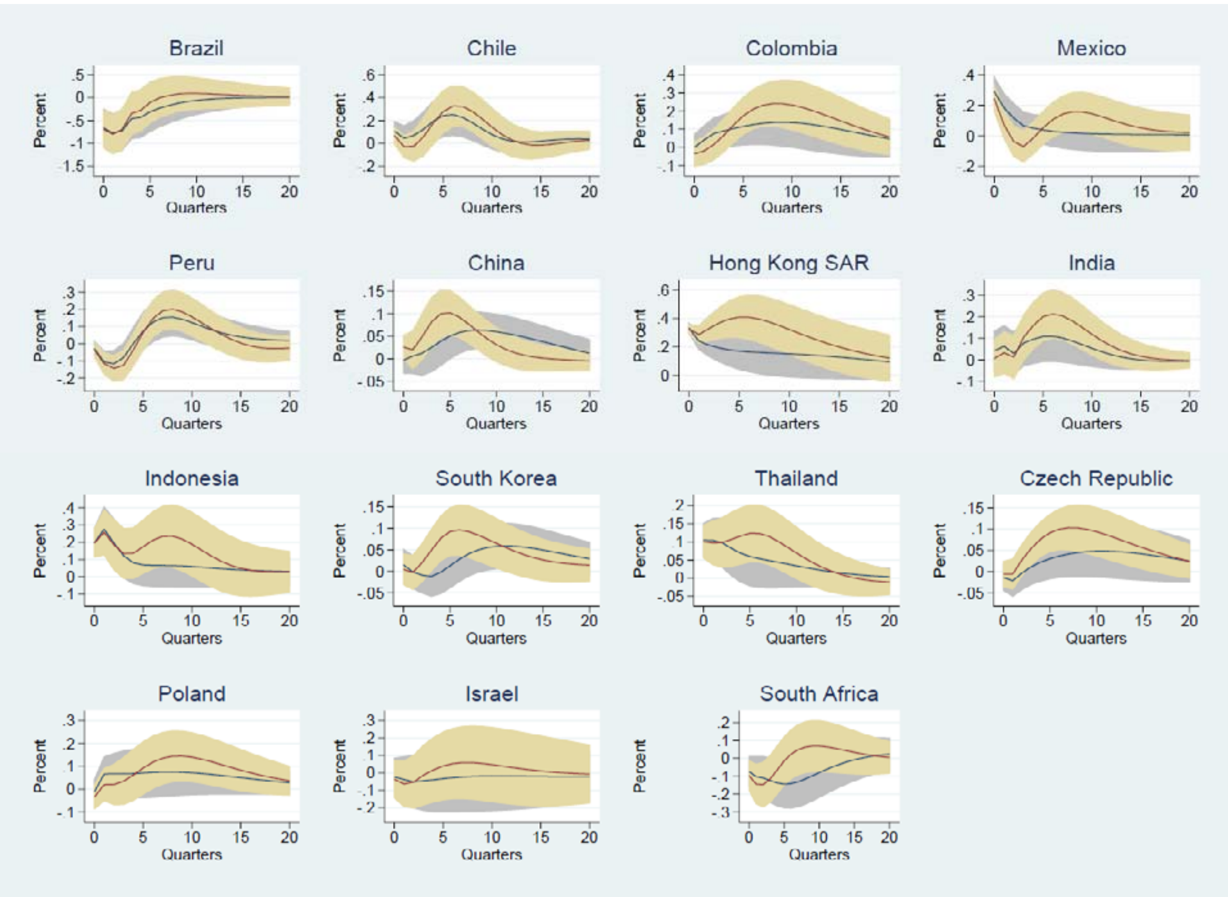
Importantly, the results for the Wu and Xia rate do not markedly differ from those for the US federal funds rate. This contrasts with the test of the linear regression models.

Impulse-Response Functions

The tests just presented are a statistical way to assess evidence of a possible structural change in the selected transmission channels. The VAR's IRFs provide an additional perspective: They show possible changes in the paths and magnitudes of the complete variables between the periods we have analysed. And, of course, IRFs capture variations above and beyond changes in each of the specific coefficients we have associated with each channel.

There are at least two key IRF features to watch. The first is the relationship between the responses of the policy rate and those of the exchange rate. In general, they should maintain some degree of consistency. One can think of this consistency in terms of uncovered interest rate parity, as explained in further detail below. Second, and perhaps most important, is the comparison of the response dynamics under (i) the assumption in model (1) of no structural change after the crisis and (ii) the assumption in model (2) of a possible structural change after the crisis, that is, in the Q3 2008–Q4 2013 period.

Impulse response functions of each EME's policy rate to a US federal funds rate shock[1] Figure 8



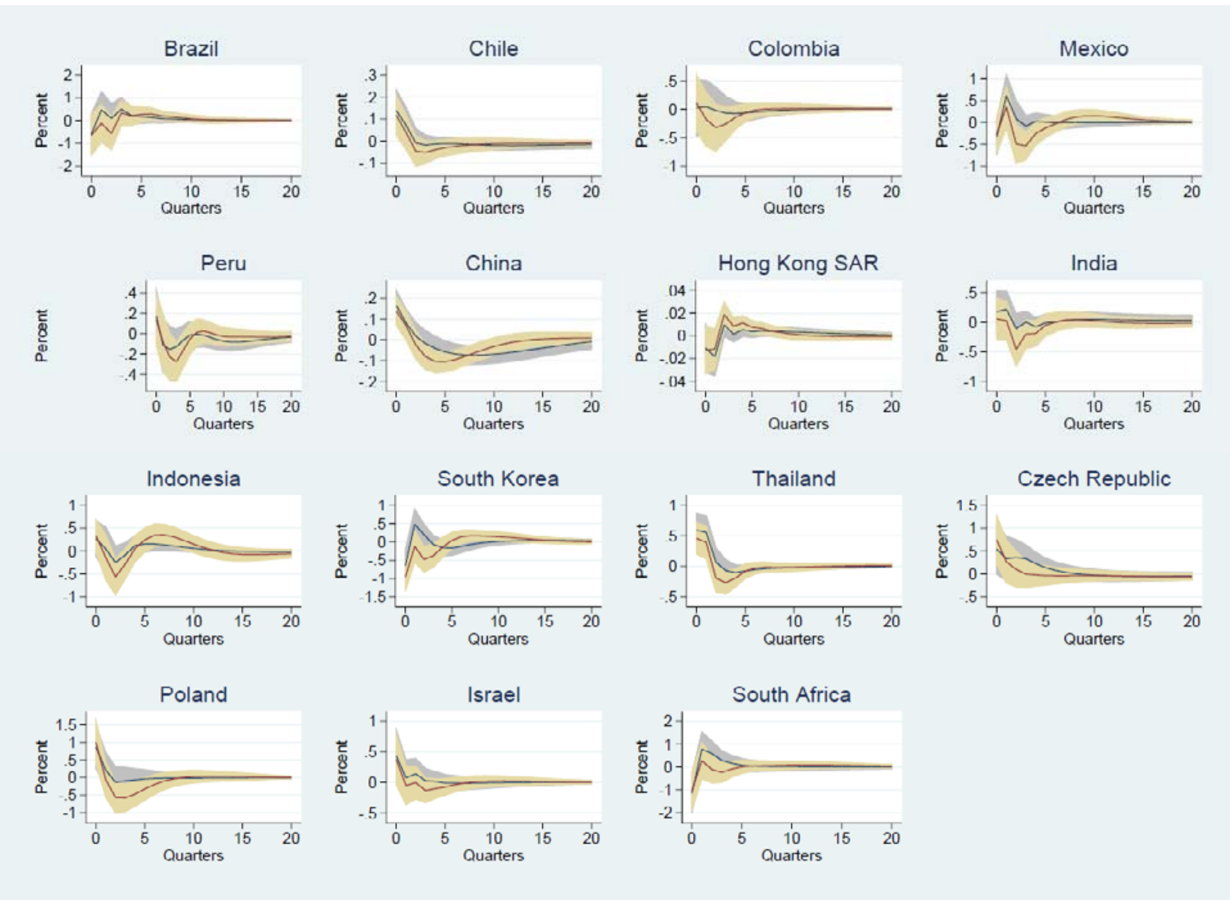
[1] The impulse is a 25 basis point orthogonal shock to the US federal funds rate. The blue lines are obtained from model (1), which assumes no change in the policy rate channel. The red lines are obtained from model (2), which allows for a change in the policy rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level.

In the case of the policy rate channel (Figure 8), the IRFs arise from an orthogonal shock of 25 basis points to the US federal funds rate. The responses from model (1) and model (2) are both shown.

A bird's-eye view of Figure 8 suggests that, given a positive shock to the US federal funds rate, the policy rate response strongly depends on the country in question. For instance, the magnitude of the responses across EMEs varies somewhat. In most cases, the shock eventually leads to an increase in the policy rate.

Impulse response functions of variations in each EME's exchange rate to a US federal funds rate shock[1]

Figure 9



[1] The impulse is a 25 basis point orthogonal shock to the US federal funds rate. The blue lines are obtained from model (1), which assumes no change in the exchange rate channel. The red lines are obtained from model (2), which allows for a change in the exchange rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level.

First, the difference in the effect of the US shock between the pre-crisis and post-crisis periods varies across some economies. Moreover, if we interpret our confidence intervals literally (at the 70% level), the channels for Indonesia and Poland attain statistical significance only in the second period.

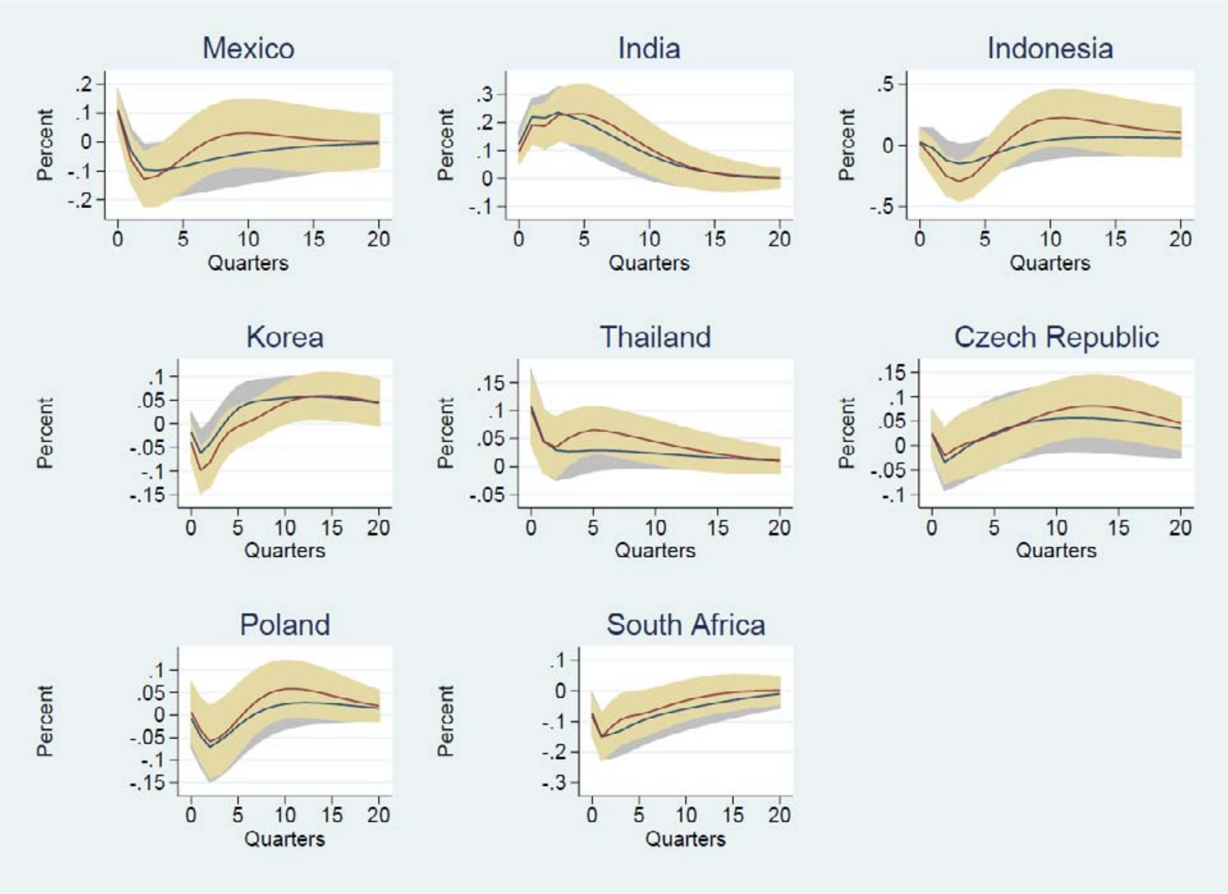
Second, in a some cases – including Colombia, Hong Kong SAR, India, Indonesia and Thailand – the IRFs suggest that the policy rate responses became more persistent in the second period. For these EMEs, the change in the policy rate channel seems to make a difference along all of the responses.

Third, in contrast, various EMEs appear to have maintained similar responses in each period.

In sum, these EME-dependent results are broadly in line with our test results.

Impulse response functions of each EME's long-term interest rate to a US federal funds rate shock[1]

Figure 10



[1] The impulse is a 25 basis point orthogonal shock to the US federal funds rate. The blue lines are obtained from model (1), which assumes no change in the long-term interest rate channel. The red lines are obtained from model (2), which allows for a change in the long-term interest rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level.

Moreover, some responses do not strictly conform with what one could expect under the assumption of uncovered interest rate parity. Specifically, the responses of Brazil and South Africa are negative and statistically significant.[22] In the periods considered, these economies have some of the largest average inflation rates within our sample. Moreover, both economies score low in the Chinn and Itto index of financial openness, a factor that could play a role in the data and thus in our estimations.

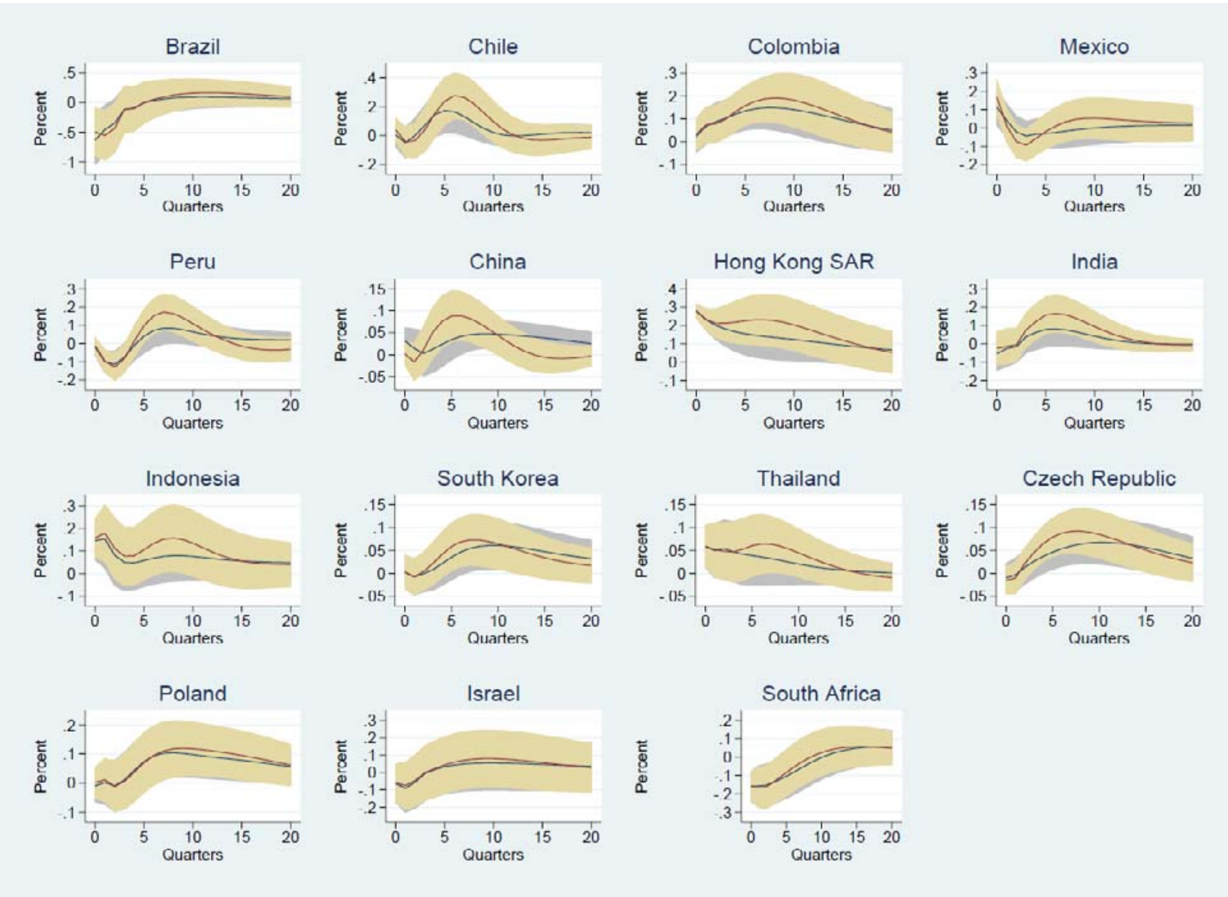
In the case of the exchange rate channel (Figure 9), the IRFs again arise from an orthogonal shock of 25 basis points to the US federal funds rate. The responses are

[22] In addition, their exchange rate responses are not statistically significant.

from model (1), which assumes no change in the channel, and from model (2), which allows for a change in the post-crisis period.

The results indicate, first, that only a very few economies may have faced a change in their exchange rate channel. Overall, the potential structural changes in the exchange rate channel do not seem very important. Moreover, many of the responses are not statistically significant in any of the periods.

Impulse response functions of each EME's policy rate to a Wu and Xia rate shock[1] Figure 11



[1] The impulse is a 25 basis point orthogonal shock to the Wu and Xia rate. The blue lines are obtained from model (1), which assumes no change in the policy rate channel. The red lines are obtained from model (2), which allows for a change in the policy rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level. See Wu and Xia (2013) for the Wu and Xia rate.

Second, the magnitude of the responses varies widely across economies. For example, the exchange rate of Hong Kong SAR essentially stays put, while South Africa responds with 100 basis points of currency depreciation on impact.

Third, only three EMEs undergo a statistically significant depreciation of the currency at some point. Moreover, in some economies, the possible structural change in the exchange rate channel has implications for their responses to the shock, but only after several quarters have elapsed.

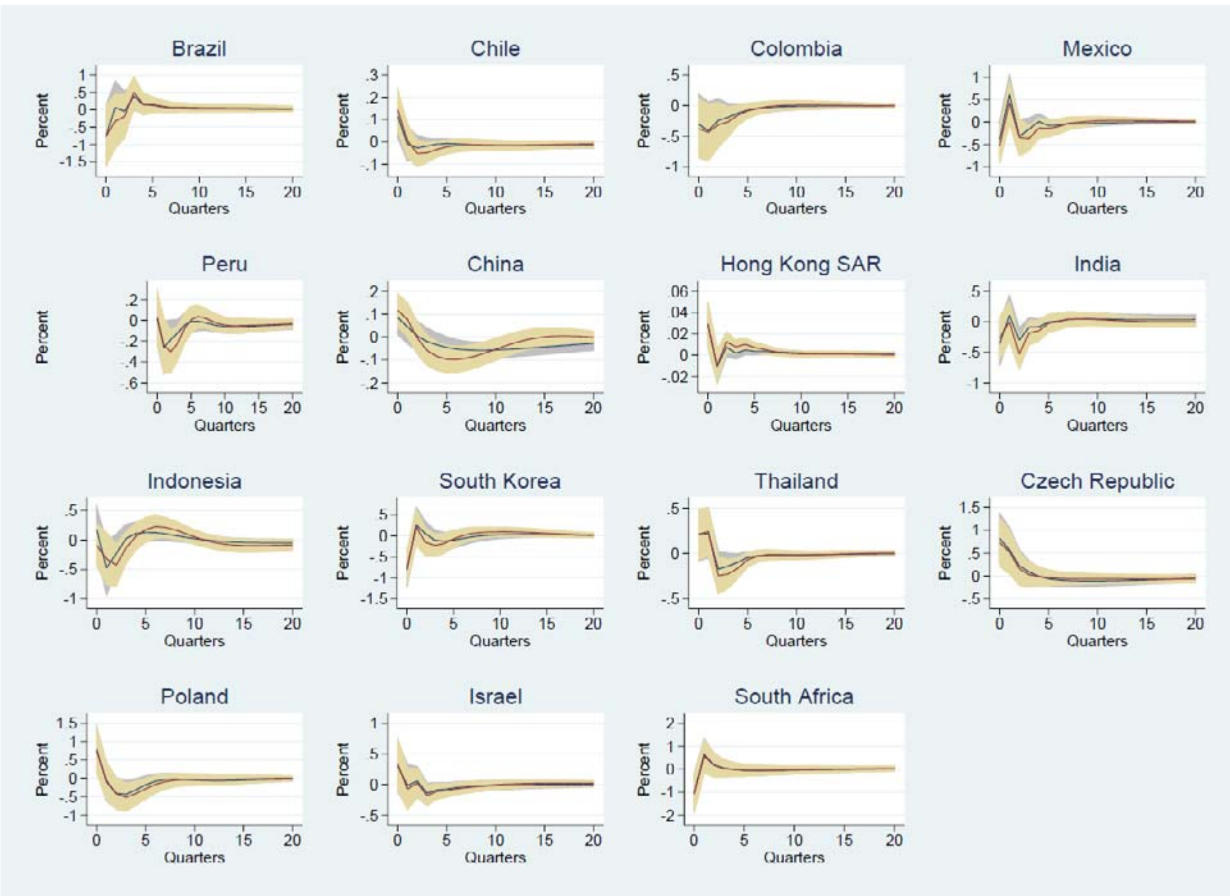
In general, the prevalent exchange rate arrangement and monetary policy regime are relevant in explaining the effects we have measured with the IRFs. For example, Hong Kong SAR, which anchors its currency to the US dollar, experiences only a negligible variation in its exchange rate. In contrast, inflation targeters tend to have more ample and lagged variations in their exchange rate responses, as the exchange rates serve as buffers to external shocks.

For the IRFs involving the long-run rate, the evidence of a change in the related channel is not conclusive (Figure 10). In general, the paths are maintained.

Moving on to the IRFs that use the Wu and Xia rate in place of the US federal funds rate (Figure 11), we find that, first, the evidence of a possible structural change in the policy rate channel depends on the EME in question. For most cases, unconventional monetary policies seem to attenuate the differences in the responses before and after the crisis.

Impulse response functions of variations in each EME's exchange rate to a Wu and Xia rate shock[1]

Figure 12



[1] The impulse is a 25 basis point orthogonal shock to the Wu and Xia rate. The blue lines are obtained from model (1), which assumes no change in the exchange rate channel. The red lines are obtained from model (2), which allows for a change in the exchange rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level. See Wu and Xia (2013) for the Wu and Xia rate.

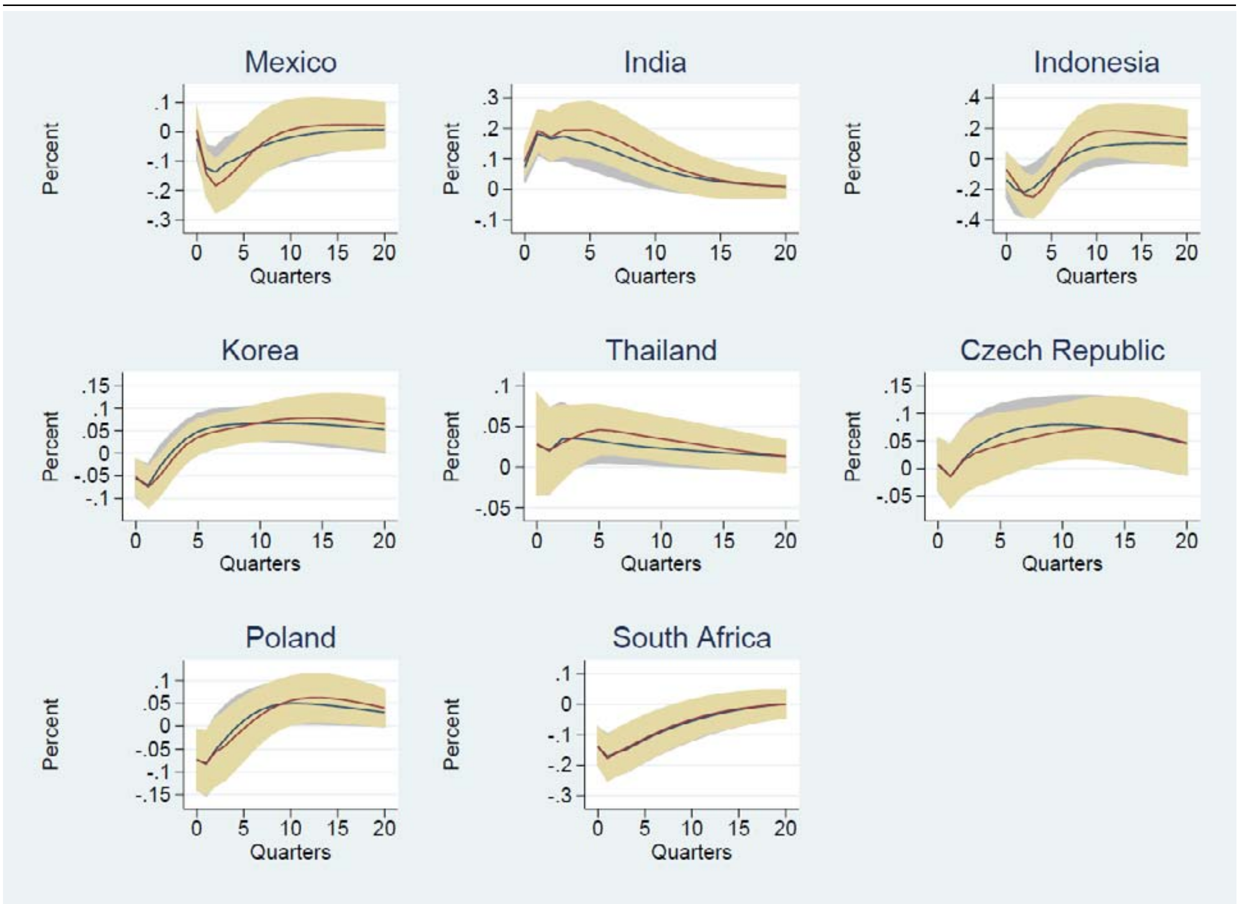
Second, except for a few cases, the exchange rate channel does not structurally change for most EMEs. The responses to shocks to the Wu and Xia rate are in general very similar, and in some cases the response's paths are identical (Figure 12).

Third, in the case of the long-run rate channels, structural changes in the periods considered (Figure 13) are also country dependent. This is broadly in line with the results we have previously shown, in particular in Table 3. Two economies – Indonesia and, especially, South Africa – have, on impact, a stronger response; and surprisingly, the effects have the opposite sign from the one expected.

We set all IRFs' confidence intervals at a 70% level. Had we considered a higher level, confidence intervals would have been much wider, and evidence of no structural change in the transmission channels would have been stronger. This comment is applicable to all the IRFs we consider in this paper. Thus, the tests are more likely to reject the null hypothesis of no change, whereas the confidence intervals in the IRFs are more likely to be supportive of the null hypothesis. The IRF confidence intervals are not directly comparable to those of the tests because the former capture the uncertainty associated with the shocks to the economies, and the latter the uncertainty related to the estimated coefficients. Thus, in this vein, the tests on the linear regression and the FAVAR coefficients are more comparable to each other than either is to the IRFs.

Impulse response functions of each EME's long-term interest rate to a Wu and Xia rate shock[1]

Figure 13



[1] The impulse is a 25 basis point orthogonal shock to the Wu and Xia rate. The blue lines are obtained from model (1), which assumes no change in the long-term interest rate channel. The red lines are obtained from model (2), which allows for a change in the long-term interest rate channel and potentially in other channels; any such structural changes are assumed to have occurred in the Q3 2008–Q4 2013 period. Confidence intervals are set at the 70% level. See Wu and Xia (2013) for the Wu and Xia rate.

Moreover, it is relevant to assess the degree of consistency between the policy rate responses and the exchange rate responses and the extent to which it might have changed after the third quarter of 2008. As mentioned, it is useful to consider such consistency under uncovered interest rate parity (ie $i_t - ff_t = E_t(log(fx_{t+1} / fx_t) = E_t(dfx_{t+1})$. We discuss this consistency in terms of the IRFs for the federal funds rate. Hence, if a positive shock to ff_t takes place, the most common response is for the policy rate, i_t, to increase and for the change in the exchange rate, dfx_{t+1}, to increase (ie depreciate) as well.[23] One can think of three other responses that, while plausible, are less likely.[24]

In this context, we have the following comments. First, consider EMEs with a floating exchange rate and an inflation targeting regime, eg Colombia and Mexico. In these economies, the policy rates respond with an increment, while the exchange rates depreciate, in accordance with uncovered interest rate parity.

Second, Indonesia is an example of how the policy rate's response might offset the US federal funds shock. Thus, the appreciation of the exchange rate might be initially seen as contrary to what is expected. Yet, the marked increment in the policy rate might be offsetting the US federal funds shock, thus making the exchange rate appreciate, as explained above. These two examples are all fairly consistent with uncovered interest rate parity.

Third, some of the results are quantitatively uneven. For instance, Korea's exchange rate appreciates on impact by about 80 basis points. This could have been reasonable provided that Korea's policy rate response had been on the order of 2 basis points – qualitatively plausible but hardly quantitatively so.

Nonetheless, it is counterintuitive if on impact the policy rate decreases *and* the exchange rate appreciates (assuming the expected exchange rate stays constant). We have three plausible explanations for this combination: (i) the model might be over-parameterised, thus not capturing the dynamics of the variables; (ii) the EME in question might have a low degree of financial openness, and its macroeconomic variables could be reflecting such restrictions; and (iii) if prices adjust only sluggishly, the EME's exchange rate might for some time appreciate even though US inflation might be increasing while the EME's inflation rate is decreasing.[25]

Final Remarks

All in all, we have found mixed results. In effect, whether an EME has undergone a structural change in the policy rate, exchange rate, or long-term rate channels depends on the EME in question. However, the evidence is not uniform across the

[23] An extension of the uncovered interest rate parity in terms of a risk premium is possible; ie $i_t - ff_t = E_t(dfx_{t+1}) + rp_t$. We leave such a possibility to future research.

[24] First, the policy rate, i_t, increases more than proportionally, and the exchange rate, dfx_{t+1}, appreciates. Second, the policy rate increases less than proportionally and the exchange rate depreciates. Third, the interest rate decreases and the exchange rate depreciates more than proportionally. The exact response depends on the prevalent exchange rate arrangement, the monetary policy regime, and other related policies.

[25] This last argument is akin to Dornbusch's overshooting model. A fourth option is to consider an extension of uncovered interest rate parity in terms of a risk premium, the one described in footnote 23.

various exercises and tests we have performed. Notably, some of the structural change we have documented might have taken place through second-round effects or, quite possibly, through other channels, which we believe our model is only implicitly capturing.

Although mixed, the results have some policy implications. First, regardless of the response channel, an increase in the sensitivity of EMEs to US monetary policy shocks could lead to higher dependence on US economic developments and accordingly to a higher impact of US policy on EMEs' policy cycles.

Second, in the same vein, EMEs might nowadays be facing more stringent policy trade-offs. This could partially explain what we have recently seen in some cases, which some perceived as authorities having decided to implement policy responses due to events in the US monetary policy stance. Understanding the degree to which such trade-offs might have changed is relevant for EME policymakers, who must remain aware of the policy trade-off magnitudes they are facing.

Third, since several EMEs may have gone through similar shifts in transmission channels, it is crucial to examine the extent to which some of the policies implemented by one EME can have an impact on other EMEs. For instance, the relative monetary stance and related macroeconomic policies in one EME can affect other EMEs, potentially deflecting capital flows; the possibility that such interaction could restrict an EME's policy even further is certainly latent.[26] This underscores the importance of having a sound policy framework in which government officials have readily available policy options with which to implement a cohesive and flexible policy response.

Furthermore, we believe there are at least three issues that require further scrutiny. First, as indicated above, some of our results suggest possible structural changes in channels not explicitly modelled. Disentangling such channels and learning their relative strength in the international transmission mechanism remains an important research endeavour.[27]

Second, what are the reasons behind the apparent structural change in some channels? Several are possible. For instance, are we seeing an upsurge in correlations between key international macroeconomic variables, which would increase the correlation among central bank responses? In contrast, have EMEs' central bank policy functions become more sensitive to changes in US monetary policy? Both effects probably played a part in such general changes, but it is important to understand their relative contribution in each EME.

Third, what are the economic implications of the structural change in a given transmission channel? If the importance of some channels has indeed grown or declined, how concerned should we be about the eventual tightening of US monetary policy beyond the withdrawal of unconventional policy measures? Once more, this brings home for EMEs the importance of having strong macroeconomic fundamentals, including a sensible policy framework.

[26] In addition, based on this point and as a more concrete exercise, it seems useful to explore an extension of our model in which data from two or perhaps more EMEs are used under the same FAVAR. This could, in principle, allow for the assessment of possible cross effects between EMEs.

[27] Relatedly, it would be relevant to further explore our models' specifications.

Appendix

IMF classification of de facto exchange rate regimes and monetary policy frameworks

The IMF (2013) classification system is based on IMF members' de facto exchange arrangements as identified by IMF staff, which may differ from the members' officially announced arrangements. The scheme ranks exchange arrangements on the basis of their degree of flexibility and the existence of formal or informal commitments to exchange rate paths. It distinguishes forms of exchange arrangements, in addition to arrangements with no separate legal tender, to help assess the implications of the choice of exchange arrangement for the degree of independence of monetary policy. The classification system presents members' exchange rate regimes against alternative monetary policy frameworks in order to highlight the role of the exchange rate in broad economic policy and to illustrate that different exchange arrangements can be consistent with similar monetary frameworks. The following sections explain the exchange arrangement categories.

Exchange rate anchor

The monetary authority stands ready to buy or sell foreign exchange at given quoted rates to maintain the exchange rate at its predetermined level or within a range (the exchange rate serves as the nominal anchor or intermediate target of monetary policy). These regimes cover those with no separate legal tender as well as currency board arrangements, fixed pegs with or without bands, and crawling pegs with or without bands.

Monetary aggregate target

The monetary authority uses its instruments to achieve a target growth rate for a monetary aggregate, such as reserve money, M1 or M2, and the targeted aggregate becomes the nominal anchor or intermediate target of monetary policy.

Inflation targeting framework

This involves the public announcement of medium-term numerical targets for inflation, with an institutional commitment by the monetary authority to achieve these targets. Additional key features include increased communication with the public and the markets about the plans and objectives of monetary policymakers and increased accountability of the central bank for its inflation objectives. Monetary policy decisions are guided by the deviation of forecasts of future inflation from the announced inflation target, with the inflation forecast acting (implicitly or explicitly) as the intermediate target of monetary policy.

Other

The country has no explicitly stated nominal anchor but rather monitors various indicators in conducting monetary policy. This category is also used when no relevant information on the country is available.

Descriptions of exchange rate markets based on HSBC (2011)

1. Brazil. Brazil has a free-floating regime implementing occasional interventions. The *National Monetary Council* sets the exchange rate regulations. The *Central Bank of Brazil* intervenes through the spot, swaps, and futures markets. In time of significant appreciation, it has also implemented capital controls.
2. Chile. The Chilean peso is a floating non-deliverable currency. The *Central Bank of Chile* will intervene occasionally in the exchange rate market. The exchange rate is determined in the interbank foreign exchange rate market.
3. China. The *People's Bank of China* keeps a managed float with reference to a basket of currency. The renminbi is non-deliverable and partially convertible (with respect to the capital account). On 19 June 2010, China's central bank announced a change in its exchange rate regime to increase its flexibility. The offshore renminbi market is developing quite swiftly.
4. Colombia. The *Bank of the Republic* maintains a flexible exchange rate regime with intervention rules to procure a certain level of international reserves, to limit excessive volatility, and to moderate excessive appreciation or depreciation of the nominal exchange rate. The mechanisms for intervening include discretionary purchases/sales of US dollars in the spot market.
5. Czech Republic. The *Czech National Bank* oversees a freely floating exchange rate. The Czech koruna is fully convertible. The Czech Republic joined the European Union in 2004, but there is no definite date for it to adopt the euro.
6. Hong Kong SAR. The *Hong Kong Monetary Authority* upholds a currency board system under which its monetary base is fully backed by foreign reserves. The Hong Kong dollar is a convertible and freely tradable currency.
7. India. The *Reserve Bank of India* oversees a managed floating regime. The Indian rupee is convertible on the current account but has some restrictions with respect to the capital account.
8. Indonesia. The *Bank of Indonesia* maintains a managed floating currency regime. The Indonesian rupiah is tradable but non-deliverable.
9. Israel. The *Bank of Israel* maintains a freely floating currency. It intervenes at times of disorderly market conditions.
10. Korea. The *Bank of Korea* preserves a floating exchange rate regime and might intervene under excess volatility. The won is fully convertible and tradable on a non-deliverable basis in the offshore market.
11. Mexico. The *Foreign Exchange Commission* formed by the central bank and the Ministry of Finance are responsible for exchange rate policy. The *Bank of Mexico* preserves a freely floating foreign exchange regime. It mostly intervenes using rules-based mechanisms to procure orderly conditions and liquidity in the exchange rate market.
12. Peru. The *Central Reserve Bank of Peru* intervenes in the foreign exchange market to prevent excess volatility in the exchange rate by buying and selling US dollars.
13. Poland. The *National Bank of Poland* maintains a freely floating currency. The zloty is freely convertible and is one of the most commonly traded currencies

against the euro. Poland joined the European Union in 2004, but there is no definite date for it to adopt the euro.

14. South Africa. The *South African Reserve Bank* oversees a managed floating exchange rate system. The rand is not yet fully convertible. The exchange rate controls have been gradually relaxed.
15. Thailand. The *Bank of Thailand* operates a managed floating currency regime and intervenes regularly to avoid volatility in the exchange rate market. The baht is to a large extent convertible and deliverable.

References

Bernanke, Ben S, J Boivin and P Eliasz (2005): "Measuring the effects of monetary policy: a factor-augmented vector auto-regressive (FAVAR) approach", *Quarterly Journal of Economics,* vol 120, pp 387–422.

Boivin, J, and M Giannoni (2009): "Global forces and monetary policy effectiveness", in J Galí and M Gertler (eds), *International Dimensions of Monetary Policy*, Chicago University Press.

Chinn, M, and H Ito (2006): "What matters for financial development? Capital controls, institutions, and interactions", *Journal of Development Economics*, vol 81, no 1, pp 163–92.

Eichengreen, B, et al (2011): "Rethinking monetary policy", The Committee on International Economic Policy and Reform.

Fernandez-Villaverde, J, J Rubio-Ramírez, T Sargent and M Watson (2007): "ABCs (and Ds) of understanding VARs", *American Economic Review*, vol 97, no 3, pp 1021–26.

Friedman, T (2005): *The World Is Flat 3.0: A Brief History of the Twenty-first Century*, Picador.

Galí, J, and M Gertler (eds) (2009): *International Dimensions of Monetary Policy*, Chicago University Press.

HSBC (2011): "HSBC's emerging markets currency guide", HSBC Global Research.

IMF (2013): "De facto classification of exchange rate regimes and monetary policy frameworks", International Monetary Fund, www.imf.org/external/NP/mfd/er/index.aspx.

Kim, S, and D Yang (2009): "International monetary transmission and exchange rate regimes: floaters vs. non-floaters in East Asia", ADBI Working Paper Series no 181.

Noriega, A, C Capistrán and M Ramos-Francia (2013): "On the dynamics of inflation persistence around the world", *Empirical Economics*, vol 44, no 3, pp 1243–65.

Rajan, R (2013): "A step in the dark: unconventional monetary policy after the crisis", Andrew Crockett Memorial Lecture, BIS, www.bis.org/events/agm2013/sp130623.htm.

Stock, J, and M Watson (1999): "Forecasting inflation", *Journal of Monetary Economics*, vol 44, no 2, pp 293–335.

Takáts, E, and A Vela (2014): "International monetary policy transmission", BIS background paper, www.bis.org/publ/bppdf/bispap78b_rh.pdf.

Wu, J, and F Xia (2013): "Measuring the macroeconomic impact of monetary policy at the zero lower bound", Department of Economics, University of California, San Diego, www.econweb.ucsd.edu/~faxia/pdfs/JMP.pdf. The Wu and Xia "Policy rate for the US" data are at www.econweb.ucsd.edu/~faxia/PolicyRate.html.

List of participants

Central banks

Central Bank of Argentina	**Miguel Angel Pesce** Deputy Governor
Central Bank of Brazil	**Eduardo Lima** Head, Research Department
Central Bank of Chile	**Sebastián Claro** Member of the Board
People's Bank of China	**Hu Xiaolian** Deputy Governor **Zhu Jun** Deputy Director General, International Department **Lin Ran** Deputy Director of BIS Division, International Department **Lin Zan** Assistant to the Deputy Governor
Bank of the Republic (Colombia)	**Hernando Vargas** Deputy Governor
Czech National Bank	**Mojmír Hampl** Vice-Governor
Hong Kong Monetary Authority	**Dong He** Executive Director, Research Department
Magyar Nemzeti Bank	**Ádám Balog** Deputy Governor
Bank Indonesia	**Perry Warjiyo** Deputy Governor **Arya Rangga Yogasati** Manager, Assistant to the Deputy Governor
Bank of Israel	**Nadine Baudot-Trajtenberg** Deputy Governor
Bank of Korea	**Jun Il Kim** Deputy Governor and Chief Economist
Central Bank of Malaysia	**Sukhdave Singh** Deputy Governor
Bank of Mexico	**Manuel Ramos Francia** Deputy Governor

Central Reserve Bank of Peru	**Renzo Rossini** General Manager
Bangko Sentral ng Pilipinas	**Diwa C Guinigundo** Deputy Governor
National Bank of Poland	**Witold Koziński** Vice President
Saudi Arabian Monetary Agency	**Ahmed AlKholifey** Deputy Governor for International Affairs **Mohammed Alabdullah** Economic Specialist, International Affairs Department
Monetary Authority of Singapore	**Jacqueline Loh** Deputy Managing Director
South African Reserve Bank	**Francois Groepe** Deputy Governor
Bank of Thailand	**Paiboon Kittisrikangwan** Assistant Governor **Acharawat Srisongkram** Economist, International Department
Central Bank of the Republic of Turkey	**Mehmet Yörükoğlu** Deputy Governor
Central Bank of the United Arab Emirates	**Saif Hadef Al-Shamsi** Assistant Governor for Monetary Policy & Financial Stability Affairs

Bank for International Settlements

Claudio Borio
Head of Monetary and Economic Department

Philip Turner
Deputy Head of Monetary and Economic Department

Madhusudan Mohanty
Head of Emerging Markets
MED Policy, Coordination & Administration