Monetary policy transmission and the long-term interest rate in emerging markets

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I. Introduction and summary

Since the early 1990s, the progressive shift towards inflation targeting in emerging market economies (EMEs) and the growing use of short-term interest rates as operating instruments has underscored the need to better understand the channels of monetary policy transmission in EMEs.

A question of particular interest is how changes in short-term rates – which are either set by monetary authorities or influenced strongly by them – are related to long-term ones. This paper seeks to shed light on this relationship by first discussing the various factors that influence long-term rates, including expectations of future policy and inflation, risk premia and foreign interest rates. Reductions in the level and volatility of inflation, improvements in liquidity and reductions in credit risk may have all contributed to a distinct reduction in the level and volatility of term spreads (the difference between long- and short-term rates) in emerging market economies. Central bank questionnaire responses indicate that inflation expectations are now better anchored, and the influence of external factors on domestic long-term rates has in some cases increased.

The relative importance of domestic policy and foreign factors in influencing long-term rates is also examined by estimating a vector autoregression model for a group of emerging market economies. This analysis indicates that: (i) the domestic long-term interest rate in our set of emerging markets is most affected by its own innovations, which suggests that changes in long-term interest rates largely reflect variation in the term spread due to changes in expected inflation or risk premia; (ii) the magnitude of these innovations has fallen in recent years, which is broadly in line with the reduction in the level and volatility of term spreads; and (iii) while their contribution to explaining the behaviour[2] of long-term interest rates in emerging markets is still small, foreign long-term rates sometimes have a larger impact on domestic long-term rates than does the domestic policy rate. This impact in some cases has also increased over time. A number of issues of interest to policymakers may be highlighted.

First, the reduction in inflation and inflation volatility has anchored inflation expectations in a number of emerging market economies, reducing the need for policymakers to respond aggressively to shocks. A question this raises is what set of interest rate and communications policies will ensure that such credibility is maintained.

Second, reductions in risk premia have had an expansionary influence on emerging market economies by reducing financing constraints. This raises the question of whether policy rates need to rise (other things being equal) to offset the stimulus from reduced financing constraints. Another question is whether reductions in risk premia might have gone too far, such that long-term interest rates are now "too low", exposing emerging financial markets to a possible sudden reversal in investor sentiment.

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[2] More precisely, the variance of the forecast error.

Third, what are the implications of an increased role for external factors in determining domestic long-term rates for policy setting? Should the information content of the foreign yield curve or foreign news be taken into account in assessing monetary conditions? As above, does this imply that policy rates (other things being equal) should be set differently?

The rest of the paper is organised as follows. Section II discusses the determination of long-term interest rates in a closed economy, and some factors that may account for the reduction in term spreads. Section III summarises interest rate determination in an open economy, the conditions under which domestic long-term rates will be anchored by external interest rates, and the extent to which it appears these conditions are being met. Section IV highlights what is known about the relationship between policy rates and long-term interest rate prices in emerging markets based on both central bank responses to a questionnaire and existing research. Section V describes the dynamics of the relationship between short-term rates, foreign interest rates and long-term rates based on empirical estimates of the VAR model.

II. Determinants of long-term interest rates and the term spread in a closed economy

As financial markets develop, the relationship between short-term and long-term interest rates becomes an increasingly important issue for central bankers. One reason is that policymakers typically influence very short-term rates (eg overnight rates), but spending, and consequently inflation, is usually related to interest rates at longer maturities. Another reason is that, as discussed below, long-term interest rates contain information about expected future paths of inflation and risk premia; the behaviour of long-term rates thus reveals how markets perceive policy and economic conditions.

Table 1

Level and volatility of daily spread[1]

	One-year rate						Five-year rate[2]					
	Average			Standard deviation			Average			Standard deviation		
	2001	2005	change	2001	2005	% change	2001	2005	change	2001	2005	% change
India	0.3	0.7	0.4	1.0	0.4	–65	0.6	1.5	0.9	1.1	0.5	–60
Korea	0.7	0.6	–0.1	0.4	0.3	–12	1.4	1.2	–0.2	0.6	0.4	–31
Malaysia	...	0.2	...	...	0.2	...	0.7	0.8	0.1	0.3	0.1	–58
Philippines	4.2	2.2	–2.0	1.3	0.6	–57	5.3	3.5	–1.8	1.4	0.8	–46
Thailand	0.6	0.6	0.0	0.4	0.1	–61	2.1	1.8	–0.3	0.6	0.4	–39
Brazil	4.4	–0.7	–5.1	2.5	0.8	–67	6.0	–1.7	–7.7	3.3	0.8	–76
Mexico[3]	1.9	–0.3	–2.2	0.8	0.4	–44	3.9	–0.2	–4.1	1.1	0.6	–46
Czech Rep	0.3	0.1	–0.2	0.4	0.2	–36	0.8	1.0	0.2	0.5	0.2	–55
Hungary	–0.7	–0.3	0.4	1.0	0.8	–17	–2.5	–0.3	2.2	1.1	1.0	–2
Poland[4]	–0.8	–0.4	0.4	1.1	0.3	–68	–4.9	–0.2	–4.7	2.2	0.5	–75
Turkey	25.8	1.9	–23.9	23.4	0.9	–96	...	...	...	...	...	...

[1] Long-term minus short-term rate, in percentage points. [2] For Brazil, three-year rate. [3] 2001 column refers to 2003. [4] 2001 column refers to 2002 for one-year rate.

Sources: Bloomberg; Datastream; BIS calculations.

To illustrate, Table 1 shows that spreads between long-term and short-term rates have fallen significantly in a number of emerging market economies in the course of this decade. Volatility in these spreads has also fallen across the board.

What could explain the observed declines in the level of spreads and their volatility? In a deep and liquid government bond market where the central bank fully controls the nominal short rate, the nominal yield curve will be driven by market participants' views about the course of monetary policy. Participants will form their views based on the underlying macroeconomic conditions and the likely reaction of the monetary authority and how this will affect the outlook, notably inflation. These views give rise to expectations about the path of nominal short rates and to term premia associated with the uncertainty surrounding these expectations.

Expectations of inflation. In order to equalise returns across different maturities, long-term rates will depend on current short-term rates and market expectations of future short-term rates; this is known as the expectations theory of the term structure. As short-term rates are influenced directly by policy, in effect, long-term rates reflect expectations of future monetary policy. Furthermore, since the nominal rate is the sum of expected real returns and the nominal rate of inflation, the nominal rate on a long-term bond between today and the time the bond matures can be expressed as the sum of expected real returns and inflation over that period:

$$i_t^n = \frac{1}{n}\sum_{i=0}^{n} E_t r_{t+i} + \frac{1}{n} E_t \overline{\pi}_t^n + \rho = r_t^n + \pi_t^n + \rho \qquad (1)$$

where i_t^n is the nominal interest rate on a bond maturing n periods from time t, $E_t r_{t+i}$ is the one-period real rate of interest rate (averaged over the term of the bond), $E_t \pi_t^n$ is the expected inflation over the period of the bond and ρ is the risk premium charged by domestic residents for holding a domestic bond. The second equality is to simplify the notation.

Thus, fluctuations in the long-term interest rate, and the corresponding spread with the short-term rate, will reflect changes in expected real rates and in expected inflation (the variance of inflation would influence term premia; see below). Some estimates suggest that changes in expectations of inflation can have a very large impact on long-term rates (accounting for nearly 80% of the fluctuations in long-term rates in the UK over the period 1985–1994; see Barr and Campbell (1997)).[3]

Due to the relatively recent (and in some cases still incipient; see below) development of bond markets in a number of emerging market economies,[4] analysing the impact of changes in expectations of inflation on the term structure over an extended period is not always possible. Nevertheless, Mehl (2006) has recently performed a related exercise. He studies 14 emerging market economies to see whether the slope of their yield curve predicts domestic inflation (and growth) over the past decade. Mehl finds that a yield curve does help predict inflation; after a 100 basis point steepening observed a year and a half earlier, inflation (and growth) is expected to accelerate by around 30 basis points a year ahead. Adding the yield curve also improves out-of-sample forecasts of inflation for about half of the countries in his sample.

Of particular interest is that inflation and its volatility have fallen considerably in a number of emerging markets in this decade. One explanation is that shocks have been smaller; in

[3] However, direct tests of the expectations theory of the term structure itself have in some cases rejected it.

[4] For example, in Thailand long-term interest rates are not available over a full business cycle of expansion and contraction; see Bank of Thailand (2006). In Mexico, the issuance of longer-term securities began in earnest at the beginning of this decade.

particular, fiscal positions have stabilised or improved in a number of emerging market economies. Another explanation is that inflation is less sensitive to shocks because it is anchored by stable inflation expectations, particularly in inflation targeting countries. A body of recent research suggests that a credible inflation target has helped to anchor inflation expectations in developed and emerging market economies. Using a measure of compensation for expected inflation and inflation risk at long horizons in the US, the UK and Sweden, Gürkaynak, Levin and Swanson (2006) find that forward inflation compensation is insensitive to economic news when a country targets inflation. In a study of selected Latin American economies, De Mello and Mocerro (2006) find evidence suggesting that inflation targeting regimes have anchored inflation expectations in Brazil, Chile and Mexico.[5]

The yield curve slope out to one year might also react quite differently from the slope at longer horizons to changes in near-term inflationary expectations. The former could rise as the market expects monetary policy to resist, whereas the latter (assuming success) might stay relatively flat. Variations in the responses to policy changes at different maturities are reported by a number of central banks (see below).

Term premia. Long-term rates generally exceed the predictions of the expectation theory; for example, Poole (2006) observes that in the US over the past 50 years, the 10-year Treasury rate has averaged about 90 basis points above the federal funds rate. Two reasons can be offered for expecting even larger term premia in emerging financial markets. First, a history of high and volatile rates of inflation expose holders of longer-term (unindexed) securities to a higher risk of loss. As noted previously, inflation has become more stable and it is likely that this has reduced term premia in recent years. Second, emerging financial markets tend to be comparatively thin and illiquid compared to developed markets. In many cases, there is no active secondary market in long-term bonds so that investors needing to dispose of their holdings over a short period can experience significant capital losses. One rough proxy for potential bond market liquidity is market size, which has been associated with more market turnover and lower bid-ask spreads. McCauley and Remolona (2000) suggest that government bonds outstanding must exceed around $100–200 billion in order to sustain a liquid government bond market. Emerging bond markets still appear to be small by this criterion, with only few exceptions. As can be seen in Graph 1, by 2005, only China, Korea, Malaysia, Mexico and South Africa had reached a total (government and private) bond market size of about $100 billion or higher.[6] Brazil, Thailand and Argentina had markets in the $65–$85 billion range; while the remaining markets were all below $50 billion. However, there is also some evidence that emerging bond markets are growing quite rapidly. For example, using BIS data, Eichengreen, Borenzstein and Panizza (2006) estimate that between 1994 and 2004 domestic bonds as a share of GDP rose from nearly 30% to over 40% in East Asia and the Pacific and approximately doubled to almost 40% in Latin America, while rising from 100% to more than 120% in developed markets.

Central bank questionnaire responses also indicate that liquidity in a number of emerging bond markets has increased. Apart from bond market growth, bid and ask spreads have fallen, and maturities have in some cases lengthened. Nevertheless, turnover ratios in many countries are still low.[7]

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[5] For falling trends and international convergence in inflation, see BIS (2006) Chapter 4; on volatility, see Mohanty and Turner (2008, this volume), Table 2.

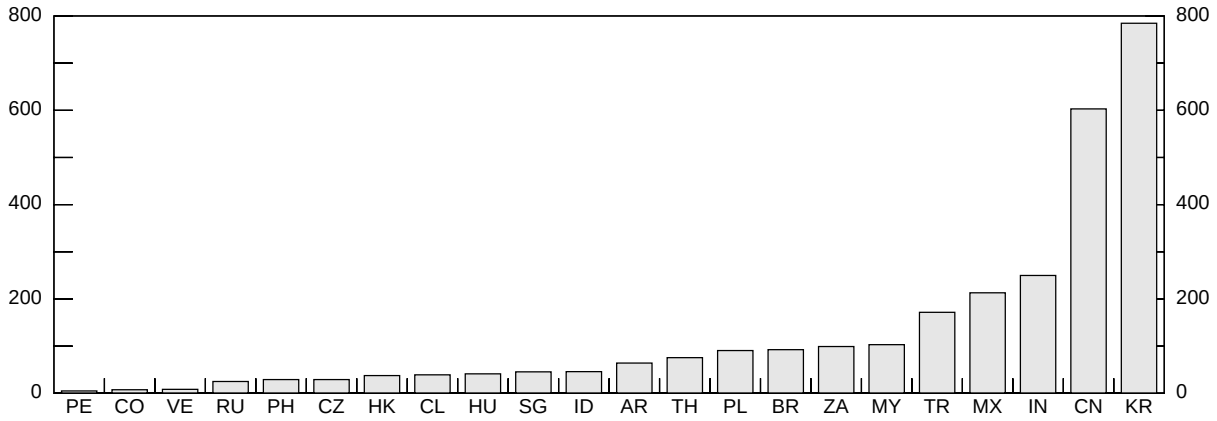
[6] The presence of a large private sector bond market can add to liquidity if it does not lead to market segmentation.

[7] See discussion of Table A10 in Mohanty and Turner (2008). For Asia, also see Gyntelberg, Ma and Remolona (2005). For Latin America, see Jeanneau and Tovar (2006). These papers note that liquidity remains an issue despite progress.

Graph 1

Bond market size[1]

End-2005, in billions of US dollars



[1] Amounts outstanding of domestic long-term debt securities plus local currency part of international long-term debt securities; for some countries, only domestic long-term debt securities. The corresponding figures for the US, Japan and the UK are 19, 7 and 1 trillion US dollars, respectively.

Source: BIS.

An example of greater financial market depth is Mexico: in 1995 the government could only borrow in the domestic market at less than one-year maturity. Maturities have risen significantly since 2000, when three-year and five-year bonds were first issued. In July 2001, 10-year government bonds were issued, while in October 2003 20-year bonds were auctioned for the first time. Another example is Poland, where the liquidity premium is negligible. All segments of the Polish treasury bond market at maturities of up to 10 years are liquid, allowing investors to execute trades quickly and without influencing market prices. Liquidity is concentrated in the five- and 10-year segment, where outstanding amounts of specific bond issues exceed PLN 20 billion (EUR 5 billion), fulfilling the requirement for benchmark status. In Thailand, according to the central bank, "the Thai bond market has already developed to a stage where information embedded in the term structure of interest rates reflecting market expectations of future short-term interest rates can be useful for monetary policy purposes."[8]

Positive term premia may also reflect the fact that investors need to be compensated for the risk of losses from default, and these risks generally rise with the time to maturity. This can be an important consideration in emerging market economies where sovereign debt in many cases is rated sub-investment grade. However, such risk premia appear to be declining. Converting ratings to a numerical scale reveals that the mean sovereign rating of the emerging markets in our sample rose in this decade, from below BBB+ at the end of 2001 to above BBB+ at the end of 2005 (the median rose from around A– to around A over this period) according to Standard & Poor's. The dispersion (standard deviation) in ratings fell much more dramatically, by about 29%.

Policy implications. The factors described previously can have important implications for the relationship between short-term rates and long-term rates and monetary policy transmission. If expected inflation is high and volatile, or equivalently, if inflation expectations are not well

[8] Bank of Thailand (2006, page 29, paragraph 1). This was before the introduction of capital controls on 18 December 2006, which appears to have affected the operation of the Thai bond market. However, restrictions have been reversed over time.

anchored, long-term rates will tend to be more volatile as expectations shift, and will be less responsive to policy rates. This will generally be associated with higher and more volatile term spreads, as was observed at the beginning of the decade in some of the countries included in Table 1. Policymakers may then need to respond more aggressively to shocks in order to influence long rates and achieve the desired path of output and inflation. On the other hand, if policy rate changes are credibly expected to respond to keep the economy on track (ie inflation within target and growth at potential), the long-term rate may change less than proportionately (or not at all) in response to shocks. An important point to bear in mind is that while reductions in inflation appear to reflect better policies, including the shift to inflation targeting, they also may reflect the effects of favourable global supply shocks or favourable market sentiment that could reverse in time. Under these conditions, the appropriate set of interest rate and communication policies that can help keep inflation expectations anchored warrant further examination.

Reductions in risk premia also have implications for policy as the associated reduction in financing constraints tends to stimulate the economy. One question of interest is whether policy rates need to rise to offset this stimulus. Another question is whether reductions in risk premia might have fallen too far. If long-term interest rates are now "too low", emerging financial markets could be exposed to a possible sudden reversal in investor sentiment.

III. Long-term interest rates in an open economy

In economies that are highly integrated with the rest of the world, domestic yields or asset prices may be significantly influenced by developments in foreign markets.[9] Nominal interest rate determination in an open economy can be described by:

$$i_t^n = r_t^{n,W} + \pi_t^{n,W} + \Delta s_{t+n}^e + \rho^W \qquad (2)$$

The first two right-hand terms are the expected world real rate of interest rate and world rate of inflation, Δs_{t+n}^e is the expected average rate of depreciation of the nominal exchange rate over the term of the bond and ρ^W is a risk premium that global markets apply to the domestic bond.

Financial integration of a small open economy implies that the determination of long-term interest rates satisfies equation (2). For the resulting long-term rate to also satisfy equation (1), the determinants of interest rates in a closed economy must converge to, or be anchored by, foreign determinants. To illustrate this we subtract equation (2) from equation (1) to obtain:

$$(r_t^n - r_t^{n,W}) + (\pi_t^n - \pi_t^{n,W}) - \Delta s_{t+n}^e + (\rho - \rho^W) = 0 \qquad (3)$$

Equation (3) suggests that convergence of domestic nominal interest rates with foreign rates will generally imply: (i) real interest rate convergence; (ii) stable real exchange rates; and (iii) convergence in risk premia of domestic and foreign residents.

Real interest rate convergence. Real interest rate convergence appears to be occurring with the growing globalisation of saving and investment, which implies that real interest rates are increasingly determined globally. However, recent empirical evidence suggests that convergence still tends to be one-sided, with the real rate in the largest economy, the US, affecting real rates in smaller economies, but not necessarily vice versa. The creation of the

[9] For a discussion in the context of developed markets, see Christiansen and Pigott (1997).

relatively large eurozone has altered, but not eliminated, this one-sided relationship (Chinn and Frankel (2005)).

Stable real exchange rates. Real exchange rate stability would imply that the relative inflation terms and the nominal exchange rate in equation (3) cancel out. One way to meet this condition is if purchasing power parity holds; however, the empirical evidence suggests that purchasing power parity does not hold at the horizons of interest to policymakers. Another way to achieve this is for inflation rates to converge and for nominal exchange rates to remain stable. As noted previously, inflation convergence is occurring, but the fact that many countries now maintain floating exchange rates implies a continuing wedge between domestic and foreign (nominal) interest rates. Having said that, the empirical evidence provided in Saxena (2008, this volume) that this wedge might not be very robust. She finds that as long as capital is highly mobile, the foreign interest rate effect on the domestic rate is larger *under regimes classified as floating* (de facto or de jure) than under those classified as pegging. One explanation is that those countries with floating exchange rates tend to have a higher degree of capital mobility. Another is that countries whose exchange rate regimes are classified as floating intervene actively in the foreign exchange market and do not fully sterilise, which would tend to link foreign to domestic rates. However, they are not as successful in stabilising the exchange rates as countries who are classified as pegging.[10]

Equalisation of risk premia of domestic and foreign investors. In open economy models, no distinction is usually made between domestic and foreign residents in describing risk premia. While risk premia of these two types of agents do share common elements (eg they are likely to reflect concerns about inflation, exchange rate volatility or default),[11] there are reasons to believe there may be important differences. For example, the risk tolerance of foreign investors – which would be reflected in risk premia – may differ from that of domestic residents because the former have more diversified portfolios or are exposed to conditions (eg investment opportunities or performance or liquidity in the rest of the world) that do not directly affect domestic investors. The equalisation of risk premia between the closed and open economy is more likely to happen if: (i) financial integration significantly increases the pool of foreign investors relative to domestic; or (ii) portfolios of domestic and foreign investors become more diversified and thus more "similar".

The equalisation of risk premia thus depends on the degree of integration with global financial markets. As reported in Saxena (2008), such integration has increased, as the share of external assets and liabilities as a percentage of GDP has grown significantly. Another indicator is the degree of foreign participation in emerging bond markets. Although this is still relatively small, in some cases it is large enough to have an impact. According to a recent report of the Committee on the Global Financial System (2007), the foreign share in local currency bond markets has grown rapidly in some emerging market economies, and is respectively 22% and 27% of the total in Poland and Hungary, 9% and 11% in Mexico and Turkey, and 3% to 6% in Thailand, Malaysia and South Africa.[12]

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[10] Christiansen and Pigott (1997) also suggest that floating does not completely insulate domestic interest rates from foreign interest rates.

[11] This risk premium would contain components related to currency risk as well as country risk (covered interest differential). For an explicit decomposition, see, for example, Chinn and Frankel (2005).

[12] According to the same report, the estimates provided by market participants are usually higher: by way of comparison, partly relying on BIS data, Eichengreen, Borensztein and Panizza (2006, Figure 17) estimate that the share is nearly 30% in Hungary, over 20% in Poland, below 10% in Mexico and Turkey, around 5% in Argentina and Malaysia, and well below 5% in Thailand, Peru, Indonesia and Korea. This compares to over 50% in the US. Based on information on US holdings, foreign participation in some other markets also appears to be small. See Burger and Warnock (2004), whose methodology is used in part by Eichengreen, Borensztein and Panizza (2006).

To sum up, we may highlight two points from the preceding discussion. First, inflation expectations and risk premia have fallen and are more stable than they have been in the past; this may explain the significant reduction that has occurred in the course of this decade in the level and volatility of long-term rates and term spreads in emerging market economies. Second, globalisation introduces another channel that can influence the long-term interest rate and the effectiveness of monetary policy. However, it is not entirely clear how important it is because some factors (eg floating exchange rates, differences in risk preferences) may introduce a wedge between domestic and foreign nominal long-term rates. We attempt to shed further light on this last point in the next two sections.

IV. Effects of policy rates and external factors on long-term rates: central bank views

Given the preceding, what is the relative importance of short-term rates, risk premia and external factors in influencing long-term interest rates in emerging market economies? Based on their responses to the questionnaire circulated for this meeting, central bank views can be summarised by three main points.

First, the policy rate influences long-term rates, but more stable inflation expectations have dampened the direct impact. Central banks generally reported that the effect of the policy rate on long-term rates is significant, although in some cases the effect was temporary (Table 4 in Mohanty and Turner (2008)). In Malaysia, the pass-through from policy rates to short-term and long-term rates has reportedly risen over time, perhaps due to more bank competition and the development of more liquid bond markets following the move to a more market-based interest rate framework in April 2004. In Chile, Larraín (2005) finds that policy rate surprises affect longer-term rates. In Hungary, a monetary policy surprise affects the entire yield curve of government bonds, although the effect is temporary (see the contributions in this volume of Vonnák (2008) and Mohanty and Turner (Table 4, 2008)).

A number of central banks (eg those of Chile, the Czech Republic, Mexico and Colombia) have said that the credibility of monetary policy and inflation targets has increased and have highlighted two implications. One is that long-term rates are now less sensitive to a variety of shocks including changes in the policy rate, but this is seen as a desirable. For example, in Mexico, inflation targeting has implied more anchoring of expectations, as the dispersion of expectations among market forecasters has fallen. While in the past monetary policy appeared to generate parallel movements in the yield curve without changes in slope, monetary policy actions since 2001 have changed the slope of the curve; that is, monetary policy tightening implies a flatter yield curve.

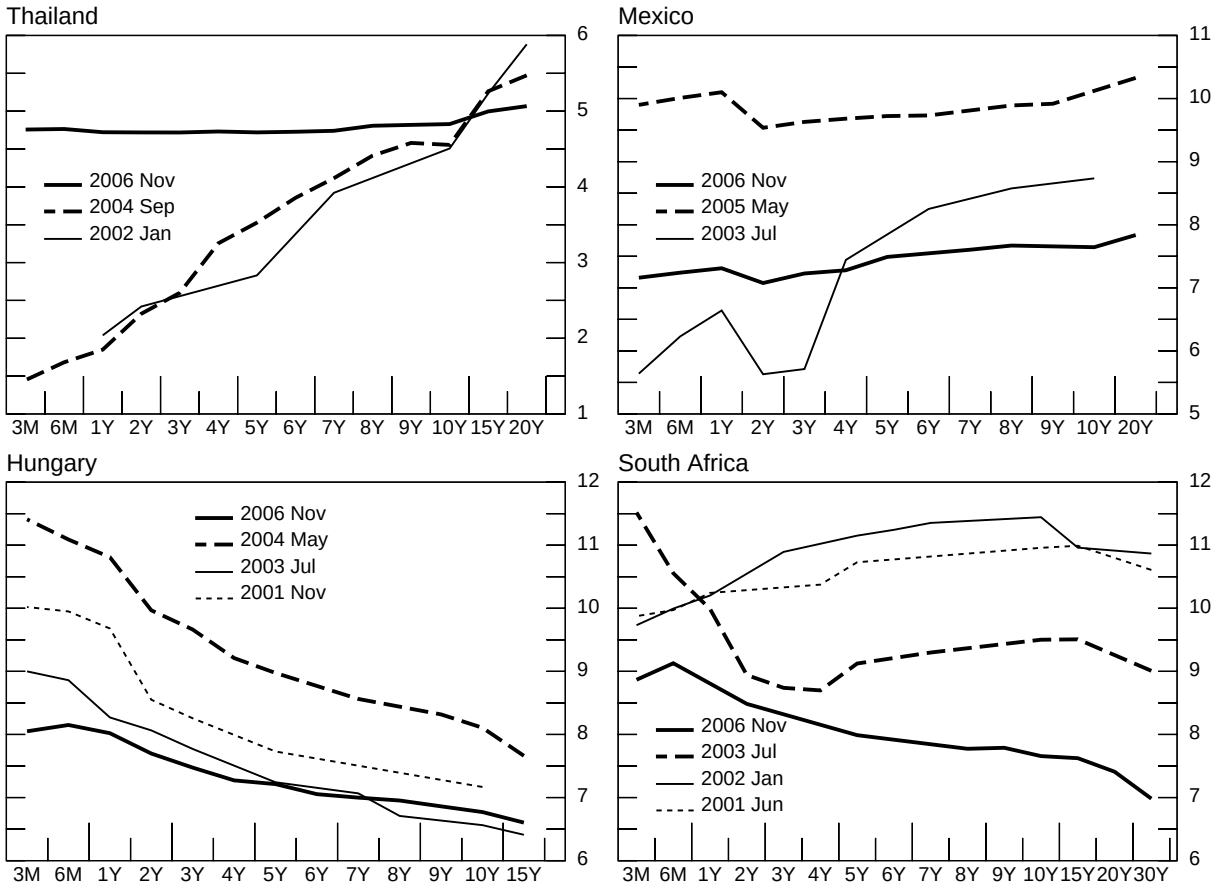
To illustrate, Graph 2 shows the pattern in yield curves in a number of emerging market economies as policy tightened or eased. As can be seen, the Mexican yield curve was initially upward sloping but there was a significant flattening as interest rates rose between July 2003 and May 2005. Rates subsequently fell, but the yield curve was still flat in November 2006. In effect, the tightening helped stabilise inflationary expectations, allowing the whole yield curve to drop subsequently. (For further discussion of bond markets and yield curves in Latin America, see Jeanneau and Tovar (2006)). Thailand's upward sloping yield curve also flattened in the course of this decade (note the difference in scale). In Hungary and South Africa, inverted yield curves also flattened as rates fell.

It is worth noting that a flattening yield curve is not always seen as a sign of greater credibility. For example, Bevilaqua, Mesquita and Minella (2008, this volume) note that as monetary policy was tightened in Brazil in 2004, longer-term yields increased little, resulting in a flattening yield curve and a comparatively small increase in the real interest rate at a one-year horizon. They interpret this as reflecting the small impact of tightening on inflation expectations, due to a lack of policy credibility. However, more recently, long-term rates have

fallen in anticipation of disinflation, and a flattening yield curve has reflected monetary easing that is consistent with meeting the inflation target in the context of such disinflation. In this setting, the longer term-rate is seen as having become "more sensitive to actual and expected changes in the basic interest rate", reflecting increased policy credibility.

Graph 2

Local currency sovereign yield curves



Source: Bloomberg.

Another implication is that there is less need for aggressive policy adjustment due to better anchored expectations. For example, since the adoption of inflation targeting in Colombia in 1999, the credibility of the central bank has risen as it has closed the gap between actual and target inflation. In 1999, only one third of people surveyed believed the central bank would meet its inflation target; seven years later the percentage had increased to 90%. As a result, the magnitude of interest rate policy shocks has fallen.[13] In the Czech Republic, the central bank has gradually gained greater credibility after the adoption of inflation targeting, reflecting good communication and successful disinflation. The result is that the typical policy

[13] The interest rate policy shock is based on Bayesian estimation of an interest rate policy rule in the context of a dynamic stochastic general equilibrium model of the Colombian central bank. The volatility of interest rate policy shocks has fallen since March 2000 from 54% to 8%. Higher credibility might reflect the central bank of Colombia's success in steadily closing the gap between observed and target inflation. The mean absolute gap fell from 2% in 1997–99 to 0.65% for 2000–05.

rate change has fallen from 0.5 percentage points in 1998–99, at the beginning of inflation targeting, to 0.25 percentage points recently.

Second, risk premia still affect long-term rates, but their relative importance has declined. Even in cases where the effect of the policy rate was still thought significant, long-term rates could be influenced by fluctuations in risk premia. For example, in Turkey the debt service burden and the maturity structure of the debt stock are important determinants of market interest rates. The risk premium thus dominates the effect of the policy rate on long-term rates. Since the adoption of floating, and especially after 2002, however, the relationship between short- and long-term rates appears to have strengthened. Market rates and overnight rates follow a parallel pattern, while the risk premium has also come down with a fall in the debt burden. During certain periods, and especially when there is a heightened perception of risk, market rates still diverge from overnight rates. It is expected that the decline in the level and volatility of the risk premium will continue, particularly in the context of increased central bank transparency.

Third, in some countries, but not all, external factors are increasingly important. As noted earlier, shocks to foreign interest rates affect domestic rates in emerging markets, even under floating. In line with this, some central banks see external factors playing a major role in influencing interest rates, particularly at the long end.[14] For example, in Hungary, shocks to the risk premium and long-term expectations regarding eurozone entry contribute significantly to exchange rate and yield curve movements; monetary policy has to react often to shifts in the risk assessment of foreign investors. As noted earlier, research by Rezessy (2005) indicates that monetary policy decisions have immediate impact on the yield curve, but the impact is largest at the short end of the yield curve and smallest at the long end. Long-term interest rates are more sensitive to global risk appetite and expectations concerning Hungary's euro convergence.

In Mexico, the central bank is less able to influence rates in the long part of the yield curve. While the maintenance of a stable monetary policy would still have an impact by lowering the risk premium of domestic long-term rates, the long part of the Mexican yield curve is increasingly influenced by global conditions. For example, during the period of market volatility in 2006.Q2, yield curves steepened as investor risk appetite fell. The spread between the 20-year government bond interest rate and one-day funding rate moved from 61 bps during 2006.Q1 to 206 bps.

In Poland, the short end of the yield curve is mainly sensitive to changes in the key central bank interest rates. The rate on the two-year treasury bond is driven by the implications of the expectations theory of the term structure. Foreign influences are most important for the yields on 10-year bonds, which are shaped by the term risk premium and inflation expectations. Nonresidents are the most important holders of long-term bonds, and the risk premium reflects macroeconomic and political conditions and exchange rate risk.

With the issuance of 12-year inflation indexed bonds in 2004, the central bank of Poland can estimate inflation expectations embedded in long-term yields. For example, at the June 2006 CPI-linked bond auction, average inflation expectations were revealed to be stable over the next 10 years. Since the beginning of March 2006, rising long-term yields have reflected an increase in the term risk premium associated with a fall of global risk appetite for risky assets.

In contrast, some central banks did not emphasise external factors in their questionnaire responses, or said that these factors play a more limited role in influencing interest rates. For

[14] Research by Andritzky et al (2005) also suggests that external factors are relatively important; they indicate that emerging market bond spreads respond more to rating actions and changes in global rates than to domestic data and policy announcements.

example, Vargas (2008, this volume) reports that financial market interest rates generally follow the policy rate, although research shows that interest rate pass-through is incomplete and weakened in this decade because of a delinking of mortgage loans and short run interest rates. Malaysia reports that movements in the yield curve so far follow the general policy direction even if capital account liberalisation has led to an increase in short-term and long-term financial flows (see also Ooi (2008, this volume)). In Thailand, an increasing degree of capital account openness has not significantly affected the yield curve. The short end of the yield curve is largely influenced by the policy rate. The long end of the yield curve is more difficult to control, and is likely to be influenced by market inflation expectations and the economic outlook. In Turkey, the short end of the yield curve is also affected by central bank rates, while the middle segment (18–24 months) seems to respond to inflation expectations. At the long end, risk and term premia are embedded in expected future short-term rates.

In South Africa, short dated bonds influence the South African Reserve Bank's (SARB) repurchase rate, while longer dated bond yields reflect inflation expectations and other factors and are more difficult to control. However, the SARB does not aim to control such yields directly; bond yields are determined by supply and demand factors.

Additional perspective is provided by Mehl (2006). He finds that that the US yield curve helps predict inflation in half of the countries in his sample, while the slope of the euro area yield curve conveys information for future inflation in the new EU member states. (He reaches a similar conclusion for growth). On average, a 100 basis point steepening of the US or euro yield curves observed a year earlier implies an expected acceleration of inflation of around 60 basis points a year ahead. In half the countries in his sample, the US or euro area slope of the yield curve is a better predictor than emerging economies' own domestic slope for inflation (two thirds for growth). He finds that the ability of external slopes to predict economic outcomes is stronger in countries that pegged their exchange rate over part of the sample period (specifically Hong Kong, Poland, Saudi Arabia and Taiwan), after controlling for relative market liquidity and commonalities in economic shocks. This is broadly in line with the Hong Kong Monetary Authority's response to our questionnaire, which indicates that both short-term and long-term yields follow US rates under the linked exchange rate system. However, Mehl suggests that international yield curve spillovers are mainly channelled through the short end of the maturity spectrum.

V. Empirical analysis

To further clarify the relationship between short- and long-term rates, we estimate an econometric model that attempts to identify the direct impact of changes in short-term rates and foreign long-term rates on domestic long-term rates of similar maturity. Identifying this impact poses a number of challenges. One is that financial markets invest a great deal of resources in forecasting monetary policy decisions and, as noted previously, the resulting expectations are embedded in the term structure of interest rates. This implies that changes in policy are often anticipated, which can make it difficult to identify any direct relationship between changes in short-term rates and long-term interest rates. For this reason, some researchers have focused on identifying policy rate surprises and relating these to changes in long-term interest rates (Rigobon and Sack (2002) for the US, Rezessy (2005) for Hungary and Larraín (2005) for Chile). Others have instead focused on how economic news – which may include policy announcements and developments that influence the path of policy – affect long-term interest rates (Fleming and Remolona (1999)).

In this paper we implement a different empirical approach; we estimate a (near) vector autoregression model of interest rates. The model allows us to describe the dynamic interaction between domestic interest rates at various maturities and short-term interest rates or foreign interest rates. It also provides a method for identifying underlying shocks and assessing their relative importance in driving long-term interest rate behaviour.

1. The model and data

The relationship between long-term interest rates, the policy rate and foreign interest rates can be described by the following (near) vector autoregression system in first differences:

$$\Delta i_t^{f,m} = a_0 + \sum_{i=1}^{T} a_i \Delta i_{t-i}^{f,m} + u_{1t} \qquad \text{Foreign long-term rate} \qquad (4)$$

$$\Delta i_t^{SR} = b_0 + \sum_{i=1}^{T} b_i \Delta i_{t-i}^{f,m} + \sum_{i=1}^{T} b_{i+T} \Delta i_{t-i}^{SR} + \sum_{i=1}^{T} b_{i+2*T} \Delta i_{t-i}^{m} + u_{2t} \qquad \text{Domestic short-term rate} \qquad (5)$$

$$\Delta i_t^{m} = c_0 + \sum_{i=1}^{T} c_i \Delta i_{t-i}^{f,m} + \sum_{i=1}^{T} c_{i+T} \Delta i_{t-i}^{SR} + \sum_{i=1}^{T} c_{i+2*T} \Delta i_{t-i}^{m} + u_{3t} \qquad \text{Domestic long-term rate} \qquad (6)$$

Equation (6) is the focus of the present discussion. It says that the domestic long-term rate depends on the lagged foreign rate of similar maturity, the lagged short-term rate, and its own lags..[15] The same set of predetermined variables influence the short-term interest rate (equation 5). However, by construction domestic variables have no influence on the foreign interest rate; they do not appear in the specification of equation (4).

The ordering of equations (4) to (6) is maintained in the computation of impulse responses to (orthogonalised) innovations in each of the variables. These innovations are identified by a Choleski decomposition of the variance covariance matrix of the residuals of the equations in this system. Our focus will be on responses by the domestic long-term interest rate to innovations in each variable. One identifying assumption implied by this ordering is that the foreign rate is exogenous (contemporaneously) to both domestic rates. Another identifying assumption is that the domestic short-term rate is exogenous to the long-term rate at a daily frequency. This assumption appears to be plausible, since the short-term rate is anchored by the policy decisions of the central bank, and changes in this policy occur relatively infrequently in daily data (typically on the occasions when the monetary board meets, which can occur once every several weeks or even once a quarter).

Estimation was implemented using daily data on short-term (overnight or interbank) rates and rates at one-, three-, five- and 10-year maturity. A US interest rate for a security of comparable maturity was used to represent the foreign rate..[16] Data for the period 2001:01:01 to 2006:09:30 were generally collected from Bloomberg. Five lags were selected (three in the case of Korea).

Two sets of questions were addressed:

1. *Which variables help forecast long-term interest rates*? This was done by testing which variables lead or Granger-cause long-term interest rates over the full sample period.

2. *What is the recent dynamic impact of the variables in the model on long-term interest rates*? Has this relationship changed? This was done by estimating the (accumulated) impulse response of long-term interest rates to shocks to each series. In order to verify the most recent responses, and bearing in mind that these might have changed with disinflation and possible significant reductions in risk premia, we estimate impulse responses over two periods: (1) 2001:01:01–2004:06:29, when the Federal Reserve was easing; (2) 2004:06:30–2006:09:30, when the Federal Reserve was tightening.

[15] Plausible alternative specifications would include adding the foreign short-term interest rate and an error-correction model. These are left for future research. Some results on the impact of foreign short-term interest rates are provided by Saxena (2008).

[16] Although the US rate rather than a European rate was used as the foreign rate for central Europe, the estimated effect of a shock to the foreign rate on the domestic rate is still strong relative to the impact of the domestic policy rate. See Appendix A.

To conserve space, impulse responses were estimated only for longer-term rates at one-year and five-year maturity. A caveat is that we focus on point estimates, which are subject to a margin of uncertainty.

2. Results

Forecasting long-term rates

As reported in Table 2, tests of Granger causality suggest that, with some exceptions, external long rates are better predictors of longer-term yields in emerging market countries than are short-term interest rates. Changes in short-term rates generally do not lead rates at longer maturities in other countries in the group included in Table 1. However, changes in the short-term rate lead (Granger-cause) changes in rates at one-, three-, five- and 10-year maturities in Thailand and Mexico. They also lead changes at one-year maturity in Korea, at one- and three-year maturity in the Czech Republic and at five- and 10-year maturities in Poland. Whether the preceding results have anything to do with bond market size (Graph 1) is unclear; while Korea, Malaysia and Thailand have among the larger emerging bond markets, the Czech Republic does not.

Table 2

Tests of Granger causality

P-values on null hypothesis of no Granger causality, full sample

	India		**Korea**		**Malaysia**		**Philippines**		**Thailand**	
1-year										
Foreign rate	0.01	***	0.19		0.27		0.40		0.00	***
Short-term rate	0.06	*	0.04	**	0.42		0.80		0.03	**
3-year										
Foreign rate	0.48		0.99		0.00	***	0.51		0.00	***
Short-term rate	0.72		0.76		0.76		0.81		0.02	**
5-year										
Foreign rate	0.38		0.54		0.01	***	0.13		0.00	***
Short-term rate	0.13		0.79		0.89		0.41		0.00	***
10-year										
Foreign rate	0.07	*	0.01	***	0.00	***	0.39		0.00	***
Short-term rate	0.36		0.67		0.55		0.88		0.00	***
	Brazil		**Mexico**		**Czech Republic**		**Hungary**		**Poland**	
1-year										
Foreign rate	0.47		0.36		0.34	**	0.01	***	0.01	***
Short-term rate	0.02	**	0.02	**	0.01	***	0.41		0.65	
3-year										
Foreign rate	0.60		0.34		0.00	***	0.01	***	0.00	***
Short-term rate	0.00	***	0.07	*	0.00	***	0.44		0.25	
5-year										
Foreign rate			0.70		0.00	***	0.00	***	0.09	*
Short-term rate			0.08	*	0.13		0.93		0.02	**
10-year										
Foreign rate			0.95		0.00	***	0.01	**	0.25	***
Short-term rate			0.00	***	0.50		0.55		–0.04	***

***Reject null at 1%; **reject null at 5%; *reject null at 10%.

The regression results more consistently indicate a closer relationship between foreign and domestic long rates. In particular, changes in US rates lead changes in domestic rates at 10-year maturity in all countries except Mexico. In Thailand and central Europe (the Czech Republic, Hungary and Poland), this relationship generally holds for all other maturities as well. Remarkably, changes in the US rate do not lead changes in domestic rates in Mexico or Brazil.

Impact of shocks on long-term rates

The graphs in Appendix A report the impulse responses of domestic long-term rates to innovations in the foreign (US) rate, the policy rate and the own domestic long rate. We focus initially on the most recent period (the last two graphs on each row). The first point to note is that the largest impact is from a shock to the (own) domestic long-term rate. While it is tempting to conclude from this that domestic shocks are therefore the most important drivers of long-term interest rates, such an inference is probably not valid. A shock to the domestic long-term rate could reflect a shift in the term risk premium, due to less investor risk tolerance or greater investor uncertainty; this could well reflect foreign as well as domestic investor sentiment. A more fully specified model might be able to capture such nuances.

With this qualification in mind, the impulse responses (point estimates) once again convey the impression that foreign interest rate shocks in many cases have a larger impact on long-term rates. Focusing on the most recent period (2), the point estimates generally show larger responses of domestic long rates to the foreign long-term rate than the domestic short-term rate.

Has the transmission of shocks changed?

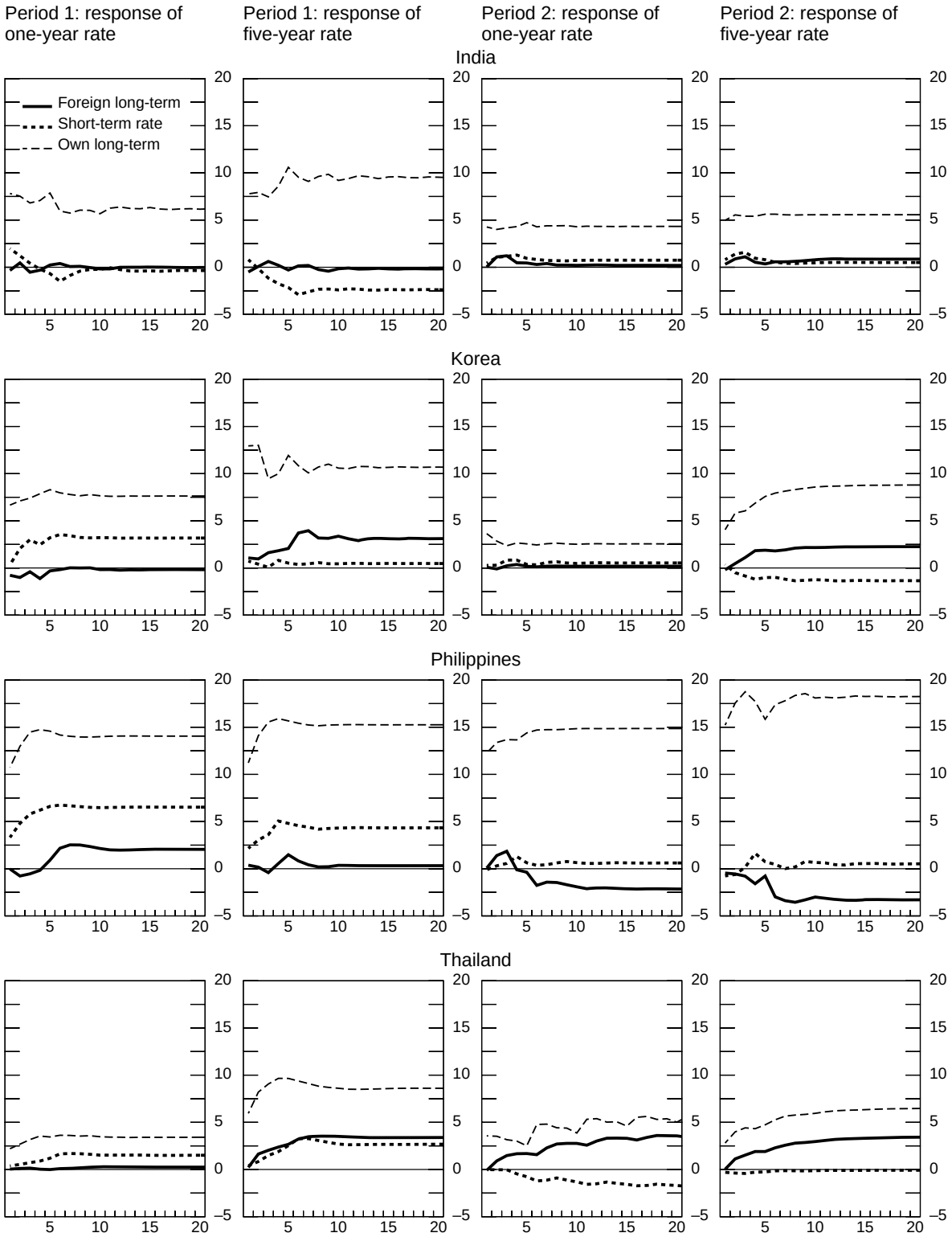
Two trends are apparent when comparing the responses in the two periods.

First, the magnitude of shocks to domestic long-term rates and the cumulative responses has in a number of cases declined, which is in line with the earlier discussion that expectations of inflation and risk premia have fallen. There are some exceptions; Hungary for both long-term rates, the Philippines for the five-year rate, and Thailand for the one-year rate.

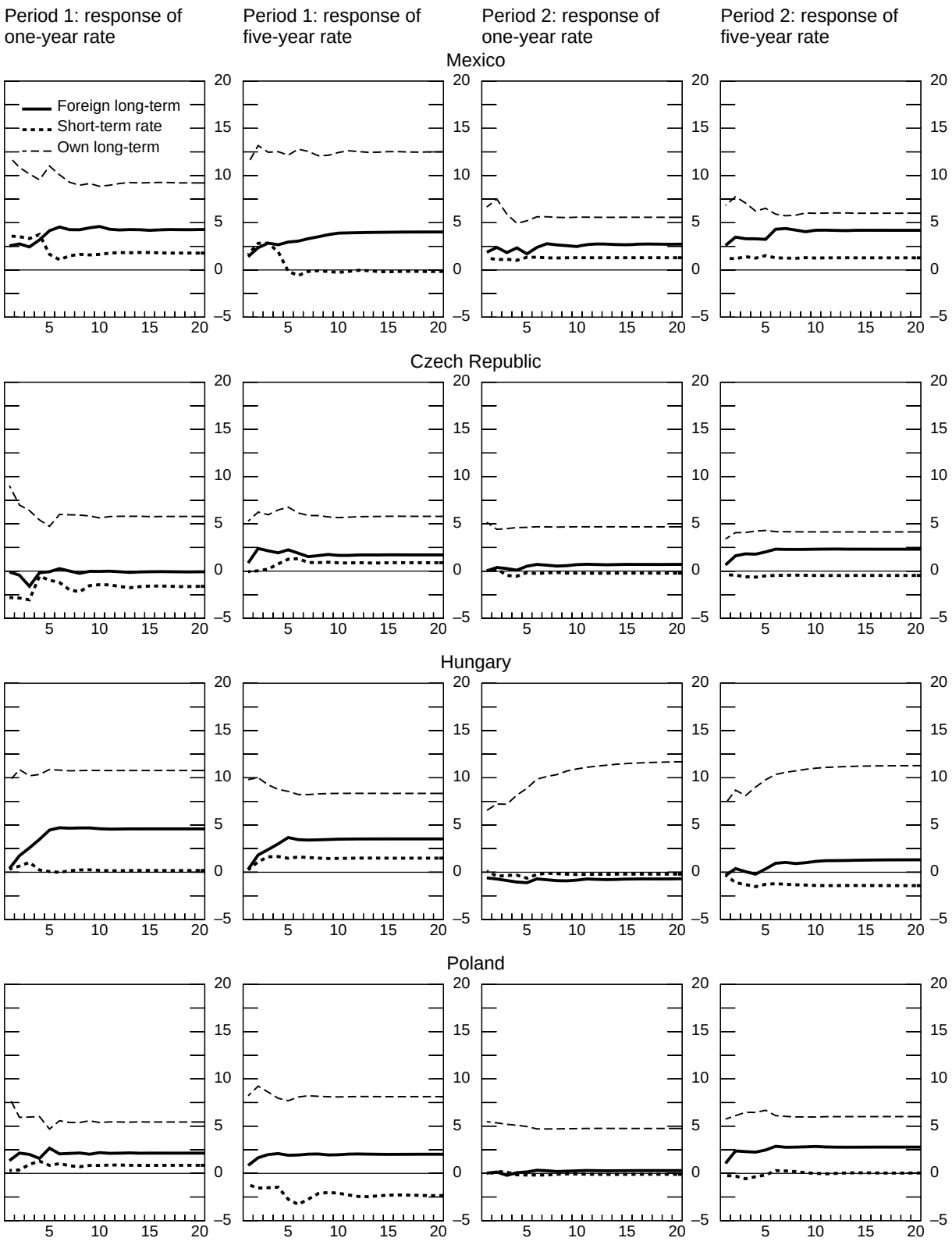
Second, there are some cases in the first period only in which shocks to the domestic short-term rate have a larger direct effect (in absolute value terms) than foreign shocks (Korea, the Philippines and Brazil). On balance, the relative impact of domestic short-term rates and foreign rates gives the impression that external influences were in some cases already apparent at the beginning of this decade. Furthermore, such influences have increased in some countries. Having said that, the importance of innovations in either policy rates or foreign long-term interest rates in the estimated model is small. Variance decomposition results consistently attribute most (around 90% or higher) of the variance of forecast errors in the domestic long-term rate to its own innovations. Research using alternative specifications may shed further insight on the evolution of the policy transmission mechanism and the factors that drive long-term interest behaviour in EMEs.

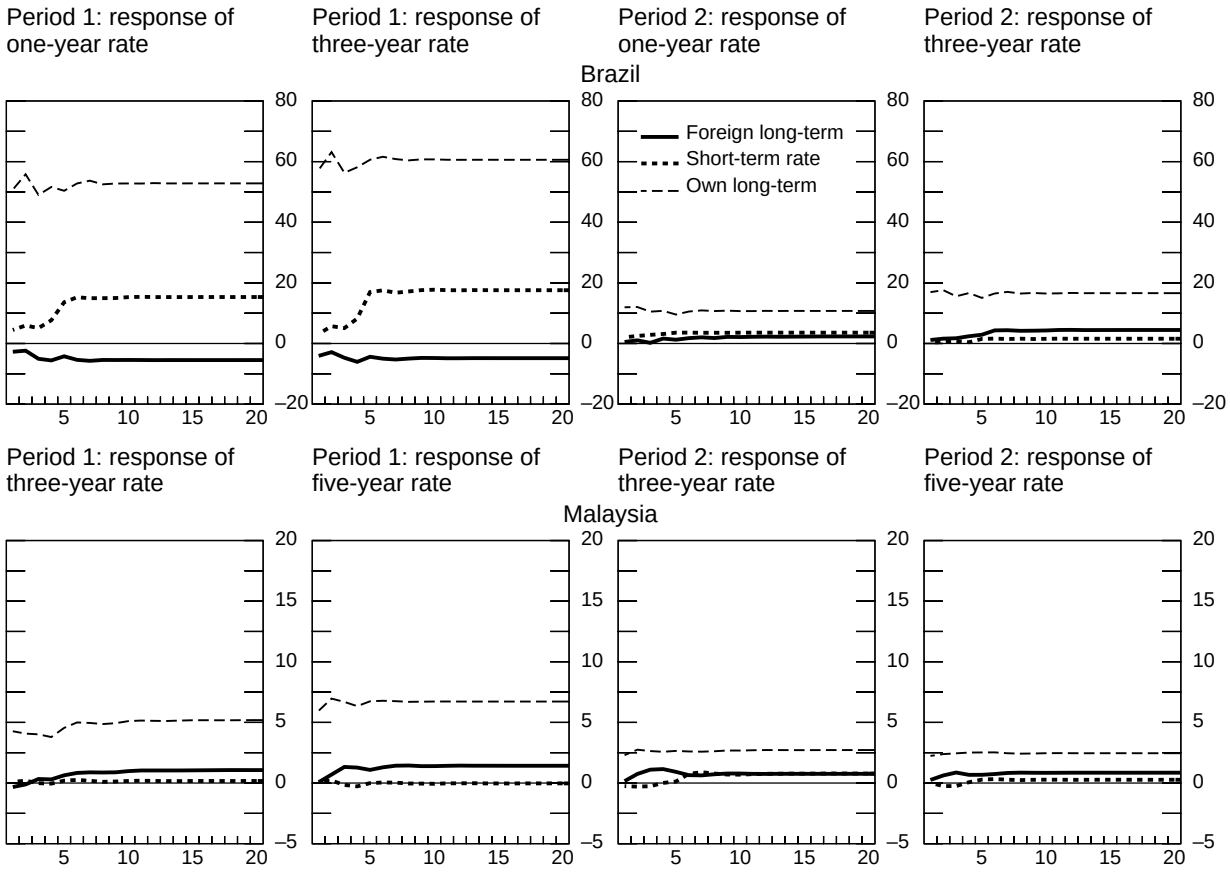
Appendix A

Response of long-term rates to shocks[17]



[17] Impulse responses: period 1 = 2001:01:01 to 2004:06:29; period 2 = 2004:06:30 to 2006:09:28.


Period 1: response of one-year rate
Period 1: response of five-year rate
Period 2: response of one-year rate
Period 2: response of five-year rate
Mexico
Foreign long-term
Short-term rate
Own long-term
Czech Republic
Hungary
Poland
20
15
10
5
0
–5
5
10
15
20


Period 1: response of one-year rate
Period 1: response of three-year rate
Period 2: response of one-year rate
Period 2: response of three-year rate
Brazil
Foreign long-term
Short-term rate
Own long-term
80
60
40
20
0
–20
5
10
15
20
Period 1: response of three-year rate
Period 1: response of five-year rate
Period 2: response of three-year rate
Period 2: response of five-year rate
Malaysia
20
15
10
5
0
–5

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