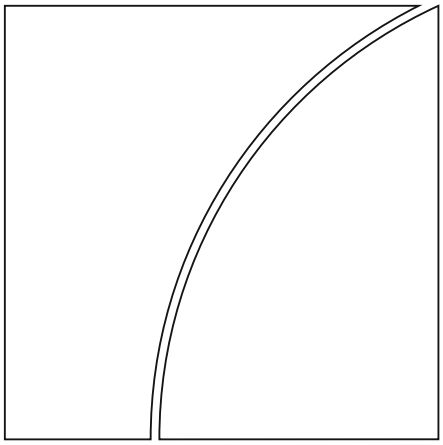

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by Blaise Gadanecz, Ken Miyajima, Chang Shu

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Exchange rate risk and local currency sovereign bond yields in emerging markets

Blaise Gadanecz, Ken Miyajima, Chang Shu[1]

In this paper we consider the role of exchange rate risk in influencing local currency sovereign bond yields in emerging market economies (EMEs). We explicitly account for exchange rate expectations and uncertainty around them, as measured by exchange rate volatility. The analysis points to an important influence of exchange rate risk: when exchange rate volatility increases, investors require a larger yield compensation for holding EME local currency sovereign bonds. The impact of exchange rate volatility has become more important since May 2013, when investors realised that the Federal Reserve may reduce the scale of its asset purchases sooner than previously expected.

JEL classification: E43, E44

Keywords: Emerging markets, exchange rate risk, local currency sovereign bond yields

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Contents

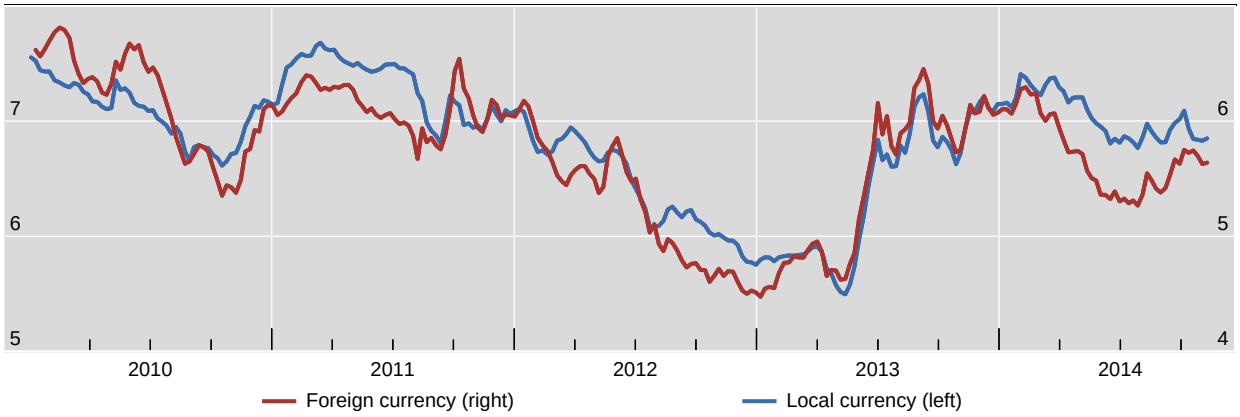
1. Introduction

Between 2010 and early 2013, the general appreciation of emerging market economy (EME) currencies against the US dollar made investing in EME local currency bonds an attractive proposition for international investors. Concerns about exchange rate risk did not seem to moderate investment into such bonds. This seemed to be a break with the past, when EME local currency bonds had not been able to attract much foreign investment because of fears that EME currencies were inherently unstable or could easily weaken in case sentiment in global markets turned against EMEs. Some observers saw the early 2010s as the absolution of EME currencies from the "original sin", ie the inability of EMEs to borrow in their own currencies (Eichengreen and Hausmann (1999)).

Such views seem to have changed since May 2013, when EMEs experienced a period of turbulence triggered by the Federal Reserve's announcement that it might start reducing its large-scale asset purchases earlier than previously expected. At the time, it was not clear whether global investors' interest in EME local currency bonds would be affected temporarily or more permanently. But in the second half of 2013 exchange rate risk started to assume an increasingly important role in EME sovereign debt markets (BIS (2014a)), with important implications for investors, domestic and foreign alike, and central banks[2] in EMEs (see, for instance, BIS (2014b)).

Emerging market sovereign foreign currency and local currency bond yields

In per cent — Graph 1



Note: JP Morgan EMBI Global and GBI EM Global indices.

Source: JP Morgan.

To illustrate the role of exchange rate risk, Graph 1 plots EME local currency sovereign bond yields against their foreign currency counterpart. The two yields have moved broadly in parallel,[3] pointing to the influence of similar risk factors

[2] Reflecting the importance of exchange rate risk in influencing domestic asset prices and economic activity, central banks in EMEs have taken actions to help smooth exchange rate movements in times of market stress.

[3] See CGFS (2009), pp 115, Graph H4, for a similar result.

(eg credit and liquidity risks). But one can also notice a relatively persistent wedge between local and foreign currency bond yields, suggesting a potential role of exchange rate risk.

Assessing the impact of exchange rate risk on local currency sovereign yields is not trivial because the exchange rate itself is affected by factors that also influence bond yields. Drivers of bond yields include country-specific factors, international factors common to all EMEs, and investor risk preferences. Country-specific factors comprise changes in domestic interest rates, inflation, as well as sovereign credit risk relative to major currency areas and other EMEs. International factors include interest rates in major currency areas, external shocks and changes in international investors' risk preferences that can affect exchange rate movements across EMEs as a group.[4]

Another complication stems from the direction of causality between exchange rate risk and local currency sovereign yields. One view, which has influenced our analysis, is that causality runs from exchange rate risk to local currency sovereign yields. When uncertainty about the future path of the exchange rate increases, foreign investors with exchange rate exposures would require greater yield compensation for holding local currency bonds. If these investors were unable to roll over their exchange rate hedges and wanted to sell their bond holdings, yields would rise. Another view is that shocks can be transmitted from the local currency bond market to the foreign exchange market. Because the former is usually shallower and less liquid, foreign investors tend to rely on foreign exchange instruments to hedge their holdings of local currency bonds, eg foreign exchange options that protect against extreme market volatility. Such position taking in turn tends to move the exchange rate.

Does the range of factors mentioned above fully capture the exchange rate risk component of local currency sovereign yields in EMEs? We argue that this may not be the case. Exchange rate factors may also capture the effects of other explanatory variables on local currency bond yields. But exchange rate factors could also affect local currency bond yields independently of other variables. We therefore consider additional measures of exchange rate risk – in particular, the central forecast of the future path of exchange rates and uncertainty around it, as represented by implied exchange rate volatility. We thus extend previous studies (Gonzalez-Rozada and Levy-Yeyati (2008), Peiris (2010), Longstaff et al (2011), Jaramillo and Weber (2013a, 2013b)), which tend to focus on domestic and international fundamentals of local currency sovereign yields. To our knowledge, implied exchange rate volatility is explicitly considered for the first time in an empirical model of EME local currency sovereign bond yields.

Our results suggest that EME local currency sovereign bond yields are indeed influenced by at least one of the additional measures of exchange rate risk. Specifically, when implied exchange rate volatility increases in EMEs, investors require a larger yield compensation for holding these bonds. We also show that investors have been attaching greater importance to exchange rate risk since May 2013, when investors realised for the first time that the Federal Reserve may reduce

[4] For example, Chinn and Frankel (1994) decompose the foreign-local interest rate differential into country factors and an exchange rate risk premium, and associate the latter to investors' risk preference.

the scale of its asset purchases sooner than previously expected. The results are broadly unchanged when subjected to a number of robustness checks, including to potential reserve causality running from local currency bond yields to exchange rate volatility.

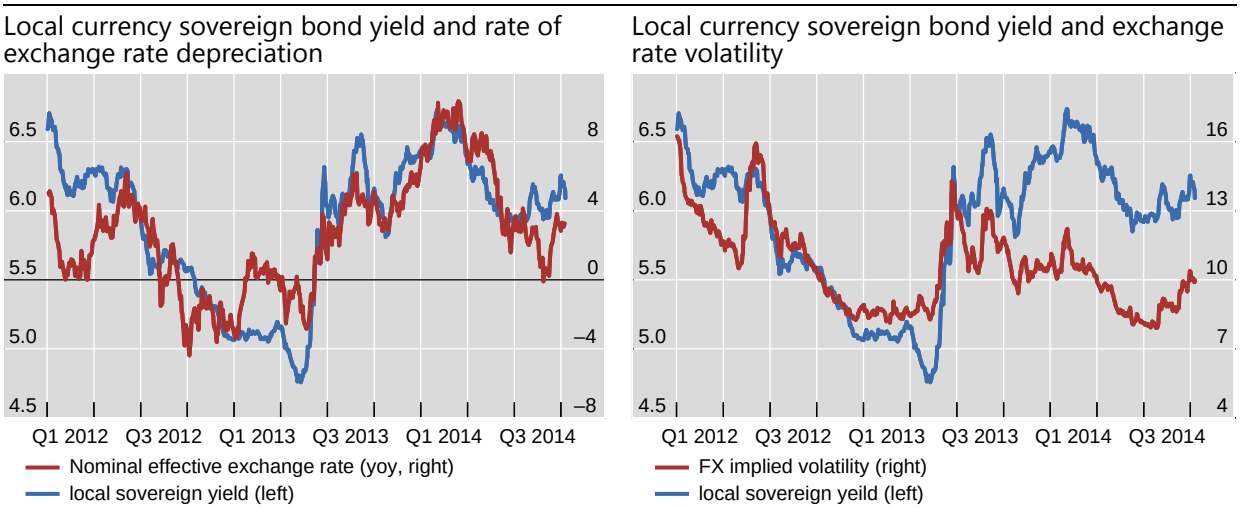
The rest of the paper is organised as follows. Section 2 presents stylised facts and preliminary regressions to demonstrate the importance of exchange rate risk for the modelling of EME local currency sovereign bond yields. Section 3 reviews the literature on sovereign risk. Section 4 discusses the data and modelling methodology, and Section 5 reports the empirical results. Section 6 assesses the robustness of our key result. Section 7 draws conclusions.

2. Exchange rate risk and local currency sovereign bond yields

Exchange rate risk can be important for EME local currency government bond yields for several reasons. First, investors are exposed to exchange rate risk on their bond positions. Perceived changes in exchange rate risk can therefore move local currency bond yields. Second, large currency mismatches in corporate, banking or household sector balance sheets in EMEs increase default risks for local currency sovereign bonds. Third, a perception of greater exchange rate risk can reduce liquidity in foreign exchange and domestic bond markets, which tends to be low in many EMEs even in tranquil times. For instance, the unexpected depreciation of a local currency could prompt investors to move out of assets denominated in that currency and thus reduce foreign exchange market liquidity.

EM local currency sovereign bond yield and exchange rate performance[1]

In per cent — Graph 2



1 A higher rate of nominal effective exchange rate change indicates a greater rate of depreciation. Implied exchange rate volatility for 3-month at-the-money contracts.

Sources: JPMorgan; authors' calculations.

Graph 2 suggests that EME local currency sovereign yields have moved in tandem with two commonly used measures of exchange rate risk– the rate of

exchange rate depreciation and exchange rate volatility. The left panel shows that, between mid-2013 and early 2014, local currency sovereign yields rose, while the rate of depreciation of nominal effective exchange rates increased. The right panel shows that implied exchange rate volatility and local currency sovereign bond yields followed a roughly similar pattern in the past few years.

Preliminary regression

To verify the growing role of exchange rate risk in local currency sovereign bond markets in EMEs, we conduct a preliminary econometric investigation, mainly using the data presented in Graph 2.

We consider a small number of explanatory variables to explain movements in five-year yields on EME domestic currency sovereign bonds (y). First, as a measure of sovereign credit risk, we use the major index of foreign currency EME sovereign bond spreads, the JPMorgan Emerging Market Bond (EMBI) Index ($embispd$). Second, we include the rate of deprecation of the nominal effective exchange rate (s). The third explanatory variable is implied exchange rate volatility.[5] This measure appears to be correlated with the EMBI index. Therefore we use the residual of implied exchange rate volatility regressed on the EMBI index ($fxvolresid$) to capture information contained in exchange rate volatility over and above that in the EMBI index. The model, summarised by equation (1), is estimated in first differences (including the calculation of the residual of exchange rate volatility) using daily data for 12 EMEs for the period of January 2012–June 2014.[6,7]

$$d(y_t^i) = \alpha^i + \beta_1 * d(embispd_t^i) + \beta_2 * d(s_t^i) + \beta_3 * fxvolresid_t^i + \epsilon_t^i \quad (1)$$

We considered three sub-periods in the sample in order to check whether the role of the explanatory variables changed. Local currency sovereign bonds generally rallied during January 2012–April 2014. Subsequently, they sold off during May–December 2013, and rallied again during January–June 2014.

The simple regression analysis broadly confirms the view that exchange rate risk assumed a greater role during the recent period of market volatility. As local currency sovereign bond yields declined during January 2012–April 2013, a one percentage point increase in exchange rate volatility not explained by the EMBI index was associated with a little over 2 basis point increase in yields. The sensitivity surged to over 4 basis points during May/June 2013, and to 5 basis points in the subsequent period. The sensitivity of local currency sovereign yields to both exchange rate movements and the EMBI spread increased during May/June 2013. The impact of exchange rate movements levelled off afterwards, but that of the EMBI spread remained elevated. With this result in mind, we will investigate the role of exchange rate risk using a fuller fledged model after a brief literature review.

[5] Recognising that the exchange rate is in nominal effective terms, we use the volatilities of bilateral exchange rates against the US dollar, except for the Czech Republic, Hungary and Poland, where we consider the volatility of bilateral exchange rates against the euro.

[6] We use a Generalised Autoregressive Conditional Heteroskedasticity (GARCH) approach. Time invariant country effects are controlled for by dummy variables.

[7] The 12 EMEs include Brazil, Chile, Colombia, Hungary, Indonesia, Malaysia, Mexico, Philippines, Poland, Russia, South Africa and Turkey.

Determinants of yields on EM local currency sovereign bonds Table 1

	Jan 12 – Apr 13	May – Jun 13	Jul 13 – Jan 14	Feb – Jun 14
EMBI index	0.168***	0.372***	0.271***	0.341***
Residual of fx volatility on EMBI index	0.021***	0.042***	0.052***	0.051***
Nominal effective exchange rate changes	0.002***	0.022***	0.007***	0.009***
N	3,465	442	1,544	922

Note: All variables in daily changes. GARCH(1,1) was estimated for a panel of Brazil, Chile, Colombia, Hungary, Indonesia, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Turkey. Coefficients on country dummies and ARCH/GARCH terms are not reported. ***, ** and * stand for statistical significance at the 1, 5 and 10% levels, respectively.

Source: Authors' estimates using daily data.

3. Literature review

A key financial market development in EMEs over the past decade has been the expansion of domestic bond markets. EMEs faced difficulties in borrowing in their own currencies in the 1980s and 1990s, a phenomenon often characterised as the "original sin" (Eichengreen and Hausmann (1999)). But from 2004 to 2013 the stock of domestic currency debt issued by EMEs increased fivefold, to more than $5.6 trillion.[8] This seemed to vindicate the views of Burger and Warnock (2006, 2007) that EMEs were not inherently dependent on foreign currency borrowing. Deeper domestic bond markets broadened the range of financing options for both sovereign and corporate borrowers and helped cushion the negative impact of financial shocks on the real economy in EMEs. Moreover, foreign investors showed a growing preference for EME local currency sovereign debt.

There are relatively few studies that focus on the determinants of sovereign yields in EME domestic bond markets. Earlier research tends to examine advanced economies, mainly the United States.[9] Related studies on EMEs often concentrate on foreign currency denominated bonds (Gonzalez-Rozada and Levy-Yeyati (2008), Longstaff et al (2011)). Baldacci and Kumar (2010) study a panel of 31 advanced economies and EMEs over the past three decades. Jaramillo and Weber (2013a, 2013b), Miyajima et al (2014), and Peiris (2010) focus exclusively on EME local currency bonds.

This literature identifies several key determinants of bond yields. Among domestic factors, Gale and Orszag (2003) find strong empirical support for the hypothesis that weaker fiscal positions lead to higher bond yields. Miyajima et al (2014) show that greater monetary and fiscal policy credibility enhances the stability of sovereign bond yields. Peiris (2010) finds that the fiscal balance has greater

[8] Meanwhile, the stock of foreign currency sovereign bonds has increased from $300 billion to $500 billion.

[9] See Gale and Orszag (2003) for a comprehensive review of 59 studies on sovereign risk modelling in advanced economies.

impact on local currency sovereign bond yields in EMEs than monetary aggregates and real economic activity. Baldacci and Kumar (2010) confirm the importance of fiscal conditions in determining local currency bond yields in both advanced and emerging markets. Piljak (2013) argues that domestic macroeconomic factors, particularly monetary policy and inflation, are more important than global factors for domestic government bond markets in EMEs.

International factors (ie external shocks common to all EMEs) have also been found to be important determinants of sovereign bond yields and spreads. Although most studies focus on foreign currency bond yields, external factors also play a role in determining local currency bond yields. Longstaff et al (2011) analyse a decade-long dataset through to 2010 and find that movements in the VIX, representing a global factor, can explain a large degree of commonality in the variation of credit default swap spreads for a set of advanced and emerging market sovereigns. Gonzalez-Rozada and Levy-Yeyati (2008) find that a very large fraction of movements in EM foreign currency bond spreads during the decade up to 2005 can be accounted for by the evolution of global factors such as global liquidity (international interest rates) and risk appetite (high-yield corporate bond spreads in advanced economies). Remolona et al (2008) argue that the risk premium reflecting the risk of unexpected losses explains a large fraction of EME foreign currency sovereign bond spreads. Other studies confirming the influence of measures of market sentiment and global risk aversion include Eichengreen and Mody (2000), McGuire and Schrijvers (2003) and Bellas et al (2010). The importance of global monetary conditions, often proxied by US short or long term interest rates, is identified by a number of studies such as Gonzalez-Rozada and Levy-Yeyati (2008), Hartelius et al (2008), Dailami et al (2008) and Miyajima et al (2014). More recent work argued that the low term premia on US Treasuries has strong influence on offshore US dollar credit creation (McCauley, McGuire and Sushko (2014)) or on fixed investment and financing decisions in EMEs (Turner (2014)).

The relative importance of domestic and international factors may have changed as EMEs have become increasingly integrated into the global economy and financial markets. Kumar and Okimoto (2011) argue that domestic long-term interest rates had become increasingly dependent on global investors' preferences, with country-specific risk factors playing a more limited role. Jaramillo and Weber (2013a) highlight that, during times of market stress, global investors tend to discriminate against EMEs with weaker fundamentals. However, Du and Schregner (2013) argue that estimated "local currency government credit spreads" are less sensitive to global factors than foreign currency sovereign bond spreads. Overall, international factors such as global risk appetite and global savings/investment seem to have become more important, increasing cross-country correlations of long-term government bond yields over the past two decades.

Beyond domestic and international factors, exchange rates can be another important determinant of local currency bond yields. This is prominently discussed in the "carry trade" literature.[10] Gyntelberg and Remolona (2007) find that high average returns on local currency assets reflect a large downside risk of sudden and large depreciation of the target currencies – and/or appreciation of the funding

[10] The carry trade strategy involves borrowing in a currency with low interest rates and investing in one with high interest rates.

currencies. Miyajima et al (2014) show that the high returns on EME local currency bonds could be offset by the high volatility of EME exchange rates. This is particularly the case during times of market stress, when the capacity of local currency assets to preserve value could weaken significantly (Turner (2012)). The importance of exchange rates for local currency bond yields varies with the availability of instruments to hedge exchange rate exposures. For instance, McCauley, Shu and Ma (2014) argue that turnover in non-deliverable foreign exchange forwards has increased as non-residents have been using them to hedge rising investment in local currency bonds in EMEs.

4. Data and methodology

To formally model local currency sovereign bond yields, we follow the framework by, for instance, Jaramillo and Weber (2013a, 2013b), Miyajima et al (2014) and Peiris (2010), with the important extension of considering exchange rate factors. Similar to previous studies, we rely on a panel fixed effects regression. For the dependent variable, y, we use the five-year local currency sovereign bond yield for 20 major EMEs.[11] We use monthly data spanning from January 2005 to December 2013. The following baseline equation is estimated in first differences:

$$y_{t,k} = \alpha_k + \theta * s^e_{t,k} + \kappa * iv_{t,k} + \beta * i^e_{t,k} + \gamma * \pi^e_{t,k} + \delta * g^e_{t,k} + \zeta * f^e_{t,k} + \vartheta * rating_{t,k} + \varphi * cre_{t,k} + \tau * fh_{t,k} + \lambda * VIX_t + \mu * USTP_t + \varepsilon_{t,k} \quad (2)$$

In equation (2), we consider three sets of explanatory variables that are related to (i) exchange rates, (ii) domestic fundamentals, and (iii) international factors (for country k at time t; ε is a random error). The explanatory variables are drawn from the literature discussed in the previous section.

i) Exchange rate factors (specific to each EME):

s^e: Twelve-month ahead forecast of the rate of change in the bilateral exchange rate, where a positive value of s^e corresponds to a depreciation of the domestic currency (%, yoy)[12]

iv: Volatility of bilateral exchange rates implied by 3-month at the money options (%)

ii) Domestic factors (specific to each EME):

α : Country fixed-effect

i^e : Twelve-month ahead forecast of short term interest rates (%)

π^e: Twelve-month ahead forecast of inflation (%, yoy)

g^e: Twelve-month ahead forecast of GDP growth (%, yoy)

[11] Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey.

[12] Bilateral exchange rates against the US dollar, except for the Czech Republic, Hungary and Poland (bilateral exchange rates against the euro).

f^e : Twelve-month ahead forecast of the fiscal balance (% of GDP)

$rating$: Local currency sovereign credit ratings

cre : Foreign currency sovereign credit spreads

fh: Foreign holdings of local currency bonds (% of the country's bonds outstanding).

iii) International factors (common to all EMEs):

VIX : Implied volatility of the US stock index S&P500 (%)

$USTP$: Estimated US 10-year term premia (%)

We control for exchange rate risk by using the central forecast of exchange rate performance and a measure of exchange rate volatility. The central forecast enters the estimation as expected depreciation in 12 months horizon – ie the rate of change between the expected exchange rate level 12 months ahead and the prevailing spot exchange rate. Currency depreciation incurs a loss to dollar-based investors who would demand a higher yield to compensate for this risk premium. It may also increase yields by lifting inflation expectations. We expect the coefficient sign on this variable to be positive.

We control for exchange rate volatility implied by the pricing of at the money option contracts on exchange rates with a 3-month tenor. Greater uncertainty about the future path of the exchange rate should prompt foreign investors to demand higher risk premia on domestic assets, increasing local currency bond yields. However, it may also discourage domestic investors from allocating their funds away from domestic bonds into foreign assets. Sustained domestic demand for domestic bonds can compress local currency bond yields. Thus, the sign of the coefficient is ambiguous.

Among domestic variables, the domestic short-term interest rate represents the monetary policy stance. Indicators of inflation, GDP growth and the fiscal balance determine domestic and international investors' risk assessment with respect to domestic macroeconomic volatility. Local currency bond yields are expected to increase as investors expect a higher short-term interest rate and inflation. These yields are expected to decline as investors forecast higher GDP growth and improved fiscal conditions and therefore a lower country risk premium.[13]

To capture any information embedded in credit rating actions and financial markets not captured by measures of macroeconomic fundamentals, we also control for local currency sovereign credit ratings and foreign currency sovereign credit spreads. Local currency sovereign credit ratings are introduced in changes from one month to another, and additionally as level dummy variables. The levels

[13] For the domestic macroeconomic variables, we use forecasts published by Consensus Economics to the extent possible in order to help alleviate the issue of endogeneity. An empirical issue in estimating a reduced-form bond yield equation is the downward bias in coefficients arising from possible reverse causality from the left to the right side variables. For example, bond yields and the fiscal balance may be negatively associated due to a common factor such as the business cycle, creating potential biases in the estimation. An economic slowdown may be associated with lower interest rates (through monetary easing) while at same time worsening the fiscal balance (through automatic stabilisers). Such an identification problem is difficult to resolve without a structural model, but can at least be reduced by using forecast variables (Laubach (2009)).

(notches) observed in the previous month take account of the non-linearities in the relationship between yields and ratings. Sovereign CDS spreads are used to capture foreign currency sovereign credit spreads mainly because of the indicator's wider country coverage relative to the EMBI index. Lower sovereign CDS spreads and ratings upgrades are expected to lower local currency sovereign bond yields.

A key development over the past several years has been the rising interest of foreign investors in local currency bonds in EMEs. EME local currency sovereign bonds have become relatively more attractive and accessible (through a greater degree of capital account openness). While foreign inflows to EMEs can be underpinned by cyclical factors, such as carry trade incentives, institutional investors globally are believed to have also been reallocating funds into EME assets on a structural basis. We control for this by introducing foreign holdings of local currency bonds (as a per cent of each country's bonds outstanding). The data are obtained from the IMF's Sovereign Investor Base Dataset for Emerging Markets, which include different categories of foreign investors.

The sign of the coefficient on the share of foreign holdings is difficult to predict a priori. One view in the literature is that high foreign investor penetration into local currency EME bond markets can raise domestic currency yields due to a greater chance of sudden withdrawals (Calvo and Talvi (2005)). Another view is that greater capital account openness would be associated with lower domestic interest rates (Eichengreen and Rose (2014)). Yet another view is that foreign investors compress local currency sovereign yields by pushing up bond prices through their purchases (Gadanecz et al (2014)). Warnock and Warnock (2009) argue that official sector investment into US bond tends to lower the yields on those bonds. To assess whether any impact of foreign holdings is part of a yield-seeking behaviour driven by US term premia, we also interact foreign bond holdings with US term premia.

Explanatory variables and expected signs of coefficients Table 2

Group	Exchange rate		Domestic		International	
Variable	One year ahead exchange rate forecast	+	Short rate forecast	+	VIX Index	+
	Implied exchange rate volatility	+/–	Inflation forecast	+	US term premia	+
			GDP growth forecast	–		
			Fiscal balance forecast	–		
			Local currency sovereign credit ratings	+		
			Foreign currency sovereign CDS spreads	+		
			Share of foreign holdings	+/–		

Insofar as international factors are concerned, EM local currency government yields tend to move together with US long term interest rates. Easy US liquidity conditions reduce the yields on US fixed income securities, leading to greater search for yield outside of the US. This would be further encouraged by lower funding cost in US dollars. Together, these elements would reduce EM yields. US monetary conditions are represented by the estimated US 10-year term premia and we expect its coefficient to be positive. We also introduce a measure of global risk sentiment,

which affects both country risk and currency risk, represented by the VIX index. We expect the variable to be positively associated with EME domestic bond yields.

Table 2 summarises the expected signs on our exchange rate, domestic and international factors. The data are summarised and discussed in greater detail in the Appendix.

5. Regression results

In examining the determinants of EME local currency sovereign bond yields, we estimate several specifications with different combinations of the three sets of factors (exchange rate, domestic, and international factors). This allows us to check the stability of coefficients before arriving at a fully-specified model which includes all three sets of determinants. We use data in first differences except the control for the level of sovereign credit ratings. We rely on Newey-West standard errors with an autocorrelation of up to 12 lags to correct for heteroskedasticity and autocorrelation of the residuals.[14]

The estimation results summarised in Table 3 suggest that exchange rate risk (proxied by the implied volatility of the exchange rate) positively and significantly affects local currency bond yields. This finding holds even after controlling for exchange rate forecasts, domestic factors, international factors or both. A one percentage point increase in implied exchange rate volatility is associated with a 4–7 basis point rise in local currency bond yields.[15] By comparison, the impact of expected currency depreciation is less robust, as inflation forecasts account for at least some of the elements underlying exchange rate forecasts.

Turning to the coefficients on the domestic and international factors, those on domestic short-term interest rate forecasts, inflation forecasts and fiscal balance forecasts are consistently significant and largely stable in terms of magnitude across different models. In particular, a 100 basis point rise in short rate forecasts is associated with a 18–19 basis point increase in the sovereign bond yield, regardless of the model specification. Movements in inflation forecasts have a similar impact: a one percentage point increase in the variable being associated with an 18 basis point increase in sovereign bond yields. A one percentage point of improvement in the fiscal balance (expressed as a percentage of GDP) is associated with a 6–7 basis point reduction in the sovereign yield.

[14] Computed this way, the Newey-West standard errors are larger than unadjusted standard errors obtained via OLS, which is an indirect confirmation of the presence of heteroskedasticity and time dependence in the estimated residuals.

[15] In unreported regressions, we used a volatility measure derived from risk reversals – the difference in implied volatilities of similar out-of-the money call and put options – instead of volatilities obtained from the pricing of at-the money options. The sensitivity of local currency government bond yields to these alternative volatility proxies is similar to our main result, or larger, depending on the delta of the out-of-the money options.

Fixed effects panel model of local currency 5-year sovereign bond yields in EMEs

January 2005–December 2013 Table 3

Model number	1	2	3	4	5
Exchange rate factors					
One year ahead exchange rate forecast	–0.010**	–	–	–0.003	–0.002
Implied exchange rate volatility	0.066***	–	–	0.044***	0.046***
Domestic factors					
Short rate forecast	–	–	0.185***	0.183***	0.178***
Inflation forecast	–	–	0.176***	0.178***	0.176***
GDP growth forecast	–	–	–0.048	–0.050	–0.040
Fiscal balance forecast	–	–	–0.065**	–0.062**	–0.060**
Sovereign rating change	–	–	–0.132	–0.111	–0.108
[sovereign rating level dummies at t-1 not reported]					
[country dummies not reported]					
CDS spread	–	–	0.007***	0.005***	0.006***
Foreign bond holdings	–	–	–0.087**	–0.088***	–0.076**
Foreign holdings * US term premia	–	–	0.233	0.290*	–0.076
International factors					
VIX Index	–	0.007***	–	–	–0.006**
US term premia	–	0.297***	–	–	0.382***
Constant	0.012	0.013	–0.642***	–0.665***	–0.564***
Number of observations	2,079	2,079	1,036	1,036	1,036
Adjusted R^2	0.061	0.026	0.206	0.217	0.236

Authors' estimates using monthly data. All variables in monthly changes (except the level dummies). The estimation period is from January 2005 to December 2013 and excludes a 9-month window around the Lehman collapse. The country sample includes Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey. The panel was estimated with Newey-West standard errors with an autocorrelation of up to 12 lags. ***, ** and * stand for significance at the 1, 5 and 10% levels, respectively.

Higher foreign holdings of EME local currency sovereign bonds are associated with lower yields on those bonds, suggesting foreign investors' demand bids up bond prices. As we tried each sub-category of foreign holdings by investor type, nonbank holdings emerged as the most important category of foreign investors affecting local currency bond yields. For each additional percentage point increase in foreign nonbank holdings, local currency bond yields fall by 8–9 basis points. The interaction term of foreign holdings with the US term premia has significant effect on EME local currency sovereign bond yields in one specification. A one percentage point rise in foreign nonbank holdings increases the transmission of the US term premia to EME sovereign yields by 30 basis points.

As regards international factors, the coefficient on the VIX is positive when included in the model only with the US term premia. However, it turns negative when included together with all other explanatory variables (model 5), meaning that a rise in the VIX tends to reduce, rather than increase, domestic bond yields. This is consistent with the results in Miyajima et al (2014). They find that prior to the onset

of global financial crisis in 2008, EME local currency sovereign bond yields tend to rise with the VIX. However, after 2008, these yields tend to decline as the VIX rises. Another explanation could be that risk aversion changes during different phases of the business cycle (Duyvesteyn and Martens (2014)).

We find a large degree of pass-through of the US 10-year yield to local currency sovereign bond yields in EMEs. A one percentage point increase in the US 10-year term premia leads to up to a 40 basis point increase in EM local bond yields. This result is consistent with Obstfeld (2014), who finds cross-country evidence that long-term US interest rates have affected those in EMEs in recent years. It is also in line with Miyajima et al (2014) who find that the impact of the US 10-year yield has increased, despite having become less durable, compared to the period prior to the global financial crisis in 2008.

6. Robustness: importance of exchange rate factors

We check the robustness of our main finding about the importance of exchange rate factors in determining EME local currency sovereign bond yields. To this end, we re-estimate our benchmark model in a number of different ways. First, we use a GMM regression to control for reverse causality issues between bond yields and the exchange rate. Second, we look at different sub-periods to check how the importance of exchange rate factors in driving bond yields may have changed over time. Lastly, we analyse different sets of EMEs grouped by the degree of capital account openness and exchange rate regime.

Potential reverse causality

The direction of the causality between local currency sovereign bond yields and exchange rate volatility can run in both directions. One view is that movements in exchange rates and exchange rate volatility can influence local currency sovereign bond yields.[16] Foreign investors typically roll over foreign exchange hedges from month to month to hedge their local currency government bond holdings. In periods of market turbulence, the cost of protection against exchange rate risk tends to rise, which can prompt foreign investors to unwind their bond positions and raise local currency bond yields.

Another view is that changes in bond yields drive exchange rate movements. This is consistent with uncovered interest parity conditions, which postulate that exchange rates are determined by interest rate differentials. In many EMEs, the foreign exchange market is often more liquid than the local currency bond market, and foreign investors may use foreign exchange as a proxy hedge for their local currency bond exposures. Because these investors adjust their foreign exchange hedging based on bond performance, movements in local currency sovereign bond yields influence exchange rate movements, even though exchange rate risk and duration risk are different in nature.

[16] See, for instance, Chinn and Frankel (1994), Gyntelberg and Remolona (2014), Miyajima et al (2014).

Bivariate Wald tests (reported in Table A1 in the Appendix) confirm that for a majority of EMEs in our sample, the direction of the causality goes from exchange rate volatility to local currency sovereign bond yields. This is especially the case in Asia and eastern Europe. In these two regions, local currency sovereign bond markets are relatively liquid and foreign participation relatively large (for the period of 2005–13, foreigners held 10% of total local currency sovereign bonds outstanding on average in Asia, and 20% in eastern Europe). Therefore exchange rate risk and its hedging have probably had a greater impact on local bond yields.[17]

To check robustness we rely on the panel dynamic GMM methodology (or system GMM) to obtain unbiased estimates of our benchmark model (model 5). This methodology was introduced by Arellano and Bond (1991), and further developed by Blundell and Bond (1998). In order to alleviate the computational requirements of the GMM estimation, the benchmark model was estimated without rating dummies, using both the panel fixed effect (Newey) and GMM approaches.

Our benchmark result is robust to potential reverse casualty issues. Table A2 shows that panel system GMM results are broadly similar to those using a panel fixed effect approach.[18] In particular, exchange rate volatility remains a significant determinant of EM local currency sovereign bond yields. This remains the case when we change the number of lags from 1 to 2 in GMM estimations, and also when we add foreign holdings as a control variable to the models. We arrive at a similar conclusion when we keep rating dummies, and instead drop country dummies.[19]

Before and after the collapse of Lehman Brothers in 2008

The global financial crisis in 2008–09 has led to important changes in investor behaviour and in the global monetary and financial environment. We re-estimate model 5 for before and after the 2008 Lehman crisis (models 6 and 7). We separately estimate a set of models after replacing the VIX index and the US term premia with time dummies as an alternative indicator of international factors.

The results reported in Table A3 in the Appendix suggest that implied exchange rate volatility consistently remains a key and significant determinant of local currency sovereign yields in various subperiods. Nevertheless, its magnitude varies. The size of the coefficient for the pre-Lehman period (model 12) is similar to that of the baseline model (model 5). During the post-Lehman period (model 13), the size falls somewhat but its statistical significance increases.

[17] Meanwhile, in Latin American countries, where foreign participation has been lower, inflows and outflows of funds into local currency sovereign bond markets, and the resulting changes in yields, have tended to affect foreign exchange volatility. In the case of China and Hong Kong SAR, whose currencies have not been floating freely against the US dollar, the causality runs in both directions.

[18] As reported in Table A2, we generally cannot reject the null hypothesis of no autocorrelation. The Hansen test does not reject the null hypothesis of no over identification. The fact that the Sargan test rejects the hypothesis may be due to the fact that the Hansen test is more robust than the Sargan test. For example, the Sargan test is not distributed as chi-squared under heteroskedasticity but the Hansen test is. Another explanation could be that the number of instruments in our model is large.

[19] Result available upon request.

The result may also signal that investors' search for yield strengthened as unconventional monetary policies in the wake of the Lehman crisis brought advanced economy yields to ultra-low levels. For instance, some of the domestic factors that are important determinant during the pre-Lehman period lose explanatory power during the post-Lehman period (exchange rate forecasts and foreign nonbank holdings). We obtain a broadly similar result when estimating the models using time dummies, instead of the VIX and the US term premia (Table A4 in the Appendix).

Meanwhile, the coefficient on US term premia, which was insignificant during the pre-Lehman era, becomes large and statistically significant during the post-Lehman era. There, a one percentage point decline in the US term premia is associated with a 50 basis point decline in local currency sovereign bond yields in EMEs. Our results are in accordance with Kumar and Okimoto (2011) and Jaramillo and Weber (2013a) who also find that the influence of global factors has increased over time.

Before and after expectation of US tapering rose in mid-2013

As mentioned earlier, investors' expectation started to firm in May 2013 that the US Federal Reserve would phase out quantitative easing. This seems to have marked another important turning point for EME assets. Recognising data constraints, we take the post-Lehman period and break it into pre- and post-US Fed tapering announcement. We drop the share of foreign nonbank holdings from our model because the variable, spanning through December 2013, shortens the estimation period.

The last two columns of Table A3 (models 14 and 15) show that, most importantly, the sensitivity of EME local currency sovereign bond yields to exchange rate risk increases after mid-2013. This confirms the view that investors have been attaching greater importance to exchange rate risk in more recent periods. In particular, a one percentage point increase in implied exchange rate volatility is associated with a 1 basis point rise in yields during the pre-tapering phase. The sensitivity rises to 5 basis points in model 15, though it is only significant at the 12% level. However, when time dummies are used, implied exchange rate volatility during June 2013–April 2014 is statistically significant at the 5% level (model 20 in Table A4 of the Appendix). Overall, the coefficient is economically large and consistent with the estimate using daily data reported in Section 2.

Capital account openness and exchange rate regime

The importance of exchange rate factors on local yields can vary according to the degree of capital account openness and exchange rate regime. Cross-border capital flows may respond more to changes in exchange rate forecasts and their uncertainty when capital account openness is greater. In our baseline model, the foreign holdings controls are likely to capture some of this effect. The type of exchange regime could influence the degree of pass through of exchange rate factors to domestic bond yields in EMEs. For instance, investor's propensity to hedge exchange rate exposure may be lower when the exchange rate is less flexible, which can increase the sensitivity of EM domestic yields to exchange rate factors.

We separate 20 EMEs into two groups relying first on the Chinn-Ito index of capital account openness. Separately, the 20 EMEs are regrouped using IMF classification of de facto exchange rate regime. In estimating our regression model, we focus on the post-Lehman period in a bid to reduce the potential impact of regime change. Following the global financial crisis in 2008–9, the international transmission of global monetary and financial conditions appears to have increased. The Chinn-Ito index suggests that the degree of capital account openness has fallen somewhat.

The results reported in Table A5 of the Appendix suggest that exchange rate volatility remains a statistically significant determinant of local currency sovereign yields regardless of the monetary policy framework. The coefficient on implied exchange rate volatility is stable across the models. It is however somewhat larger in less flexible exchange rate regimes. One interpretation is that a given level of exchange rate volatility can correspond to a larger uncertainty and can create a greater impact on local currency bond yields. Or, when the credibility of a fixed exchange rate is questioned, a given exchange rate fluctuation could result in a larger market reaction than when the exchange rate fluctuates under a floating regime by the same amount.

7. Conclusion

Understanding the pricing of sovereign risk in EME domestic bond markets is important for global investors and EME central banks. Recent EME exchange rate movements have strongly affected EME asset returns measured in foreign currency. This paper has attempted to fill the gap in the literature by explicitly accounting for exchange rate factors – in particular exchange rate expectations and uncertainty – in modelling local currency sovereign bond yields in EMEs.

Our empirical analysis suggests that exchange rate risk is a key determinant of EME local currency sovereign bond yields. Exchange rate risk could rise due to both domestic and international factors and amplify the negative impact of these factors on bond yields. For instance, lower domestic economic growth or higher fiscal deficits in EMEs can weaken the currencies of these countries and increase uncertainties about exchange rate stability. An adverse shock in international markets can have a similar effect. As a result, investors demand a larger risk premium to compensate for higher expected default risk and greater uncertainty about the future path of exchange rates.

Our findings also corroborate those in the literature related to the relative importance of domestic and global drivers of EME local currency sovereign bond yields. Domestic factors, particularly short-term interest rates and fiscal balances, are key determinants of EMEs local currency sovereign bond yields, but local currency bond yields are also affected by global monetary conditions, particularly after the onset of the financial crisis in 2008. In particular, the significant easing in monetary policy in advanced economies has prompted investors to search for yield. Probably reflecting growing foreign participation in EME domestic bond markets, local currency bond yields in EMEs have since been moving more closely with the US long-term yields.

Exploring the implications of exchange rate hedging for local currency yields can be a useful area for future research. McCauley, Shu and Ma (2014) argue that such hedging conducted in forward markets, particularly offshore, has implications for local currency bond yields. Indeed, some of our results also suggest that, when exchange rate exposure is hedged less – owing for instance to a less flexible exchange rate regime – the impact of exchange rate volatility on local currency bond yields could be larger.

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Appendix

We plot the data used in the regression analysis in terms of simple averages across the 20 EMEs. The local currency 5-year sovereign bond yields (used as the dependent variable) traded at around 7% prior to 2008. They rose to around 8% as the global financial crisis intensified, and subsequently, trended downward. They surged when expectations for US tapering of asset purchases intensified in May 2013 and have remained relatively volatile.

The explanatory variables can be classified into three groups: domestic, exchange rate and international factors. Graph A1 shows domestic factors. Short term interest rate forecasts had already declined, notably through the middle of the 2000s, reflecting rapid disinflation across EMEs. During 2005–08, they remained in a 6–7% range, but have fallen to around 4–5% since 2009 reflecting monetary accommodation EMEs provided to support economic growth. Inflation forecasts have been broadly stable at around 4% yoy over the last decade, reflecting generally better macroeconomic management and stronger monetary policy credibility. GDP growth forecasts were stable at around 5% through 2011, except for the drop in 2008–09. They have fallen to 4% yoy in the last couple of years. Fiscal balance forecasts continued to improve until the Lehman shock in 2008 prompted EMEs to take forceful fiscal response. Fiscal balance forecasts improved from the 2009 trough but have plateaued at around –2% of GDP in the last few years.

Apart from a number of downgrades which occurred in 2009 as capital outflows followed the Lehman crisis, sovereign credit ratings have generally and steadily improved between 2005 and 2013 across EMEs. Sovereign CDS spreads surged in the aftermath of the Lehman collapse, but have returned to pre-crisis levels since. The share of local currency sovereign bonds held by foreign nonbank investors has risen to above 20% of total stock outstanding, exceeding the pre-Lehman level of up to 18%.

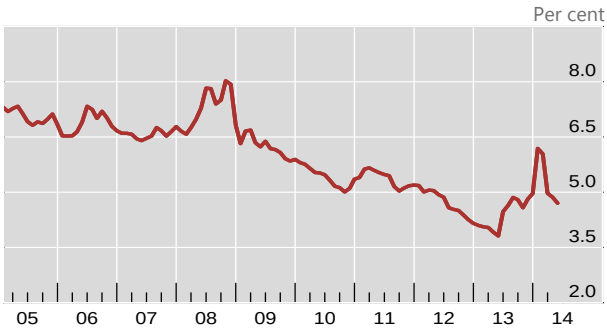
Exchange rate factors represent a distinct group and are the focus of our paper. Graph A2 shows that there were persistent expectations of EME currency appreciation against the US dollar since 2009 reflecting strong capital inflows to EMEs. However, since the middle of 2013 market participants have expected EME currency depreciation. Despite the directional shift in exchange rate expectations, implied exchange rate volatility has generally fallen to near pre-Lehman lows.

As far as international factors are concerned, Graph A3 shows that movements in the VIX suggest global investor risk sentiment has fallen to relatively low levels since 2009 but remained volatile. The US 10-year term premia fell steadily since 2008 toward negative territory before starting to return in the middle of 2013 to around zero.

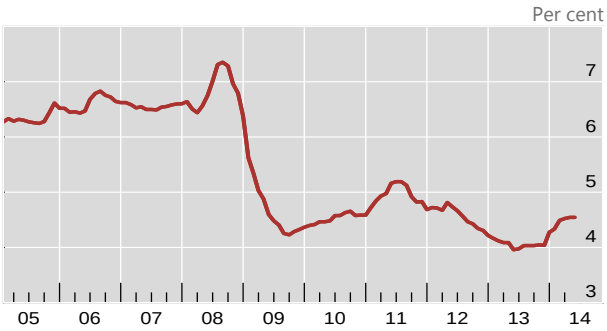
Domestic factors

Graph A1

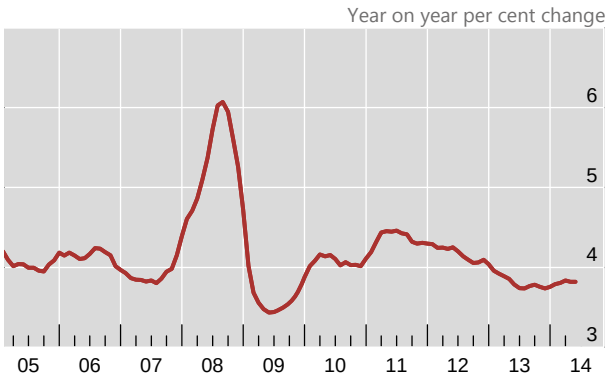
LCC bond yields



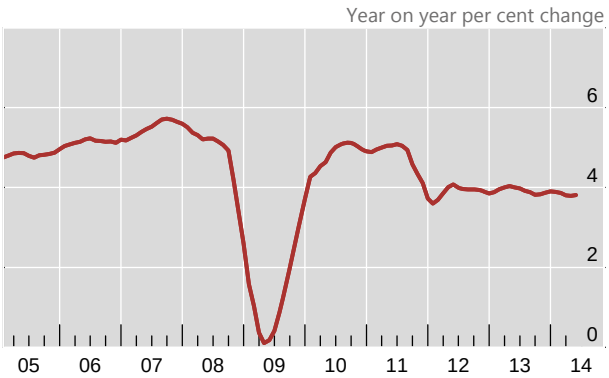
Short-term interest rate forecasts



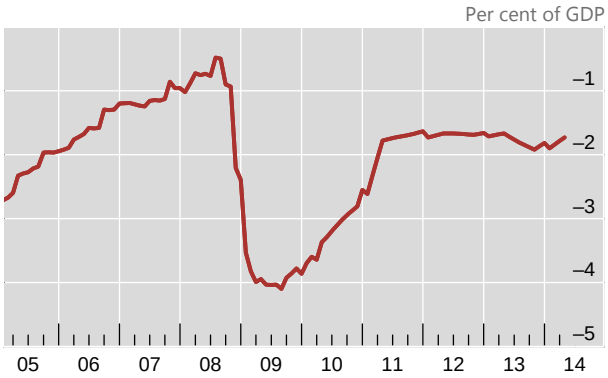
Inflation forecasts



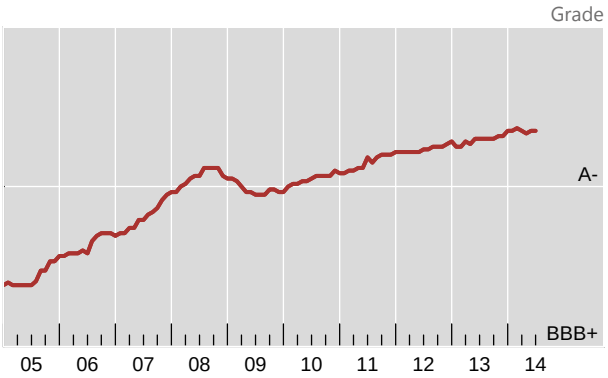
GDP growth forecasts



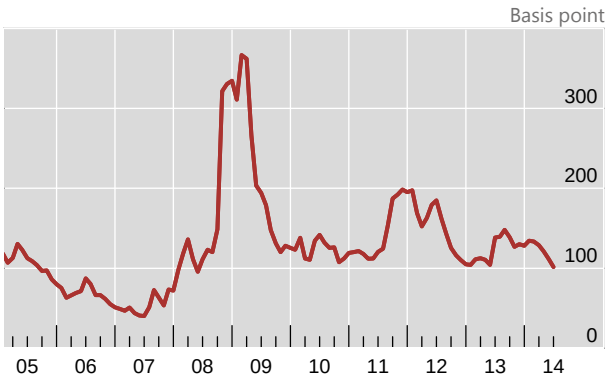
Fiscal balance forecasts



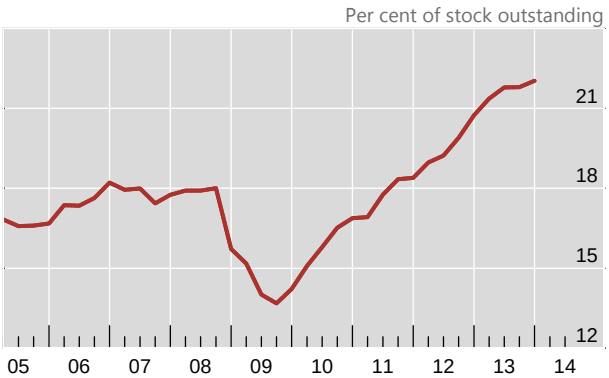
Ratings



CDS spreads



Foreign nonbank holdings of domestic government bonds



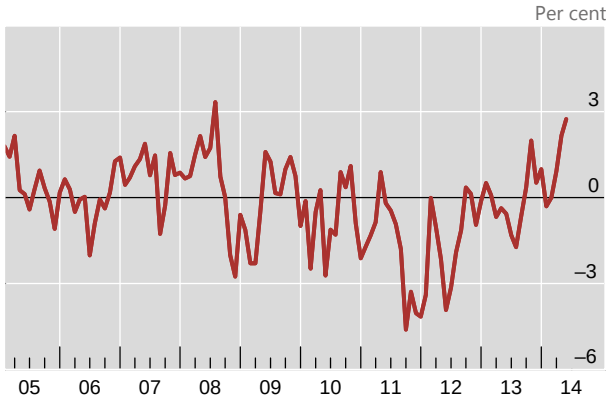
Note: The data are simple averages of the 20 EMEs (to the extent applicable) listed in footnote 6 in the main text.

Sources: Bloomberg; Fitch; GFD; Consensus Economics; JP Morgan; Markit; Moody's; S&P; IMF; BIS calculations.

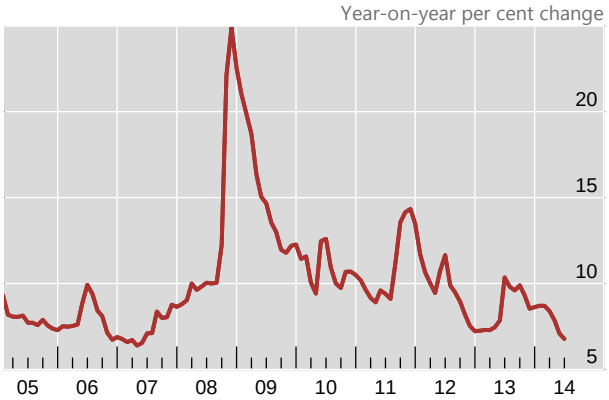
Exchange rate factors

Graph A2

Exchange rate change forecasts



Implied exchange rate volatility



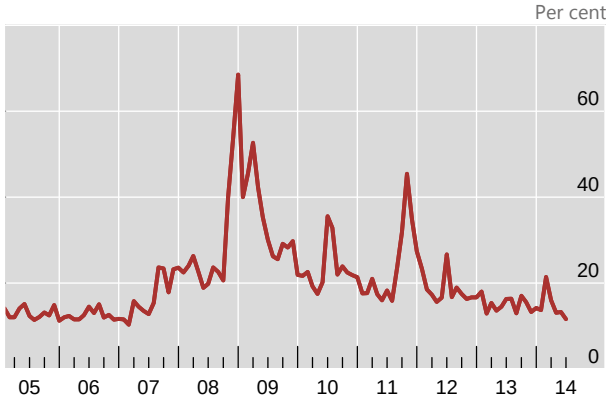
Note: The data are simple averages of the 20 EMEs (to the extent applicable) listed in footnote 6 in the main text.

Sources: Consensus Economics; JP Morgan; BIS calculations.

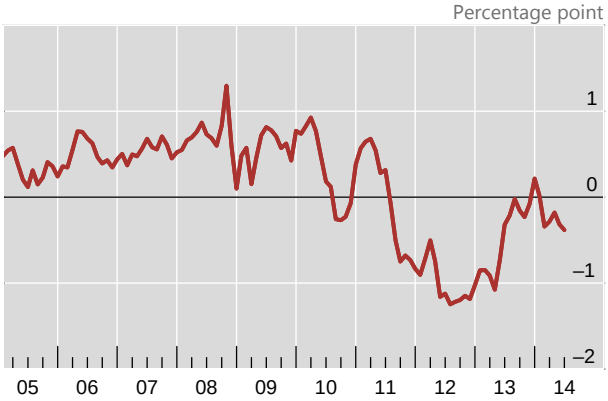
Global factors

Graph A3

VIX



US term premium



Note: The data are simple averages of the 20 EMEs (to the extent applicable) listed in footnote 6 in the main text.

Sources: Bloomberg; BIS calculations.

Bivariate Wald tests on the direction of the causality between exchange rate volatility and bond yields

January 2005–December 2013 Table A1

H0:	Exchange rate vol → bond yields[1]		Bond yields → exchange rate vol[2]	
Number of lags (months)	7	12	7	12
China	*	**	**	***
Hong Kong SAR			**	***
India			*	
Indonesia	*			
Korea	*			
Malaysia				
Philippines				
Singapore				
Thailand	***	***	**	
Brazil				
Chile			*	
Colombia	*			***
Mexico			*	**
Peru	*	***		
Czech Republic	*	**		
Hungary	***	***		*
Poland				
Russia	***	***		
Turkey	***	***		
Israel	*	*	*	
South Africa			**	**

Authors' estimates using monthly data. [1] p-values associated with the null hypothesis that exchange rate volatility does not Granger-cause local currency sovereign bond yields. [2] p-values associated with the null hypothesis that local currency sovereign bond yields do not Granger-cause exchange rate volatility. ***, ** and * stand for significance at the 1, 5 and 10% levels, respectively.

Panel fixed effects and panel system GMM models of local currency 5-year sovereign bond yields in EMEs

Table A2

Model number	6	7	8	9	10	11
	No foreign holdings			With foreign holdings		
	Panel FE	SGMM 1lag	SGMM 2lags	Panel FE	SGMM 1lag	SGMM 2lags
Exchange rate factors						
One year ahead exchange rate forecast	–0.003	–0.003	–0.004*	–0.004	–0.006*	–0.006*
Implied exchange rate volatility	0.029***	0.023***	0.025***	0.041***	0.037***	0.037***
Domestic factors						
Short rate forecast	0.250***	0.250***	0.255***	0.171***	0.176***	0.176***
Inflation forecast	0.115**	0.104**	0.113**	0.177**	0.170***	0.170***
GDP growth forecast	–0.007	–0.039	–0.034	–0.026	–0.050	–0.050
Fiscal balance forecast	–0.010	–0.018	–0.017	–0.044*	–0.059**	–0.059**
Sovereign rating change	–0.086	–0.090	–0.090	–0.099	–0.100	–0.100
CDS spread	0.007***	0.007***	0.006***	0.007***	0.007***	0.007***
Foreign bond holdings				–0.086**	–0.095**	–0.095**
Foreign holdings * US term premia				–0.080	–0.039	–0.039
International factors						
VIX	–0.006***	–0.005***	–0.005***	–0.005*	–0.003	–0.003
US term premia	0.402***	0.380***	0.375***	0.357***	0.316***	0.316***
Number of obs.	1,728	1,728	1,728	904	904	904
[Constant and country dummies not reported]						
p-values:						
First order autocorrelation		0.037	0.037		0.143	0.143
Second order autocorrelation		0.139	0.141		0.143	0.143
Sargan test		0.00	0.00		0.00	0.00
Hansen Test		1.00	1.00		1.00	1.00

Authors' estimates using monthly data. All variables in monthly changes (except for country dummies). The estimation period is from January 2005 to December 2013 and excludes a 9-month window around the Lehman collapse. The country sample includes Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey. The panel fixed effect model was estimated with Newey-West standard errors with an autocorrelation of up to 12 lags. The panel system dynamic GMM model was estimated with 1 and 2 lags. ***, ** and * stand for significance at the 1, 5 and 10% levels, respectively. The p-values reported in the last 4 rows refer to the system GMM. They correspond to tests of the null hypotheses of no auto correlation; and no overidentification (Sargan and Hansen tests).

Fixed effects panel model of local currency 5-year sovereign bond yields in EMEs

Estimates by sub-periods

Table A3

Model number	5	12	13	14	15
	Full sample	Pre/post Lehman		Pre/post tapering announcement	
		Pre Lehman	Post Lehman	Pre taper	Post taper
	Jan 2005-Dec 2013	Jan 2005-June 2008	Apr 2009-Dec 2013	Apr 2009-Apr 2013	June 2013-Apr 2014
Exchange rate factors					
One year ahead exchange rate forecast	–0.002	–0.032**	–0.003	0.002	–0.013
Implied exchange rate volatility	0.046***	0.045*	0.029**	0.012	0.050^
Domestic factors					
Short rate forecast	0.178***	0.422***	0.200***	0.214***	0.144***
Inflation forecast	0.176***	0.179***	0.180***	0.103*	0.274
GDP growth forecast	–0.040	0.187	–0.074	–0.032	0.356
Fiscal balance forecast	–0.060**	–0.059	–0.041	–0.012	–0.161
Sovereign rating change	–0.108	–0.366	–0.106	–0.051	–0.117
[sovereign rating level dummies at t-1 not reported]					
[country dummies not reported]					
CDS spread	0.006***	0.006***	0.005***	0.004***	0.011***
Foreign bond holdings	–0.076**	–0.183***	–0.029		
Foreign holdings * US term premia	–0.076	–0.281	–0.112		
International factors					
VIX Index	–0.006**	–0.019***	–0.005*	–0.004**	–0.004
US term premia	0.382***	0.023	0.501***	0.416***	0.357**
Constant	–0.564***	–0.576**	–0.576**	–0.112	0.007
Number of observations	1,036	549	575	923	198
Adjusted R^2	0.236	0.304	0.410	0.182	0.516

Source: Authors' estimates using monthly data. All variables in monthly changes (except the ratings level dummies). Estimation periods as per table headers. The pre- and post-tapering regressions exclude the foreign bond holdings control, as those data are only available up to December 2013. The country sample includes Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey. The panel was estimated with Newey-West standard errors with an autocorrelation of up to 12 lags, except for the pre-and post-tapering announcement robustness checks where one lag was allowed. ***, ** and stand for significance at the 1, 5 and 10 levels, respectively. ^: significant at the 12% level.

Fixed effect panel model of local currency five-year sovereign bond yields in EMEs

Estimates with time dummies

Table A4

Model number	16	17	18	19	20
	Full sample	Pre/post Lehman		Pre/post tapering announcement	
		Pre Lehman	Post Lehman	Pre taper	Post taper
	Jan 2005-Dec 2013	Jan 2005-June 2008	Apr 2009-Dec 2013	Apr 2009-Apr 2013	June 2013-Apr 2014
	Exchange rate				
One year ahead exchange rate forecast	0.002	–0.026	0.001	0.004	–0.001
Implied exchange rate volatility	0.057***	0.056**	0.052***	0.018*	0.075**
Domestic factors					
Short rate forecast	0.153**	0.341**	0.215***	0.220***	0.153**
Inflation forecast	0.106**	0.030	0.142*	0.079	0.301
GDP growth forecast	–0.005	–0.180	–0.108	–0.050	0.294
Fiscal balance forecast	–0.072**	–0.066	–0.040	–0.024	–0.017
Sovereign rating change	–0.062	–0.358	0.037	0.035	–0.095
[sovereign rating level dummies at t-1 not reported]					
CDS spread	0.008***	0.005***	0.006***	0.006***	0.009***
Foreign bond holdings	–0.058	–0.156**	–0.003		
Foreign holdings * US term premia	–0.211	–0.266	–0.035		
[Time dummies not reported]					
Constant	–0.503***	–0.609*	0.103	0.215	0.166
Number of observations	1,036	549	575	923	198
Adjusted R^2	0.356	0.421	0.524	0.170	0.554

Source: Authors' estimates using monthly data. All variables in monthly changes (except the ratings level dummies). Estimation periods as per table headers. The pre- and post-tapering regressions exclude the foreign bond holdings control, as those data are only available up to December 2013. The country sample includes Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, South Africa, Thailand, Turkey. The panel was estimated with Newey-West standard errors with an autocorrelation of up to 12 lags, except for the pre-and post-tapering announcement robustness checks where one lag was allowed. ***, **, and * stand for significance at the 1, 5 and 10% levels, respectively.

Fixed effect panel model of local currency five-year sovereign bond yields in EMEs

Estimates by capital account openness and FX regime for the post-Lehman period — Table A5

Model number	21	22	23	24	25
	All countries	High KA openness	Low KA openness	FX regime flexible	FX regime rigid
Exchange rate factors					
One year ahead exchange rate forecast	0.001	–0.002	0.004	0.004	–0.013*
Implied exchange rate volatility	0.022**	0.020*	0.025*	0.022**	0.034**
Domestic factors					
Short rate forecast	0.226***	0.170**	0.233***	0.254***	0.028
Inflation forecast	0.114*	0.081	0.175**	0.085	0.261**
GDP growth forecast	–0.034	–0.049	0.002	0.020	–0.122*
Fiscal balance forecast	–0.022	–0.008	–0.047	–0.021	–0.013
Sovereign rating change	–0.060	–0.071	–0.112	–0.093	0.114
[sovereign rating level dummies at t-1 not reported]					
[country dummies not reported]					
International factors					
VIX Index	–0.005***	–0.005***	–0.004*	–0.006***	–0.004*
US term premia	0.470***	0.416***	0.535***	0.517***	0.321***
Constant	–0.134	–0.145**	–0.148	–0.064	–0.136**
Number of observations	1,139	590	549	798	341
Adjusted R^2	0.319	0.339	0.305	0.323	0.178

Source: Authors' estimates using monthly data. All variables in monthly changes (except the ratings level dummies). The estimation period is from April 2009 to December 2013. The pre- and post-tapering regressions exclude the foreign bond holdings control, as those data are only available up to December 2013. The country sample includes Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey. The panel was estimated with Newey-West standard errors with an autocorrelation of up to 12 lags, except for the pre-and post-tapering announcement robustness checks where one lag was allowed. ***, **, and * stand for significance at the 1, 5 and 10% levels, respectively.