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Financial intermediation and monetary policy transmission in EMEs: What has changed post-2008 crisis?[1]

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Abstract

In contrast to the benign neglect of the financial system in traditional monetary models, there has been growing evidence in recent years that the size and the structure of financial intermediation play a critical role in the transmission of monetary policy. This paper reviews the implications of three key post-2008 crisis developments in financial intermediation – the role of banks, the globalisation of debt markets and the sustained decline in global long-term interest rates – for various transmission channels of monetary policy in EMEs. The paper argues that the globalisation of debt markets means that monetary policy can no longer be conducted through the short-term interest rate alone. This raises questions about the appropriate instruments to be used for economic stabilisation in this new environment.

Key words: financial intermediation, monetary policy, central banks

JEL classification: E52, E58, G15

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I. Introduction

The purpose of this paper is to review what has changed to the monetary transmission mechanisms of emerging market economies (EMEs) since a previous review on this subject in BIS (2008) and Mohanty and Turner (2008). A key finding then was that the introduction of inflation targeting by many EMEs in the 1990s, together with reforms to abolish interest rate controls, to strengthen central bank credibility and to develop local bond markets, had marked a major turning point for monetary policy in many countries. These reforms had helped not only to reduce earlier constraints on monetary policy stemming from a high degree of fiscal dominance and liability dollarisation but also to increase the role of interest and exchange rates in monetary policy transmission, leading to an environment of low and stable inflation.

However, the past decade has seen major changes in the pattern of financial intermediation in EMEs which have been accompanied by a rapid evolution of the external monetary environment, especially following the global financial crisis (GFC) of 2008. How have these developments affected the monetary transmission mechanisms in EMEs? Has the earlier assessment changed? And how have central banks dealt with the evolution of the external environment? Our objective here is to explore some of these questions in a fairly selective manner, drawing on a large, though still developing, post-crisis literature on monetary policy in EMEs.

Understanding how central banks' instruments work has major implications for the stance of monetary policy. For the past several decades, that understanding has been greatly shaped by the New Keynesian literature, leading to what Clarida et al (1999) call the "science of monetary policy". In this framework the policy rate set by the central bank and its commitment to vary that rate in a way that is consistent with its policy objectives play a critical role in determining the effects of monetary policy.

The precise channel through which monetary policy influences the economy has been a hotly debated issue in the academic literature. In typical transmission models, given assumptions of frictionless financial markets, perfect asset substitutability and rational expectations, the overnight rate set by the central bank determines the long-term interest rate, the exchange rate and other asset prices which, in turn, determine the path of aggregate spending and inflation (Taylor (1995), Woodford (2003), and Boivin et al (2011)). Term and risk premia – central to the analysis of imperfect asset substitutability by Tobin (1969), and Modigliani and Sutch (1967) – play no role in the transmission mechanism. In addition, these models assume that the size of central banks' balance sheets has no independent influence on aggregate demand so that bank reserves are provided perfectly elastically at the policy rate. Another assumption underlying these models is that in globally integrated economies, central banks' ability to control interest rates is a function of the degree of exchange rate flexibility (the so called trilemma doctrine). Hence a fully floating exchange rate is able to insulate domestic monetary policy from external shocks (Clarida et al (2001), Gali and Monacelli (2005), and Woodford (2009)).

The New Keynesian models, particularly those incorporating features such as asymmetric information and credit market imperfections, appeared to describe fairly well the working of monetary policy before the GFC. For instance, the "financial accelerator" literature (Bernanke et al (1999), and Bernanke and Gertler (1995)) highlighted the role of the "external finance premium" in the transmission mechanism. A key point of these papers was that the external finance premium paid by borrowers varies with the policy rate and the quality of their balance sheets.

Because collateral is central to households' and firms' ability to access credit, asset prices play a major role in the amplification of monetary shocks (Kiyotaki and Moore (1997)). In contrast, the "credit view" literature stressed the importance of lenders' capital and financing constraints which affect their ability to supply credit (Kashyap and Stein (2000), and Bean et al (2002)). Given imperfect substitutability between reservable deposits and other liabilities, monetary policy generates credit supply effects because some banks are less able than others to replace deposit funding with outside finance.

However, a major reassessment of mainstream monetary transmission models has taken place since the GFC. While integrating real world financial frictions into monetary policy models continues to be a tough challenge for economists, recent research has pointed to at least four areas in which the change in thinking has been significant. First, the crisis has demonstrated that central banks can use both quantity and price instruments simultaneously to achieve their goals. This has been most visible in the use of balance sheet policies by major advanced economy (AE) central banks to control monetary conditions after short-term interest rates hit the zero lower bound. As Friedman and Kuttner (2011) noted: "the ability (of the central bank) to choose the level of the policy interest rate and the size of its balance sheet independently, over time horizons long enough to matter for macroeconomic purposes… represents a fundamental departure from decades of thinking about the scope of central bank action". In contrast to the efficient markets models underlying the term structure hypothesis, there is now explicit recognition that term and risk premia play a crucial role in the determination of the cost of credit even in financially mature economies. The recent analysis by Gertler and Karadi (2013) has reinforced this view.

Second, in contrast to what conventional monetary transmission models assume, there is now increasing evidence that long-term interest rates are influenced more strongly by global than local factors such as the domestic business cycle or monetary policy (Obstfeld (2015), Turner (2014) and (2015), and Miyajima et al (2015)). There is nothing new about the tendency of long-term interest rates to move together across economies. What is comparatively recent is that the correlations of bond yields in EM currencies have increased significantly since the GFC. Such a shift in market correlation is of great significant to policymakers because it can weaken the role of the policy rate in the transmission mechanism and contribute to unwarranted fluctuations in credit, creating risks to monetary and financial stability.

Third, there has been a clear shift in the perception of the role of the exchange rate in the transmission mechanism. Not only have the responses of trade variables to exchange rate movements been smaller than assumed earlier but exchange rates have also become far more volatile than can be inferred by measures of interest rate differentials. A further dimension has been that the growth of currency mismatches associated with the expansion of unhedged dollar borrowing by EMEs have meant that currency depreciation can be contractionary (Bruno and Shin (2014)).

Finally, a key missing link in the earlier literature, as documented by Gertler and Kiyotaki (2011), was that it largely focused on the financing constraints faced by non-financial borrowers and treated financial intermediaries as a veil, thus ignoring the numerous agency problems and non-linear asset price dynamics confronting the financial system. Indeed, as shown by Adrian and Shin (2010) and (2011), capital and value-at-risk constraints facing financial intermediaries matter for their lending behaviour. Because monetary policy affects asset prices and bank profitability it can alter such financing constraints, causing shifts in the supply of credit. The interaction between the short-term interest rate, lenders' risk perceptions and their attitude towards lending has been increasingly referred to as the "risk–taking channel" of monetary policy (Borio and Zhu (2012), and Bekaert et al (2013)).

The paper is structured as follows. In section II, we begin with a brief review of financial intermediation in EMEs to highlight the fact that many of the recent developments relating to the monetary transmission mechanism can be traced to changes in the size and nature of financing in EMEs as well as in the external monetary environment facing them.

In section III, we discuss a few implications of these changes for the role of the interest rate, exchange rate and credit channels in EMEs. One key finding of this section is that domestic monetary policy has to contend with an increased globalisation of debt markets, and with long-lasting shifts in global long-term interest rates. These developments have the potential to make monetary conditions highly volatile.

In section IV, we use a structural VAR model to consider some empirical applications to India and note that the relatively closed character of the country's domestic debt markets has probably helped limit the impact of external monetary shocks on the economy, particularly through bond price and exchange rate channels. Our results suggest that domestic monetary policy through the short term interest rate continues to play a significant role in macroeconomic stabilisation.

In Section V, we turn to a reduced-form monetary transmission model to illustrate a few policy challenges for central banks when domestic financial markets are closely linked to international financial markets. A key implication is that, with the globalisation of debt markets, the conduct of monetary policy through the short-term interest rate has become a much more complicated task, raising issues about the most appropriate instruments for stabilising inflation and output. In section VI, we present our conclusions.

II. Recent changes in financial intermediation in EMEs

Historically, banks have been at the centre of financial intermediation in EMEs. Although the financial systems of EMEs were relatively open to international portfolio flows, in many cases the scale of these flows remained somewhat limited which meant that domestic interest rates were, to a large extent, tightly linked to those of the key monetary policy instruments of the central bank. Hence monetary policy effects were largely determined by developments in the banking system. However, the environment in which monetary policy is conducted in EMEs has undergone a major transformation over the past decade. In this section we focus on three main changes: (a) the relative role of banks versus debt markets; (b) the globalisation of debt markets; and (c) the evolution of global long-term interest rates.

II.1 The relative role of banks and bond markets

Table 1 shows total credit extended to the non-financial private sector of major Asian EMEs as a percentage of GDP before and after the GFC as well as in the mid-2000s. The data cover credit from all sources, including those being provided by banks and bond markets, and from domestic and foreign sources. For comparison, the table also provides averages for other major regions. As can be seen from the table, the ratio of total credit to GDP increased rapidly in most countries between 2004 and 2013. The trend started earlier but accelerated following the GFC.

It is important to note that credit has grown much faster in economies that are more open to capital flows and/or maintain some form of exchange rate link with currencies of the major AEs than those that are less so financially open or have adopted a flexible exchange rate regime. This is particularly true in Hong Kong SAR with its linked exchange rate system and highly open capital account (as well as its role as an international financial centre), but also in China even with its relatively closed capital markets. Notwithstanding their relatively independent monetary policy regimes, Korea, Malaysia and Singapore have all seen rapid increases in total credit to GDP ratios since the GFC.

Private sector credit and domestic bank lending in EMEs[1] Table 1

	Total credit to non-financial private sector (as a share of nominal GDP)[2]			Bank credit to non-financial private sector (as a share of total credit to non-financial private sector)		
	2004	2007	2013	2004	2007	2013
Emerging Asia	97	98	129	85	83	81
China	124	118	181	96	91	75
Hong Kong SAR	164	183	261	90	83	81
India	38	50	59	96	93	92
Indonesia	27	26	39	87	93	89
Korea	139	160	185	74	76	67
Malaysia	131	114	135	96	96	100
The Philippines	41	34	41			
Singapore	101	97	137	91	84	87
Thailand	109	97	127	97	98	97
Memo:						
Latin America[4]	*33*	*39*	*54*	*51*	*57*	*62*
Central and eastern Europe[5]	*62*	*79*	*96*	*49*	*56*	*53*
Other EMEs[6]	*49*	*62*	*62*	*82*	*85*	*89*

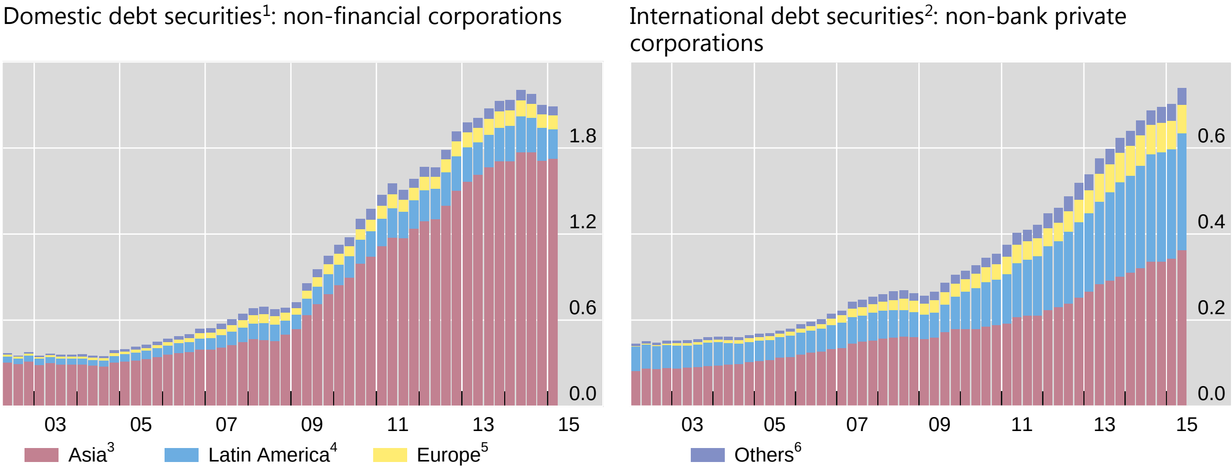
[1] For aggregates, simple average. [2] BIS calculations of total credit to private non–financial sector. [4] Argentina, Brazil, Chile, Colombia, Mexico and Peru. [5] The Czech Republic, Hungary and Poland. [6] Algeria, Israel, Russia, Saudi Arabia, South Africa, Turkey and United Arab Emirates.

Sources: IMF, *International Financial Statistics*; national data; BIS international banking statistics; BIS securities statistics.

Another fact emerging from Table 1 is that the share of credit from the banking system in total non-financial private credit has fallen in a number of countries. Even though banks continue to be important in credit allocation in EMEs, their role has declined over the past decade, especially in Asia. China is a major example where the share of bank credit in total credit has fallen by 21 percentage points between 2004 and 2013. Many other Asian economies have also seen significant declines in the share of bank credit.

Domestic and international debt securities

Amounts outstanding (USD trn) Graph 1



[1] By residence. For the Czech Republic, Hong Kong SAR and Poland, calculated as the difference between total debt securities by residence and international debt securities by residence. [2] By residence. [3] For Asia, sum of China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [4] For Latin America, sum of Argentina, Brazil, Chile, Colombia, Mexico and Peru. [5] For Europe, sum of the Czech Republic, Hungary, Poland, Russia and Turkey. [6] For others, sum of Israel, Saudi Arabia and South Africa.

Sources: BIS securities statistics; BIS calculations.

A mirror image of the declining share of banks in credit is the growing importance of debt securities markets. Graph 1 shows two main dimensions of debt securities issuance by non-financial EME corporations – domestic and international issuance. Financial intermediation through debt markets has increased sharply and a large part of that intermediation has moved offshore.[4] What is striking is that EME non-financial corporations have sharply increased their international debt issuance which registered a more than three-fold expansion between 2008 and 2013. Again, Asia seems to be leading the EMEs.

II.2 Globalisation of debt markets

In addition to the change in the composition of financing just discussed, the markets for debt securities have become increasingly global. There are several dimensions to the recent globalisation of debt markets, including the diminishing importance of national borders in the determination of capital flows, the use of foreign currency in the denomination of debt transactions and the structure of local EME currency debt markets.

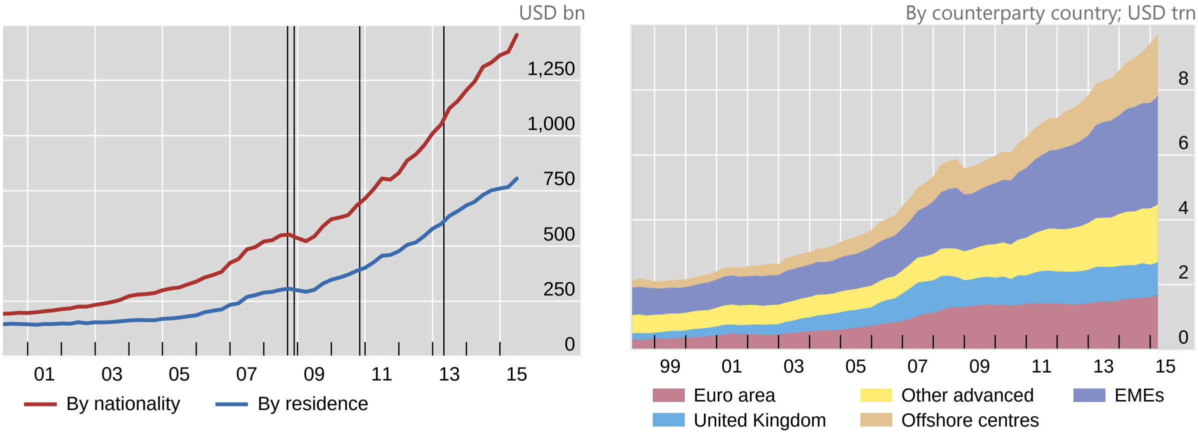
[4] See Hattori and Takáts (2015) for a recent review of bond market financing in EMEs.

Global debt markets and US dollar credit

Graph 2

International debt securities issued by non-bank private corporations[1]

US dollar credit to non-banks outside the United States[2]



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

[1] 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. [2] See R McCauley, P McGuire and V Sushko, "Global dollar credit: links to US monetary policy and leverage", *BIS Working Papers,* no 483, January 2015.

Sources: IMF, *IFS*; Datastream; BIS international debt statistics and locational banking statistics by residence; BIS calculations.

In the IMF's traditional definition of capital flows, the concept of residency of the borrower plays a central role in the determination of the economic and financial area of a country, and hence of the magnitude of flows into and out of that country. However, as pointed out by Bruno and Shin (2014) and Avdjiev et al (2015), with capital flows straddling national borders, residency has become increasingly irrelevant as a concept for measuring capital flows. Take, for instance, the subsidiary of a Brazilian firm located in London issuing a dollar bond in London. The issue will not be recorded as a capital flow in the balance of payment statistics even though the funds may be used ultimately by the parent firm in Brazil. Avdjiev et al (2014) discuss several channels through which the funds mobilised by subsidiaries could reappear as disguised capital flows.

The red line in the left-hand panel of Graph 2 shows the scale of outstanding debt issuance by EMEs by nationality of borrowers. These numbers capture international debt issuance by all non-financial corporations of a country residing anywhere in the world. They are thus different from those based on residency shown by the blue line in Graph 2. On the nationality definition, debt issuance by non-financial EME firms has not only grown rapidly since 2009 but it is now twice as large as that based on the residency of borrowers.

The second dimension of the globalisation of debt markets concerns the use of national currencies. An implicit assumption of traditional monetary transmission models is that national balance sheets are denominated in national currency so that changes in monetary policy have implications for the flow of funds within the economy.[5] However, as the experience of widespread dollarisation in the 1980s and 1990s demonstrated, the influence of national monetary policy is limited when a large part of domestic liabilities and assets is denominated in foreign currency (Kamin et al (1998) and Mohanty and Turner (2008)).

While the degree of dollarisation of EME banking systems has fallen considerably over the past decade that of the non-bank sector has increased. This is a global phenomenon but with a large EME component. The global expansion of dollar debt does not represent dollar borrowing by US residents that are naturally affected by dollar interest rates but by non-bank borrowers in the rest of world that have chosen to denominate their debt in dollars. The right-hand panel of Graph 2 reports McCauley et al (2015)'s estimates of outstanding dollar debt of non-bank borrowers outside the United States.[6] As can be seen from the Graph, total dollar credit outstanding against non-bank, non-US borrowers has expanded by more than four-fold between 2000 and 2015, from less than $2.2 trillion to $9.7 trillion. Dollar credit to EME non-bank borrowers has recorded the fastest increase, constituting the single largest component of the total by 2015.

Reinforcing this trend is the third dimension of the globalisation of debt markets which is linked to the internationalisation of EME bond markets. During the 1980s and the 1990s, the local currency bond markets of EMEs were not only underdeveloped but remained largely inaccessible to foreign investors. This, however, started to change at the beginning of the 2000s as local bond markets started to develop in many EMEs and foreign investors began to invest in these markets (or began to diversify their portfolios), reducing barriers to international arbitrage. Estimates by the World Bank suggest that the share of non-resident holding of local EME currency bonds in the total stock of local currency bonds has more than doubled between 2008 and 2013 (from 13% to 30%). According to a BIS survey conducted in 2012, in a number of major EMEs the share of non-resident holdings varied between 30 and 50% (Mohanty (2014)). Indeed, as argued by Shin and Turner (2015), growing non-resident investment in local EME currency bond markets and rapid expansion of international debt issuance by EME corporations represent two defining elements of the recent financial landscape of EMEs.

II.3 Global long-term interest rates

Finally, another major factor shaping monetary conditions across the world has been the behaviour of the global long-term interest rate. The left-hand panel of Graph 3 plots King and Low (2014)'s estimate of the global real long-term interest rate which is an average of the real 10-year spot yields of the G7 economies (nominal yield minus expected inflation). The red and blue lines show the unweighted and GDP-weighted averages, respectively. Whereas the world real long-term interest rate was largely range bound during the 1980s and early 1990s, it started to decline steadily at the beginning of the 2000s. The trend accelerated after the GFC, particularly following the introduction of large-scale asset purchase programmes by the Federal Reserve and the central banks of other AEs. The GDP-weighted real long-term interest rate

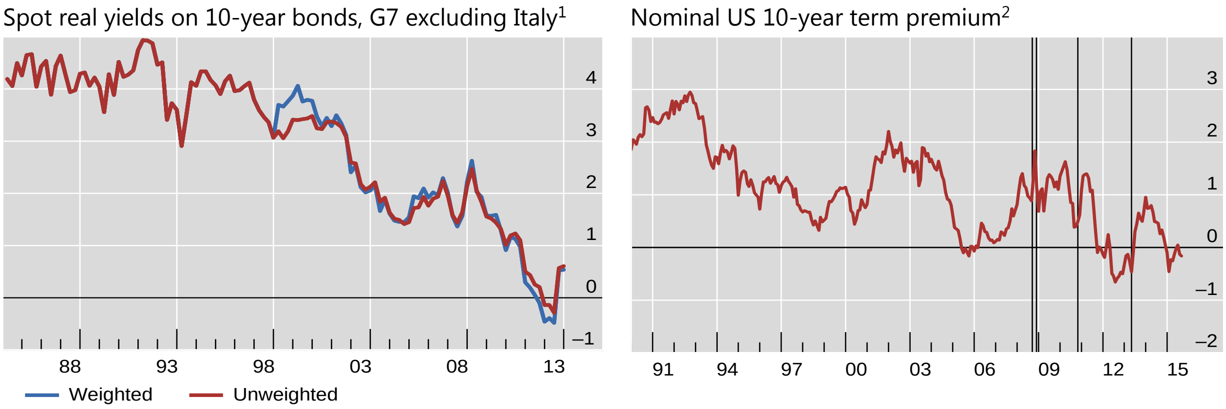
[5] Avdjiev et al (2015) point out that traditional international finance is the outcome of a "triple coincidence". Besides its obsession with residency and currency, it places more emphasis on aggregate flows than on their sectoral composition.

[6] See also McCauley et al (2015) for an update.

tells a similar story, although the data are only available for a relatively short period of time.

World real long term interest rates

In per cent — Graph 3



Vertical lines indicate the bankruptcy of Lehman Brothers on 15 September 2008; Federal Reserve announcements of quantitative easing on 25 November 2008 and 3 November 2010; and the FOMC's hint of policy 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, February 2014. [2] Sum of inflation and real yield risk premia, the latter calculated using the BIS term structure model.

Sources: BIS calculations. The left-hand panel was reproduced from M King and D Low ,"Measuring the "World" Real Interest Rate", *NBER Working Paper*, no 19887, February 2014.

Evidence from a recent report by the Executive Office of the President (2015) suggests that US long-term yields tend to revert to the mean over time. But that reversion can be slow and may not necessarily return to a constant mean (Hamilton et al (2015)). Economic theory suggests that real interest rates are likely to be bounded because the underlying variables such as saving and investment respond to changes in interest rates which tends to bring real rates back to their steady state levels. However, the fact that the world real long-term interest rate has been declining over much of the past two decades confirms the hypothesis that the changes in either direction can be quite persistent. This can cause major shifts in resource allocation, international capital flows and spending across countries.

To understand the sources of this variation, the right-hand panel of Graph 3 shows an estimate of the 10-year US term premium taken from Hördahl and Tristani (2014). There are, of course, other components of the long-term interest rate, including market expectations of the short-term interest rate and of inflation (which are not reported here). The graph nevertheless shows that a significant part of the recent decline in the long-term interest rate reflects movements in the US term premium which, after trending downward during much of the past two decades, has fallen to very low or negative levels.[7]

[7] Understanding the behaviour of the long-term interest rate remains one of the most challenging issues in economics. There are several competing hypotheses about the underlying drivers of low long-term risk-free yields. Prominent among these are the "global saving glut" hypothesis of Bernanke (2005); the "global banking glut" proposition of Shin (2012); the "excess financial system elasticity" view of Borio and Disayatat (2011); and the "safe asset shortage" idea of Caballero et al (2008).

III. Monetary transmission mechanisms post-2008 crisis

How have these developments affected the transmission of monetary policy in EMEs? In this section, we consider three main channels – the interest rate, exchange rate and credit channels – to review the potential effects of recent changes in financial intermediation on the transmission mechanism.

III.1 The interest rate channel

Interest rate often plays a key role in the transmission of monetary policy shocks. A rise in the policy rate by the central bank to dampen incipient inflation pressure leads to a rise in the short-term market interest rate and, therefore, to rises in most borrowing and lending rates in the economy. For this, the real interest rate is important: a rise in the nominal rate that reflects higher inflation expectations – so that the real rate remains constant – will not change the perceived marginal costs of borrowing. Furthermore, since monetary policy operates most effectively by influencing the demand for durable goods, what matters is the extent to which changes in the policy rate affect funding costs for long-term projects. Following Mishkin ((2007) and Boivin et al (2010)), this relationship can be formalised by a user cost of capital equation which, in a closed economy, can be expressed as:

$$U_t^c = P_t^c \, [E \, \{(i_t^m - \pi_t) - (\pi_t^c - \pi_t)\} + \delta]$$

Which can be equivalently written as:

$$U_t^c = P_t^c \, [E \, \{i_t^m - \pi_t^c\} + \delta] \quad (1)$$

Where P_t^c is the relative price of new capital, i_t^m the domestic short-term interest rate, π_t^c asset price inflation, δ the rate of depreciation and E the expectations operator. We are abstracting away from tax considerations, which nevertheless may be important sometimes, for example, when thinking of interest rate deductibility (by adjusting the nominal interest rate by the marginal tax rate). The user cost of capital equation shows that the economic spending decisions of agents depend on the expected real interest rate and the real price appreciation of an asset over its entire life. Assuming sticky prices, monetary policy affects the demand for long-lived assets to the extent that it can change the expected future path of the real interest rate and the value of the asset. It is therefore obvious that the long-term interest rate plays a key role in the transmission mechanism of monetary policy.

Housing investment offers a clear example of how the user cost channel works. A tighter monetary policy increases the cost of capital for prospective home buyers both by increasing long-term financing costs and weakening expected future house price appreciation, causing a slowdown in construction activity and aggregate demand. This direct effect is magnified by the fact that developments in the housing market affect the wealth position and creditworthiness of borrowers. For instance, in the United States residential investment is found to be highly sensitive to the user cost of capital, even though the estimates of elasticity vary widely, from -0.2 to -1.0 (Mishkin (2007)).[8]

[8] Leamer (2007) has argued that housing is in some sense special. Because house prices tend to be less flexible than other prices, changes in housing demand lead to smaller price movements but larger volume adjustments. The close association between housing and business cycles means that monetary policy can have a significant influence on economic activity through interest rates.

The user cost framework just described assumes that long-term interest rates and asset prices move in tandem with the expected future path of the short-term interest rate. However, to the extent that the term premium may move independently – as the events following the GFC demonstrated – long-term funding costs can deviate substantially from the stance of monetary policy. In addition, Equation 1 was proposed in the context of a closed economy. But, as the previous section highlighted, with the growing global integration of EMEs' debt markets, this assumption is increasingly unrealistic.

One way to account for these factors is to bring them explicitly into the user cost equation. Let us denote the long-term sovereign bond yield in domestic and international markets as $\mathrm{LT^d}$ and $\mathrm{LT^{US}}$, respectively, and note that international arbitrage implies that the expected rate of depreciation of the exchange rate should be equal to the sum of the yield differential and the country risk premium ρ , we have:

$$\mathrm{LT^d} - \mathrm{LT^{us}} = \mathrm{E}[\Delta \mathrm{e}] + \rho \quad (2)$$

Decomposing the long-term yield into expected interest rate and term premium such that $\mathrm{LT^d} = \mathrm{E}\,[\mathrm{i_t^m}] + \mathrm{q^d}$ and $\mathrm{LT^{US}} = \mathrm{E}\,[\mathrm{i_t^{us}}] + \mathrm{q^{us}}$ and substituting in equation (1) we have:

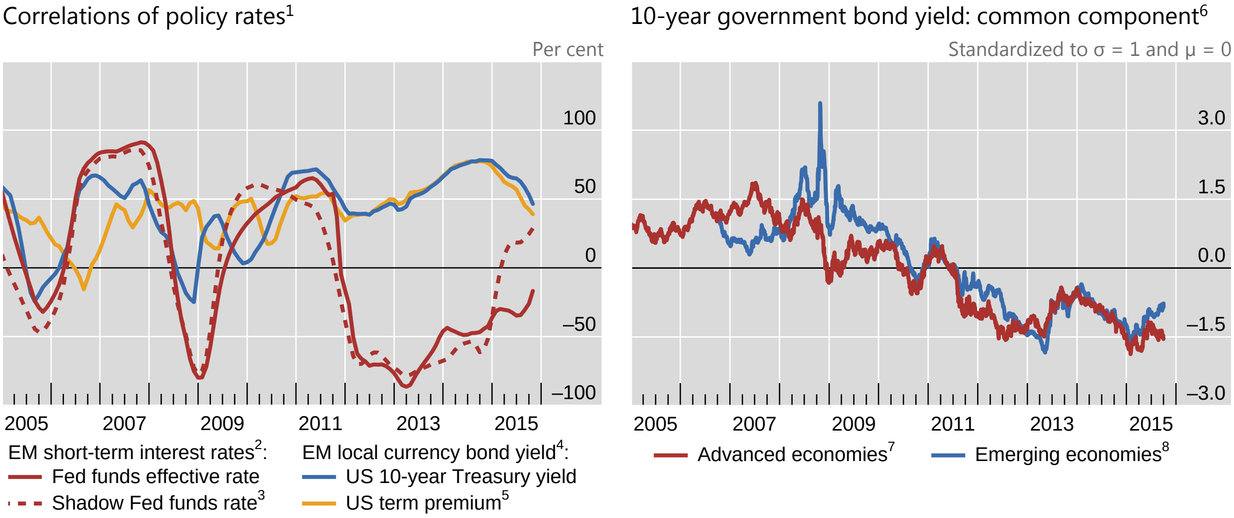
$$\mathrm{U_t^c} = \mathrm{P_t^c}\,[\mathrm{E}\,\{\mathrm{i_t^{us}} + \Delta\mathrm{e} - \pi_t^c\} + (\,\mathrm{q^{us}} - \mathrm{q^d})\; + \rho + \delta] \quad (3)$$

According to this equation, the user cost of capital in an open economy depends on three main elements. The first is the degree of correlation between risk-free domestic and international yields, which could stem from a correlation of the expected future short-term EME interest rate with the expected future fed funds rate (assuming that the US interest rate is the base rate for all EMEs). In a world with prefect capital mobility, the domestic risk-free long-term interest rate equals the US risk-free long-term interest rate and monetary policy primarily works through the exchange rate. The second element is the degree of correlation between the term and currency risk premia of EMEs, and the US term premium. Again, under perfect capital mobility, it is the US term premium that matters for the long-term EME interest rate, plus country risk and currency risk premia. The third element is the asset price change associated with capital flows which also affects the user cost of capital. Note that equation (3) is an expression linking the cost of credit with the interest rate from the perspective of the borrower and hence does not reflect the factors that may affect the supply of credit.

III.1.1 Correlation of bond yields

A key empirical issue is how domestic funding costs actually respond to a change in the central bank's policy rate. To the extent that EME firms have unrestricted access to international debt markets, the pass-through of the policy rate to domestic borrowing costs could be reduced because the user cost of capital is likely to move closely with foreign interest rates. In this case, the impact of domestic monetary policy depends on the degree of substitutability between domestic currency and dollar assets. Assuming limited exchange rate changes, a policy-induced rise in domestic interest rates would prompt borrowers to switch to dollar debt and savers to domestic currency assets, leading to a partial loss of control of monetary conditions. At the same time, monetary authorities must consider the adverse implications of interest rate changes for the exchange rate and financial stability (see Rossini and Vega (2008)).

Correlations of interest rates — Graph 4



[1] Coefficient of linear correlation calculated on a three-year moving window. [2] Simple average of countries with a flexible exchange rate regime: 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. [3] Based on Lombardi and Zhu (2014). [4] JPMorgan Government Bond Index – Emerging Markets (GBI-EM), 7–10 years. [5] Decomposition of the 10-year nominal yield according to an estimated joint macroeconomic and term structure model; see P Hördahl and O Tristani, "Inflation risk premia in the euro area and the United States", *International Journal of Central Banking*, vol 10, no 3, September 2014. Yields are expressed in monthly in zero-coupon terms. [6] The common component is the first principal component across each group of economies, and ignores country-specific factors. [7] Across the euro area, Japan, the United Kingdom and the United States. [8] Across Brazil, Chile, China, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Singapore, South Africa and Thailand.

Sources: Bloomberg; Datastream; JPMorgan Chase; national data; BIS calculations.

Ideally, the user cost of capital should not change if firms borrowing in dollars hedge their exposure to the expected future depreciation of the domestic currency against the dollar. In practice, however, such hedging is unlikely to be complete and firms may be attracted to minimise funding costs in the short run by leaving a large part of their dollar borrowing unhedged.

In partially dollarised economies, much depends on how domestic yield curves behave in response to domestic and foreign interest rate shocks. As a first attempt, in the left-hand panel of Graph 4 we report the coefficient of the rolling correlation of EME interest rates with the US interest rate and term premia. The correlations are computed using monthly data over a fixed window of three years for a group of major EMEs but excluding those that have a fixed exchange rate regime (eg Hong Kong SAR). The solid red line shows that the correlation of the average EME policy rate with the fed funds rate has fluctuated over time, with a mean close to zero for the period shown. In the post-crisis period, this correlation has been actually negative. Because the fed funds rate has been close to zero since 2009, we recomputed the correlation using an estimate of the shadow fed funds rate taken from Lombardi and Zhu (2014). As the dotted red line shows, the results are broadly similar although the correlation has recently turned positive.

By contrast, as the blue line of the right-hand panel of Graph 4 shows, with a few exceptions, the correlation of EME long-term interest rates with the US long-term rate has not only been positive throughout the past decade but has also increased steadily following the GFC. What is striking is that this correlation appears to stem mostly from the co-movement of EME long-term rates with the US term premium (yellow line).

The right-hand panel of Graph 4 throws further light on this by reporting the first principal component of EME and AE long-term interest rates, this time including a larger pool of countries than just the United States. The common component of the two series moved in the opposite direction to each other before the GFC but started to co-move very tightly after it. It also broadly confirms King and Low (2014)'s estimates that the global long-term rate has declined to very low levels in the past decade.

Since interest rate levels are likely to be correlated because of several factors unrelated to monetary policy, a formal test must consider these correlations in first differences and allow for other determinants. A familiar test proposed by Sambaugh (2004) and Klein and Sambaugh (2013) is as follows:

$$\Delta i_{jt} = \propto + \beta \Delta i_{bt} + \gamma' x_{jt} + u_{jt} \qquad (4)$$

Where i is either a short-term or long-term interest rate, the subscript "j" refers to home country and "b" to a base country, X is a vector of domestic variables determining the home interest rate, and u represents the difference in risk characteristic of home and base country assets. In a fully credible peg regime, the home country interest rate equals the base country interest rate, hence $\beta=1$ and $\gamma = 0$. Conversely, a fully independent monetary policy implies that $\beta=0$ and $\gamma=1$. For any intermediate values of β and γ the pass-through of the base country interest rate to home country rate will be partial.

Recent studies investigating equation (4) have generally converged to the conclusion that β is significantly positive for long-term interest rates but insignificant or only weakly positive for short-term interest rates.[9] Miyajima et al (2015), using data for a panel of 11 well-developed local EME currency bond markets, found that the response of 10-year EME bond yields to 10-year US Treasury yields increased sharply to 53 basis points (due to a 100 basis points increase in US Treasury yields) after the GFC from 31 basis points for the entire sample starting in January 2000. During periods of adverse market dynamics (such as the May–June 2013 "taper tantrum"), this response rose to slightly over 100 basis points. Using quarterly data for the most recent periods and a larger set of EMEs, Sobrun and Turner (2015a) reported similar results: whereas EME bond yields were weakly correlated with US yields during 2000–2004 their response became strong and statistically significant after 2005.

A litmus test for many studies is how to control for the unobserved common shocks that could lead to spurious correlations of interest rates. Obstfeld (2015) addresses this issue by considering different base country rates for different countries (such as the dollar interest rate for Mexico, the euro interest rate for Poland and so on) so as to minimise the common time effects in the panel regression. His results suggest that while the coefficient on short-interest rates in equation (4) is small and insignificant that on long-term yields is highly significant at the 1% level. Even after changing the base country rates, the response of long-term EME rates to AE long-term rates continues to be 40–50 basis points.

Kharroubi and Zampolli (2015) use a cross-section mean group estimator, as suggested by Pesaran (2006), to control for unobserved common shocks. Their results suggest that short-term interest rates in flexible exchange rate regimes neither

[9] See, for instance, Turner (2015), Obstfeld (2015), and Kharroubi and Zampolli (2015). For detailed country-wide estimates of the response of EME bond yields to US bond yields, see Takáts and Vela (2014), and BIS (2014).

respond to the base country interest rate nor to global risk cycles. However, they find a statistically significant effect for domestic long-term interest rates which rises by 60 basis points in response to a 100 basis points rise in the base country long-term rate. In addition, their estimates suggest that the response of domestic long-term interest rates to domestic short-term rates is relatively small (around 20 basis points in both the pre- and post-crisis period). Sobrun and Turner (2015b) report similar findings, and note that the impact of changes in the term premium in the benchmark bond yield is greater than the impact of changes in expected future short-term interest rates.

In sum, the evidence is quite solid that the long-term interest rates of EMEs have been highly correlated with global long-term rates, which is consistent with our open economy user cost of capital framework. Other studies have also shown that this correlation could be due more to changes in the US term premium than to market expectations of the US short-term interest rate (Miyajima et al (2014)). A shock to the US term premium is qualitatively different because it has the potential to generate more severe repricing of EME assets.[10]

III.1.2 Pass-through to bank lending rates

Is the interest rate channel still relevant? The answer depends, of course, on the structure of the financial system of a country. While the ratio of securities financing to total credit has increased across EMEs, there is a significant difference across countries. Yet, a high degree of bank financing does not necessarily insulate domestic monetary policy from external shocks because banks are both issuers and investors in securities markets, and compete with securities markets for their clients.

The degree of response of bank lending rates to the policy rate will be conditioned by several factors. The first is the degree of competition within the banking system as well as with the securities markets. In general, the higher the degree of competition among banks in the loan market is, the lower is the probability that the bank intermediation spreads would fluctuate to offset the impact of policy rate changes.[11] The introduction of more players in the credit market through the securities markets can weaken the oligopolistic structure of the banking system, leading to a stronger transmission of monetary policy to the banking system. On the other hand, the greater importance of capital markets in financial intermediation may accentuate information asymmetry problems between borrowers and lenders, leading to higher risk premia and a weaker monetary transmission mechanism more generally.

A second factor is the funding structure of the banking system. Bank lending rates reflect expected short-term rates over the full maturity of a loan which means that they include a maturity risk premium that can vary with the health of banks' balance sheets. In addition, banks have a more varied liability structure than just reservable deposits which suggests that their average funding costs may change only

10 Using post-GFC data, Miyajima et al (2014) report that a 100-basis points rise in the US 10-year term premium is associated with a 60 basis points increase in Asian long-term interest rates two months after the shock. Moreover, the effect of a term premium shock is twice as large as that from a shock to the US long-term interest rate.

11 On the role of structural factors in the transmission of monetary policy to bank lending rates, see Cottarelli and Kourelis (1994), BIS (1995) and Borio and Fritz (1995).

slowly in response to a change in the central bank's policy rate.[12] This factor assumes particular importance, given that banks in many EMEs have accessed non-deposit funding sources, including from the securities markets, to finance a significant part of their asset growth. A recent BIS survey indicated that the average contribution of non-deposit liabilities in total bank liabilities in a group of 20 EMEs was about 28% over the period ranging from 2004 to 2013 (Ehlers and Villar (2015)). In countries where financial markets are more developed (eg Hong Kong SAR, Korea and Mexico) such none-core liabilities accounted for a much larger share of total bank liabilities.

A third factor is the nature of deposit and loan contracts. A high share of short-term liabilities in total bank liabilities and short-term loans in total bank assets increases the pass-through of a given change in the policy rate to the average funding cost of banks and, ultimately, to that of their borrowers. That said, the reliance on short-term liabilities also makes banks more vulnerable to shocks to domestic money markets and international capital flows, reducing their ability to transform maturity and sustain credit supply. This implies that banks in countries with underdeveloped securities markets are likely face a trade-off while optimising their asset and liability structures to minimise funding and interest rate risks.

This factor is likely to be particularly important in EMEs where the contractual maturity of bank liabilities tends to be quite short, with a median of just about four months for a group of 11 economies at the end of 2013 (Ehlers and Villar (2015)). In addition, a high proportion of bank deposits in EMEs bears variable rates (50–70%), which means that deposit rates in many cases are effectively indexed to the policy rate. Although information is more limited for bank lending contracts, the picture is somewhat different across regions. For instance, while variable residential mortgage contracts accounted for 70–99% of total residential mortgages in Asia in 2013, fixed rate contracts dominated mortgage markets in Latin America with a ratio of close to 100% in Brazil and 70–96% in Argentina, Chile, Colombia and Mexico.

A rough indication of how bank lending rates behave in response to policy rate changes is given by the scatter plots in Graph 5 summarising data for seven Asian economies over the past decade. The preference for four-quarter changes over single-quarter changes in interest rates was guided by the consideration that bank lending rates exhibit short-run stickiness due to the existence of fixed adjustment costs. The positive slope of the trend line in Graph 5 suggests that the response of the lending rate to the policy rate is quite different from that of the long-term bond yield. That said, the average response of the household lending rate (16 basis points) is just about half of the response of the business lending rate (34 basis points). In addition, the explanatory power of the regression is not very high for household lending rates.

A similar exercise exploring the relationship between bank lending rates and US long-term rates did not yield meaningful results.[13] While more systematic analysis is

[12] See Berlin and Mester (1999), and Illes et al (2015) for a formal loan pricing model.

[13] The results from a panel regression for the household lending rate (HLR) and corporate lending rate (CLR) including both the policy rate (POL) and US-10 Treasury yields (US 10) are the following:

HLR = -0.132 + 0.160 POL – 0.161 US10   R2 = 0.09

(1.247)   (2.042)   (-1.515)

CLR = -0.233 + 0.315 POL – 0.277 US10   R2= 0.51

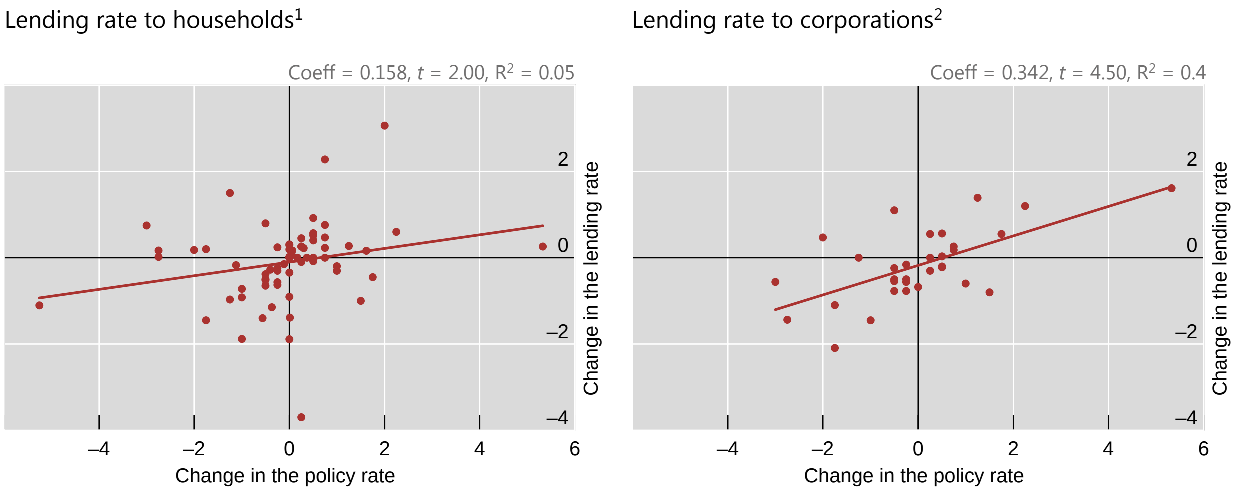
(-2.158) (4.490)   (-2.575)

needed to reach reasonable conclusions, the preliminary evidence we gathered nevertheless suggest that the interest rate channel of monetary policy may not have been completely eroded by the recent rapid growth of dollar borrowing by EME firms.

Lending rates and policy rates

Annual changes, in percentage points

Graph 5



[1] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia and Singapore. [2] India, Indonesia and Korea.

Sources: Datastream; national data.

III.2 The exchange rate channel

Another important transmission channel is the exchange rate which mainly operates in economies with a flexible exchange rate. As interest rates fall due to an expansionary domestic monetary policy, domestic interest bearing assets become relatively less attractive, triggering capital outflows and exchange rate depreciation. However, currency depreciation may have several opposing impacts and the net effect on output may turn out ultimately to be positive or negative. While depreciation may boost exports and hence overall aggregate demand, on the one hand, it may also lead to an erosion in the net worth of borrowers with foreign currency debt and thus to a decline in aggregate spending, on the other. A depreciating currency can also lead to higher inflation depending on the degree of pass-through of import prices to domestic prices.

A good example of how the exchange rate channel works is Singapore – an open economy par excellence. Given a high import content of domestic consumption (around 40%), the exchange rate has a direct impact on domestic inflation (Loh (2014)). And, since the exchange rate has predictable effects on the demand for exports and factor inputs, it also has an indirect effect on inflation. In addition, the country has a large net international investment position vis-à-vis the rest of the world and the daily exchange rate movement of the Singapore dollar is managed by the Monetary Authority of Singapore. With trade effects reinforcing balance sheet effects – currency depreciation improves rather than worsens the net wealth position – the exchange rate plays an important countercyclical role in the economy.

However, in economies with significant currency mismatches, the role of the exchange rate can be very different. For instance, consider the following aggregate demand equation:

$$y_t - y^* = \gamma\ (y_{t-1} - y^*) - \ \beta\ (r_t - r^*) - \ \lambda \Delta e_t + \epsilon_t \qquad (5)$$

Where y is actual output, y* is potential output, r is the real interest rate, r* is a normal or equilibrium real interest rate, e is the real exchange rate and ∈ is a disturbance term. The output gap in this model is negatively related to the real interest rate gap as well as the exchange rate. A negative coefficient on λ assumes that currency depreciation is associated with improved trade balances and easier financing conditions. In practice, however, λ could take any plausible value depending on the structure of the economy. One form of contractionary devaluation, highlighted by the earlier literature, is an exchange rate-induced rise in import costs, which turns λ positive, particularly in economies heavily dependent on commodity imports (Frankel (2011)). It is also possible that exchange rate elasticities are considerably smaller in economies that rely heavily on imported inputs for export production. The second type of contractionary devaluation, which received much attention during the EME currency crises of the 1990s, is the case of liability dollarisation where currency depreciation is associated with a widespread deterioration of borrowers' balance sheets, causing tighter financing conditions.[14]

Eichengreen (2002) points out that the impact of the exchange rate in economies with large currency mismatches is likely to be non-linear – while small currency depreciations are likely to satisfy the conditions for λ being negative, large depreciations can cause severe financial distress because "they confront banks and firms with asset prices for which they are unprepared, while doing little to enhance competitiveness effects because of the speed with which they are passed through into inflation".

However, scepticism about the role of the exchange rate changed considerably in the aftermath of the financial crises in Mexico (1994–95) and Asia (1997–98) which not only heralded a new era of independent monetary policy in EMEs – led in many cases by the introduction of inflation targeting – but prompted concerted efforts by the authorities of EMEs to reduce the degree of currency mismatches (see BIS (2008)). At the same time, the degree of exchange rate pass-through into inflation declined, improving the growth and inflation trade-off facing the central bank.

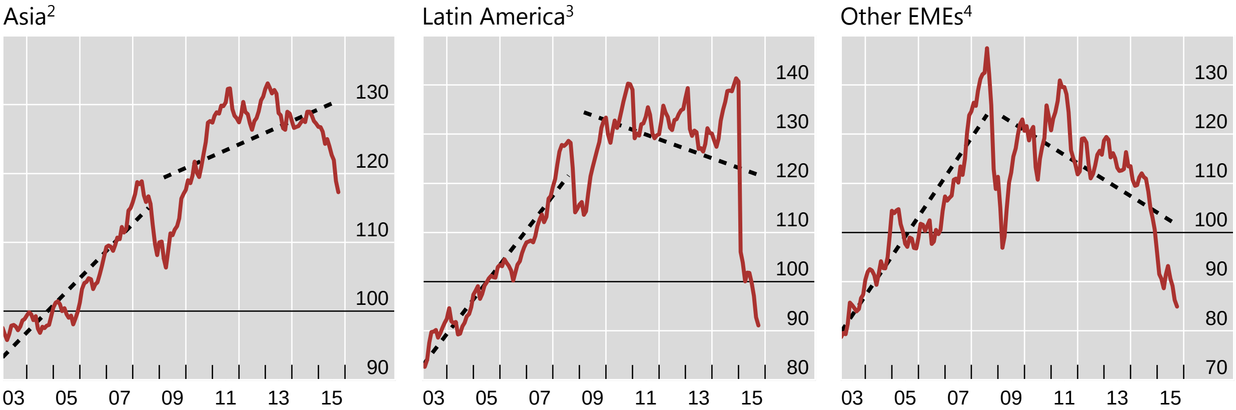
III.2.1 Post-crisis changes

Since 2010, however, currency mismatches in many emerging markets have increased – notably because of a substantial increase in foreign currency borrowing by emerging market non-financial companies (Chui et al (2016). The exchange rate has therefore come back to the centre of the monetary policy debate post-GFC. As shown in Graph 6, real exchange rates have exhibited protracted cycles with upswings of currency appreciation followed by downswings of depreciation. Latin America is a case in point. While the average real exchange rate in the region at end-October 2015 was roughly at its level of 2005, the intervening period has seen rapid movements on both the strong and weak sides. In Brazil, exchange rate cycles have had a significant impact on financial and economic conditions. A similar, though less prolonged, trend

14 For evidence on the contractionary impact of devaluations on balance sheets, see Cavallo et al (2004) and Bebczuk et al (2006). For the analytical literature on the balance sheet effects of the exchange rate, see Caballero and Krishnamurthy (2002), Cespedes et al (2004) and Chang and Valesco (2000).

in the real exchange rate has been visible in several parts of Asia (eg India and Indonesia) and central and eastern Europe (eg Turkey and Hungary).

Real exchange rate in EMEs[1] Graph 6



Dashed-black lines represent trends for the periods January 2003 to July 2008 and February 2009 to June 2015, respectively.

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

Source: National data.

A key contributing factor has been the behaviour of commodity prices (BIS (2014)). In many oil-exporting countries, exchange rate swings have been associated with sustained shifts in the terms-of-trade. At the same time, the correlation between the exchange rates of EMEs and indicators of global risk aversion (such as the VIX index of US stock market volatility) increased considerably in the aftermath of the GFC (Rajan (2014)). Miranda-Agrippino and Rey (2013), and Rey (2013) have argued that shifts in global investors' risk appetite have led to an unusual convergence of exchange rate and asset price cycles across the globe.

One effect of such currency movements in the face of large accumulated foreign currency debt has been that the credit cycles in EMEs now tend to co-move more closely with the dollar exchange rate. Bruno and Shin (2014) have used the expression "the risk-taking channel of the exchange rate" to characterise a model in which global banks play a key role in the transmission of external shocks through the channelling of liquidity from the US money market to local EME banking systems. Since dollar depreciation improves the balance sheets of bank borrowers with dollar debt, it reduces the credit risk effectively faced by banks, leading to an expansion of lending. Conversely, periods of strong dollar appreciation are followed by contractions in global banks' balance sheets and widespread dollar shortages. In terms of equation (5), this means that the sign and the value of λ are not a static function of the degree of currency mismatches but vary depending on the force of the amplification mechanism at work.

There is also increasing evidence that the exchange rate can affect financing conditions even without such financial imbalances. One such mechanism is the interaction between the foreign exchange and bond markets, which can be caused by speculative investor positioning and pro-cyclical investment strategies by some types of investor such as professional asset managers (Feroli et al (2014)). Turner (2012) shows that the hedged and unhedged returns on local currency EME bonds have consistently diverged, suggesting that the exchange rate played a crucial role in bond market dynamics. The failure of the uncovered interest parity (UIP) condition means that foreign investors have had an impact on the risk premium, causing large fluctuations in domestic monetary conditions.[15] When the exchange rate is appreciating, investors may take speculative carry positions in bond markets to gain from the expected future appreciation which drives down EME risk premia and bond yields to very low levels. During periods of market stress, however, as the currency depreciates and uncertainty about the future exchange rate rises, foreign investors rush to the exit, causing higher bond yields and tighter financing conditions.[16]

Such currency-related carry trades may not only be restricted to non-resident investors in EME securities. EME residents could also make use of dollar debt issuance to undertake similar investment strategies, leading to highly volatile capital and credit flows. For instance, a recent study has found that non-financial companies had used US dollar bond issuance to take on financial exposure that shared the attributes of dollar carry trades (Bruno and Shin (2015)). The proceeds of such bond issuance were invested in high-yielding bank deposits as well as in shadow banking products and commercial paper.

III.3 The credit channel

The credit channel of monetary policy operates through the balance sheets of lenders and borrowers, and depends on the degree of financial imperfections in an economy.[17] A key question raised by the GFC, particularly in the light of the recent rapid increase in bank leverage in many AEs, is the extent to which the behaviour of financial intermediaries can contribute to magnifying the impact of monetary policy on credit supply. Gertler and Kiyotaki (2011) introduce financing constraints facing banks into the original financial accelerator model proposed by Bernanke et al (1999). To the extent that banks' own balance sheet conditions constrain their ability to access deposit funding and that they are vulnerable to idiosyncratic liquidity shocks, dysfunctions in market leads to jumps in the external finance premium as experienced by many countries during the GFC.

An aspect of the credit channel that has received much attention post-2008 crisis is the link between monetary policy and risk-taking by financial intermediaries. Adrian and Shin (2011) consider the behaviour of financial intermediaries that typically mark a significant part of their assets to market (shadow banks such as interdealer brokers or banks that invest heavily in securitised products). In their model, individual bank managers are risk-neutral but face a value-at-risk limit. An easier monetary policy, by boosting asset prices and profitability, reduces banks' capital and value-at-risk constraints, encouraging them to take on more risk. In the equilibrium, the market

[15] See also Chin and Frankel (1994), Longstaff et al (2011), Gonzalez-Rodzada and Levy-Yeyati (2008), Du and Schreger (2013), and Miyajima et al (2014) on the role of the risk premium in EME debt markets.

[16] Gadanecz et al (2014) estimate a bond yield model for EMEs allowing for a currency risk premium proxied by the 3-month implied volatility of currency options. Their results suggest that a one percentage point increase in implied currency volatility is associated with a five basis points increase in local EME currency bond yields over 2005–2013.

[17] See Brunnermeier et al (2012) for a review of the role of financial frictions in macroeconomics.

price of risk becomes endogenous, amplifying the impact of monetary policy on credit.

Acharya and Naqvi (2012) discuss a similar risk-taking channel where the incentive structure facing bank managers, rather than the financing constraints of banks, plays a key role in the propagation of credit and asset price cycles. Since the compensation of bank managers is linked to the volume of loans, excessive liquidity is associated with systematic mispricing of downside risk, causing credit and asset price bubbles. Nicolo et al (2010) discuss several other mechanisms that may be at work in strengthening the link between monetary policy and risk-taking by financial intermediaries.

Given the lower level of development of their financial systems, the credit channel may be of particular relevance to EMEs. Several recent studies based on pre-crisis EME data suggest that monetary policy has a stronger effect on banking systems that are less well-capitalised and competitive than others.[18] And monetary policy may have a particularly large effect on smaller banks whose access to outside finance can be very limited. Agenor and Montiel (2008) discuss monetary policy effects in economies where weak protection rights of lenders and high probabilities of default cause banks to over-collateralise loans. Under such conditions, an easy monetary policy lowers the lending constraints of large firms but squeezes small and marginal borrowers who have little to gain from higher asset values. A segmented credit market with a large informal sector may thus make EMEs simultaneously vulnerable to procyclical credit market dynamics and active credit rationing. Agenor and Pereira da Silva (2013) cite the example of Brazil where bank lending spreads have been inversely correlated with fluctuations in economic activity, providing evidence of pro-cyclical credit dynamics.

While it is difficult to determine the precise effects of changes in financial intermediation on credit supply in EMEs, recent research provides useful guidance. One key finding emerging from this literature is that the globalisation of banking may have weakened the link between domestic monetary policy and credit variables (Cettorelli and Goldberg (2012)). Because global banks use their own internal capital markets to channel funds across borders, they could potentially offset the impact of changes in domestic interest rates on credit variables. This also implies that EME credit conditions may become more vulnerable, particularly to US monetary policy shocks. The results reported by Cettorelli and Goldberg (2012) suggest that a 100-basis points increase in the fed funds rate reduces the foreign lending activity of large US commercial banks by as much as 2.2%, implying a significant contractionary effect on EMEs.

Second, the expansion of dollar debt in EMEs implies that their domestic credit conditions are now very closely connected to the availability of dollar liquidity. This was, for instance, vividly demonstrated by the collapse of Lehman Brothers in 2008 which spread shock waves across the globe and caused large-scale dollar shortages and huge deleveraging pressures on EMEs (McGuire and von Peter (2009)). As the shock transmitted to the FX swap markets, the cost of dollar funding escalated to very

[18] For a recent review of the credit channel, see Beck et al (2014). For evidence in the context of EMEs, see Khwaja and Mian (2008), Firth et al (2009), Olivero et al (2011), and Kohlscheen and Miyajima (2015).

high levels, precipitating a broad tightening of credit conditions across EMEs.[19] More generally, as argued by Borio et al (2011), the sharp rise in the dollar liabilities of EMEs over the past decade has meant that EME credit cycles have become more closely synchronised with cross-border credit cycles. In typical boom periods, cross-border credit tends to grow faster than overall credit, with banks resorting to wholesale dollar funding markets to finance new asset growth.[20] The process reverses itself, with higher US interest rates leading to a large-scale unwinding of dollar borrowings and a widespread slowdown of credit to EMEs. [21]

Finally, to the extent that risk-taking activities dominate, the credit channel is likely to become an important financial stability concern for many EMEs. Unfortunately, compared with the voluminous literature on the bank lending channel, there is very little empirical work on the risk-taking channel in EMEs, owing largely to the lack of detailed historical data on individual lenders and borrowers. That said, evidence based on aggregate credit data provide some guidance. For instance, using a cross-country panel model, Kohlscheen and Rungcharoenkitkul (2015) found that external factors such as the US dollar exchange rate and the implied volatility of the US stock market (as proxied by the VIX index) had become more significant drivers of credit growth in EMEs after the GFC than they were before. Consistent with the risk-taking channel of the exchange rate, their results suggest that a 10% appreciation of EME currencies against the dollar is associated approximately with an 85 basis points increase in credit growth in EMEs in the short run and a 135 basis points increase in the long run.

IV. Monetary policy transmission in India: an empirical assessment

In this section we try to find out which channels of monetary policy transmission are the most important in India. In addition to the three specific channels discussed in the previous section, we also consider the asset price channel that operates through equity prices. A number of studies have already examined monetary policy transmission in India. For example, Al-Mashat (2003), using a quarterly structural vector error correction model (VECM) for the period 1980 to 2002, found that the interest rate and exchange rate channels were important but that the bank lending channel was weak due to presence of directed lending regulations. However, Pandit et al (2006) found that the bank lending channel with small banks was more responsive to a policy shock. Singh and Kalirajan (2008) contend that the significance

[19] See Baba and Packer (2009).

[20] See Avdjiev and Takáts (2014) for further evidence on the role of cross-border credit in bank lending to EMEs.

[21] McCauley et al (2015) note that since 2009 this role has been taken over by the international bond market following a sharp decline in US term premia. Shin (2014) has termed the recent growth of international bond issuance as "the second phase of global liquidity", the first being the rapid expansion of cross-border bank lending following policy rate cuts by AEs in 2008.

of the policy rate increased substantially when that rate became the major monetary policy variable in India in the post-1990s reform period.[22]

In our analysis, we also try to answer the question of whether US-specific shocks have had an impact on Indian monetary conditions. That is, in addition to testing for the traditional channels of transmission, we check whether US shocks are directly transmitted to India's long-term bond yields and whether such shocks are met with policy reactions by the central bank which is much similar to the enquiry by Miyajima et al (2014).

IV.1 Data and methodology

We use a structural vector autoregressive (SVAR) framework in the same manner as employed by Khundrakpam and Jain (2012) and examine one channel at a time, keeping in mind that only a limited number of variables should be considered in order not to lose too many degrees of freedom. Therefore, we first estimate a baseline SVAR model and then augment the model with other channels. We differ from previous studies on India by taking US monetary policy shocks explicitly into consideration.

All data are quarterly, seasonally adjusted, and converted to logs (except for the interest rate variables). Most of the variables were found to be integrated of order one and hence were first-differenced them to make them stationary.

We first run the baseline SVAR model without any of the above transmission channel variables. We use the following variables: 10-year US term premium (us_gov10_premia), real non-agricultural non-government GDP (ind_rgdp_nang) for output, wholesale price index (WPI, ind_wpi) for prices and weighted average call rate (ind_call_rate) as policy rate. The 10-year US term premium is used as a proxy for foreign monetary influence. Non-agricultural, non-government GDP is defined as total GDP excluding agriculture and related activities, and "community, social and personal services". We use this variant of GDP as we expected it to be more responsive to interest rate changes.

As for structural restrictions, of our domestic variables the weighted call rate responds contemporaneously to real GDP and WPI but not vice versa. Further, the WPI variable is modelled to depend contemporaneously on real GDP. Finally, the US variables are exogenous to all domestic variables in the system. Therefore, the variables in the baseline model are ordered as: {us_gov10_premia, ind_rgdp_nang, ind_wpi, ind_call_rate}. The baseline model thus gives us an idea of how the domestic interest rate channel works in terms of influencing output and inflation. Further, we can also check whether US monetary policy has played any role in the evolution of Indian macroeconomic variables and policy rate settings.

Turning to augmenting our model with other transmission channels, we keep the same baseline restrictions and assume that the additional channel is contemporaneously affected by all the other variables included in the baseline model. Thus, the variables in the augmented model are ordered as: {us_gov10_premia, ind_rgdp_nang, ind_wpi, ind_call_rate, 'channel variable'}. The channel variables are: non-food credit (ind_nbfoodcr) for the credit channel, BSE Sensex (ind_bsesensex) for the asset price channel, the real effective exchange rate (REER, ind_reer) and the

[22] Other recent studies on Indian monetary transmission mechanisms include Aleem (2010), Patra and Kapur (2010), and Khundrakpam and Jain (2012).

nominal effective exchange rate (NEER, ind_neer) for the exchange rate channel and 10-year government bond yield (YLD_IND_10) for the bond price channel.

Additionally, in both sets of model we use gross portfolio inflows as an exogenous variable to account for other global influences. We also include a dummy variable that takes a value of 1 in the peak crisis period (2008 Q1–2009 Q1) and 0 otherwise. The analysis is done for the data from 1996 Q2 to 2014 Q4.

IV.2 Results: the baseline model

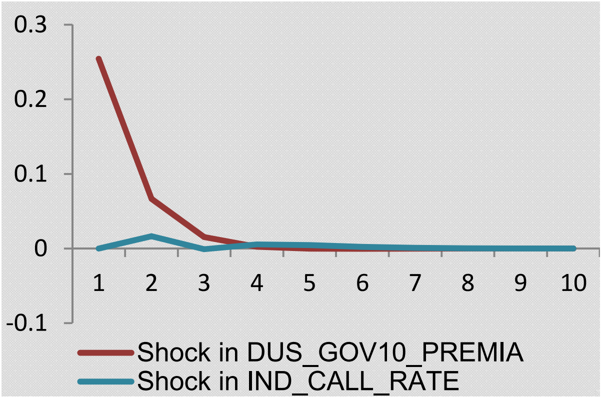
We present the impulse responses from the baseline model in Graph 7 which shows the dynamic responses of output and inflation to a one standard deviation shock in the call rate. Both output and inflation respond negatively to positive shocks in the call rate – as would be expected in models with sticky prices. We also note that, in response to a call rate shock, the decline in GDP growth precedes the negative impact on inflation. Moreover, the peak impact on inflation is also felt with a lag of one quarter from the peak impact on GDP.

The remarkable negative response of output to shocks in the call rate may be due partly to the fact that we use non-agricultural, non-government GDP as a measure of output, therefore, by definition, excluding less interest rate sensitive portions of GDP. However, this result is robust to using aggregate real GDP, where the responses are still negative and significant, albeit smaller. Further, we also checked if those results were influenced by our identification strategy, causing contemporaneous correlation between output and the call rate. We, therefore, ran the model without the restriction that the call rate responds contemporaneously to output (keeping all the other restrictions as before) and we reached the same conclusion about the dynamic response of output to call rate shocks. In short, our results confirm the findings of others such as Aleem (2010), and Khundrakpam and Jain (2012) that shocks to the call rate do have predictable effects on the economy.

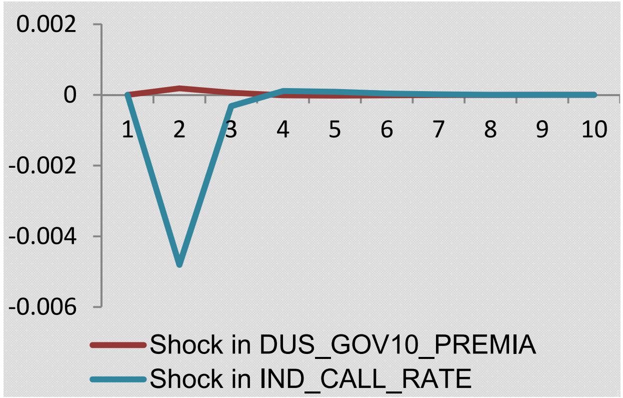
For the US term premium, we do not find any evidence of it affecting output or the call rate. Thus, over the period of the study, US monetary policy does not seem to have had any major influence on Indian monetary policy settings. To check for the importance of a direct long-term interest rate channel, we augmented the benchmark model with a bond price variable, represented by the yield on 10-year Government of India bonds. Miyajima et al (2014) in a very similar model specification found that the long-term US interest rate had a remarkable influence on long-term interest rates in east Asian economies. We did not expect such dramatic results in the case of India because of the relative insulation of Indian debt markets from international participation. The impulse responses for this model are presented in Graph 8. As expected, the 10-year Indian Government bond yield shows no significant response to US term premium shocks. Further, all the baseline results still hold.

Impulse responses from the Baseline model Graph 7

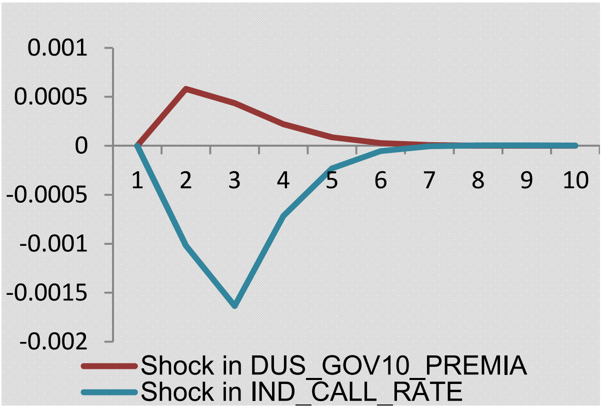
Impulse responses from the Baseline model



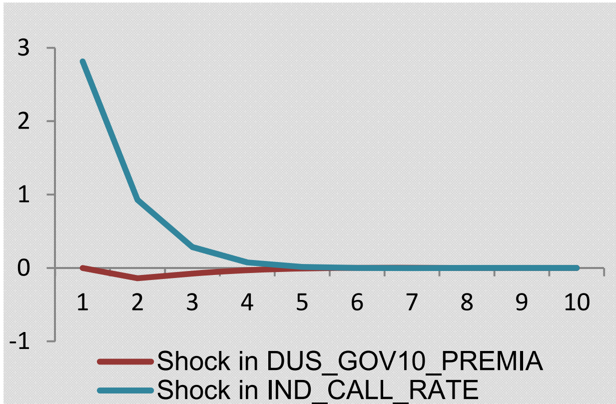
Impulse responses from the Baseline model



Response of DLN_IND_WPI



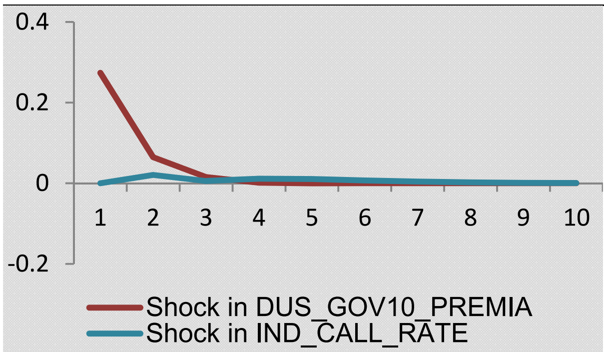
Response of IND_CALL_RATE



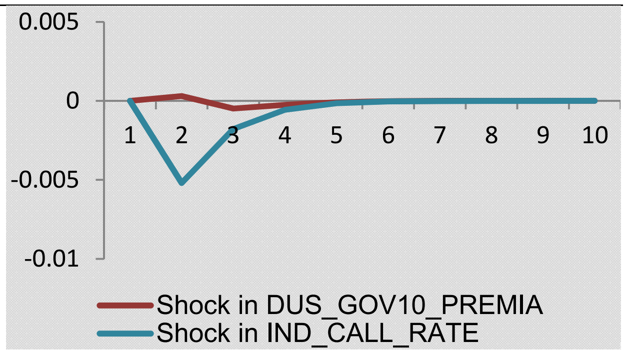
Our results are consistent with the findings of Ghosh et al (2016) in this volume that India has been able to keep its monetary policy independence intact from the influence of external forces due to its cautious approach to bond market liberalisation. Although India has progressively relaxed limits on foreign purchases of domestic bonds in recent years, the share of foreign ownership remains very low. Another reason for incomplete arbitrage is limited capital account convertibility which restricts borrowings by resident firms and households in the international debt markets. Our results complement the analysis of Ghosh et al (2016) in another way. They examine the impact of US monetary policy on capital flows to India and conclude that equity flows are more sensitive to global risk aversion but debt flows react more strongly to US interest rates. We investigate the same question by focussing on the price channel of transmission of US unconventional monetary policy - which is influenced by but does not necessarily depend on the quantity of capital flows - and conclude that domestic monetary policy remains relatively unaffected.

Impulse Responses from the Augmented Model with Indian Bond Yield | Graph 8

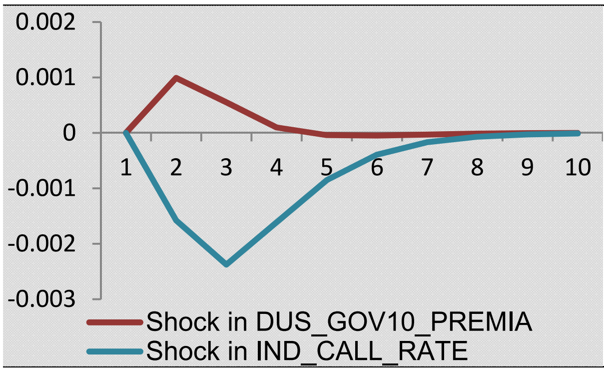
Response of DUS_GOV10_PREMIA



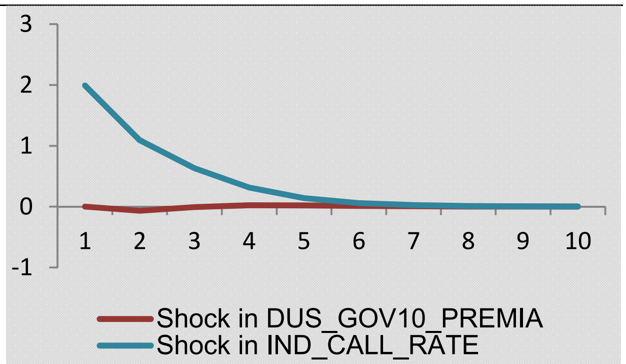
Response of DLN_IND_RGDP_NANG



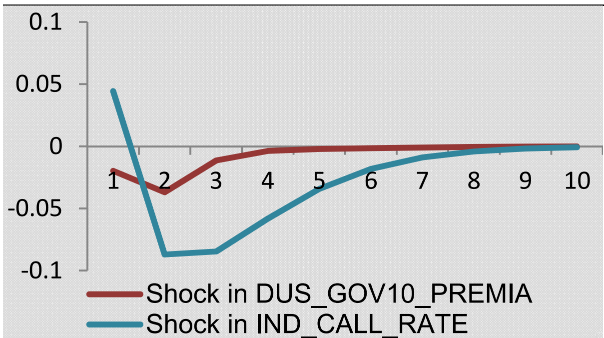
Response of DLN_IND_WPI



Response of IND_CALL_RATE



Response of DYLD_IND_10



IV.3 Results: Augmented model with additional transmission channels

Through the augmented models, we want to test whether and how the short-term policy rate and US term premium shocks transmit to other channels of monetary transmission.

The impulse responses for models including transmission variables are presented in Graphs A1–A4 in the Annex. The first is the credit channel which is expected to work on top of the direct interest rate channel. The efficacy of this channel depends obviously on whether a significant number of borrowers rely on banks. Further, a higher US term premium can reduce credit growth by weakening banks' balance sheets (due to an expected higher non-performing loan ratio) and making them more risk averse. Graph A1 shows the relevant impulse responses. While the results of the baseline model hold, we find that a positive shock to the call rate leads to a decline in non-food credit. By contrast, the response of non-food credit to a US term premium shock is not significant.

We turn next to assessing the asset price channel. A tightening of monetary policy is expected to make equity, as an asset class, less attractive than other assets such as bonds leading to a fall in equity prices. And this may, through Tobin`s q ratio, reduce investment. Also, a decline in equity prices may reduce consumption demand through a net wealth effect on households. Similarly, a rise in the US term premium is expected to push asset prices down, for example, by leading to capital outflows. As a proxy for the asset price channel in India, we use the BSE SENSEX which is the most popular index of Indian equity prices. The relevant impulse responses are shown in Graph A2. We find again that the results of the baseline model hold. Also clearly, a positive shock to the policy rate leads to a decline in equity prices, which peaks after two quarters following the shock. However, we do not see the US term premium shock as having any significant effect on asset prices.

Finally, we look at the exchange rate channel for which we consider both the REER and the NEER. Graph A3 and A4 presents relevant impulse responses when the REER is taken as the transmission channel. Here we find a result that is contrary to what we expected. While the baseline results hold true again, we find a positive shock to the policy rate leads to a real exchange rate depreciation. Khundrakpam and Jain (2012) explain this diversion from the UIP condition by contending that interest rate differentials do not play an important role in exchange rate determination in India. As discussed before, part of the explanation is that the most interest sensitive component of capital flows (ie the debt component) is restricted in India, reducing the currency appreciation effect of a higher interest rate. Another reason could be that tighter monetary policy may actually reduce equity flows by weakening growth prospects. Thus, on a net basis it is possible for a positive policy rate shock to lead to a decline in net capital inflows and to a currency depreciation. We find a similar result when we take the NEER as a transmission channel. In the case of a US term premium shock, we find no significant effect on the REER or the NEER for the reasons mentioned above.

To sum up, we find that the interest rate is an important channel of monetary policy transmission in India as it has significant effects on output and inflation. Among the other channels, both the asset price and credit channels are active while the bond price and exchange rate channels do not work in the expected way mainly due restrictive capital account policies. Our results thus provide indirect evidence that external monetary policy shocks are transmitted to domestic financial systems through globally integrated debt markets. In other words, the "impossibility trinity" holds: an open debt market limits the sphere of influence of domestic monetary policy on the economy. In what follows, we use a simple reduced form model to demonstrate the challenges facing the monetary authority.

V. Interest rate setting in globalised debt markets

V.1 The closed economy case

In this section, we present a simple monetary model to illustrate how a globalised debt market might complicate central banks' response. Following Genberg (2008), the analytical model comprises four equations: the Phillips curve, IS equation, central bank reaction function and financial intermediation equation. These equations are written in the simplest form and the lagged values are suppressed (although they may nevertheless be important). We also assume a frictionless economy, so that imbalances such as currency mismatches and credit market imperfections do not play a role. We first start with a closed economy model:

$$\pi_t = \alpha \, Ygap_t + \varepsilon_t^{\pi} \tag{6}$$

$$Ygap_t = \beta_1[i_t^m - \pi_t] + \beta_2 \, U_t^c + \varepsilon_t^{Ygap} \tag{7}$$

$$U_t^c = P_t^c \, [E\,\{i_t^m - \pi_t^c\} + \delta] \tag{8}$$

Equation 6 is a simple version of the Phillips curve where inflation (π_t) depends on the output gap ($Ygap_t$). The error term ε_t^{π} captures the omitted factors and a white noise component. Equation 7 defines the IS relation with the output gap being dependent on the short-term nominal market interest rate (i_t^m) net of inflation (π_t) and the expected user cost of capital (U_t^c). The last term is again our error term and has the usual interpretation. Equation 8 is the user cost of capital equation (identical to that of equation (1)).

By substituting the expected user cost expression in the IS equation we have:

$$Ygap_t = \beta_1[i_t^m - \pi_t] + \beta_2 P_t^c \, [E\,\{i_t^m - \pi_t^c\} + \delta] + \varepsilon_t^{Ygap} \tag{9}$$

Next we define the central bank's reaction function in equation (10), which links the policy rate (i_t^p) to the output gap and deviation of actual inflation (π_t) from the target (π^T):

$$i_t^p = \gamma_0 + \gamma_1 \, [\pi_t - \pi^T] + \gamma_2 Ygap_t + \varepsilon_t^{ip} \tag{10}$$

This is basically a form of the Taylor Rule. Note, however, that we have an additional term (γ_0) in the interest rate rule (usually assumed to be a constant) to capture other factors that have become important for central banks in EMEs.

Our discussion in the previous sections suggests that the size and the form of financial intermediation are crucial for the transmission of monetary policy shocks. Most notably, firms have been able to access bond markets to finance investment. In a closed economy framework, this could, for instance, mean that the market borrowing rate (i_t^m) is now more tightly linked to the policy rate (i_t^p).

We therefore, need a relationship between (i_t^p) and (i_t^m) that takes into account several institutional factors creating a wedge between the policy rate and the market rate which we denote by X_t. It may also include the effects of the pricing power of banks and structural impediments to interest rate setting in the banking system. It can also be thought to be capturing the general level of risk aversion or perceived credit risk in the economy:

$$i_t^m = \theta_1 \, i_t^p + \theta_2 \, X_t + \varepsilon_t^{im} \tag{11}$$

In order to characterise the static equilibrium market interest rate (i_t^m) and the equilibrium policy rate (i_t^p), we solve for the market interest rate and policy rate in equations (9) and (10) when the output and inflation gaps are zero. We therefore have:

$$i_t^{m^*} = \pi^T - \frac{\beta_2}{\beta_1} P_t^c[E\{i_t^m - \pi_t^c\} + \delta] + \frac{1}{\beta_1}\varepsilon_t^{Ygap} \quad (12)$$

$$i_t^{p^*} = \gamma_0 + \varepsilon_t^{ip} \quad (13)$$

Note, again that the error terms have the usual meaning as discussed above. We are now ready to find an expression for γ_0 and using that we augment the traditional Taylor rule. Thus, by substituting equation (12) and (13) in (10) we have:

$$\gamma_0 = \frac{1}{\theta_1}(\pi^T - \frac{\beta_2}{\beta_1} P_t^c[E\{i_t^m - \pi_t^c\} + \delta]) - \frac{\theta_2}{\theta_1}X_t + \frac{1}{\theta_1}\frac{1}{\beta_1}\varepsilon_t^{Ygap} - \frac{1}{\theta_1}\varepsilon_t^{im} - \varepsilon_t^{ip}$$

Where, $\frac{1}{\theta_1}\frac{1}{\beta_1}\varepsilon_t^{Ygap} - \frac{1}{\theta_1}\varepsilon_t^{im} - \varepsilon_t^{ip}$ are a bunch of errors which we denote by φ.

Finally, our simplistic but augmented monetary policy reaction function can be written as:

$$i_t^p = \frac{1}{\theta_1}(\pi^T - \frac{\beta_2}{\beta_1} P_t^c[E\{i_t^m - \pi_t^c\} + \delta] - \theta_2 X_t) + \gamma_1[\pi_t - \pi^T] + \gamma_2 \ Ygap_t + \varphi + \varepsilon_t^{ip} \quad (14)$$

Ignoring the two error terms, the last two terms are the usual Taylor Rule arguments. The first term explicitly brings into the policy rule the expected user cost and financial intermediation factors. This relation will be used as baseline when we open up the economy to international bond flows.

Two main implications of the closed-economy augmented Taylor rule are worth noting. First, as discussed by Genberg (2008), it predicts how financial intermediation can affect the "neutral interest rate" to stabilise the economy. One example, discussed in section III, is the case of increased bond financing leading to lower intermediation spreads. This is akin to monetary easing. To maintain a neutral monetary stance the central bank must respond by increasing the policy rate. By contrast, an increase in perceived credit risk that is unrelated to economic fundamentals or to higher intermediation spreads resulting from the attenuation of an asymmetric information problem through the bond market will mean that monetary conditions have tightened, thus requiring a lower policy rate.

Second, our augmented central bank reaction function also illustrates how market expectations of the interest rate and asset prices play an important role in the design of an appropriate interest rate response, particularly when market expectations deviate from those desired by the central bank. This is likely to affect the size and the speed of the response of aggregate demand to changes in the policy rate as well as other shocks driving these expectations. For instance, a cut in the policy rate may be accompanied by an unexpected buoyancy of housing prices, leading to a faster than expected transmission of policy shocks to the housing market which may not be welcome by the central bank from the view point of financial stability. The same phenomenon could also be driven by bouts of housing price inflation that are completely unrelated to monetary policy (as in the case of demographic shocks), which increases the perceived pay-off to home buyers from housing investment, driving spending and inflation away from target.

The main point to note is that the conventional Taylor rule still serves a useful purpose in stabilising the economy. To the extent that changes in domestic financial intermediation are gradual, central banks can prevent major risks to monetary and financial stability by appropriately adjusting their policy response. Precisely for this reason, in many countries the monetary authorities regularly monitor a wide range of real and financial market indicators to detect and address some of these risks.

V.2 The open economy case

Using the above framework, we can also bring open economy considerations into the picture. Consider, the expected user cost equation in an open economy which is identical to equation (3):

$$U_t^c = P_t^c\,[E\,\{i_t^{us} + \Delta e - \pi_t^c\} + (q^{us} - q^d) + \rho + \delta]$$

We want to arrive at an open economy interest rate rule as we did in case of the closed economy. Equation (15) provides such an expression:

$$i_t^p = \frac{1}{\theta_1}(\pi^T - \frac{\beta_2}{\beta_1}P_t^c\,[E\,\{i_t^{us} + \Delta e - \pi_t^c\} + (q^{us} - q^d) + \rho + \delta] - \theta_2 X_t) + \gamma_1\,[\pi_t - \pi^T] + \gamma_2\,Ygap_t + \varphi + \varepsilon_t^{ip} \qquad (15)$$

The open economy interest rate rule clearly demonstrates how foreign factors may have a bearing on monetary policy settings. According to equation (15), in a globalised environment the neutral policy rate will have to be set by taking into account domestic and US term premia, currency risk premia and expected exchange rate movements. We can now think of several scenarios where the policy rate has to be adjusted independently of core domestic objectives. Take, for instance, the case of a lower US term premium that results from policy actions such as large-scale quantitative easing by the Federal Reserve. This prompts a sharp exchange rate appreciation that reduces the cost of credit in the short run. Note that this leads to an easing of domestic monetary conditions, requiring a higher domestic interest rate to stabilise inflation. Such a strategy is especially problematic when domestic fundamentals require an opposite action, and would be unsustainable if higher interest rates encouraged more capital inflows. A reverse scenario may quickly develop if the US term premium starts to rise as was the case, for instance, during the "taper tantrum" episode of 2013 and which led to a sudden tightening of monetary conditions.

Equation (15) also predicts the neutral rate in more direct cases of Federal Reserve actions such as forward guidance (by which it indicated its intention to maintain a zero fed funds rate into the future). Such guidance directly changes the expected path of future US short-term rates and hence credit costs facing EME borrowers. Again, it is difficult to envisage the central bank playing by equation (15). In practice, the dilemma could be more complicated because the exchange rate may appreciate too fast and too soon. Moreover, such appreciation may trigger an unwelcome credit boom, raising risks to financial stability.

In short, with the globalisation of debt markets, monetary policy conducted through the short-term interest rate becomes a much more complicated task. A simple Taylor rule is unlikely to be sufficient in stabilising the economy against external monetary shocks, requiring monetary authorities to depend on a multiplicity of instruments to balance domestic and external objectives (eg Obstfeld (2015)). India's approach has suggested that the degree of capital account openness – and therefore the choice monetary policy regime – plays an important role in determining the impact of external shocks.

VI. Conclusion

The objective of this paper was to review changes in the monetary transmission mechanism in EMEs following several major developments in financial intermediation over the past decade. The globalisation of debt markets, together with a sharp decline in the global long-term interest rate and the accumulation of large dollar debts by EME non-financial corporations, have complicated the transmission mechanism of monetary policy in many countries. One well-known consequence of reduced barriers to international arbitrage is that domestic asset prices cannot deviate too much from international prices. The analysis in this paper suggested that these developments have affected all major channels of monetary policy. This creates new dilemmas for monetary and financial stability policies. That said, as regards to India, our results suggest that domestic monetary policy may have been relatively insulated from global shocks because of the country's cautious approach to securities/financial market liberalisation. Short-term interest rate continues to play a significant role in the macroeconomic evolution of the Indian economy.

A key question is the extent to which the recent changes to the transmission mechanism affect interest rate settings, especially in small open economies. Our results suggest that the traditional Taylor rule can still be a reasonable guide to monetary policy in relatively closed economies subject to gradual changes in financial intermediation. In this case, the neutral interest rate could be adjusted to prevent major inflation risks stemming from changes in financial intermediation. The challenges are more complicated in globally integrated debt markets. As discussed by Obstfeld (2015) and Agenor and Pereira de Silva (2013), a single interest rate instrument is unlikely to be a satisfactory solution in most cases, requiring the central bank to use other instruments (such as foreign exchange intervention, bond market operations and macro-prudential tools) to reduce risks to price and financial stability.

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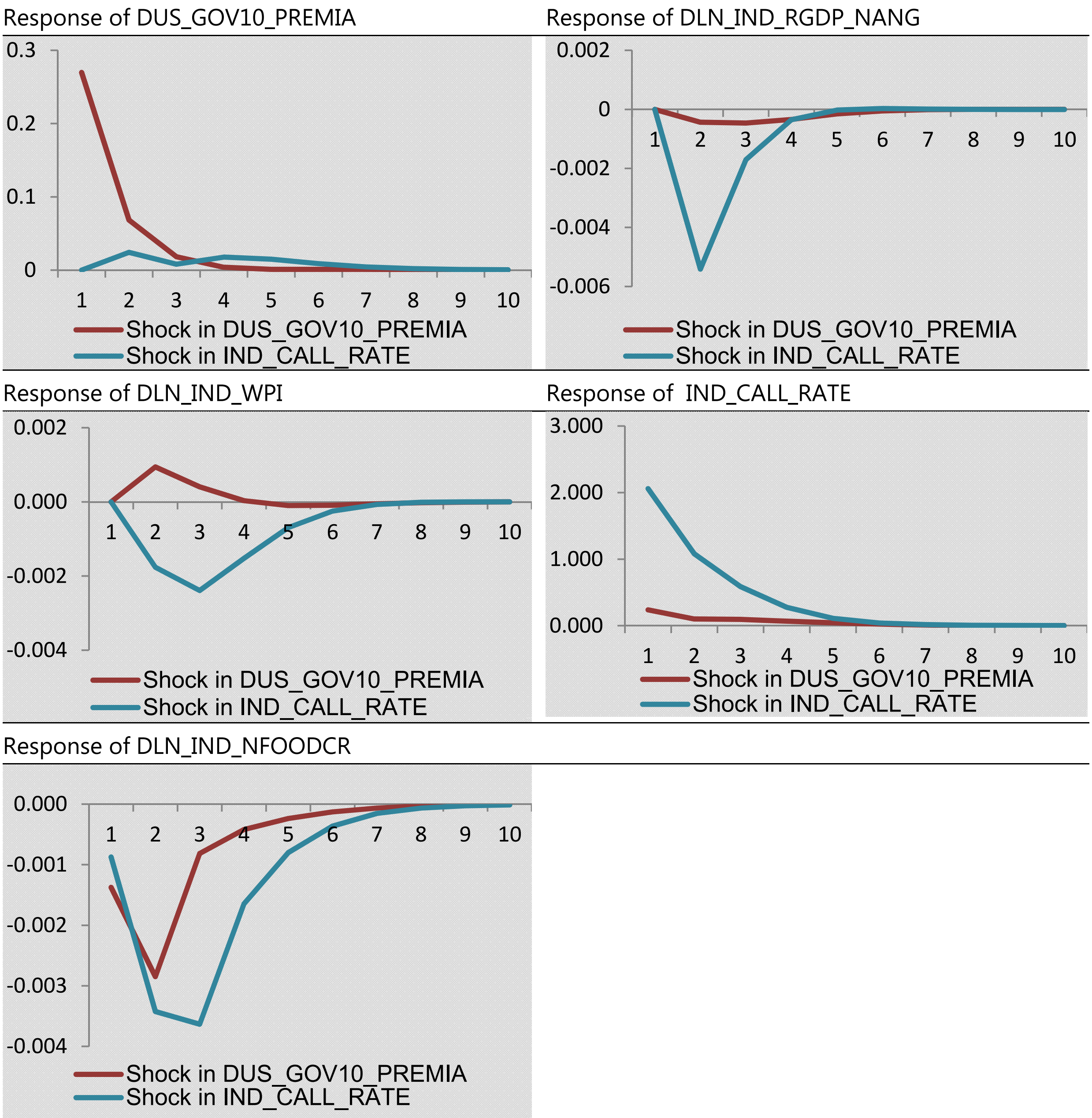
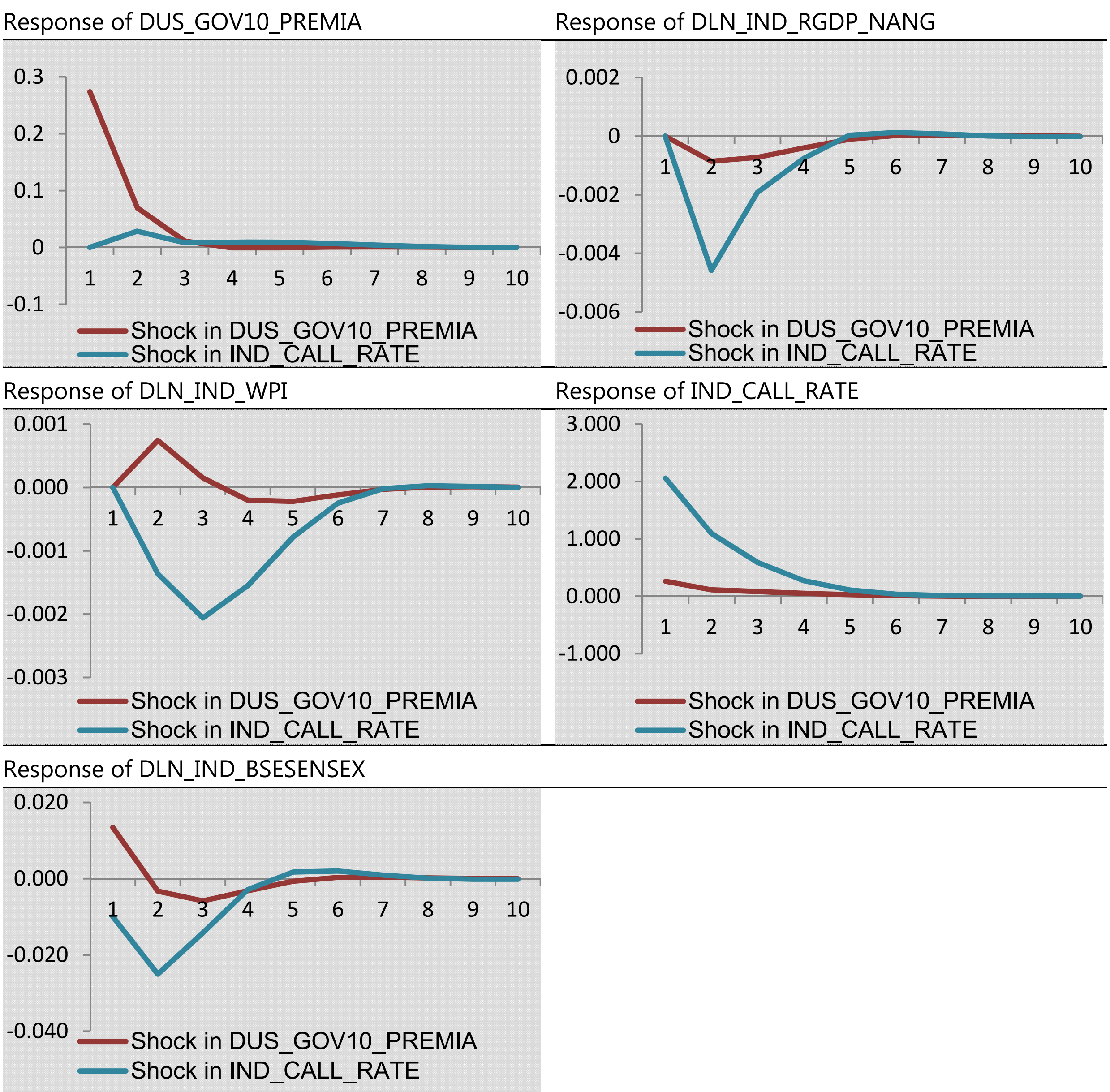
Annex

Impulse Responses from the Augmented Model with Credit Channel | Graph A1

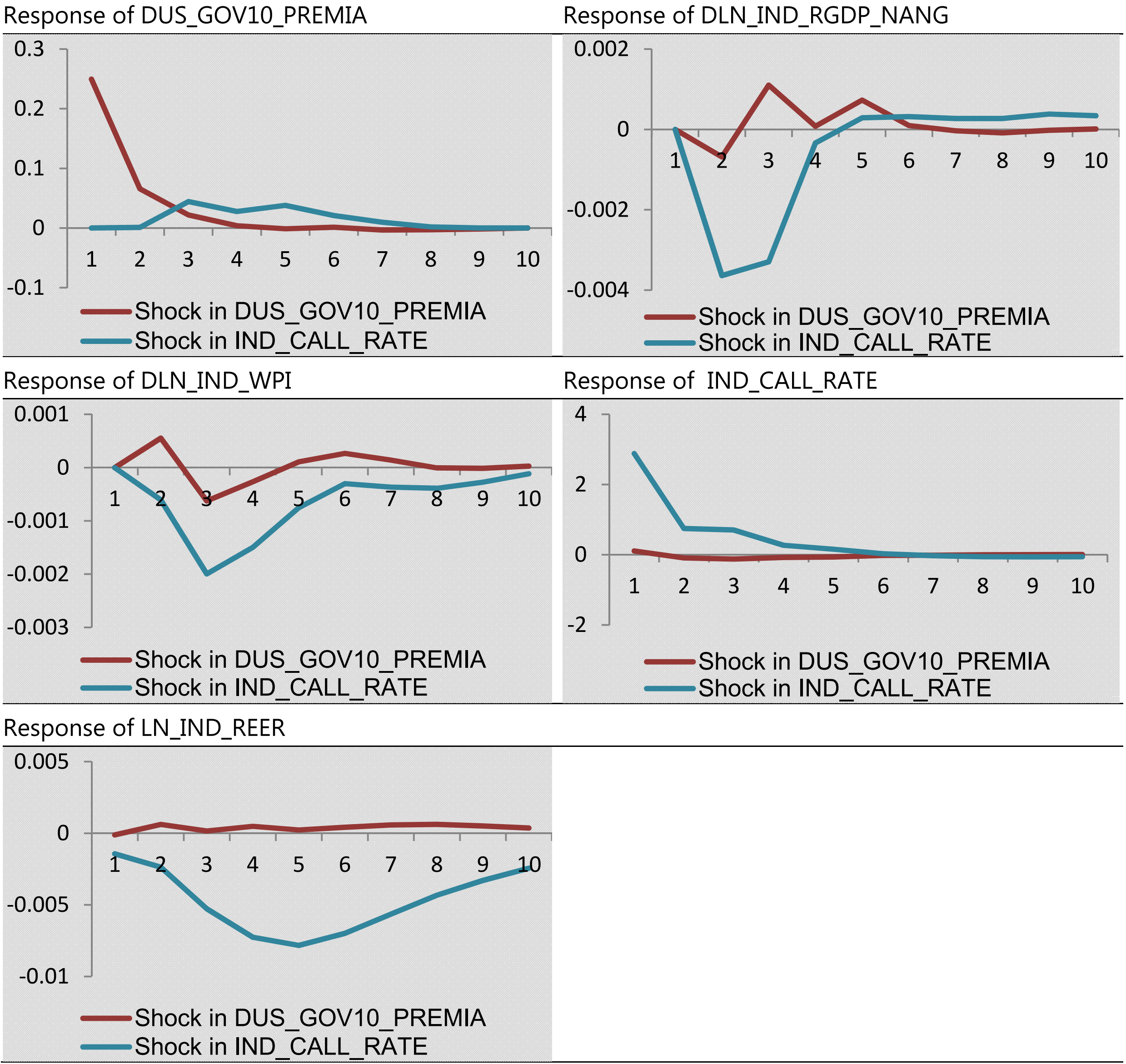


Impulse Responses from the Augmented Model with Asset Price Channel Graph A2



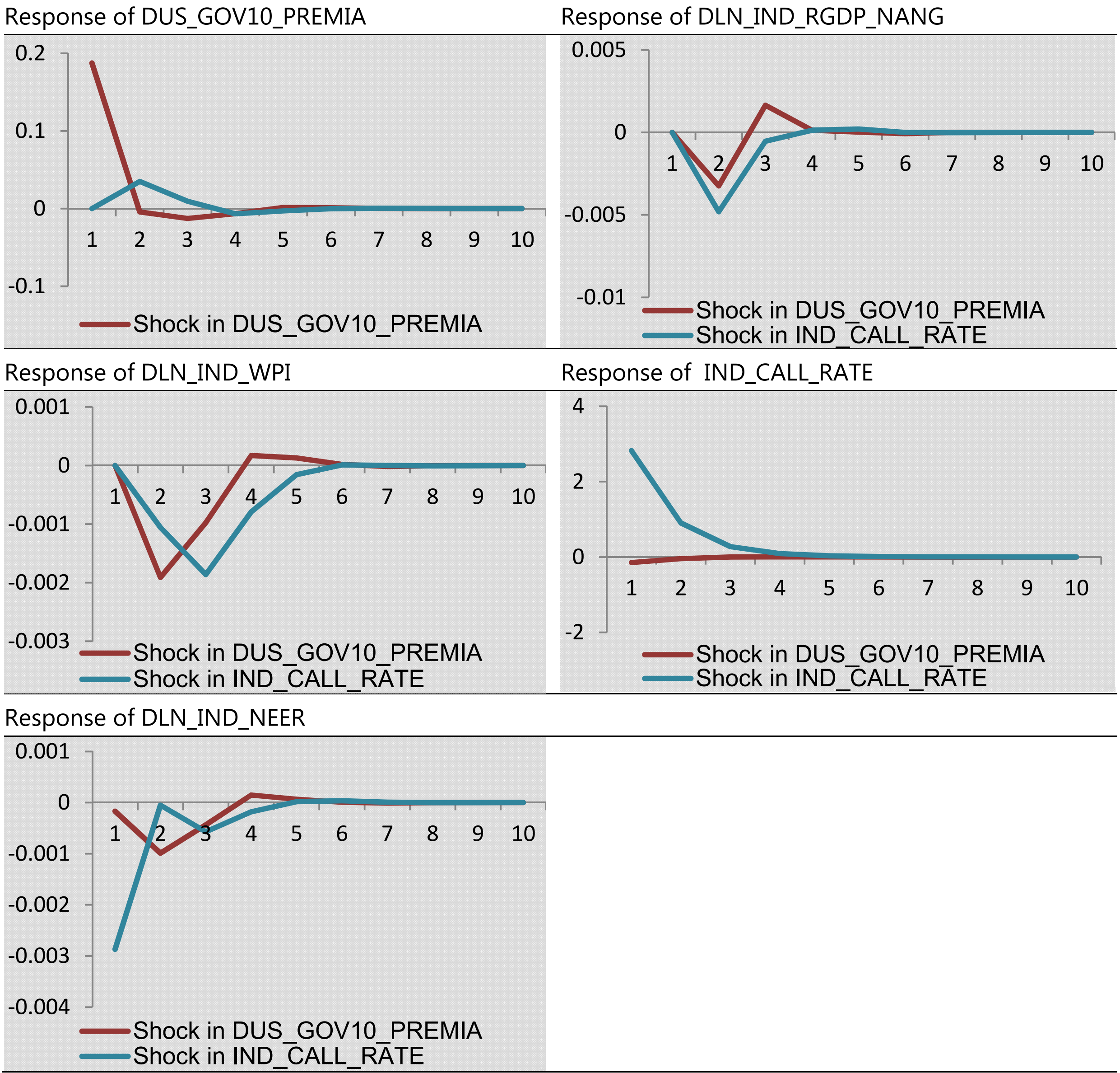
Impulse Responses from the Augmented Model with Exchange Rate Channel (REER)

Graph A3



Impulse Responses from the Augmented Model with Exchange Rate Channel (NEER)

Graph A4



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