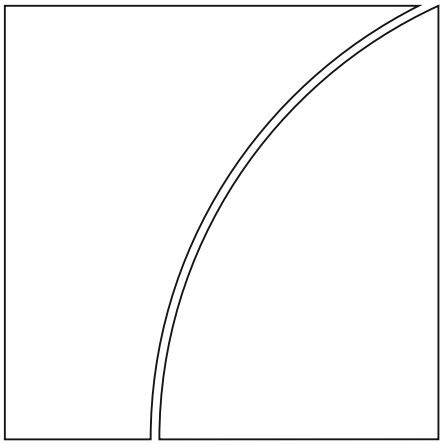

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by Ken Miyajima, M.S. Mohanty and James Yetman

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Spillovers of US unconventional monetary policy to Asia: the role of long-term interest rates[1]

Ken Miyajima, M.S. Mohanty and James Yetman

Abstract

This paper reviews the role of long-term interest rates in international monetary transmission and related policy challenges in the wake of exceptionally easy US monetary policy. It employs a panel VAR model to examine the impact of a very low US term premium on relatively small open Asian economies. The results show that unconventional US monetary policy spills over to Asia mainly through low domestic bond yields and rapid growth of domestic bank credit. Financial integration does not appear to reduce the control of national monetary authorities over short-term policy rates. However, it does compromise control over long-term rates that are key determinants of economic activity. In light of the results, the paper reviews potential policy options to deal with volatile term and risk premiums.

JEL classification: E43, E52, E53, F42

Keywords: Asian economies, international monetary transmission, long term interest rates, monetary policy, risk premium.

[1] This is a revised version of the paper presented at the Bank Negara Malaysia conference on "the future direction of monetary policy frameworks and strategies in emerging market economies" on 21 May 2014. We are thankful to our discussant Roberto Chang for valuable suggestions; to Claudio Borio, Hans Genberg, Luis Oscar Herrera, Marco Lombardi, Robert McCauley, Frank Packer, Hyun Song Shin, Robert Subbaraman, Elod Takats, Philip Turner, Christian Upper, Bill White and other participants at the conference as well as an internal presentation at the Bank for International Settlements for helpful comments; to Tracy Chan and Bat-el Berger for statistical assistance; and to Magdalena Jeziorska for secretarial help. We thank Wenxin Du and Jesse Schreger for sharing their estimates of sovereign risk spreads on emerging market local currency bonds with us. The errors that remain are solely ours.

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1. Introduction

There is now significant evidence that a prolonged period of very accommodative monetary policy in the United States and other major advanced economies has greatly eased financial conditions in emerging market economies (EMEs), creating difficult dilemmas for their central banks in delivering price and financial stability.[2] Views, however, differ as to whether these dilemmas stem from difficulties in setting an appropriate short-term interest rate or the lack of effective instruments in controlling the price of long-term debt and bank credit.

For example, in traditional New Keynesian models with sticky prices and frictionless financial markets, the exchange rate plays the role of a shock absorber; see Clarida, Galí and Gertler (2001) and Galí and Monacelli (2005). Typically, therefore, while a cut in foreign interest rates leads to a real appreciation of the domestic currency, the impact is moderated by expected higher foreign output and hence higher demand for the country's exports.[3] But because the positive output effect comes with a lag, rapid currency appreciation may force some EME central banks to lower their policy rates (Taylor, 2014). This can result in a loss of monetary policy independence.

New Keynesian models, however, tend to underestimate monetary spillover effects for at least two reasons. The first is that, even if the policy rate is assumed to be under the central bank's full control, long-term interest rates can fluctuate because of changes in the term premium triggered by capital flows to bond markets (Turner, 2013 and 2014a). Gertler and Karadi (2013) confirm this by demonstrating that the Federal Reserve's unconventional monetary policy works mainly through the term premium and credit spreads. If US monetary policy transmits to EMEs in part via bond markets, then focusing attention only on the short-term rate and the exchange rate can bias the assessment of the policy stance in these economies.

A second reason is that credit supply functions are missing from the traditional models. As pointed out by Adrian and Shin (2010), the delegation of capital allocation decisions to financial intermediaries raises an agency problem that can be addressed by placing constraints on leverage. Monetary policy affects the haircuts that financial intermediaries apply to the collateral against which they lend. To the extent that an easier US monetary policy reduces the capital and collateral constraints of banks in EMEs, it has the potential to trigger credit booms. In addition, the exchange rate may play an important role in risk-taking (Bruno and Shin, 2014).[4] Because currency appreciation strengthens borrowers' balance sheets, it reduces the perceived credit risk of lenders, leading to rapid credit growth. If the risk-taking channel is an important driver of credit growth, a flexible exchange rate

[2] See a growing literature on international transmission of monetary policy including Taylor (2014), Chen et al (2014), IMF (2014), Bruno and Shin (2013), Rey (2013) and He and McCauley (2013).

[3] Woodford (2009) shows that with a fully flexible exchange rate, sticky prices and unit elasticity of substitution between domestic and foreign goods, foreign monetary policy has no effect on domestic output and inflation, except through changes in foreign output. To the extent that an expansionary monetary policy in the rest of the world increases expected future foreign output, and hence expected inflation in the home country, a higher equilibrium real interest rate will be required to stabilise the economy.

[4] See Borio and Zhu (2012) for a discussion on the risk-taking channel of monetary policy.

is likely to amplify rather than dampen the impact of external monetary shocks.[5] In the words of Rey (2013), central banks face a "dilemma not trilemma".

In this paper, we address two interrelated questions. First, how does US unconventional monetary policy affect domestic financial conditions and monetary policy decisions in EMEs? In particular, what is the role of long-term interest rates in the international transmission of monetary shocks? Second, what instruments are likely to work in dealing with shifts in term and risk premiums?

We throw light on these questions by estimating a monetary transmission model for Asian economies, allowing for a separate long-term interest rate channel. We then extend this model to examine the role of the credit channel (via risk-taking). Our panel VAR model includes five relatively small open Asian economies viz., Indonesia, Korea, Malaysia, the Philippines and Thailand. To correct for possible bias that may stem from the correlation of fixed effects with the instruments, we apply the forward-mean differencing method suggested by Arellano and Bover (1995) to our system GMM estimator. We also cross-check the results with those from VAR models estimated for the individual countries separately.

We reach two main conclusions. First, the term premium in US Treasuries has played an important role in setting financial conditions in Asia, both before and after the recent global financial crisis. Movements in this benchmark do not depend only on US developments but also respond to global developments. Impulse responses from the panel VAR model suggest that a one percentage point increase in the US 10-year term premium leads to approximately 0.6 of a percentage point increase in Asian domestic long-term bond yields within three months of the shock. The response of domestic real bank credit is also meaningful, declining by 1% relative to trend within the first month of the shock. Our findings are consistent with Obstfeld (2014) who notes that "one of the most potent channels for international monetary and financial transmission clearly runs through long term interest rates". Similar evidence has also been reported recently by McCauley, McGuire and Sushko (2014) who find a break in the relationship between the US term premium and the growth of offshore dollar credit for non-US entities around 2009. Our results suggest that the loss of monetary policy independence for EMEs, if any, arises from difficulties in controlling the long-term interest rate, rather than the short-term rate (as has often assumed in the literature).

The second conclusion we highlight relates to appropriate monetary policy strategy in Asia. Foreign exchange (FX) intervention and traditional macroprudential tools may address some of the consequences of a very low US long term rate, but perhaps not sufficiently. Instead, we highlight the importance of liability-based macroprudential tools (Hahm et al, 2012) and debt management policies as possible additional instruments to deal with volatile risk and term premiums. The importance of debt management policies as a monetary policy instrument has been suggested by the experience of the Federal Reserve and the Bank of England, both of whom intervened through large-scale bond purchase programmes to address dysfunctional monetary policy transmission mechanisms. Yet there are potential downsides to such a policy, including weaker fiscal discipline, which must be kept in view.

[5] This is consistent with the findings of Gourinchas and Obstfeld (2012) that currency overvaluation tends to end in financial crises in most advanced and emerging markets.

The rest of the paper is as follows. Section 2 discusses the importance of long-term interest rates in the transmission of monetary shock in an open economy and how the US term premium might play a role in this. Section 3 briefly reviews Asian monetary policy and long-term interest rates both before and after the 2008 crisis. Section 4 presents results from the panel VAR model. Section 5 discusses potential policy options for Asian economies to respond to large international spillovers. Section 6 then concludes.

2. Monetary policy transmission and external shocks: does the long-term interest rate matter?

In the standard description of monetary transmission channels, control of a key short-term interest rate is considered sufficient to have a powerful effect on the entire economy. Since a large part of the transmission of monetary policy occurs via the direct interest rate impact on investment and consumer durables, what matters is how changes in the policy rate by the central bank affect the user cost of capital, which determines the demand for credit and thus aggregate spending. Following Boivin, Kiley and Mishkin (2011), the user costs of capital (U^c) in a closed economy can be expressed as:

$$U^c = P^c[E[(i - \pi) - (\pi^c - \pi)] + \delta], \quad (1)$$

where P^c is the relative price of fixed capital, i is the short-term interest rate, π is inflation rate, π^c is asset price appreciation, δ is the rate of depreciation and E is the expectations operator.[6] Assuming a constant depreciation rate, equation (1) shows that the user cost of capital depends on the expected real interest rate and real price appreciation of the asset over its entire life. Spending plans of households and firms are determined by their views not only of current short-term rates but also expected future short rates. In most economies, this information is given by a key risk-free rate, usually the yield on government bonds. When markets function well, arbitrage between instruments of different maturities imply that short-term interest rates are important for determining the full yield curve.

The global financial crisis, however, challenged this conventional wisdom.[7] The periods of market dysfunction highlighted that the levels of various interest rates and asset prices can remain different, sometimes substantially so, from those that might have been expected based on past experience of "normal" times. It is now well accepted that term premiums on assets can vary independently from fundamentals, at times offsetting the impact of changes in short-term rates. Under such circumstances, central banks can use their balance sheets to influence these risk premiums by buying and selling assets in financial markets. In addition, central banks in advanced economies have taken significant strides in trying to use communication as a policy lever, under the guise of "forward guidance", to influence the expected path of future short-term interest rates.

[6] The user cost of capital also depends on the tax rate, which is not considered here for simplicity.

[7] See Chang (2013) for a recent review.

The user cost framework can also be extended to analyse monetary policy transmission in economies that are highly integrated with global capital markets. International arbitrage implies that the rate of exchange rate deprecation should be associated with yield differentials:

$$LT^d - LT^{us} = E\,\Delta(e) + \rho, \tag{2}$$

where LT^d is the yield on domestic government bonds, LT^{us} is the corresponding yield on US Treasury, e is the nominal exchange rate vis-a-vis the US dollar and ρ is the currency risk premium. Using the term premium q, long-term yields can be decomposed as $LT^d = \mathsf{E}\,(i^d) + q^d$ and $LT^{us} = \mathsf{E}\,(i^{us}) + q^{us}$. Combining (1) and (2) and rearranging terms, the user cost of capital in an open economy can then be expressed as:

$$U^c = P^c[E\,[\,i^{us} + \Delta e - \pi^c\,] + (q^{us} - q^d) + \rho + \delta]. \tag{3}$$

Although the user cost is shown in terms of domestic currency, it is invariant to the choice of the funding currency on the assumption that households and firms hedge their FX exposures on foreign currency debt. Hence, both domestic and foreign currency borrowers face the same effective cost.

Equation (3) illustrates that there are several possible channels through which unconventional US policy can affect the cost of capital and bank credit in EMEs. The first is a change in the expected path of future US short term rates. For example, the Federal Reserve used forward guidance to signal its intention to maintain a zero fed funds rate into the future. This reduces US long-term bond yields, easing financing conditions in EMEs. If EME central banks hold the path of the short-term rate constant in response, the exchange rate will appreciate, overshooting relative to what is implied by the interest rate differential (Obstfeld, 2014). Therefore domestic financing conditions in EMEs ease. By contrast, if EME central banks lower the path of short-term rates in response, this would reduce appreciation pressures on the exchange rate. Over time, however, as expectations adjust, the exchange rate may be expected to depreciate to the level implied by the new interest rate differential.

A second channel operates through asset prices (π^c). Capital inflows are typically associated with higher property and equity prices, which further reduce the user cost of capital, making investment in these sectors appear more profitable. One well-known channel is that the lower user cost of capital boosts the market value of assets relative to replacement costs (Tobin's q), increasing investment in residential and non-residential projects. These impacts are usually reinforced by the positive balance sheet effects of higher asset prices and a stronger exchange rate. Firms and households that have accumulated large foreign currency debts are likely to experience wealth gains from a temporary reduction in the domestic currency value of their foreign currency debt. This boosts demand for credit as well as the creditworthiness of these borrowers, encouraging banks to expand credit – the so called "financial accelerator" channel, as identified by Bernanke et al (1999) and further developed by Bruno and Shin (2014).

The net economic effects of lower bond yields, higher domestic asset prices and a stronger exchange rate depend on the structure of the economy. In countries with a large tradable sector real exchange rate appreciation reduces exports and can substantially weaken that sector's growth prospects, at least in the short run. The effect on aggregate output may be limited, if non-tradable output expands. However, Turner (2014b) argues that, even so, central banks are unlikely to be indifferent to the resulting shrinkage of the tradable sector, as this can create risks

to financial stability. Taken together, lower bond yields and exchange rate appreciation may provide a rationale for lowering the path of short-term interest rates.

A third channel operates through the term premium and the currency risk premium (q and ρ). A lower US term premium, similar to a decline in the expected path of US short term interest rates, leads to exchange rate appreciation and reduces the cost of capital in the short run.

It is generally assumed that government bonds (such as US Treasuries) are free of credit risk, and therefore the term premium represents compensation to investors for facing the uncertainty that future short-term rates and inflation may not turn out as expected. However, to the extent that investors consider EME government bonds to be risky assets (relative to US Treasuries), these investors are likely to demand an additional risk premium for two reasons. The first is uncertainty about the expected default probability (bond risk premium). Second, EM exchange rates historically have been more volatile than those of advanced economies, requiring further compensation for holding EME bonds (currency risk premium). And the risk premia likely account for a significant part of the local currency bond yields of EMEs.

As a result, EME bond and currency risk premiums may fluctuate with changes in US monetary policy, including the Federal Reserve's quantitative easing policy that can affect the US term premium.[8] As pointed out by Bruno and Shin (2013) and Bekaert et al (2013), a key channel operates through investor risk aversion. An easier US monetary policy reduces perceived risk and uncertainty (represented by the VIX), which boosts capital inflows and compresses risk premiums. Feroli et al (2014) show that this channel has assumed increasing importance with rapid expansion of specialised bond arbitrageurs such as asset management companies, leading to potential pro-cyclical dynamics in relatively illiquid bond markets.[9]

Such risk premiums are unobservable and need to be estimated using models. While there are widely-used indicators of risk premiums on EME foreign currency bonds (eg the JP Morgan Emerging Market Bond Index spread), such measures are not available for EME local currency bonds. Nevertheless, several recent papers confirm that the yields on these bonds include a substantial risk premium.

For instance, Du and Schreger (2013) have estimated credit spreads on local currency (LC) bonds of 10 major EMEs by constructing a synthetic, local-currency risk-free yield curve. The idea is that an investor with a dollar portfolio wanting to invest in, for instance, a Brazilian "real" government bond can swap its future payment in reals into dollars by paying a spread in the cross-currency swap (CCS) market. An equivalent operation can be used to swap risk-free US treasury yields into Brazilian reals. If UIP holds, the US treasury yield swapped into reals should be equal to the Brazilian real government bond yield. In other words, the cross-currency swap spread, which represents expected future depreciation of the real, is

[8] Several recent papers have suggested that bond risk pemiums tend to have a large global component that is highly correlated with US risk premiums (Hellerstein, 2011 and Dahlquist and Hasseltoft, 2012).

[9] In their model US monetary policy generates non-linear dynamics in relatively illiquid EM markets by strengthening a feedback loop between prices and flows. The incentive mechanism facing asset managers (whose payoffs are linked to the value of assets under management) aggravates buying and selling pressures in these markets, leading to pro-cyclical behaviour of risk premiums.

equal to the yield differential. However, the cross currency basis spread will differ from the yield differential if there is local currency sovereign credit risk:

LC credit spread = LC yield – (US yield + CCS spread). (4)

The authors show that EM local currency sovereign yields violate UIP systematically. The estimated local currency sovereign credit spread on 5-year bonds is large and positive, with a cross country mean of 130 basis points over 2005–11. The average credit spread varies widely among the 10 EMEs, ranging from 55 basis points for Peru to 313 basis points for Brazil. The authors report that the first principal component, which explains about 54% of variation in local currency sovereign credit spreads for the 10 EMEs, is significantly correlated with the VIX (correlation coefficient of 0.76). The influence of the VIX on the common component of EME foreign currency sovereign credit spreads is reported to be even stronger (correlation of 0.93) than that for the local currency bonds.[10]

Munro (2014) goes a step further by estimating bond and currency risk premiums separately for several Asian economies by employing a risk-augmented asset price model. She reports that both types of premiums are strongly influenced by the VIX. Her results also suggest that currency risk premiums are negatively correlated with the stock of FX reserves, implying that countries intervening in the FX market tend to see lower currency premiums than those that do not. However, the authorities face a trade-off. Although FX intervention lowers the currency risk premium, it tends to increase the bond risk premium.

In sum, unconventional monetary policy by central banks in large advanced economies can affect EMEs: movements in bond yields, asset prices and exchange rates have substantial implications for the cost and quantity of credit. Before examining the quantitative significance of these channels, in the next section we briefly focus on the evolution of monetary policy and long-term interest rates in Asia since the Asian financial crisis.

3. Monetary policy and long term interest rates in Asia

Ever since the Asian financial crisis (1997–98), the weight that Asian policymakers place on inflation stabilisation has been increasing. The clearest evidence of this was the adoption of formal inflation targeting by Thailand (in 2000), Korea (in 2001), the Philippines (in 2002) and then Indonesia (in 2005).[11] But even beyond the formal adoption of inflation targets in these economies, the weight on price stability has increased more broadly across the region (Filardo and Genberg, 2010).

During this period, monetary policy in many Asian economies appeared to be moving towards the standard "New Keynesian" prescription. Key elements of this approach include a short-term interest rate, or policy rate, being used as the primary monetary policy tool, which is set with an eye to ensure that expected

[10] Miyajima, Mohanty and Chan (2014) show that while the influence of the VIX on local currency bond yields of EMEs declined after 2009, that of US bond yields almost doubled, reflecting greater "search for yield" by foreign investors.

[11] See Jahan (2012).

future inflation is well behaved. As part of this evolution, the maturities of the key monetary policy targets in Indonesia, Malaysia and Thailand all declined from one month, three months and two weeks respectively to one day or overnight interest rates during the 2000s. Around this target rate, many central banks operated a "corridor" system, accepting short-term deposits from, or lending liquidity against collateral to, financial institutions at interest rate margins (relative to the policy rate).

Prior to the 1997–98 Asian financial crisis, many Asian economies did not have substantial bond markets of their own, and therefore the role of yield curves in domestic and international monetary policy transmission was limited.

However, one important development over the past decade has been the development of a liquid local currency bond market in many countries. As documented by Mehrotra, Miyajima and Villar (2012), the outstanding stock of local currency government securities in the region rose nearly five-fold between 2001 and 2010, to $2.4 trillion, and the average maturity lengthened from 3.7 to 5.7 years. Large growth in trading volumes and reduced bid-ask spreads over the past decade suggest that market liquidity is improving and transaction costs are declining. Bond markets of Korea and Malaysia are amongst the most liquid, both in the region and across EMEs as a whole. The emergence of a local currency sovereign yield curve has, in turn, led to growth in domestic corporate bond markets.

Another major development has been the rapid growth of foreign investment in Asian local currency bond markets, helping to integrate these markets with international bond markets. For instance, the ratio of foreign ownership of Asian local currency government bond markets was practically zero in many countries in the beginning of 2000s. By 2012, it rose to 30% in Malaysia and 10–15% in Korea, the Philippines and Thailand.[12] The possibility for foreign investors to arbitrage international interest rate differentials through bond markets has led to a rapid increase in capital flows to these countries.

Very few studies addressed the direct role of long-term interest rates in the monetary transmission mechanism for the pre-2008 global crisis period. One exception is García-Herrero and Remolona (2008) who show that sovereign yield curves in Asia were generally consistent with the expectations hypothesis of term structure of interest rates. More generally, there was much ambiguity about the role of the interest rate channel.[13]

[12] See Mohanty (2014).

[13] For instance, employing a structural VAR model to study the impact of changes in the monetary policy stance, Fung (2002) reported that the interest rate channel was relatively weak in Asia, while monetary policy was mostly transmitted through the exchange rate. Similarly, Disyatat and Vongsinsirikul (2003) noted that interest rates alone do not adequately capture financial and economic links in Asia, with quantity channels such as bank credit and the money supply playing a greater role in the monetary transmission mechanism. On the other hand, Mohanty and Turner (2008) show that the output and inflation response to interest rates improved in Asia in the first half of 2000s, reflecting more developed financial markets.

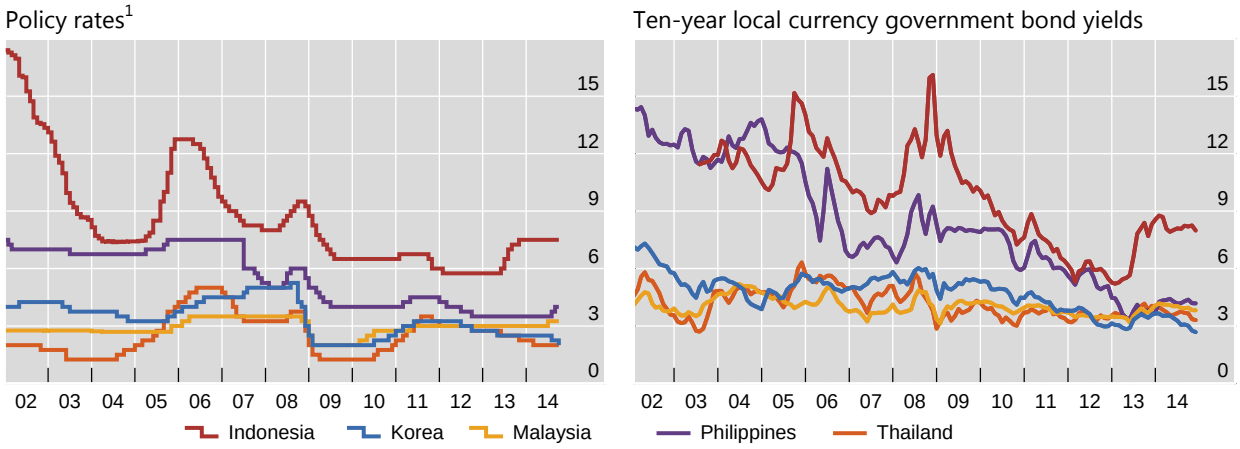
The post-2008 crisis period

In the years following the crisis, monetary policy played a prominent role in macroeconomic stabilisation. As in most advanced economies, Asian monetary authorities sharply cut their policy rates following the 2008 crisis.

However, as the left-hand panel of Graph 1 shows, policy rate movements in Asia have been far from unidirectional. Having cut rates, most central banks in the region raised them as the economic recovery firmed in 2010. Policy rates were again cut in late 2011 / early 2012 as signs of renewed economic weakness emerged. More recently, rates have remained at low levels, with the exception of Indonesia which raised policy rates sharply in May 2013 following Federal Reserve's first "taper" announcement.

Policy rates and long term yields

In per cent — Graph 1



[1] For Indonesia, BI rate; for Korea, Base Rate; for Malaysia, Overnight Policy Rate; for the Philippines, Reverse Repo Rate; for Thailand, one-day repurchase rate.

Sources: Bloomberg; Datastream.

Overall, policy rates in Asia have been quite volatile over the past six years, reflecting underlying uncertainty regarding the real economy. However, as the right-hand panel of the Graph 1 shows, the picture for the long-term interest rate is different. These rates either continued to fall or remained flat through much of the past six years, before jumping in some cases in May 2013.

In Graph 2 we plot two major indicators of co-movement of long-term rates in Asia. The first is the so-called term spread, calculated as the difference between long-term and short-term yields. These spreads have been more synchronous across Asian economies in recent years than they were before the start of the global financial crisis. While it is possible that part of this synchronicity reflects expectations that future changes in the monetary policy stance are likely to occur in lock-step across the region, this is unlikely to be the full story. Instead, synchronous term spread declines bear the hallmark of strong (common) external influences.

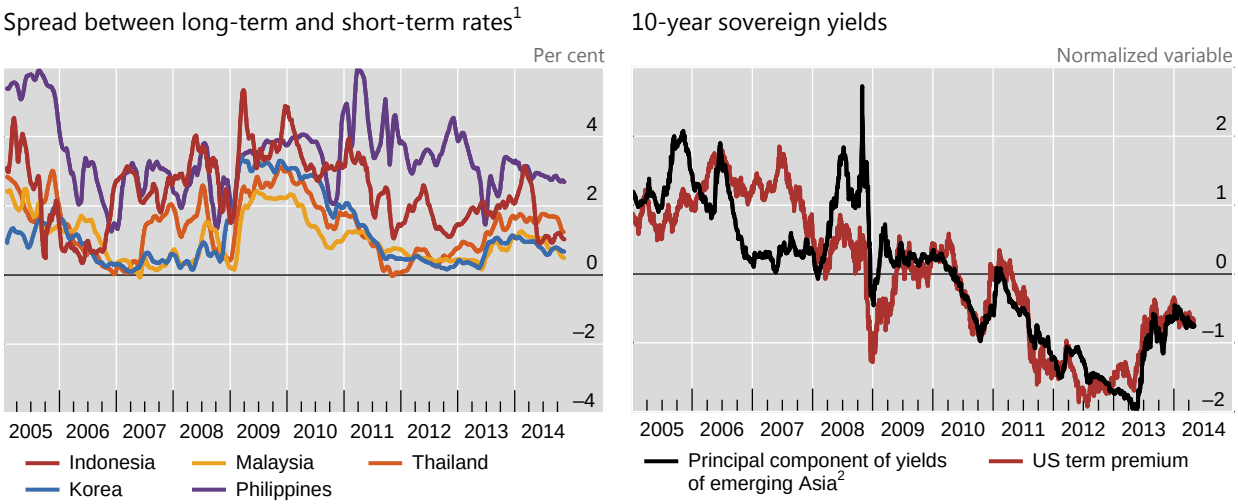
The second indicator is the correlation of long rates with the US term premium, shown in the right hand panel. The red line displays the estimated US 10-year term premium (normalised) taken from Hördahl and Tristani (2011), while the black line

reports the first principal component of long-term rates in a larger set of Asian economies than the five countries we focus on in this paper. Interestingly, the first principal component of bond yields explains in excess of 95% of the behaviour of these yields.

The US term premium has been volatile over much the past decade, touching a high of around 1.3% in October 2008 and a low of –1.2% in July 2012 before rising sharply beginning in May 2013. As can been seen from the graph, the common component of the Asian long-term rates diverged significantly from the US term premium up to 2008 but then moved highly synchronously with it afterwards, as US short-term rates reached the zero lower bound and the Federal Reserve introduced its large-scale asset purchase programme.

Long-term rates and spread

Graph 2



[1] Four-week moving average of spread between ten-year and three-month government bond yields. [2] The first principal components of 10-year sovereign yields of China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand, explaining 97% of yields of these emerging markets.

Sources: Bloomberg; CEIC; Datastream; national data; BIS calculations.

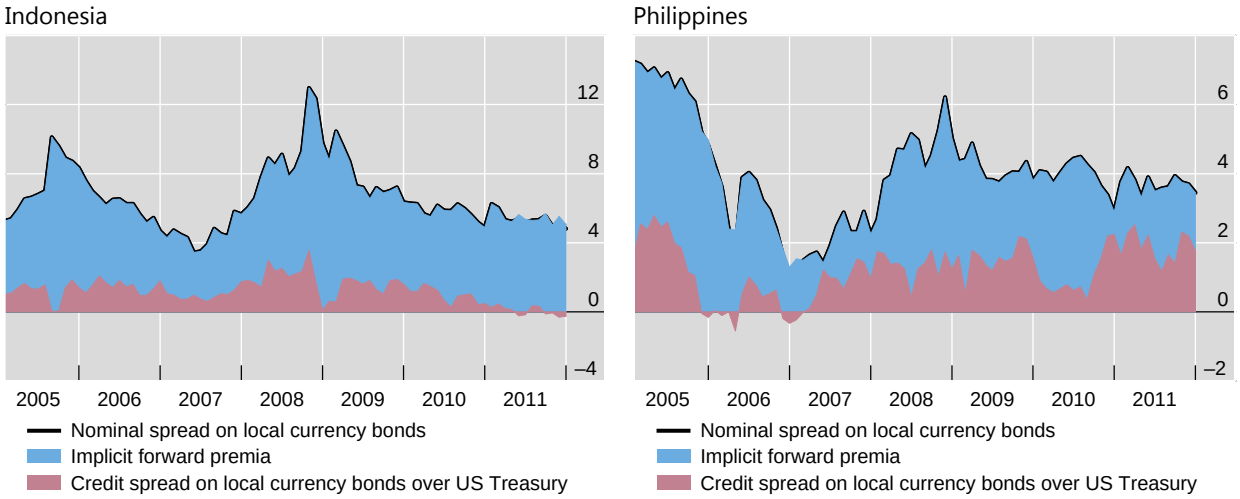
What drove this correlation? As an illustration, in Graph 3 we plot the yield differential against the US Treasury bond for Indonesia and the Philippines – the two Asian economies included in Du and Schreger's (2013) study for measuring sovereign credit spreads for EMEs. The differential is decomposed into estimates of the implicit forward premium and the residual representing the local currency sovereign risk premium.

Taken at face value, the graph shows that Indonesia and the Philippines experienced a sharp reduction in their interest rate differential over the US Treasury yield through 2007, before rising again in the run up to the 2008 global financial crisis. Much of the narrowing differential was because of a reduction in the expected rate of currency depreciation, which coincided with capital inflows, when the sovereign risk premium of the Philippines fell markedly for a brief period. The yield differential rose sharply in both economies during the 2008 crisis due to capital outflows from the region and strong depreciation pressures. It has continued on a downward trend since then.

In the post 2008-crisis period, in the case of Indonesia, almost all of the reduction in the yield differential over the US during 2009–11 came from a compression of the sovereign risk premium, coinciding with US unconventional monetary easing. By contrast, the Philippines has witnessed a considerable rise in its sovereign risk premium, which has broadly been counterbalanced by a lower rate of expected currency depreciation. These two country examples confirm the general notion that risk premiums can explain a significant share of long-term interest rate movements in Asian EMEs.

Interest rate differential over the US

In percent — Graph 3



Source: Du and Schreger (2013)

4. A panel VAR model

In this section, we examine monetary policy spillovers from the US to Asian economies by estimating a panel vector autoregression (VAR) model. We focus on two specific questions: are US long-term interest rates important for domestic monetary policy transmission in emerging Asia? And has this changed in recent years, particularly following the 2008 crisis?

Approaches to representing foreign monetary policy variables in the monetary transmission mechanism vary. Two are worth noting. The first is an indirect approach, where the US policy rate and investor risk sentiment (VIX) play an important role in credit and financial cycles in EMEs; see, for instance, Bruno and Shin (2013) and Rey (2013). In these models, output and inflation in EMEs are not explicitly modelled, under the assumption that international financial cycles drive domestic macroeconomic cycles in EMEs.

A second approach is to account for the direct effect of US monetary conditions on domestic financial and real variables in EMEs. For instance, the IMF has been actively analysing international spillovers using global transmission models. In a study focusing on Asia, Jain-Chandra and Unsal (2012) find that long-term interest rates in Asia are predominantly driven by global factors, even though

monetary policy transmission through domestic short-term interest rates also remains effective. Domestic monetary policy transmission is somewhat weaker when capital inflows surge. The authors rely on a dynamic factor model and an SVAR model estimated on data spanning 2005–10.[14] Chen et al (2014) use a global vector error correction model to study international effects of US monetary policy. They note that while US unconventional monetary policy has had significant implications for equity prices, bank credit and inflation in EMEs, the impact varies across Asia, depending on the monetary regime. They do not, however, consider the explicit role of long-term interest rates in the international transmission mechanism.

The model and identification

We use the following VAR model to estimate the relationship between the domestic variables and international variables:

$$Y_t = A_0 + \sum_{i=1}^{p} AY_{t-i} + BZ_t + \epsilon_t, \quad (5)$$

where Y is a vector of endogenous variables including industrial production (*IP*), inflation (*INF*), the domestic overnight interest rate (*IR*), the domestic five-year bond yield (*YLD*) and the bilateral nominal exchange rate against the US dollar (*NER*)[15] and Z is an exogenous variable representing US monetary influence (*US*). These variables are standard. Our innovation is to rely on the US 10-year Treasury yield and the US 10-year term premium as proxies for foreign monetary influence on Asian monetary transmission.

We obtain structural identification by imposing a standard Cholesky decomposition of the estimate of the variance-covariance matrix. Of our five domestic variables, *YLD* and *NER* are market prices and adjust instantaneously to other variables (and *NER* is often modelled as most responsive). They are modelled as depending on the contemporaneous values of the three slower-moving domestic variables: *IP*, *INF* and *IR*. Of these three, *IR* responds contemporaneously to *IP* and *INF*, but not vice versa, and inflation is modelled as depending on contemporaneous industrial production, as is commonly assumed elsewhere. Finally, the United States is exogenous to all domestic variables in the system. Thus the variables are ordered as *{US, IP, INF, IR, YLD, NER}*. Given that *YLD* and *NER* are both highly responsive market prices, we also estimate the model with the order of these two variables reversed, as in *{US, IP, INF, IR, NER, YLD}*.

Estimation

We use monthly data for two samples spanning 2003M1–2007M12 and 2009M06–2013M12 and focus on five Asian economies. The period is chosen bearing in mind

[14] See also Ramos-Francia and García-Verdú (2014) who use a factor augmented VAR model to examine possible changes to the monetary transmission mechanism in EMEs. They conclude that US unconventional monetary policy may have led to some structural changes in the links between the policy rate, the exchange rate and long term interest rates. However, the shift is not uniform across EMEs, and varies depending on the specific characteristics of the economy.

[15] For Malaysia, the nominal effective exchange rate is used for the period of 2003M01–2007M12 as the ringgit was pegged to the US dollar through the mid-2000s. The US dollar bilateral exchange rate is used for the period of 2009M06–2013M12.

the need to exclude periods of exceptional market volatility and to balance the number of monthly observations between the two sample periods. As already noted, the five Asian economies are Indonesia, Korea, Malaysia, the Philippines and Thailand. Among other major EMEs in Asia, China, Hong Kong, India and Singapore have either relatively closed capital accounts and/or relatively rigid exchange rate regimes and are therefore considered as less suitable for our analysis.

All variables except for the US term premium and interest rates (short- and long-term) are in levels and expressed in terms of percentage deviations from Hodrick-Prescott (HP) trends. The US term premium and interest rates are in percentage point deviations from their HP trends. This ensures stationarity and also allows for time-varying trends (or changing equilibrium levels) for dynamically evolving economies. The number of lags in the model is set to two.

The model was estimated using the *pvar* routine developed by Love and Zicchino (2006), which exploits a system-based GMM estimator as in Arellano and Bover (1995). As the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. The orthogonality between transformed variables and lagged regressors is preserved by forward mean-differencing (the Helmert procedure in Arellano and Bover, 1995), which removes the mean of the future observations. Then, lagged regressors are used as instruments to estimate the coefficients by system GMM.[16] We cross-check the results with those from VAR models estimated for the individual countries separately.

Benchmark results: a rise in the US long term rate

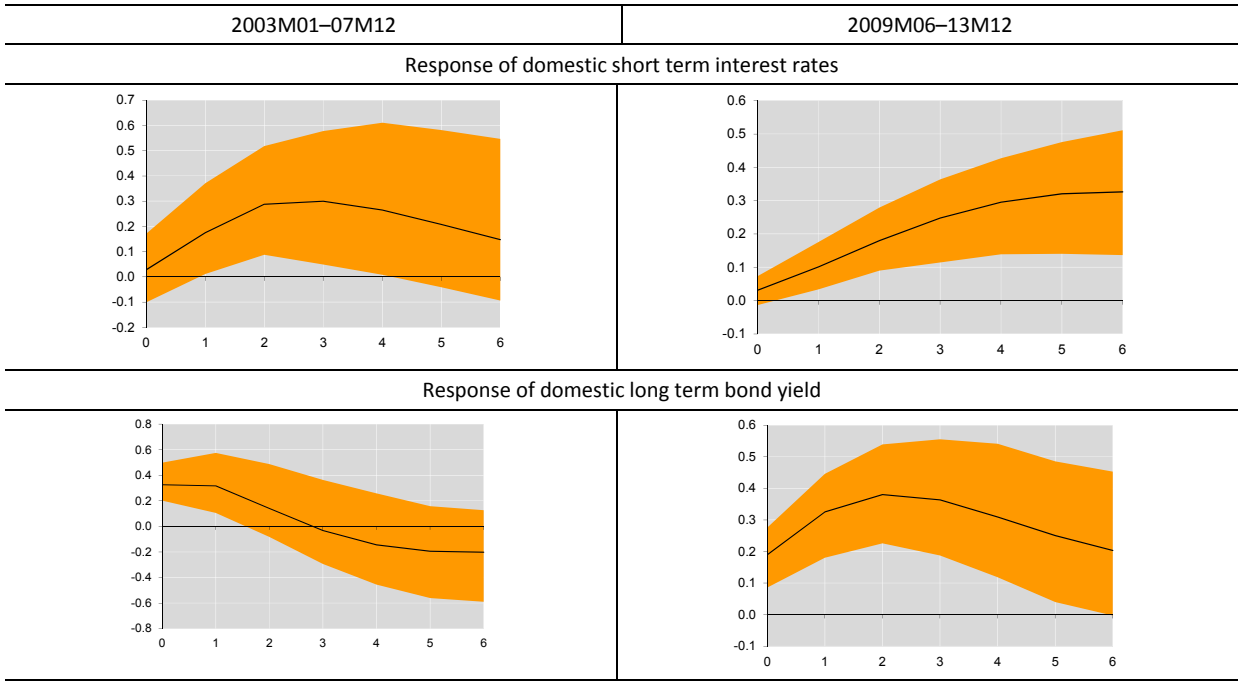
As our benchmark model, we first focus on impulse responses from a rise in US long-term bond yields. Prior to 2008, such a rise could potentially stem from innovations to either the fed funds rate or the US term premium. In the post 2008 crisis period, with short rates at zero, the dominant view is that the Federal Reserves' asset purchase programmes drove down long-term interest rates via compression of the term premium (Gertler and Karadi, 2013). Others have argued that unconventional monetary policy may have actually worked through market expectations of future short-term rates – over and above that implied by forward guidance – by providing a signal that the Federal Reserve would maintain ultra-easy monetary policy in future (Bauer and Rudebusch, 2014). Whatever the source, in this scenario, both types of innovations may be expected to have similar effects on Asian economies.

[16] Goodhart and Hofmann (2008) point out that instrumental variable- or GMM-based estimators can overcome the bias of the fixed effects estimator but are in turn subject to other drawbacks. Instrumental variable estimators are less efficient than OLS estimators, which can outweigh the bias of the fixed effects estimator in empirical applications. Moreover, when the instruments are only weakly correlated with the instrumented variables, estimated coefficients can be biased and hypothesis tests suffer large size distortions. Gambacorta et al (2014) argue that fixed effects estimators are inconsistent in dynamic panels if the coefficients on the endogenous variables differ across countries. In particular, restricting the coefficients to be the same across groups induces serial correlation in the residuals when the regressors are autocorrelated. Instrumental variables do not account for this serial correlation. Therefore Gambacorta et al (2014) rely on a mean group estimator which provides a consistent estimate of the mean effects by averaging across countries.

Graph 4 shows the response to a one percentage point increase in the US 10-year bond yield of domestic long- and short-term interest rates. The response of other variables, namely the exchange rate, industrial production and inflation, are shown in Graph A1 in the annex. As can be seen from Graph 4, the response of local currency long-term interest rates in Asia to a rise in the US long term rate is substantial in both periods. During 2003–07, Asian local bond yields immediately rise by 0.3 percentage points and return to the base line after a relatively short period, in less than two months. During 2009–13, the response is more persistent: Asian bond yields continue to rise through the following two months before returning to baseline after more than six months.

Response to a 1 percentage point increase in US 10-year bond yield

(percent or percentage point) Graph 4



Source: Authors' calculations

Interestingly, in both periods, domestic short-term interest rates rise in response to a higher US 10-year bond yield. During 2009–13 domestic short terms rate increase up to 0.3 percentage points over a 6 month period. One possible explanation is that Asian central banks tend to raise short-term interest rates defensively to prevent large capital outflows and rapid depreciation of the exchange rate.

The response of the nominal bilateral exchange rate against the US dollar appears to be more mixed (Graph A1). The response is not statistically significant during the first period. During the second period, the exchange rate appreciates briefly, which is due likely to the rise in short-term interest rates.

The results are ambiguous insofar as the impact on output and inflation is concerned. Industrial production in Asia declines in the period before the 2008 crisis but the impact is statistically insignificant after the 2008 crisis. Puzzlingly, inflation tends to rise, particularly during 2009–13. One explanation is that higher domestic interest rates pass through to domestic lending rates, increasing firms' production

costs and domestic inflation. An alternative explanation of this "price puzzle" is the failure to include a rich enough specification of the information available to policymakers. Absent those variables in the VAR system, positive innovations in interest rates may partly reflect systematic policy responses to information indicating that inflation is on the way, and therefore may be associated with higher prices.[17]

Alternative specifications: different US variables

A rise in the US fed funds rate

Our baseline result is consistent with findings of many others that US unconventional monetary policy may have reduced monetary policy independence in Asia (eg Hofmann and Bogdanova, 2012 and Takáts and Vela, 2014). However, as noted in Section 2, we think that this impact is not directly related to the US short-term interest rate, as is often postulated in theory. In order to test this hypothesis, we replace the US 10-year yield with the US fed funds rate. As the fed funds rate has been close to zero since the beginning of 2009, we use a shadow fed funds rate estimated by Lombardi and Zhu (2014).[18]

The relevant impulse responses are shown in Graph A2 in the annex. It is clear that the system does not show much systematic response to a shock to the US fed funds rate. If anything, domestic short-term interest rates in Asia tend to fall, rather than rise, following an increase in the US policy rate. In response to a one percentage point increase in the US fed funds rate, industrial production in Asia falls in both periods. The exchange rate depreciates during the second period by up to 1.5 percentage points, before returning to the baseline after three months.

A rise in the US term premium

To further check the channels through which the US long term interest rate affects Asian domestic variables, we replace the US 10-year yield with an estimate of the US 10-year term premium from Hördahl and Tristani (2011). The US 10-year term premium can increase due to a tighter US monetary policy stance, whereby the Federal Reserve sells a part of its long-term treasury holding in the market. Such a rise could also stem from a market sell-off, triggered possibly by a rise in perceived US credit or inflation risks.

The responses of domestic bond yields and the exchange rate are shown in Graph 5 and responses of other variables are reported in Graph A3 in the annex. Several key messages emerge from the graphs. Most importantly, the US term premium has greater influence on Asian long-term interest rates than the US 10-year bond yield or the fed funds rate. In both periods, domestic long yields rise by up to some 0.6 percentage points, about twice as much as that in the benchmark specification following a one percentage point rise in the term premium. A shock to the US term premium is qualitatively different from that to interest rates due to its

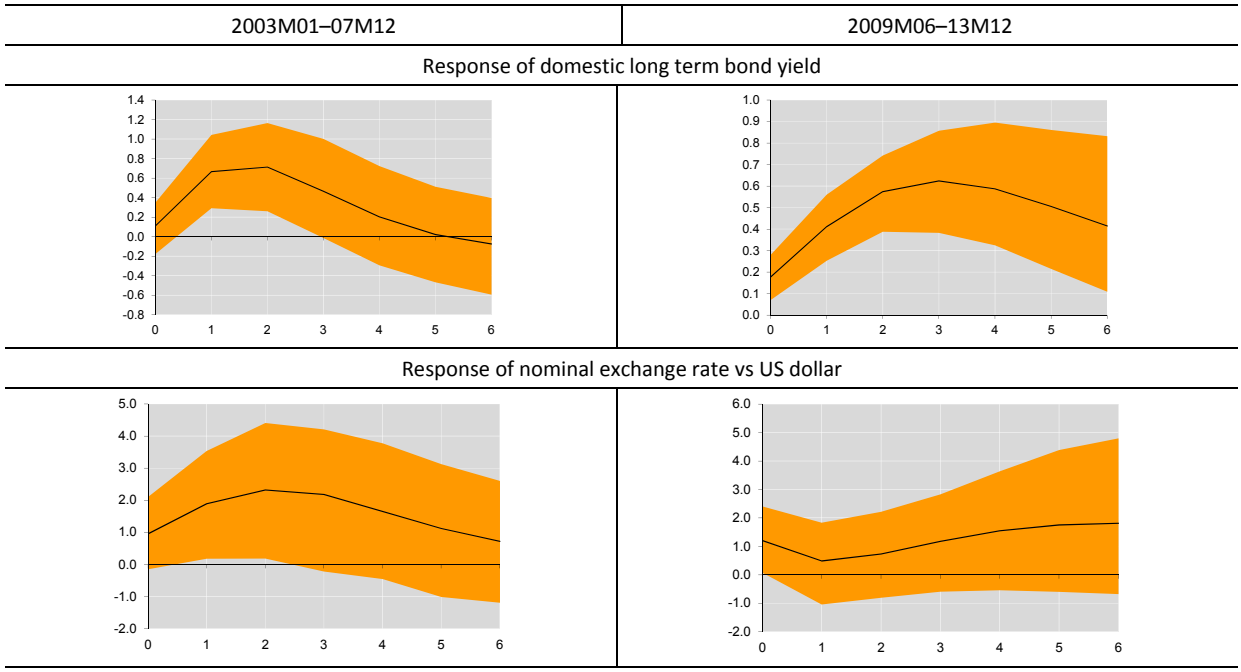
[17] Disyatat and Vongsinsirikul (2003) remove the price puzzle in their VAR models for Thailand by including bank credit.

[18] They use a range of quantity and price variables that are likely to be correlated with the fed funds rate when it was more firmly in positive territory to estimate a shadow rate.

potential to trigger a more severe re-pricing of emerging market assets. The response of the exchange rate also suggests the potential for a rise of the US term premium to worsen investor attitude toward risk. The exchange rate depreciates in both periods, even though the magnitude is larger (by one percentage point) and more persistent during 2003–07.

Response to 1 percentage point increase in the US term premium

(percent or percentage point) Graph 5



Source: Authors' calculations

The response of other variables is similar to that in the benchmark specification. The response of domestic short-term interest rates is statistically insignificant during 2003–07. However, the variable rises by up to 0.4 percentage points during 2009–13, implying that Asian central banks tend to tighten monetary policy more aggressively in response to a rise in the US term premium in the latter sample. The response of output is mixed and statistically insignificant. Inflation rises but, as in the benchmark specification, the response during 2003–07 is not statistically significant.

Alternative specification: domestic bank credit

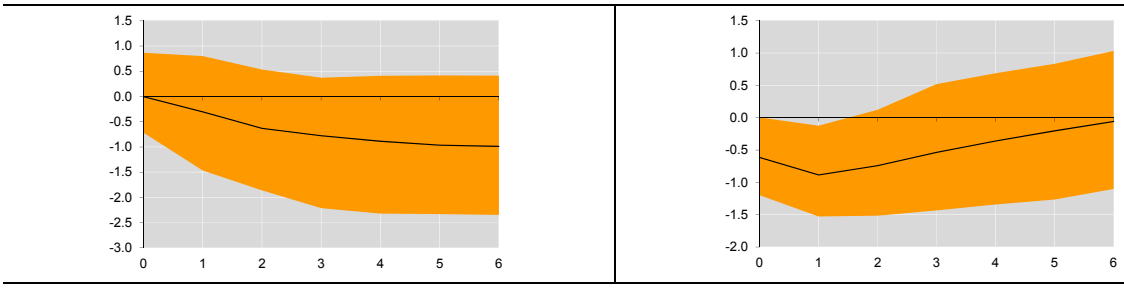
As mentioned in the introduction, risk-taking could be an important driver of credit growth. To the extent that movements in the US term premium can affect investors' attitudes towards risk, they should also influence domestic credit growth, as argued by Shin (2013a) and Rey (2013). During the period of very low global interest rates, the low US term premium is believed to have pushed large cross-border portfolio flows into EMEs, increasing their domestic credit creation (Borio et al, 2011). McCauley, McGuire and Sushko (2014) argue that the US term premium has affected the growth of dollar credit outside the United States, and that the relationship between the two has strengthened after 2009.

Moreover, credit growth tends to be more strongly correlated with output growth than industrial production. With these arguments in mind, we introduce domestic real credit (as a deviation from HP trend) into the model. And, to limit the number of variables, we drop industrial production, our previous (statistically insignificant) indicator of economic activity.

Graph 6 confirms our conjecture that the US term premium is, indeed, an important determinant of domestic credit, and thus financial stability, in the period since 2009. For the second sample period of 2009–12, a one percentage point rise in the US term premium leads to up to a one percentage point decline in real credit from trend within the first month of the shock. In contrast, the response of domestic credit is statistically insignificant during 2003–07, confirming the findings of others that the response of credit started to change after the introduction of unconventional monetary policy by the Federal Reserves around 2009. The response of other variables remains largely unaltered (Graph A4 in the annex). This finding also helps us to unravel what may be behind the weak response of Asian economic activity to a US monetary policy shock. Industrial production is only a partial measure of output; in particular it leaves out a large, growing part of output generated in sectors such as housing and other services. Domestic credit may be able to capture the output dynamics better in our alternative specification.

Response to 1 percentage point increase in the US term premium – real credit

(percent or percentage point) Graph 6



Source: Authors' calculations

Additional robustness checks

Our findings remain unchanged after several additional robustness checks. First, in our VAR model, the choice of ranking between the two domestic market prices, *YLD* and *NER*, is not obvious. When we estimate separate panel VAR models where *NER* is ordered before *YLD*, the results are broadly unchanged.

Second, our panel VAR results may be biased due to the correlation between fixed effects and lagged dependent variables. However, VAR models estimated for the five individual EMEs separately yield broadly similar results (Graphs A5 and A6). In response to a rise in the US term premium, domestic short term interest rates tend to rise, particularly during 2009–12. But domestic long-term bond yields tend to rise during both periods.

In sum, our analysis hints at the important role played by the US term premium in influencing the monetary policy stance in Asia. In particular, domestic overnight interest rates and long-term yields in the five Asian economies we examined have become more synchronised with the US term premium after the 2008 global financial crisis. And, changes in US term premiums have a larger influence on domestic credit growth, suggesting an increased role of the risk-taking channel. As bond markets have grown in importance relative to banks as a transmission channel of global liquidity, spillovers from US monetary policy on Asian economies have tended to become stronger.

5. Implications for central banks' instrument design

Our results raise questions as to how central banks should respond to a foreign monetary policy shock that has major consequences for their long term interest rates and credit growth and, therefore, monetary and financial stability. How far are traditional monetary policy instruments helpful? What other instruments might be useful? As Obstfeld (2014) argues: "… the fundamental problem for open EMEs is not ineffective monetary policy per se. The problem is a more difficult trade off among multiple objectives, the results of a shortage of reliable instruments for attaining those objectives simultaneously."

Traditional instruments

A classical answer to the problem is that EME authorities should make the exchange rate fully flexible so that it can act as a shock absorber. Failing that, if the exchange rate is not allowed to adjust for some reason, Svensson (2011) argues that the appropriate monetary policy response is to lower the policy rate and the policy rate path, leading to a temporary deviation of inflation from the target.

However, when the risk-taking channel is an important driver of the long-term interest rate and credit growth, traditional instruments may be perceived as less powerful in dealing with external monetary shocks. Currency appreciation will tend to strengthen the pro-cyclicality of bank lending, and a lower domestic policy rate may simply lead firms to substitute domestic borrowing for international funding. For instance, as Rajan (2014), the Governor of the Reserve Bank of India, notes "exchange rate flexibility in (capital flow) recipient countries … sometimes exacerbates booms rather than equilibrates. Indeed, in the recent episode of emerging market volatility after the Fed started discussing taper in May 2013, countries that allowed the real exchange rate to appreciate the most during the period of quantitative easing suffered the greatest adverse impact on financial conditions."

Past policy responses to international spillovers to Asia have tended to rely heavily on sterilised intervention in FX markets. In theory, sterilized intervention could be part of the answer. However, questions remain as to whether sterilised intervention can be an additional instrument over and above the interest rate. One

reason is that it may not be very effective in influencing the exchange rate.[19] Past experience suggests that FX intervention may be more successful in EMEs than in advanced economies because of a stronger portfolio balance channel (Disyatat and Galati, 2007). However, most recent studies suggest that, if anything, the effect has weakened considerably over time. Devereux and Yetman (2014a,b) argue that the ongoing internationalisation of financial markets means that ever larger interventions in FX markets are required to have the same effects on exchange rates.[20] Thus intervention may become increasingly costly for central banks, both financially and politically.[21]

Another issue with FX intervention relates to the practice of sterilization and the associated balance sheet effects. The textbook version of sterilized intervention assumes that money and bonds are imperfect substitutes. However, as discussed by Kumhof (2004) and Gadanecz, Mehrotra and Mohanty (2014), the use of short term central bank securities to sterilise FX intervention is unlikely to be very effective in limiting risks to monetary and financial stability. First, short-term central bank and government paper can be a very close substitute for bank reserves because both are subject to little capital loss and can be easily liquidated by banks to finance new credit. Second, given their high collateral values, short-term securities provide an easy way for investors to increase leverage by borrowing against them.

Data presented by Gadanecz et al (2014) show that the stock of securities issued by central banks in Asia in relation to GDP remained small on average in 2000 but rose to about 8% by 2009. These ratios peaked at 20% for Korea and 15% China. In addition, a large part of the central bank securities (about 85%) was of maturities of less than one year. Econometric evidence presented by the authors suggested that every one percentage point rise in the ratio of commercial banks' holding of government and central bank securities to the stock of loans leads to an additional 0.2 percentage points increase in the growth of their lending to the private sector in economies with well-capitalised banking systems with a two-year lag. This effect explains about 16% of total variance of credit growth in EMEs during 2001–2011.[22]

Another set of instruments is macroprudential tools which can reduce some of the dilemmas facing monetary authorities, especially limiting risks to the banking system.[23] Measures such as loan-to-value and debt-to-income ratios, as well as

[19] The high fiscal costs FX intervention can also be a constraint, especially if it led to an erosion of monetary policy credibility (Calvo et al, 1993). However, this may be only a soft constraint, as evidenced by the experience of Asian economies with large scale intervention over the past decade.

[20] See also Blanchard, Dell'Ariccia and Mauro (2013) who argue that FX intervention may not be successful in providing the required monetary independence in countries that are already well integrated into the global financial system but may be relatively successful in economies with highly segmented financial systems.

[21] The majority view among central banks, according to a recent BIS survey, is that intervention has only temporary effects on the exchange rate (BIS, 2013) and may even accentuate exchange rate volatility in the wrong direction (Miyajima and Montoro, 2013)

[22] From the viewpoint of optimal monetary policy design, Ostry, Ghosh and Chamon (2012) show that FX intervention may supplement monetary policy under an inflation targeting regime when shocks move exchange rates away from their "medium term, multilaterally-consistent value" provided that it is subordinated to the main goal, that is, the achievement of inflation control.

[23] See, for instance, Borio and Shim (2007) and Claessens (2013).

capital requirements linked to banks' asset growth, can reduce the pro-cyclicality of lending and prevent domestic booms associated with capital inflows.[24] And such instruments can be particularly effective when they are combined with taxation policies.[25]

However, two factors seem to be important in determining whether bank- and asset-based tools provide sufficient room for authorities to respond to external shocks. The first is the role of banks vs capital market in intermediating capital flows. When the bond market intermediates much of foreign inflows, macroprudential instruments designed to control risks on bank balance sheets are unlikely to lead to satisfactory results. The second issue about macroprudential tools relates to the market players being targeted. The current macroprudential tools may be useful in addressing some of the consequences of capital flows. However, they may not work as well if players involved are unleveraged intermediaries such as asset management companies.

Under these conditions, recent discussions about resolving monetary policy dilemmas have increasingly referred to the usefulness of capital management measures. Rey (2013), for instance, argues that given the influence of global financial cycles on monetary policy and difficulties in coordinating monetary policy across countries, authorities may need to manage capital flows in addition to using macroprudential tools. Such a recommendation has also formed part of the policy advice of the IMF to some EMEs.

Others have been concerned about the effectiveness of these measures. Even if such measures provided short-term insulation from international monetary spillovers they tend to loose effectiveness over time (Habermeier, Kokenyne and Baba, 2011). Moreover, capital flow measures entail costs and can be counter-productive if they delay other necessary policy adjustments (Caruana, 2011). And, such measures may involve significant negative externalities to the extent that they divert capital inflows from countries imposing controls to those with freer capital markets. Although Brazil introduced a tax on financial transactions (IOF) in 2011, it subsequently abolished it. While Indonesia has imposed a minimum holding period for foreign investors, it continued to receive large amounts of capital inflows.

Additional instruments: what could they be?

In the rest of this section, we discuss two other sets of policy instruments which have received relatively less attention in policy discussions, although they might be considered as less interventionist in nature compared to controls on non-residents' transactions in domestic capital markets. The first is liability-based macroprudential measures. The second is debt management policies.

[24] Using data for 57 economies, Kuttner and Shim (2013) show that maximum debt-service-to-income ratios are consistently effective at reducing housing credit growth over a period of four quarters, although the impact on house prices is not significant. A recent study by Wong et al (2011) reported a similar conclusion for Hong Kong. They also reported that LTV ratios can curb excess credit demand but have limited effectiveness over house prices.

[25] See Loh (2014), which reports that macroprudential policies in the property sector work best when complemented by other policies including taxation changes.

On the first, the usefulness of liability-based measures has been recently highlighted by Shin (2013b) and Chung et al (2014). Shin shows that non-core liabilities of banks have a close relationship with global financial conditions as banks may use international capital markets to boost funding when their lending is rising faster than the growth of core liabilities (such as retail deposits). In addition, during periods of easy global liquidity, domestic non-financial corporations may become a type of financial intermediary, issuing debt in international markets to earn a spread by depositing the proceeds in the banking system.

A levy on non-core bank liabilities could achieve several objectives. First, such a tax would act as an automatic stabilizer, hitting banks the hardest during boom times when their non-core liabilities rise rapidly. Second, the levy would leave banks' assets that are funded by core liabilities unaffected, reducing the overall effects on the domestic economy. Finally, it would reduce problems associated with a sudden stop of capital flows and the associated bank deleveraging.

The success of such a levy has recently been demonstrated by Korea. In 2010 Korea introduced a leverage cap (as a percentage of bank capital) on FX derivative position of banks followed by a macroprudential stability levy on banks' non-core FX liabilities in 2011. The stability levy was linked to the maturity of FX liabilities, with short term FX liabilities being more severely penalized (20 basis points for maturities of less than one year) than long term liabilities (2 basis points for maturities of 5 years or more). Kim (2013) shows that the leverage cap led to a persistent decline in the ratio of FX derivative positions of foreign banks to their capital, falling from 800% at the end of 2008 to about 100% by the end of 2012. The ratio for domestic banks fell from 700% to 300%. Banks' external debt structure improved substantially, with short-term FX borrowing falling significantly after the introduction of the stability levy.

As regards the second instrument, debt management policy can play a role in influencing the long term interest rate when the term premium persistently deviates from its long-run value, as borne out by the recent experiences of the Federal Reserve and the Bank of England.[26] Such policies involve direct central bank operations in the bond market to change the net supply-demand balance of government securities with the aim of changing the average maturity of government debt in the hands of the public. The channels through which central bank bond market operations affect long term interest rates remain uncertain. Nevertheless, several recent studies have shown that such operations can have a significant impact on the term premium which could arise due to the maturity preferences of bond investors (portfolio balance effects) or altering the premium demanded by risk-averse bond traders.[27]

Filardo, Mohanty and Moreno (2012) discus the relevance for debt management policies in the emerging market context and suggest that they are likely to be more effective in these economies than advanced economies. Given their relatively small market size, the impact of a given change in the net supply of securities on term premiums is arguable larger in emerging markets. Additionally, maturity preferences might differ substantially across different investor classes:

[26] See Turner (2013) and BIS (2013) for recent reviews.

[27] See, for instance, D'Amico and King (2010), Krishnamurthy and Vissing-Jorgensen (2011) and Chadha, Turner and Zampolli (2013).

banks may prefer short maturity debt to avoid large exposures to market risks; foreign investors may be interested in short-to-medium term securities to avoid interest rate exposures; while domestic pension funds may prefer longer dated bonds. Such differences will likely make the yield curve sensitive to central bank open market operations. Indeed, during May-August 2013 several Asian central banks (including Bank Indonesia and the Reserve Bank of India) intervened in the bond market in response to sharp increases in yields to stabilize markets.

To the extent that central banks exchanged short- with long-term maturities (and vice versa), the operation may not increase their holding of government securities over capital flow cycles, but only change its maturity composition. Central banks could also conduct such operations using their own securities, as is already the case in several Asian economies. The same objective could also be achieved if the government, rather than the central bank, conducted debt market operations. In any case, close coordination between the government and the central bank would be needed to reduce conflicts of interest – that is, the government should not undo the actions of the central bank by its own debt issuance policy.

One criticism against this measure is that the government may pressure the central bank to intervene in the bond market in the face of unsustainable fiscal positions, which could undermine fiscal discipline. A second criticism is that such intervention may distort the yield curve and reduce its signalling value while also exposing the central bank to interest rate risk. The success of this policy therefore depends critically on how central banks design their responses and the nature of shocks that they face. It will also depend on the assessment of the benefit from stabilizing monetary conditions and reducing financial stability risks compared to the potential costs of distorting bond market liquidity and hence the yield curve.

6. Conclusions

In this paper we reviewed the role of long-term interest rates in international monetary transmission and related policy challenges in the wake of exceptionally easy US monetary policy. Our theoretical and empirical models suggest that the US term premium played an important role in the transmission of US monetary policy to Asia, even before the 2008 global financial crisis. And, this link has strengthened following large-scale asset purchases by the Federal Reserve in the aftermath of the crisis. However, as a caveat, movements in the US term premium also reflect non-US factors including the "global savings glut" and the investment choices of those managing very large FX reserves in Asia. We did not identify the specific source of shock to the US term premium.

Our results show that a very low US term premium spills over to Asia mainly through low domestic bond yields and the rapid expansion of bank credit. These results are consistent with the findings of others (eg Obstfeld, 2014 and McCauley et al, 2014) that unconventional monetary policy in the United States and other advanced economies has been increasingly transmitted to Asia through global bond markets. There is no doubt that financial integration reduces the control of national monetary authorities over interest rates. However, this is unlikely to be because of their failure to control the price of bank reserves, but rather because of difficulties in controlling long-term rates that ultimately determine much real economic activity.

These developments are likely to have major implications for how monetary policy is conducted in Asia. FX intervention can reduce some of the challenges for monetary policy, although its effectiveness is likely to decline as markets become increasingly globalised. And persistent intervention to resist currency appreciation, financed by the issuance of short-term government and central bank securities, involves risks. Over the past decade macro-prudential policies have played a significant role in Asia in limiting risks to the financial system and complementing monetary policy in controlling inflation. However, a key issue is whether bank-based and asset-based macro-prudential rules would prove to be as effective in the face of recent changes to capital flows.

In this context, the paper highlighted the possible role of liability-based macro-prudential measures, as well as active debt management, to influence the term premium. The former can be useful in limiting risks to the financial system when bond market flows are accompanied by significant increases in lending fuelled by rapid growth in non-core funding of the banking system. The latter has implications for the behaviour of risk premiums which can be volatile during episodes of large capital inflows and outflows. That said, the effectiveness of these policies is likely to vary with the underlying source of risks to the financial system as well as institutional arrangements in different economies.

References

Adrian, T and H S Shin (2010): "Prices and quantities in the monetary policy transmission mechanism," *Staff Report no 396*, Federal Reserve Bank of New York.

Arellano, M and O Bover (1995): "Another look at the instrumental variable estimation of error-components models," *Journal of Econometrics* 68 (1), 29–51.

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

Bank for International Settlements (2014): "The transmission of unconventional monetary policy to emerging markets," *BIS Papers no 78*.

Bauer, M D and G D Rudebusch (2014): "The signalling channel for Federal Reserve bond purchases," *International Journal of Central Banking*, September, 233-289.

Bekaert, G, M Hoerova and M L Duca (2013): "Risk, uncertainty and monetary policy," *Journal of Monetary Economics* 60(7), 771-788.

Bernanke, B S, M Gertler and S Gilchrist (1999): "The financial accelerator in a quantitative business cycle framework", in J B Taylor and M Woodford (eds), *Handbook of Macroeconomics*, vol 1C, 1341-1393.

Blanchard, O, G Dell'Ariccia and P Mauro (2013): "Rethinking macro policy II: getting granular," *IMF Staff Discussion Note*, April.

Boivin, J, M T Kiley and F S Mishkin (2011): "How has the monetary transmission mechanism evolved over time?" *Handbook of Monetary Economics* (Elsevier: Amsterdam), 369-422.

Borio, C, R N McCauley and P McGuire (2011): "Global credit and domestic credit booms," *BIS Quarterly Review* September, 43-57.

Borio, C and I Shim (2007): "What can (macro-) prudential policy do to support monetary policy?" *BIS Working Papers* no 242.

Borio, C and H Zhu (2012): "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism," *Journal of Financial Stability* 8(4), 236-251.

Bruno, V and H S Shin (2013): "Capital flows and the risk-taking channel of monetary policy," *NBER Working Paper* no 18942.

Bruno, V and H S Shin (2014): "Cross-border banking and global liquidity," *BIS Working Papers* no 458.

Calvo, G A, L Leiderman and C M Reinhart (1993): "Capital flows and real exchange rate appreciation in Latin America: the role of external factors," *IMF Staff Papers* 40(1), 108-151.

Caruana, J (2011): " Capital flows to emerging market economies: a perspective on policy challenges, speech at 46th SEACEN Governors Conference, Colombo, February.

Chadha, J S, P Turner and F Zampolli (2013): "The ties that bind: monetary policy and government debt management," *Oxford Review of Economic Policy* 29(3), 548-581.

Chang, R (2013): "Rethinking monetary policy after the crash," paper presented at the Graduate Institute of International and Development Studies, Geneva.

Chen, Q, A Filardo, D He and F Zhu (2014): "Global impact of US monetary policy at the zero lower bound," HKMA-FRB New York conference on Domestic and International Dimensions of Unconventional Monetary Policy, 21 March.

Chung, K, J-E Lee, E Loukoianova, H Park and H S Shin (2014): "Global Liquidity through the lens of monetary aggregates," *IMF Working Paper* no 14/9.

Clarida, R, J Galí and M Gertler (2001): "Optimal monetary policy in closed versus open economies, an integrated approach," *American Economic Review, Papers and proceedings* 91(2), 248-252.

Claessens, S (2013): "Interactions between monetary and macroeconomic policies in an interconnected world," paper for the Bank of Thailand - IMF conference on Monetary Policy in an interconnected World, 31 October – 2 November.

D'Amico, S and T B King (2013): "Flow and stock effects of large-scale treasury purchases: evidence on the importance of local supply," *Journal of Financial Economics* 108(2), 425-448.

Dahlquist, M and H Hasseltoft (2012): "International bond risk premia," *Journal of International Economics* 90(1), 17-32.

Devereux, M and J Yetman (2014a): "Responding to exchange rates in a globalised world," *BIS Papers* no 77, 97-117.

Devereux, M and J Yetman (2014b): "Globalisation, pass-through and the optimal policy response to exchange rates," *Journal of International Money and Finance* 49(A), 104-128.

Disyatat, P and G Galati (2007): "The effectiveness of foreign exchange intervention in emerging market countries: evidence from the Czech koruna," *Journal of International Money and Finance* 26(3), 383-402.

Disyatat, P and P Vongsinsirikul (2003): "Monetary policy and the transmission mechanism in Thailand," *Journal of Asian Economics* 14(3), 389–418.

Du, W and J Schreger (2013): "Local currency sovereign risk," *International Finance Discussion Papers* no 1094, Board of Governors of the Federal Reserve System.

Feroli, M, A K Kashyap, K Schoenholtz and H S Shin (2014): "Market tantrums and monetary policy," report prepared for the 2014 US Monetary Policy Forum, 28 February.

Filardo, A and H Genberg (2010): "Targeting inflation in Asia and the Pacific: lessons from the recent past," *BIS Papers* no 52, 251-273.

Filardo, A, M S Mohanty and R Moreno (2012): "Central bank and government debt management: issues for monetary policy," *BIS Papers* no 67, 51-71.

Fung, B S C (2002): "A VAR analysis of the effects of monetary policy in East Asia," *BIS Working Papers* no 119.

Gadanecz, B, A Mehrotra and M S Mohanty (2014): "Foreign exchange intervention and the banking system balance sheet in emerging market economies," *BIS Working Papers* no 445.

Galí, J and T Monacelli (2005): "Monetary policy and exchange rate volatility in a small open economy," *Review of Economic Studies* 72 (3), 707-734.

Gambacorta, L, B Hofmann and G Peersman (2014): "The effectiveness of unconventional monetary policy at the zero lower bound: a cross-country analysis," *Journal of Money, Credit and Banking* 46 (4), 615–42.

García-Herrero, A and E M Remolona (2008): "Managing expectations by words and deeds: monetary policy in Asia and the Pacific," Bank for International Settlements, mimeo.

Gertler, M and P Karadi (2013): "QE 1 vs. 2 vs. 3. . . : a framework for analyzing large-scale asset purchases as a monetary policy tool," *International Journal of Central Banking* 9(1), 5-53.

Goodhart, C and B Hofmann (2008): "House prices, money, credit and the macroeconomy", *ECB Working Paper Series* no 888.

Gourinchas, P and M Obstfeld (2012): "Stories of the twentieth century for the twenty-first," *American Economic Journal*: *Macroeconomics* 4 (1), 226-265.

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

Hahm, J-H, F S Mishkin, H S Shin and K Shin (2012): "Macroprudential policies in open emerging economies," *NBER Working Paper* no 17780.

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

Hellerstein, R (2011): "Global bond risk premiums," *Staff Reports* no 499, Federal Reserve Bank of New York.

Hofmann, B and B Bogdanova (2012): "Taylor rules and monetary policy: a global 'Great Deviation'?" *BIS Quarterly Review*, September, 37-49.

Hördahl, P and O Tristani (2011): "Bond premia and monetary policy over 40 years," *Bank for International Settlements*, mimeo.

International Monetary Fund (2014): "2014 spillover report," *IMF Multilateral Policy Issues Report*, July.

Jahan, S (2012): "Inflation targeting: holding the line," *IMF Finance and Development*, March.

Jain-Chandra, S and F D Unsal (2012): "The effectiveness of monetary policy transmission under capital inflows: evidence from Asia," *IMF Working Papers* no 12/265.

Kim, C (2013): "Macroprudential policies: Korea's experiences," paper presented at the IMF conference on Rethinking Macro Policy II: First Steps and Early Lessons, Washington DC.

Krishnamurthy, A and A Vissing-Jorgenson (2011): "The effect of quantitative easing on interest rates: channels and implications for policy," *Brookings Papers on Economic Activity* 43(2), 215-287.

Kumhof, M (2004): "Sterilization of short-term capital inflows – through lower interest rates?" *Journal of International Money and Finance* 23 (7-8), 1209-1221.

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

Loh, Jacqueline (2014): "What have central banks from emerging market economies learnt from international transmission of monetary policy in recent years?" *BIS Papers* no 78, 309-320.

Lombardi, M and F Zhu (2014): "A shadow policy rate to calibrate US monetary policy at the zero lower bound," *BIS Working Paper* no 452.

Love, I and L Zicchino (2006): "Financial development and dynamic investment behavior: evidence from panel VAR," Quarterly Review of Economics and Finance 46 (2), 190–210.

McCauley, R N, P McGuire and V Sushko (2014): "Global dollar credit: links to US monetary policy and leverage," Papers for the 59th Panel Meeting on Economic Policy, Turkey, April.

Mehrotra, A, K Miyajima and A Villar (2012): "Developments of domestic government bond markets in EMEs and their implications," *BIS Papers* no 67, 31-50.

Miyajima, K, M S Mohanty and T Chan (2014): "Emerging market local currency bonds: diversification and stability," *Emerging Market Review*, forthcoming.

Miyajima, K and C Montoro (2013): "Impact of foreign exchange interventions on exchange rate expectations," *BIS Papers* no 73, 39-54.

Mohanty, M S (2014): "The transmission of unconventional monetary policy to the emerging markets," *BIS Papers* no 78, 1-24.

Mohanty, M and P Turner (2008): "Monetary policy transmission in emerging market economies: what is new?" *BIS Papers* no 35, 1-59.

Munro, A (2014): "Exchange rates, expected returns and risk," *Reserve Bank of New Zealand Discussion Paper* no 2014/01.

Obstfeld, M (2014): "Trilemmas and tradeoffs: living with financial globalisation," paper presented at the BIS Annual research conference, Luzern, June.

Ostry, J D, A R Ghosh and M Chamon (2012): "Two targets, two instruments: monetary and exchange rate policies in emerging market economies," *IMF Staff Discussion Note* 12/10.

Rajan, R (2014): "Competitive monetary easing – is it yesterday?" Speech at the Brookings Institution, Washington DC, 10 April.

Ramos-Francia, M and S Gracía-Verdú (2014):" The ransmission of US monetary policy shocks to EMEs: an empirical analysis," *BIS Papers* no 78, 363-397.

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

Shin, H S (2013a): "The second phase of global liquidity and its impact on emerging economies," Keynote address at Federal Reserve Bank of Kansas City, Jackson Hole conference, 23 August.

Shin, H S (2013b): "Adapting macro prudential approaches to emerging and developing economies," in: *Dealing with the challenges of Macro Financial Linkages in Emerging Markets,* Canuto, O, and S Ghosh (eds), World Bank, Washington DC.

Svensson, L E O (2011): "Monetary policy after the crisis," Speech at the Asia Economic Policy Conference, Federal Reserve Bank of San Francisco, 29 November.

Takáts, E and A Vela (2014): "International monetary policy transmission," *BIS Papers* no 78, 51-70.

Taylor, J (2014): "International monetary policy coordination: past, present and future," *BIS Working Papers* no 437.

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

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

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

Wong, E, T Gong, K L Li and H Choi (2011): "Loan-to-value ratio as a macro-prudential tool – Hong Kong's experience and cross-country evidence," *HKMA Working Papers* no 01/2011.

Woodford, M (2009): "Globalization and monetary control," in J Galí and M Gertler (eds), *International Dimensions of monetary policy*, the University of Chicago Press, Chicago and London.

Response to a 1 percentage point increase in US 10-year bond yield

(percent or percentage point) Graph A1

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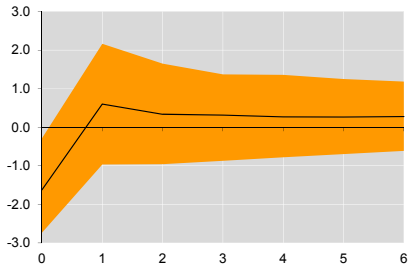
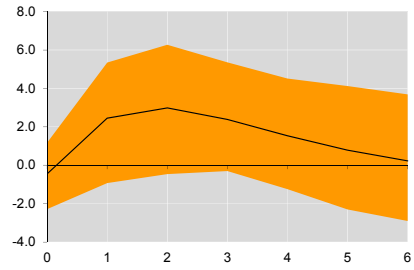
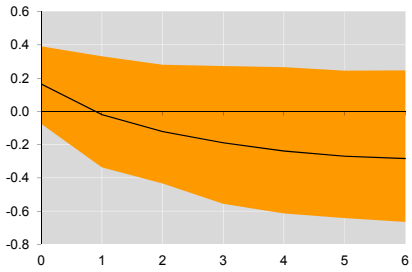
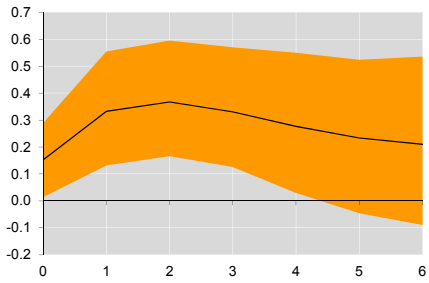
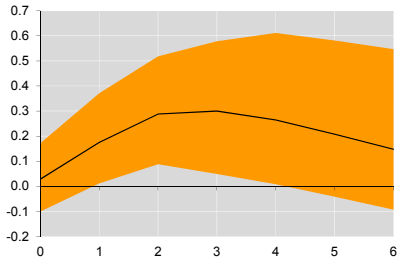
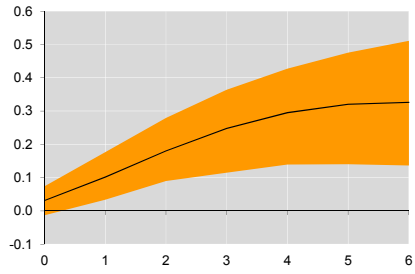
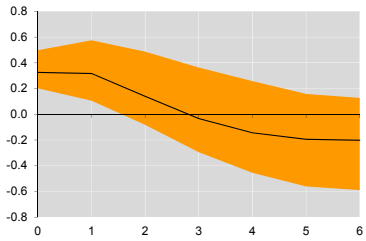
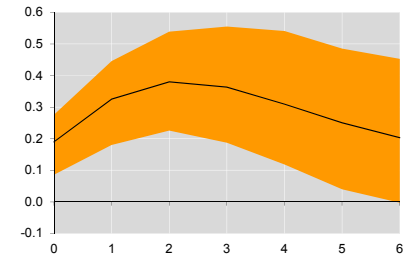
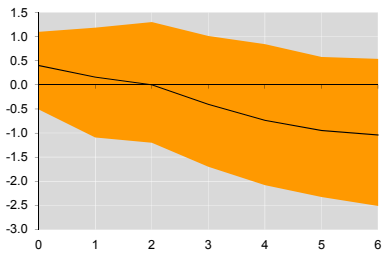
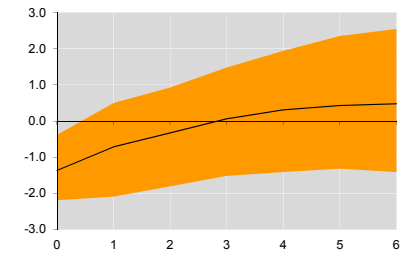
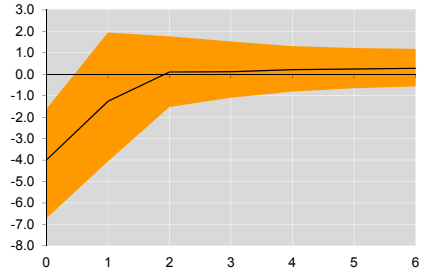
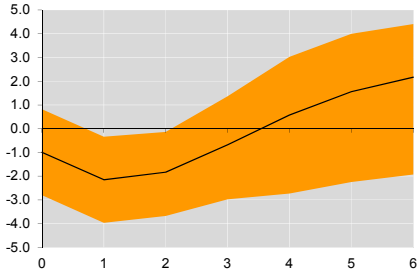
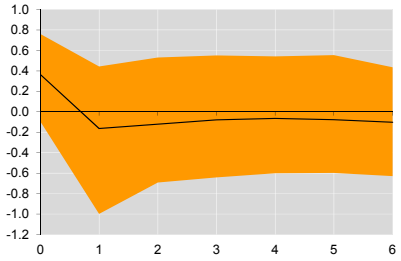
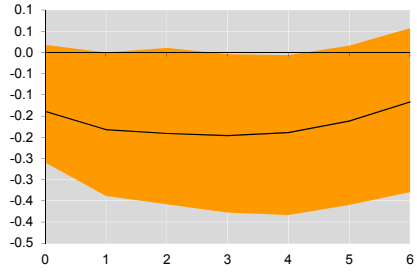
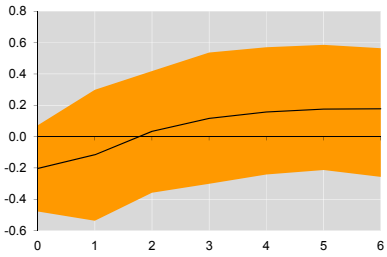
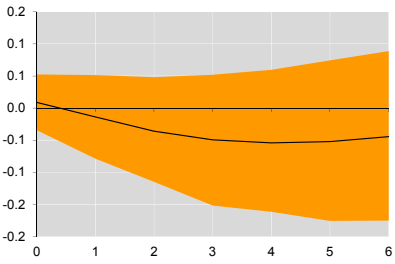
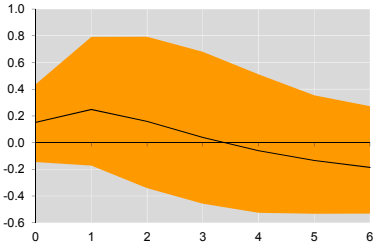
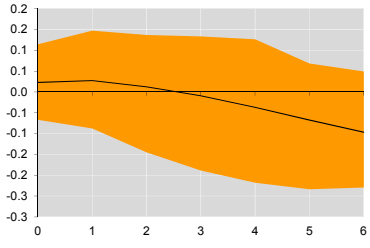
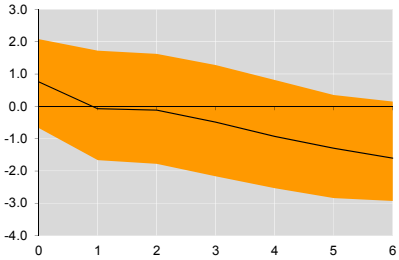
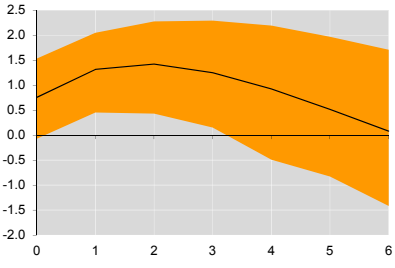
Response of industrial production	
	
Response of inflation	
	
Response of domestic short term interest rates	
	
Response of domestic long term bond yield	
	
Response of nominal exchange rate vs US dollar	
	

Source: Authors' calculations

Response to a 1 percentage point increase in US fed funds

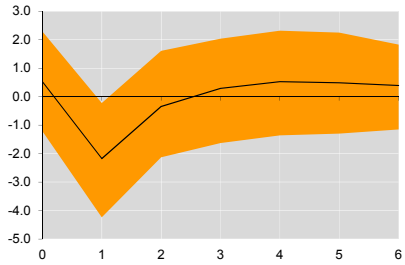
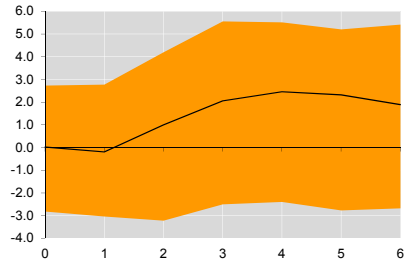
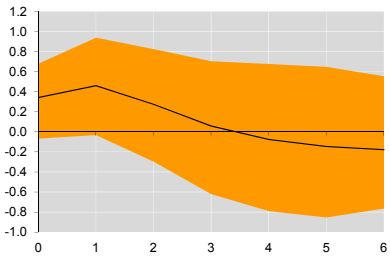
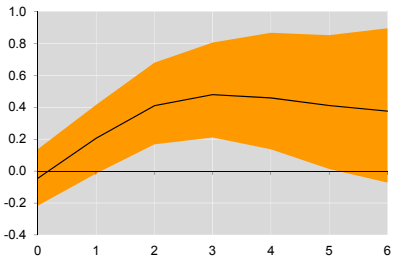
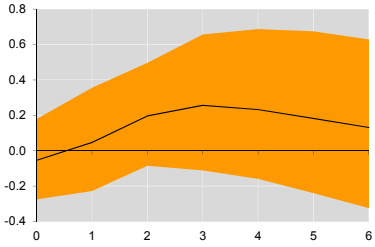
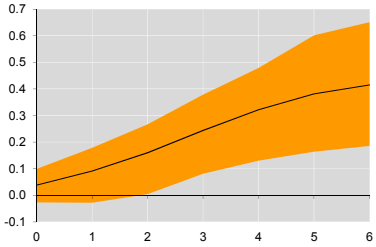
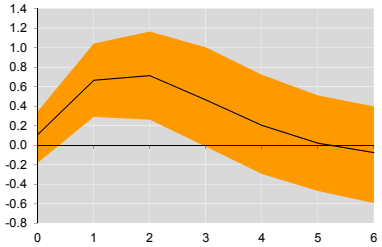
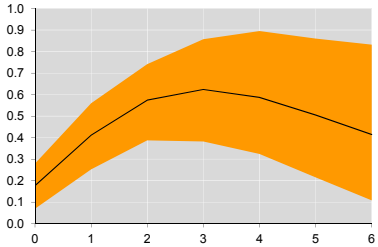
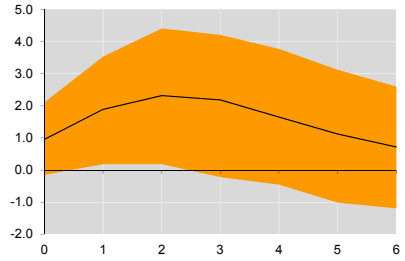
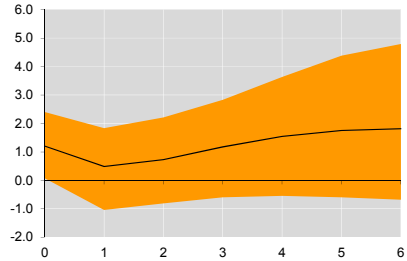
(percent or percentage point) Graph A2

2003M01–07M12	2009M06–13M12
Response of industrial production	
	
Response of inflation	
	
Response of domestic short term interest rates	
	
Response of domestic long term bond yield	
	
Response of nominal exchange rate vs US dollar	
	

Source: Authors' calculations

Response to 1 percentage point increase in the US term premium

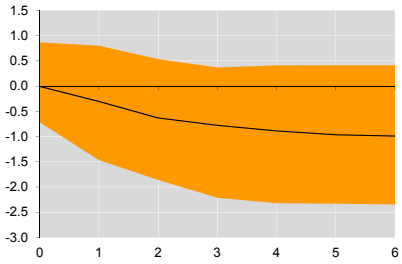
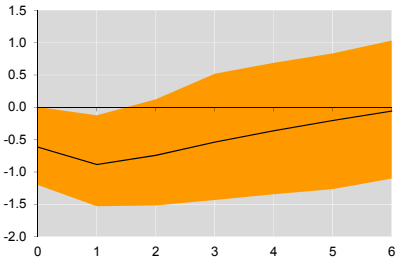
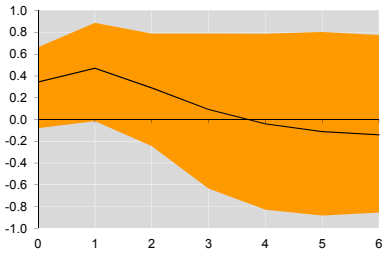
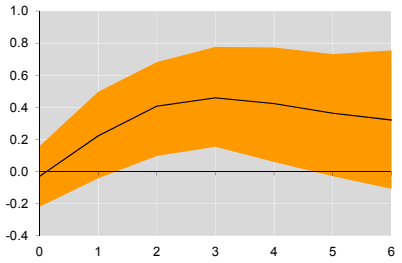
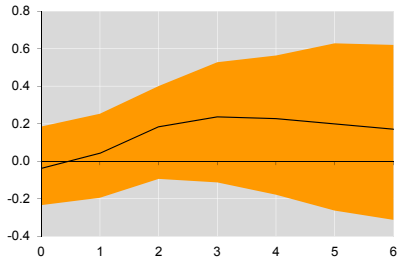
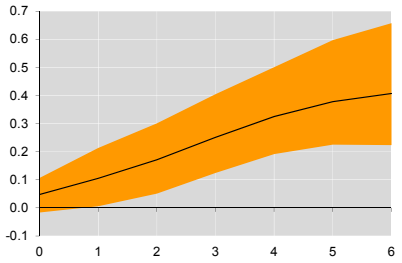
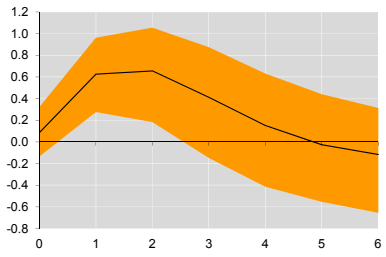
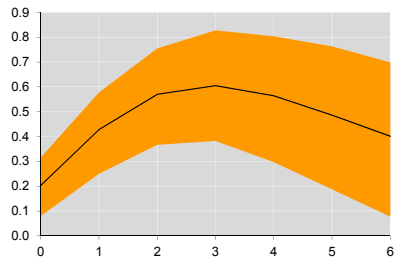
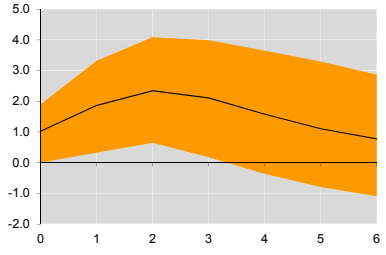
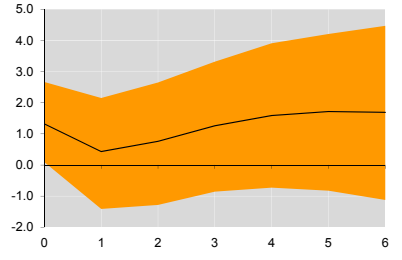
(percent or percentage point) Graph A3

2003M01–07M12	2009M06–13M12
Response of industrial production	
	
Response of inflation	
	
Response of domestic short term interest rates	
	
Response of domestic long term bond yield	
	
Response of nominal exchange rate vs US dollar	
	

Source: Authors' calculations

Response to 1 percentage point increase in the US term premium – real credit

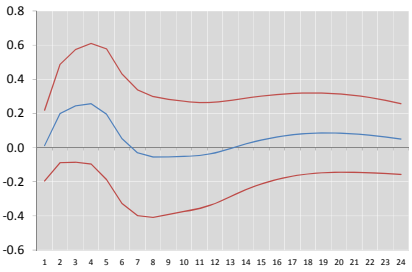
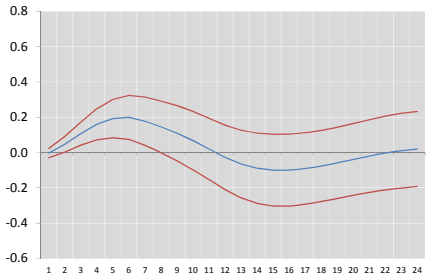
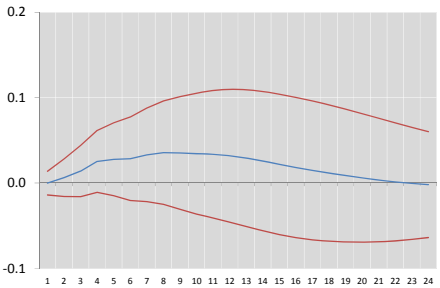
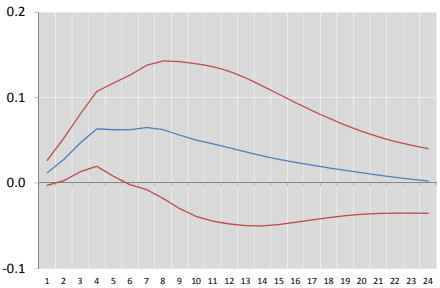
(percent or percentage point) Graph A4

2003M01–07M12	2009M06–13M12
Response of real credit	
	
Response of inflation	
	
Response of domestic short term interest rates	
	
Response of domestic long term bond yield	
	
Response of nominal exchange rate vs US dollar	
	

Source: Authors' calculations

Response of domestic short-term interest rates to a rise in US term premium

Graph A5

2000M01–07M12	2009M06–2013M12
Indonesia	
	
Korea	
	
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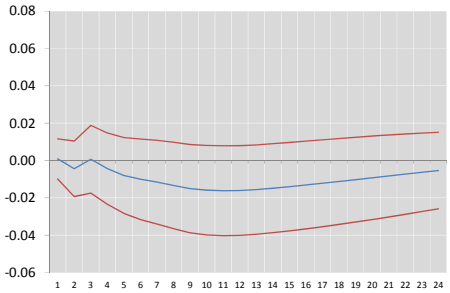	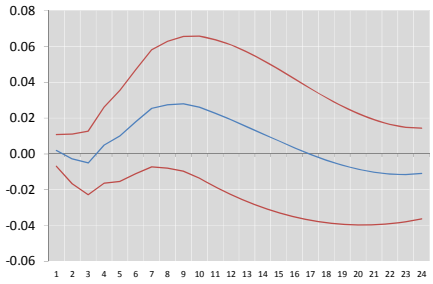
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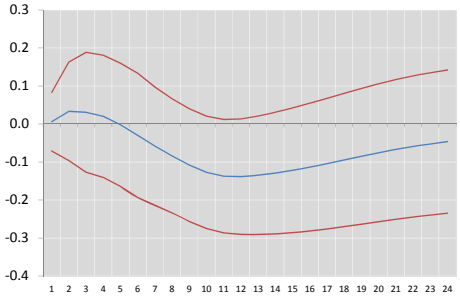	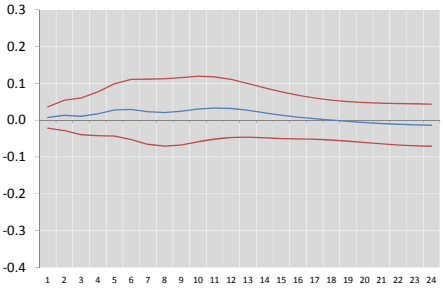
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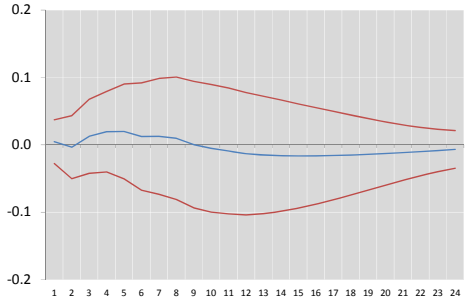
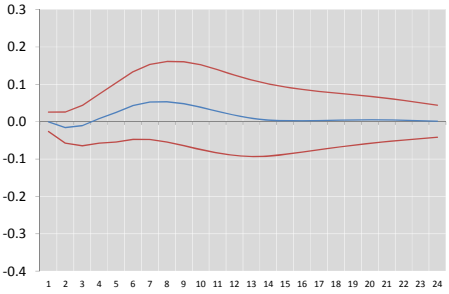
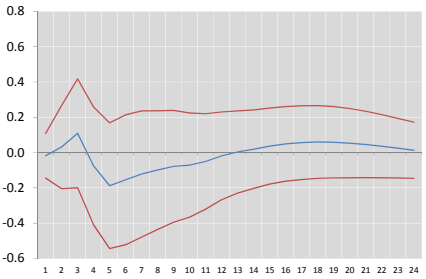
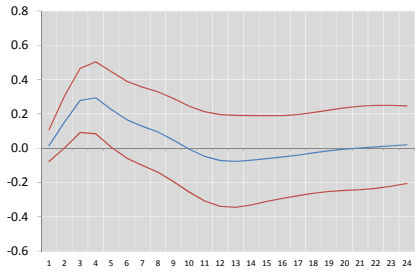
	

Response of domestic long-term interest rates to a rise in US term premium

Graph A6

2000M01–07M12	2009M06–2013M12
Indonesia	
	
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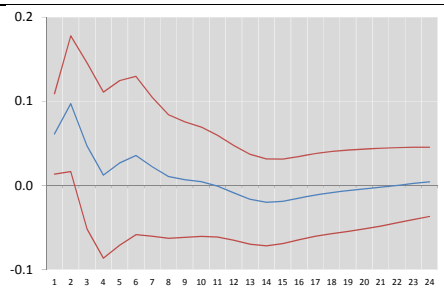	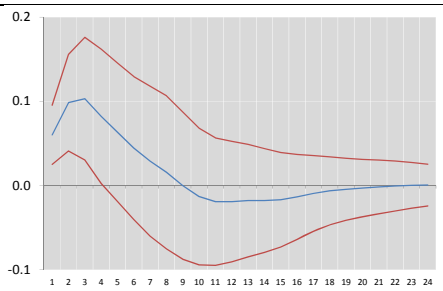
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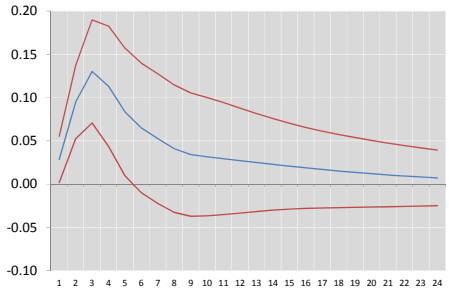	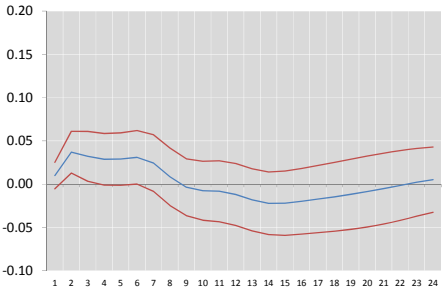
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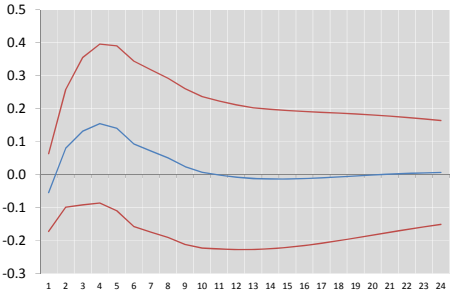	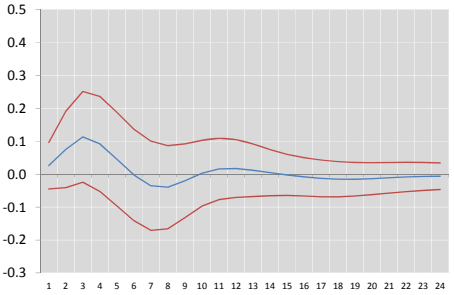
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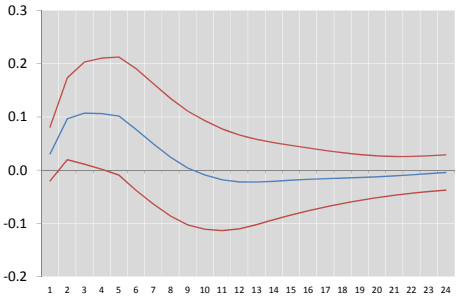	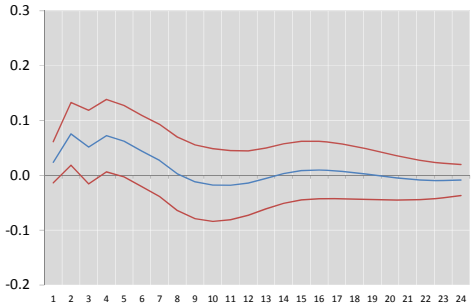

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