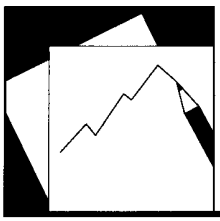
IMF Working Papers 14/215

Global Monetary Tightening: Emerging Markets Debt Dynamics and Fiscal Crises

INTERNATIONAL MONETARY FUND

WP/14/215



IMF Working Paper

Global Monetary Tightening: Emerging Markets Debt Dynamics and Fiscal Crises

Julio Escolano, Christina Kolerus, and
Constant Lonkeng Ngouana

INTERNATIONAL MONETARY FUND

 WP/14/215

IMF Working Paper

Fiscal Affairs Department

Global Monetary Tightening: Emerging Markets Debt Dynamics and Fiscal Crises*

Prepared by Julio Escolano, Christina Kolerus, and Constant Lonkeng Ngouana

Authorized for distribution by Julio Escolano

December 2014

Abstract

This paper finds that tightening global financial conditions can worsen emerging economies' public debt dynamics through an increasing interest rate-growth differential, particularly if coupled with high global risk aversion. Latin America and emerging Europe are the regions most likely to be adversely affected. In addition, historical evidence—analyzed by means of a *Poisson* count model—suggests that the frequency of sovereign debt crises increases in emerging economies at the early stage of U.S. monetary tightening cycles, at times in which the term spread also rises. The timing may be related to abrupt switches of expectations about the future course of policy in the early stages of tightening cycles.

JEL Classification Numbers: E52, F34, F42

Keywords: Debt dynamics, emerging markets, sovereign debt crisis, unconventional monetary policy, U.S. economy

Authors' E-Mail Addresses: JEscolano@imf.org; CKolerus@imf.org; CLonkeng@imf.org

* This paper benefited from discussions in the context of the 2014 Spillover Report in the IMF Research Department. The authors would like to thank Vitor Gaspar, Esteban Vesperoni, Sebastian Weber, seminar participants in the IMF's Fiscal Affairs Department for useful comments and suggestions, and Ethan Alt for excellent research assistance. Comments from other IMF departments also helped improve the paper. All remaining errors are our own.

Table of Contents

Figures

Tables

I. INTRODUCTION

Markets' expectations about the U.S. Federal Reserve's (the Fed) exit from unconventional monetary policy—beginning with the May 2013 "Taper Talk"—have triggered turbulences on bond markets worldwide and many Emerging Markets (EMs) have experienced important swings in capital flows and currency depreciation. While markets have somewhat stabilized as of mid-2014, the unwinding of unconventional monetary tools is likely to continue as the U.S. and U.K. economies strengthen. Overall, although monetary policy is likely to remain accommodative in the Euro area and in Japan for some time, global liquidity conditions are tightening.

Understanding and quantifying the spillovers from tightening monetary conditions in an increasingly interconnected world is an important and timely policy question. This paper focuses on two dimensions along which monetary policy normalization in advanced economies may affect emerging economies: (i) worsened public debt dynamics, key for fiscal sustainability; and (ii) increased likelihood of fiscal stress episodes. We examine these two issues by taking a historical look at previous tightening episodes (spanning more than five decades), with a focus on spillovers from U.S. monetary policy. The focus on U.S. tightening reflects the fact that the Fed was the first central bank to signal exit from unconventional monetary policy, starting with the May 2013 Taper Talk. Also, U.S. interest rates have traditionally driven global rates.

The first part of the paper estimates the impact of U.S. long-term bond yields on EMs Interest Rate Growth Differential (IRGD), using a yearly panel of 29 EMs over the period of 1993–2013, and controlling for relevant macroeconomic fundamentals. These estimates are subsequently used to pin-down the impact of a permanent increase in U.S. long-term bond yields on EMs public debt dynamics, using the dynamic equation of public debt. We also assess the prior whereby tighter liquidity conditions may induce investors to discriminate along countries' macroeconomic fundamentals differently at times of high global risk aversion.

The second part of the paper examines the impact of tighter U.S. monetary conditions on the frequency of sovereign debt crises across EMs, based on historical experience of fiscal stress episodes. We first identify tightening cycles in U.S. monetary policy since the mid-50s and then estimate a Poisson count model of how tighter U.S. monetary conditions have affected the frequency of sovereign debt crises in emerging economies in the past. Because of the long-term nature of debt sustainability, our analysis accounts for the dynamics of the term spread, a salient development in the current monetary policy cycle.

The findings of the paper are two-folds. First, an increase in the U.S. long-term interest rate can have important adverse effects on EMs public debt dynamics, especially in Latin America and emerging Europe: A unit permanent increase in U.S. bond yields would increase public debt by about 4½ percentage points of GDP over a five-year horizon in Latin America, at times of high global risk aversion. The equivalent increase is around 3½ percent

of GDP in Emerging Europe. Second, regarding disruptive events, the term spread helps discriminate among tightening episodes in U.S. monetary policy: the frequency of sovereign debt crises is higher at the beginning of tightening episodes that feature an increase in the term spread; there is little change in the frequency of sovereign debt crises when the term spread is relatively low (below its median historical value).

The remainder of the paper proceeds as follow. Section II reviews the existing literature. Section III assesses the impact of an increase in U.S. long-term yields on emerging markets' public debt dynamics, through changes in interest rate growth differentials. Section IV examines the impact of U.S. monetary policy tightening on the frequency of sovereign debt crises in EMs. Section V concludes and draws policy implications, in connection with the ongoing tightening in global liquidity conditions.

II. LITERATURE REVIEW

This paper lays naturally at the intersection of two strands of the literature: the literature that assesses the role of U.S. long-term bond yields on EM bonds markets developments and the one that studies the determinants of more disruptive events, such as sovereign debt crises and sudden stops.

The first strand of the literature is quite large and establishes that U.S. long-term interest rates are of primary importance for developments on EMs bond markets. For instance, Felices, Grisse and Yang (2009) find that U.S. long-term interest rates explain 60 to 70 percent of the variation in the Emerging Markets Bond Index Global (EMBIG). Uribe and Yue (2006) estimate that a quarter of fluctuations in EM spreads are caused by changes in U.S. interest rates. Also, Hartelius, Kashiwase, and Kodres (2008) find that expectations about U.S. interest rates and volatility are key determinants of EMs spreads. The literature on bond market transmissions has also distinguished between longer term comovements, and short term correlation. U.S. long-term interest rates and EM bond yields tend to be positively correlated over the medium term ("search for yield"), and negatively correlated in the short term ("flight to quality") (see for instance, Felices, Grisse, and Yang, 2009). Given our interest on fiscal sustainability, this paper focuses on longer-term comovements. Also, information on fiscal variables and sovereign crises events is mostly restricted to yearly data.

Empirical studies show strong longer term comovements between U.S. interest rates and sovereign yields/spreads and an important role for country specifics. Uribe and Yue (2006) find that countries' spreads display a large and delayed overshooting in response to an increase in U.S. interest rates, and partly relate this behavior to feedback effects from domestic variables. Further empirical evidence on the role of country fundamentals on EMs spreads is provided by Akitoby and Stratmann (2008) for fiscal fundamentals, Cantor and Packer (1996) and Eichengreen and Mody (2000) for country ratings, Peiris (2010) for macroeconomic fundamentals and foreign participation, and Miyajima, Mohanty and Chan (2012) for short term interest rates. Our study builds on the selection of variables used as proxy for fundamentals in those papers.

A few papers have also emphasized the role of global risk aversion. For instance, using monthly data for 26 EMs, Jaramillo and Weber (2013) find that fiscal variables affect domestic bond yields in EMs in times of high global risk aversion (proxied by the VIX[1]). Baldacci and Kumar (2010) find a similar relationship in a sample of 31 EMs and advanced economies. Most recently, IMF 2014d also finds a sizable response of EM bond yields to a volatility shock. In light of the importance of global risk aversion in the post-taper period, our analysis accounts for the level of the VIX. The theoretical underpinning of this approach is provided by Lizarazo (2013). The author develops an endogenous default risk model for small open economies and shows that EMs default risk, capital flows and bond prices may depend, not only on the fundamentals of the economy, but also on the level of financial wealth and risk aversion of investors.

The literature on the determinants of sovereign debt crises, however, is still relatively limited. Reinhart and Rogoff (2011) find that public borrowing surges ahead of external sovereign default. The authors also document that banking crises precede sovereign debt crises. The latter result, combined with Eichengreen and Rose (1998) finding that high interest rates in advanced economies are strongly associated with the onset of banking crises in developing countries, suggests that financial stress could be a possible spillover channel of tighter monetary conditions to the occurrence of fiscal stress episodes in EMs. Most of the literature on sovereign debt crises focuses on external debt crises, with the notable exception of Park and Song (2011). The authors find that the debt threshold that triggers domestic debt crises depends on countries' macroeconomic fundamentals. We examine both external and domestic debt crises and single out explicitly the role of tightening in U.S. monetary conditions.

Finally, and more recently, several papers have examined the spillovers from unconventional monetary policy for both easing and tightening episodes. On the former, Fratzscher, Lo Duca and Straub (2012) find that the first phase of quantitative easing lowered U.S. sovereign yields and capital flew out of EMs into U.S. equity and bonds. Portfolios rebalanced in the opposite direction under the second phase, which boosted equity markets worldwide while the impact on yields was muted. Eichengreen and Gupta (2014) analyze the impact of expectations of reduced the Fed's security purchases on EM exchange rates, reserves, and stock prices between April and August 2013 and find the size of the country's financial markets to be an important determinant, with larger markets facing more pressure. EMs which allowed real exchange rate to appreciate and the current account deficit to widen before 2013 saw the sharpest impact, while better fundamentals (fiscal, macro) did not provide insulation against the shock. In an event analysis, fundamentals were found to matter substantially, in particular around post-taper talk releases of FED minutes (IMF 2014c).

[1] The VIX (Chicago Board Options Exchange Market Volatility Index) is a measure of the implied volatility of S&P 500 index options.

Although many authors have examined the impact of long-term U.S. interest rates on foreign interest rates, this paper is to the best of our knowledge the first attempt to trace the impact on public debt dynamics, critical in view of the ongoing tightening in liquidity conditions and "post-crisis" fiscal consolidation. Also, this is the first paper that analyzes how the frequency of sovereign debt crises changes over the U.S. monetary policy cycle.

III. U.S. Long-Term Bond Yields and Public Debt Dynamics

To assess the impact of U.S. interest rates on EM debt dynamics, we first estimate the sensitivity of the Interest Rate Growth Differential (IRGD) to changes in U.S. 10-year bond yields, controlling for various relevant factors. Based on these estimation results, we quantify the impact of a one percent permanent increase in U.S. rates on the average debt levels of several regional groupings of countries.[2] In order to identify the sources of changes in the IRGD and for robustness, we also estimate the direct impact of U.S. bond yields on EM interest rates.

A. Impact on Interest Rate Growth Differentials

Our main variable of interest is the real effective interest rate, which we derive from general government interest payments and the country's public debt stock, both taken from the April 2014 *Fiscal Monitor* (IMF, 2014a). Given the lack of reliable fiscal data on a quarterly basis, we base our analysis on (unbalanced) yearly data for 29 EMs over the period 1990–2013.

There is considerable variation in the effective interest rate and the IRGD, based on the effective interest rate. Overall, there seems to be some mild correlation between the IRDG and the U.S. 10-year bond yield across our sample. We complement the impact analysis on the effective interest rate with two other sources of interest rates: domestic and international bond yields of EMs. We therefore calculate IRGDs of emerging economies based on three different interest rates: (i) the effective interest rate based on fiscal accounts data; (ii) the EMBI, based on foreign currency bond yields; and (iii) domestic government bond yields (5-year and 10-year, where available). We then assess the impact of U.S. long-term yields on these three measures of interest rate.[3]

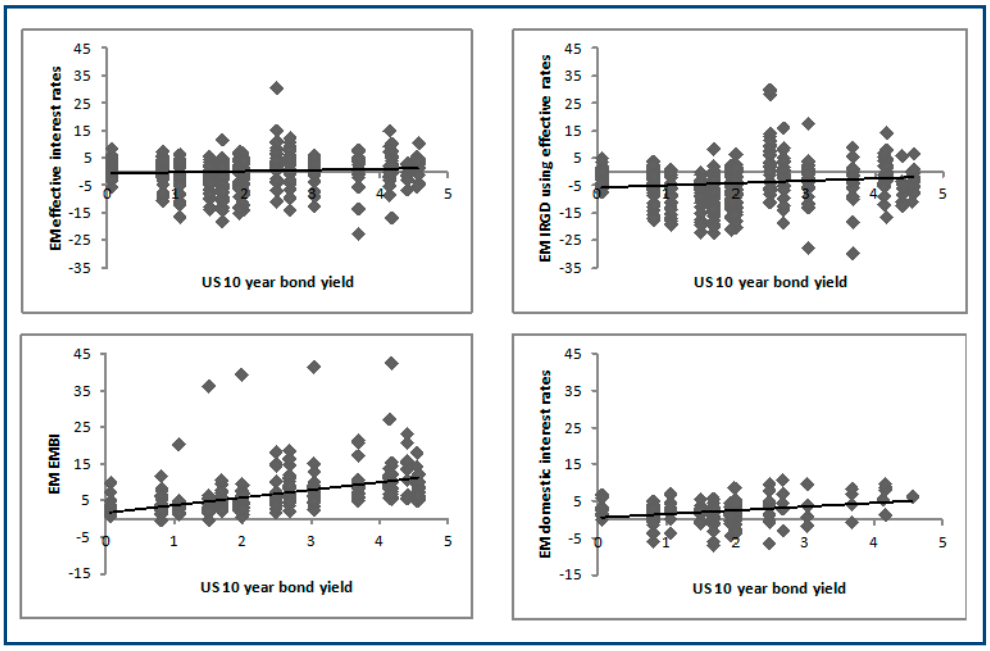
As expected, EMs foreign currency bond yields are strongly correlated with U.S. interest rates. The correlation is lower with domestic bond yields and much lower with effective interest rates (see Figure 1). The same holds for simple correlations with the IRGD based on the foreign-currency and domestic bond yields (not displayed). It is worth noting that data on

[2] See Table A1 in appendix for regional country groupings.

[3] Individual country VARs based on quarterly data on EMBI and domestic bond yield show significant positive impact of lagged U.S. government bond yields on IRGDs, in particular for Peru and Russia. Results are available upon request.

domestic bond yields are more recent, starting in 1997 for some countries, and only from 2000 for most countries.

Figure 1. U.S. 10-Year Bond Yields, EM Interest Rates and IRGDs (1995–2013)



Source: IMF, Federal Reserve Board, Bloomberg, and authors calculations. The time horizon varies across countries, due to data availability.

Econometric analysis

We regress the variations in IRGDs, based on each of the three measures of interest rate, on U.S. bond yields and various controls following, as described in Equation (1). To capture global macroeconomic conditions, we control for U.S. growth. To account for country heterogeneity, we control for a broad set of macro fundamentals following the existing literature, such as Eichengreen and others, 2014, including a battery of variables: fiscal (public, external, non-resident and foreign currency debt, and the fiscal balance); financial (inflation, credit to GDP and market capitalization); institutional (financial openness, exchange rate regime, and trade openness); and external (current account balance, foreign reserves, and real effective exchange rate).

The econometric specification reads:

$$\lambda^{k}{}_{it} = \alpha_i + \beta_1 i_t^{US} + \beta_2 VIX_t i_t^{US} + \beta_3 VIX_t + \beta_4 g_t^{US} + \gamma_1' X_{it} + \varepsilon_{it} \qquad (1)$$

where $\lambda^{k}{}_{it}$ is the interest rate growth differential of EM i in period t, based on the measure of interest rate k (effective, EMBI, or domestic bond yields); $i^{US}{}_{t}$ is the series of 10-year U.S.

government bond yields (real); VIX_t is the CBOE volatility index capturing global risk aversion;[4] $g^{US}{}_t$ is U.S. real GDP growth;[5] X_{it} a set of control variables covering EM fundamentals. The specification is estimated based on an unbalanced panel of 29 EMs using fixed effects with robust standard errors and clustered at the country level. We lag control variables where the contemporaneous relation presents a risk of endogeneity.

Estimation results

The estimations suggest that U.S. government long-term bond yields have a significant impact on the IRGD of EMs, and the impact varies markedly with global risk aversion. Under the baseline specification (see Table 1, Specification (1)) and if the (sample) average risk aversion prevails, a 100 basis points increase in U.S. bond yields leads to an 80 basis point increase in the effective IRGD. In case of very high risk aversion (95th percentile)—comparable to the state of global financial markets in 2003 or at the onset (but not the peak) of the global financial crisis [6]—the effective IRGD would increase by 380 basis points. The dependence of the response of the IRGD with respect to the VIX is consistent with the findings in IMF 2014d whereby a volatility shock would have a sizable effect on the bond yields of selected emerging economies.

Most of the impact comes from an increase in interest rates; the slowdown in growth complements the widening of the IRGD. Under the same baseline specification as above (Table 1, Specification (1)) with EM interest rates instead of IRGDs, a 100 basis points increase in U.S. long-term bond yields leads to a 50 basis points increase in the effective interest rate, at average risk aversion (see Table 2). Comparing this estimate to other studies (such as IMF 2014b and 2014c), we find that our pass-through of changes in long term U.S. interest rate onto EMs rates are rather on the low side of the spectrum—but broadly robust to alternative measures of interest rates, time periods, and frequency.

[4] See Appendix Table A2 for VIX values over the sample period.

[5] We include U.S. growth to control for the fact that an increase in the U.S. long-term interest rate may reflect a better outlook for the U.S. economy, which may not have the same impact as a purely monetary shock—IMF 2014b decomposes the interest rate shock into a "real" component and a "monetary" component, reflecting the fact that a shock to the U.S. long-term interest rate may have differential effects on emerging economies depending on the source of the shock.

[6] Incidentally, the intraday VIX reached exactly 31.1 (the 95th percentile of our sample) on October 15, 2014.

Table 1. Impact of U.S. 10-Year Bond Yields on EM IRGDs by Region

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
		EMs			Asia			Latin America			Europe			Middle East and Central Asia		
VARIABLES	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic
10y US bond yield	-4.613***	-0.0878	-4.538**	-4.013**	-0.953	-3.693	-2.909*	2.526**	-2.444	-9.842***	-2.342	-9.823	-3.530*	1.815	-
	(0.669)	(0.778)	(1.664)	(1.323)	(1.242)	(2.869)	(1.288)	(0.957)	(2.687)	(2.187)	(2.160)	(5.957)	(1.404)	(1.662)	-
10y US bond x VIX	0.271***	0.104**	0.229***	0.234**	0.110	0.237	0.230**	-0.0142	0.101	0.500***	0.251**	0.421	0.203*	-0.0468	-
	(0.0393)	(0.0404)	(0.0701)	(0.0691)	(0.0560)	(0.120)	(0.0575)	(0.0499)	(0.162)	(0.110)	(0.101)	(0.268)	(0.0842)	(0.103)	-
VIX	-0.340***	-0.106	-0.341**	-0.277**	-0.112	-0.347	-0.315*	0.0550	-0.149	-0.744***	-0.337	-0.659	-0.270	0.164	-
	(0.0785)	(0.0757)	(0.125)	(0.0923)	(0.112)	(0.211)	(0.141)	(0.120)	(0.385)	(0.160)	(0.185)	(0.466)	(0.169)	(0.188)	-
US GDP growth	-0.117	-0.453**	0.101	0.402	-0.0129	0.252	0.193	-0.573	-1.270*	-0.981**	-0.544	0.151	-0.0550	-0.644	-
	(0.237)	(0.185)	(0.257)	(0.429)	(0.175)	(0.424)	(0.310)	(0.390)	(0.411)	(0.376)	(0.373)	(0.566)	(0.833)	(0.989)	-
Public debt	0.0536**	0.205***	0.252***	0.0361	0.0703***	0.150*	0.0957	0.326***	-0.112	0.148*	0.249***	0.242	0.0558	0.321	-
	(0.0203)	(0.0448)	(0.0522)	(0.0251)	(0.0132)	(0.0731)	(0.0504)	(0.0739)	(0.270)	(0.0787)	(0.0282)	(0.136)	(0.0383)	(0.152)	-
L1 Inflation	-0.307***	0.00433***	0.357**	-0.0722	0.0433	0.150	-0.621**	0.00546*	0.998	-0.260***	-0.000647	0.536**	-0.0520	0.417**	-
	(0.0661)	(0.00106)	(0.146)	(0.0983)	(0.0500)	(0.289)	(0.162)	(0.00220)	(1.436)	(0.0513)	(0.00281)	(0.120)	(0.251)	(0.101)	-
L1 Current account	0.0584	-0.270**	-0.0466	-0.165**	-0.230***	-0.233	-0.746	-1.042	0.211	0.111	-0.215	-0.183	0.266*	-0.295	-
	(0.0904)	(0.127)	(0.109)	(0.0528)	(0.0275)	(0.206)	(0.412)	(0.525)	(0.666)	(0.234)	(0.272)	(0.230)	(0.122)	(0.164)	-
Capital openess	0.677*	-0.225	0.164	-1.880**	0.212	-1.102*	1.439**	-1.185	-3.540*	1.221	1.848**	1.884	0.320	-2.792***	-
	(0.388)	(0.715)	(1.007)	(0.689)	(0.237)	(0.519)	(0.457)	(1.030)	(1.131)	(0.853)	(0.749)	(1.196)	(0.870)	(0.358)	-
Constant	-0.0809	-9.016***	-10.53***	-4.128	-4.553	-7.894	-1.562	-15.78**	8.862	6.948	-7.565*	-4.321	-4.658	-25.93**	-
	(1.851)	(2.233)	(3.346)	(2.506)	(2.292)	(4.719)	(4.255)	(4.678)	(6.199)	(4.364)	(3.590)	(12.63)	(4.695)	(9.185)	-
Observations	488	371	154	117	66	68	99	109	21	129	112	38	102	51	11
R-squared	0.295	0.571	0.421	0.305	0.463	0.452	0.606	0.714	0.848	0.554	0.703	0.560	0.201	0.556	-
Number of clusters	30	27	17	6	5	6	6	6	4	9	9	5	6	5	1

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Fixed effects model with clustered error terms. Dependent variable is the IRGD based on the effective interest rate, the EMBIG, and domestic bond yields.

Asia: China, India, Indonesia, Malaysia, Philippines, Thailand**; Latin America**: Argentina, Brazil, Chile, Colombia, Mexico, Peru;

Europe: Bulgaria, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Turkey, Ukraine;

Middle East & Central Asia: Egypt, Jordan, Morocco, Pakistan, Saudi Arabia, Kazakhstan.

Table 2. Impact of U.S. 10-Year Bond Yields on EM Interest Rates

	(1) Effective	(2) Embi	(3) Domestic
10y US bond yield	-2.502***	1.377**	-2.139
	(0.402)	(0.633)	(1.329)
10y US bond yield x VIX	0.153***	0.00651	0.126*
	(0.0251)	(0.0296)	(0.0594)
VIX	-0.203***	0.0335	-0.181
	(0.0552)	(0.0581)	(0.106)
US GDP growth	0.127	-0.0202	0.555***
	(0.185)	(0.100)	(0.139)
Public debt	0.0199*	0.166***	0.141***
	(0.0102)	(0.0449)	(0.0448)
L1 Inflation	-0.269***	0.00405***	0.0948
	(0.0401)	(0.000921)	(0.102)
L1 Current account	0.145**	-0.0804	0.0349
	(0.0631)	(0.0555)	(0.0877)
Capital openness	0.489	-0.284	0.166
	(0.296)	(0.469)	(0.807)
Constant	3.268***	-5.466**	-3.709
	(1.139)	(2.428)	(3.015)
Observations	488	371	154
R-squared	0.237	0.671	0.293
Number of countries	30	27	17

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed effects model with clustered error terms.

As expected, the impact of U.S. bond yields is strongest on the EMBI and EMBI-based IRGD and weakest for domestic bond yields and the related IRGD, an order which does not always hold at high risk aversion (see Figure 3 for IRGDs). However, in regressions with interest rates only, domestic yields are only weakly significant.

The sensitivity of IRGDs to U.S. monetary conditions is robust to the inclusion of various controls, such as macro fundamentals, financial market parameters and institutional variables (see Tables 3 and 4). Capital market conditions as well as institutional variables seem less relevant while the level of public debt significantly increases IRGDs. The results are broadly in line with recent studies on the impact of taper announcements (IMF 2014b), which found that countries with current account surpluses, stronger fiscal balances and higher GDP growth saw smaller depreciations of exchange rates and drops in equity prices, and lower increase in bond yields.

Table 3. Impact of U.S.10-Year Bond Yields on EM IRGDs—Fiscal Control Variables

VARIABLES	(1) Effective	(2) Embi	(3) Domestic	(4) Effective	(5) Embi	(6) Domestic	(7) Effective	(8) Embi	(9) Domestic	(10) Effective	(11) Embi	(12) Domestic	(13) Effective	(14) Embi	(15) Domestic
10y US bond yield	-4.613***	-0.0878	-4.538**	-3.180*	2.450	-7.763*	-8.579***	-3.544**	-5.590**	-6.273***	-2.302	-5.466***	-4.473***	-1.820	-5.718**
	(0.669)	(0.778)	(1.664)	(1.472)	(2.659)	(2.487)	(1.413)	(1.602)	(2.123)	(1.013)	(1.494)	(1.593)	(0.680)	(1.379)	(2.036)
10y US bond x VIX	0.271***	0.104**	0.229***	0.221***	-0.0414	0.355**	0.355***	0.177***	0.253**	0.335***	0.161**	0.275***	0.267***	0.172**	0.276***
	(0.0393)	(0.0404)	(0.0701)	(0.0458)	(0.108)	(0.0932)	(0.0647)	(0.0609)	(0.0998)	(0.0530)	(0.0710)	(0.0705)	(0.0382)	(0.0663)	(0.0798)
VIX	-0.340***	-0.106	-0.341**	-0.226	0.153	-0.443	-0.531***	-0.202*	-0.357*	-0.489***	-0.210*	-0.436***	-0.323***	-0.215*	-0.379**
	(0.0785)	(0.0757)	(0.125)	(0.142)	(0.196)	(0.294)	(0.103)	(0.109)	(0.176)	(0.0939)	(0.119)	(0.124)	(0.0707)	(0.120)	(0.144)
US GDP growth	-0.117	-0.453**	0.101	0.979**	-0.0258	1.674	-0.705**	-0.596	-0.0519	-0.154	-0.455	0.153	-0.0391	-0.314	0.463
	(0.237)	(0.185)	(0.257)	(0.302)	(0.266)	(0.827)	(0.280)	(0.403)	(0.312)	(0.215)	(0.276)	(0.261)	(0.213)	(0.217)	(0.293)
Public debt	0.0536**	0.205***	0.252***												
	(0.0203)	(0.0448)	(0.0522)												
External debt				0.0905***	0.231**	0.102***									
				(0.0194)	(0.0761)	(0.0120)									
Non-res. debt							0.118*	0.326***	0.244*						
							(0.0656)	(0.0746)	(0.122)						
Foreign curr. debt										0.119***	0.277***	0.248***			
										(0.0326)	(0.0524)	(0.0262)			
L1 Fiscal balance													0.101	-0.232	0.164
													(0.165)	(0.240)	(0.164)
L1 Inflation	-0.307***	0.00433***	0.357**	-0.527	-0.000887	0.639	-0.0538	0.185***	0.353***	-0.312***	0.0714	0.351**	-0.299***	0.0546	0.230
	(0.0661)	(0.00106)	(0.146)	(0.281)	(0.00155)	(0.364)	(0.0891)	(0.0509)	(0.0959)	(0.0703)	(0.0448)	(0.158)	(0.0663)	(0.0616)	(0.188)
L1 Current account	0.0584	-0.270**	-0.0466	-0.249	-0.160	-0.0815	0.132	-0.276	0.0207	-0.130	-0.426***	-0.0482	0.0538	-0.222**	-0.0227
	(0.0904)	(0.127)	(0.109)	(0.320)	(0.227)	(0.0709)	(0.137)	(0.191)	(0.209)	(0.108)	(0.112)	(0.108)	(0.0751)	(0.101)	(0.191)
Capital openess	0.677*	-0.225	0.164	0.657	-2.705***	3.632	-1.298	0.421	-2.062***	0.354	0.168	-2.089***	0.384	-1.030	1.497
	(0.388)	(0.715)	(1.007)	(0.746)	(0.439)	(2.504)	(1.113)	(0.846)	(0.647)	(0.476)	(0.702)	(0.323)	(0.443)	(0.690)	(1.404)
Constant	-0.0809	-9.016***	-10.53***	-6.120	-15.05**	-10.68	8.685***	-1.776	0.331	3.939**	-1.596	-0.623	1.984	1.388	3.221
	(1.851)	(2.233)	(3.346)	(3.998)	(6.075)	(12.92)	(2.005)	(2.563)	(4.412)	(1.561)	(2.602)	(2.435)	(1.453)	(1.900)	(3.783)
Observations	488	371	154	102	118	24	234	193	103	402	317	146	487	337	150
R-squared	0.295	0.571	0.421	0.505	0.630	0.913	0.421	0.614	0.518	0.344	0.598	0.463	0.280	0.314	0.308
Number of ifscode	30	27	17	7	7	4	24	23	14	27	26	17	30	27	17

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Fixed effects model with clustered error terms. Dependent variable is the IRGD based on the effective interest rate, the EMBIG, and domestic bond yields.

Table 4. Impact of U.S. 10-Year Bond Yields on EM IRGDs– Financial, Institutional, and External Control Variables

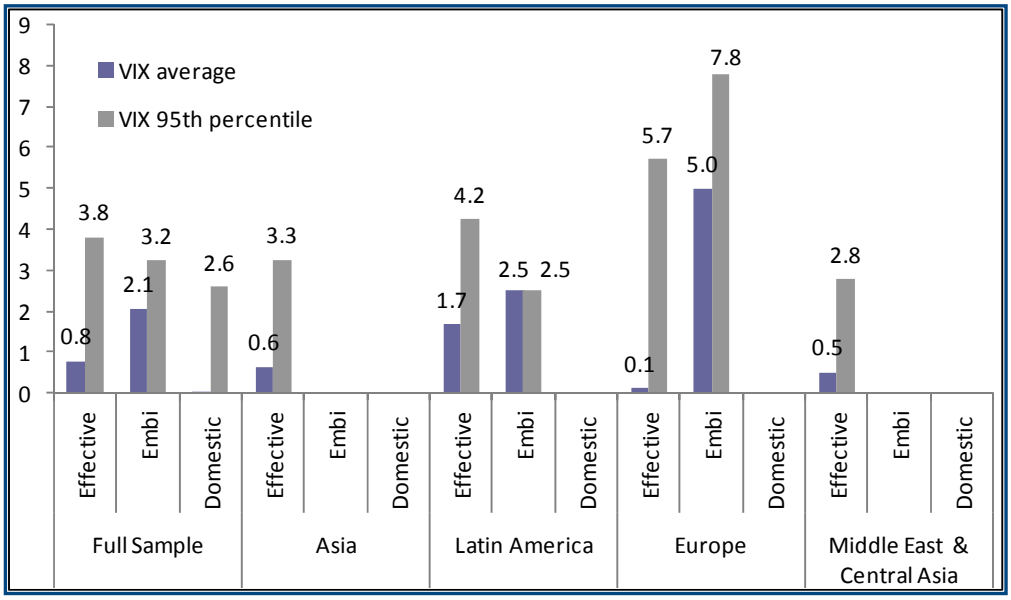
VARIABLES	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic	Effective	Embi	Domestic
10y US bond yield	-3.995***	-0.154	-4.537**	-4.119***	0.418	-3.707**	-2.789***	-0.395	-3.081	-4.892***	-0.208	-4.383**	-4.730***	-0.328	-4.652**	-5.057***	0.199	-4.929*
	(0.613)	(0.793)	(1.657)	(0.631)	(0.805)	(1.555)	(0.598)	(0.937)	(1.985)	(0.685)	(0.768)	(1.637)	(0.663)	(0.730)	(1.626)	(0.919)	(1.067)	(2.264)
10y US bond x VIX	0.252***	0.117**	0.233***	0.240***	0.0738*	0.182**	0.246***	0.180***	0.219**	0.269***	0.108**	0.218***	0.276***	0.107***	0.220***	0.271***	0.104*	0.249**
	(0.0379)	(0.0427)	(0.0705)	(0.0397)	(0.0421)	(0.0628)	(0.0407)	(0.0520)	(0.0751)	(0.0387)	(0.0402)	(0.0703)	(0.0424)	(0.0375)	(0.0671)	(0.0483)	(0.0533)	(0.107)
VIX	-0.311***	-0.141*	-0.345**	-0.297***	-0.0616	-0.269**	-0.296***	-0.356***	-0.412**	-0.346***	-0.114	-0.335**	-0.349***	-0.104	-0.333**	-0.360***	-0.137	-0.407*
	(0.0730)	(0.0780)	(0.124)	(0.0804)	(0.0808)	(0.115)	(0.102)	(0.113)	(0.158)	(0.0779)	(0.0766)	(0.128)	(0.0858)	(0.0691)	(0.121)	(0.109)	(0.0952)	(0.199)
US GDP growth	-0.0856	-0.417**	0.137	-0.256	-0.579***	-0.0649	-0.453*	-1.008***	-0.465	-0.177	-0.443**	0.0102	-0.0926	-0.515**	-0.0183	-0.182	-0.508**	0.0990
	(0.218)	(0.173)	(0.242)	(0.260)	(0.178)	(0.251)	(0.262)	(0.268)	(0.267)	(0.244)	(0.203)	(0.264)	(0.199)	(0.208)	(0.213)	(0.352)	(0.234)	(0.267)
Public debt	0.0560***	0.206***	0.247***	0.0391*	0.216***	0.227***	0.0410**	0.239***	0.282***	0.0532**	0.210***	0.276***	0.0561**	0.193***	0.264***	0.0228	0.222***	0.279***
	(0.0173)	(0.0437)	(0.0489)	(0.0222)	(0.0548)	(0.0583)	(0.0173)	(0.0605)	(0.0550)	(0.0218)	(0.0451)	(0.0688)	(0.0247)	(0.0417)	(0.0549)	(0.0367)	(0.0383)	(0.0551)
L1 Inflation	-0.294***	0.00199	0.354**	-0.305***	0.00422***	0.348**	-0.354***	0.00399***	0.347	-0.323***	0.00450***	0.372**	-0.305***	0.00376***	0.374**	-0.209***	-0.00151	0.589***
	(0.0698)	(0.00132)	(0.150)	(0.0650)	(0.00103)	(0.140)	(0.0659)	(0.00136)	(0.308)	(0.0704)	(0.00142)	(0.140)	(0.0656)	(0.00106)	(0.136)	(0.0406)	(0.00127)	(0.0871)
L1 Current account	0.0703	-0.204	-0.0362	0.0322	-0.326**	-0.0820	0.131	-0.278**	0.0309	0.0605	-0.268**	-0.0501						
	(0.0804)	(0.128)	(0.112)	(0.0948)	(0.142)	(0.104)	(0.0838)	(0.134)	(0.127)	(0.0907)	(0.124)	(0.135)						
Capital openess	0.420	-0.631	0.160	0.799**	-0.178	0.0437							0.655	-0.0642	-0.234	0.301	-0.0788	0.903
	(0.324)	(0.558)	(0.987)	(0.356)	(0.728)	(0.941)							(0.413)	(0.785)	(1.118)	(0.487)	(0.684)	(0.616)
L1 Credit to GDP	0.0685***	0.0767**	0.0153															
	(0.0197)	(0.0295)	(0.0269)															
L1 Market capital.				-0.0333***	-0.0267*	-0.0273**												
				(0.0108)	(0.0153)	(0.0128)												
Exch. rate regime							-0.564	-0.586	1.033***									
							(0.594)	(0.911)	(0.330)									
Openess										-0.0714**	-0.0209	-0.0299						
										(0.0340)	(0.0368)	(0.0330)						
L1 Intl. reserves													0.00930	-0.127**	-0.121			
													(0.0665)	(0.0480)	(0.101)			
L1 REER																0.123***	0.109**	0.123**
																(0.0405)	(0.0378)	(0.0431)
Constant	-4.875***	-12.61***	-11.30***	2.089	-8.458**	-8.273**	-1.499	-5.870**	-15.78***	6.751*	-7.496**	-9.149*	-0.265	-5.697**	-8.236*	-10.04*	-20.48***	-23.36***
	(1.588)	(2.241)	(3.482)	(2.197)	(3.364)	(3.773)	(2.900)	(2.123)	(2.446)	(3.533)	(3.320)	(4.824)	(2.126)	(2.389)	(4.478)	(5.335)	(4.553)	(3.782)
Observations	474	369	154	487	369	154	390	285	108	488	371	154	488	371	154	294	255	104
R-squared	0.304	0.590	0.422	0.315	0.571	0.437	0.384	0.629	0.495	0.304	0.572	0.425	0.294	0.551	0.433	0.349	0.603	0.601
Number of ifscode	29	26	17	30	27	17	30	23	16	30	27	17	30	27	17	17	16	11

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Fixed effects model with clustered error terms. Dependent variable is the IRGD based on the effective interest rate, the EMBIG, and domestic bond yields.

There is a large heterogeneity among countries and regions on the nature, timing and persistence of the sensitivity of IRGDs to U.S. long-term bond yields. We account for these differences by grouping countries at the regional level (as individual country regressions are limited by data availability) and by controlling for various country characteristics as described above. Estimations by regions suggest that the impact of U.S. long-term yields on emerging economies' IRGD is particularly strong in Latin America (at average risk aversion), and in Europe (at very high risk aversion) (see Table 1 and Figure 2).[7] One should note, however, that the number of observations is very low for regional regressions, in particular for domestic bond yields, as well as for some EMBI specifications (e.g., for Asia and the Middle East).

Figure 2. Impact on IRGDs by Region at Different Levels of Global Risk Aversion
(In percentage points)



Notes: Bars depict the significant impact of a one percent increase in U.S. long-term bond yields on EM IRGDs at a given value of VIX (average: 19.9 ; 95th percentile: 31.1). Coefficients are taken from the baseline specification, Table 1a, Specification (1).

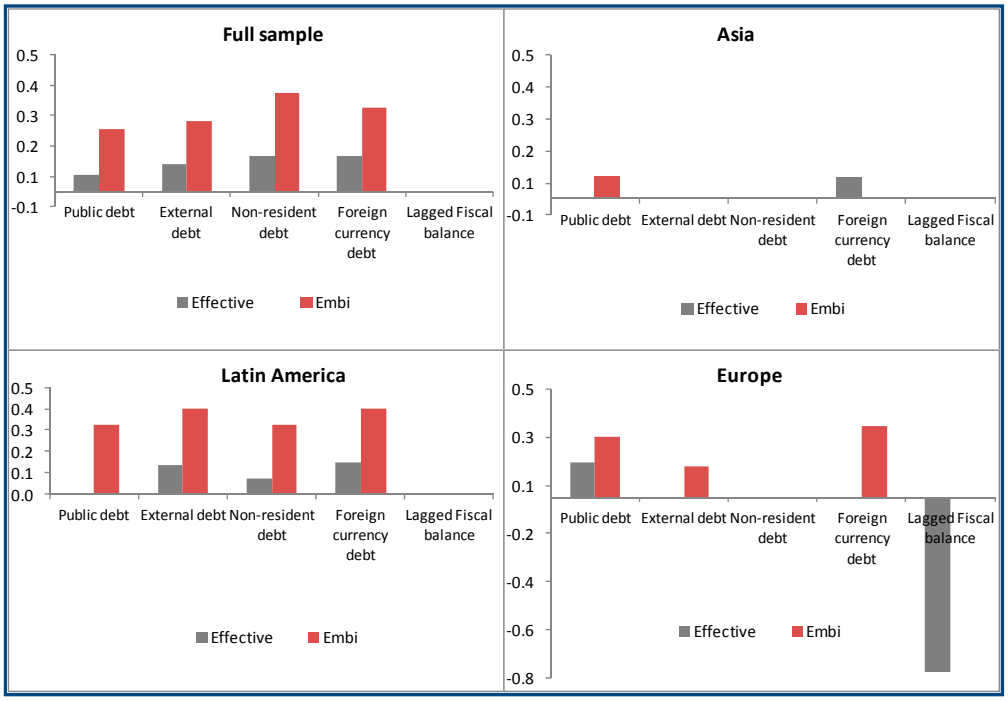
In order to better understand the differences across regions, we add interaction terms between U.S. interest rates and selected control variables to each specification reported in Tables 1, 3, and 4.[8] Estimations suggest that the reasons for the stronger impact on effective IRGDs in EMs in Latin America and—at times of high risk aversion—in Europe are threefold.

[7] We perform robustness tests for the Middle East & Central Asia by excluding oil exporters and the results remain unaltered.

[8] Regression results not reported here but available upon request.

First, debt fundamentals matter more in Latin America than in other regions. The share of foreign currency denominated debt seems to magnify the impact of U.S. bond yields on effective IRGDs in Latin America. EMs with high foreign currency debt (defined as one standard deviation above average) face a 2 percentage points higher impact of changes in U.S. interest rates than EMs with average foreign currency debt in the same region (both evaluated at average VIX). We could not observe this interaction for the effective IRGD in other regions.[9] The share of foreign currency debt in Europe is, on average, comparable to Latin America's but investors seem to be more sensitive to debt fundamentals in Latin America. This is not only the case for indirect factors influencing the transmission of U.S. interest rates. External and non-resident debts are also important determinants of the IRGD in Latin America. The direct impact of fiscal fundamentals on the IRGD is summarized in Figure 3.

Figure 3. Impact of Fiscal Fundamentals on IRGDs by Region



Second, the fiscal balance matters for Emerging Europe, both in a direct way, i.e., countries with higher deficits have higher IRGDs (see Figure 3) and indirectly (by magnifying the transmission of changes in U.S. bond yields). European EMs with a weaker fiscal position suffer a 1.5 percentage points higher increase in their IRGDs following a shock to U.S. interest rates, at average VIX. The fiscal balance affects the transmission of the U.S. interest rates to rates in Latin America only weakly. Moreover, fiscal balances in Europe are on

[9] In Asia, the EMBI-based IRGD is also affected by the share of foreign currency denominated debt, but the estimated coefficient is much smaller than for Latin America.

average one percentage point worse than in Latin America (and 1.2 percentage points worse than in Asia). Since fiscal balances can deteriorate quickly (compared with stock variables, for instance), in particular during crises, this sensitivity might help explain the relatively strong impact of U.S. interest rates on the effective IRGD in Europe at times of high VIX.

Third, the role of the VIX seems to be affected by the exchange rate regime. More floating exchange rates seem to dampen the role of the VIX. Europe, which features a particularly strong impact of the VIX, has on average more managed exchange rate regimes than Latin America and Asia.

In addition to the above cross-country (region) variations, the estimated sensitivity of the IRGD to changes in U.S. bond yields can also vary over time. Factors related to this time dimension include the maturity structure of outstanding debt, the integration of international financial markets, and a shift towards domestic bond financing. While we control for the integration of international financial markets and for the extent of domestic bond financing using proxies such as (capital account) openness and the share of foreign currency debt, these proxies (used because of data limitations) might be imperfect. We therefore re-estimate our baseline specification with a time trend and interact the trend with the U.S. interest rate and the VIX. All interactions, including the triple interaction between the U.S. interest rate, the time trend and the VIX, are highly significant. Moreover, estimations indicate that the sensitivity of the IRGD to U.S. interest rates has changed over time, with a decline at average VIX—which might be attributed, among other things, to lengthening debt maturities and more domestic financing— and an increase at high VIX—which might be due to more interconnected financial markets. The decreasing sensitivity at average VIX is mainly driven by Latin America and Asia; at all levels of VIX, Europe's IRGD has been more strongly affected by U.S. bond yields in recent years which include the global financial crisis, possibly because financial markets in Emerging Europe have been increasingly integrated to the euro zone.

B. Public Debt Dynamics

The above estimates suggest that the debt paths of EMs can change significantly following increases in U.S. long-term yields. We evaluate this impact using the dynamic equation of debt (Equation (2) below), which can be transformed to represent the changes in debt levels over the medium-term (Equation (3) below).

$$d_{j,t} = \lambda_t d_{j,t-1} + pb_{j,t} + RES_{j,t}\,;\;\; t \geq 2014 \tag{2}$$

$$\Longrightarrow (3)\ \Delta \mathrm{d_{j,t}} = d_{j,t}^{tight} - d_{j,t}^{base} = \lambda_t^{tight} d_{j,t-1}^{tight} - \lambda_t^{base} d_{j,t-1}^{base};\ t \geq 2014 \tag{3}$$

Where *j* denotes a region and "base" refers to the debt profile prior to U.S. monetary, tightening, from the April 2014 *World Economic Outlook* projections. Accordingly, $d_{j,2013}^{tight} =$

$d_{j,2013}^{base}$, and the previously estimated coefficient reflects the change in the IRGD, $\lambda_t^{tight} - \lambda_t^{base}$. It is worth noting that we do not attempt to capture changes caused by possible movements in the primary balances triggered by tightening events.[10] The computed changes in the debt-to-GDP ratio therefore solely reflect the increase in debt levels through changes in debt service and issuances, ceteris paribus. They, in particular, do not capture the potential response of policy makers to first-round changes in debt levels. We proceed this way for policy and comparability reasons. The adopted approach presents policy makers with the estimated impact in case no remedial policy action is taken, therefore increasing awareness. It also facilitates cross-country comparison of the impact of US tightening, given that countries/regions would react differently to such developments. Also, we do not factor-in the revenue impact of US monetary tightening via its impact on economic growth; evaluating this incidence would require reliable estimates of the elasticity of revenues to GDP in the group of emerging economies considered in this paper. While we acknowledge their existence, these second-round effects are likely to have a relatively small impact on the above calculated debt trajectories.[11]

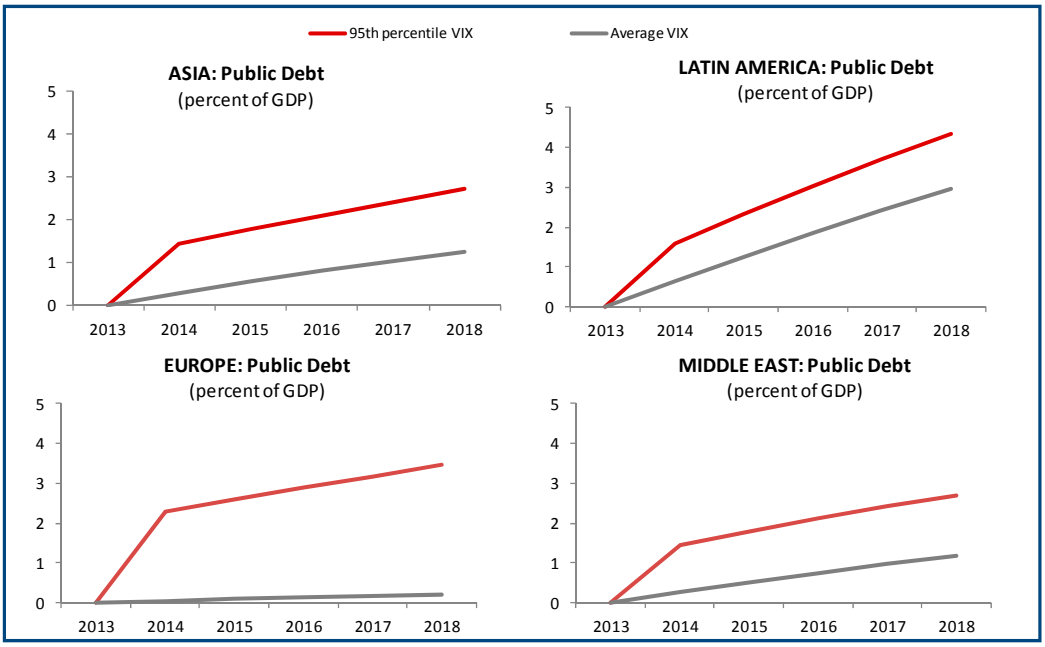
Figure 4 displays changes in the (non-weighted average) public debt by region, following a permanent one percent increase in U.S. long-term yields.[12] As above, we distinguish between "normal times" corresponding to the average VIX and times of high global risk aversion. While in the former case, only Latin America would see a sizable increase in their debt burden (about 3 percent of GDP), all regions would be affected at times of higher global risk aversion. Latin America would be hit hardest with around 4½ percentage points higher public debt-to-GDP ratio. The corresponding impact would be about 3½ percent of GDP in Emerging Europe. IRGDs would nonetheless remain negative in all regions and debt would continue to decline over the medium term.

[10] We control, however, for the level of public debt which reflects *inter alia* past fiscal balances.

[11] This is equivalent to assuming that the revenue elasticity to GDP is one, which is somewhat on the lower side.

[12] The simulation of the public debt path is done all else equal—all the control variables other than the U.S. long-term interest rate are kept unchanged throughout. As such, our projections of the impact of U.S. tightening on EM public debt dynamics are likely to be more imprecise as the projection horizon widens.

Figure 4. Impact of a Permanent Increase in U.S. 10-Year Bond Yields on Public Debt



IV. U.S. Monetary Tightening and the Frequency of Fiscal Crises in Emerging Economies

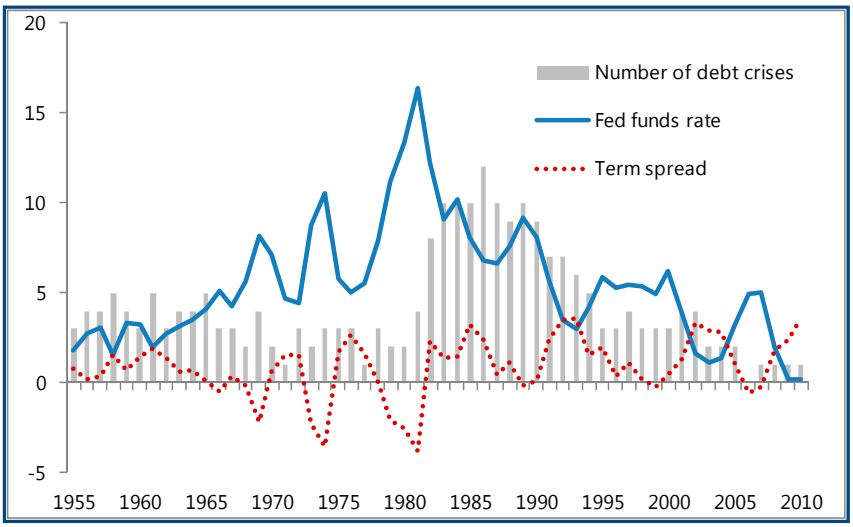
This section takes a historical look at the incidence of sovereign debt crises in EMs along the U.S. monetary policy cycle.[13] We first identify tightening episodes in U.S. monetary policy, and then examine the historical frequency of sovereign debt crises around those episodes.

As a starting point, Figure 5 portrays the evolution of the Fed funds rate and of the term spread (difference between the 10-year U.S. interest rate and the Fed funds rate) along with the frequency of sovereign debt crises in EMs since the mid-1950s (shaded bars). The chart seems to suggest that peaks in the Fed funds rate have generally been associated with a higher frequency of sovereign debt crises in EMs in the past, especially when the rise in the Fed funds rate was accompanied by a relatively high term spread. To investigate these links more systematically, we specify and estimate a *Poisson* count model for the number of sovereign debt crises in EMs. Data on sovereign debt crisis is from Reinhart and Rogoff (2011) and covers 1955–2010.[14] To account for the above empirical regularity, we allow the impact of tightening to vary with the level of the term spread, a critical feature of the current U.S. monetary policy cycle.

[13] A sovereign debt crisis here corresponds to a state of default or restructuring.

[14] We also run a *negative binomial* model for robustness and the results are very similar. In fact, there is no strong evidence of over-dispersion, which favors the *Poisson* specification. Also, there is no apparent inflation at the zero count, which obviates the need to recourse to the *Zero-Inflated Poisson* specification.

Figure 5. U.S. Monetary Policy and the Frequency of Sovereign Debt Crises in EMs (1955–2010)



Source: Federal Reserve Board, Reinhart and Rogoff (2011), and authors' computations.

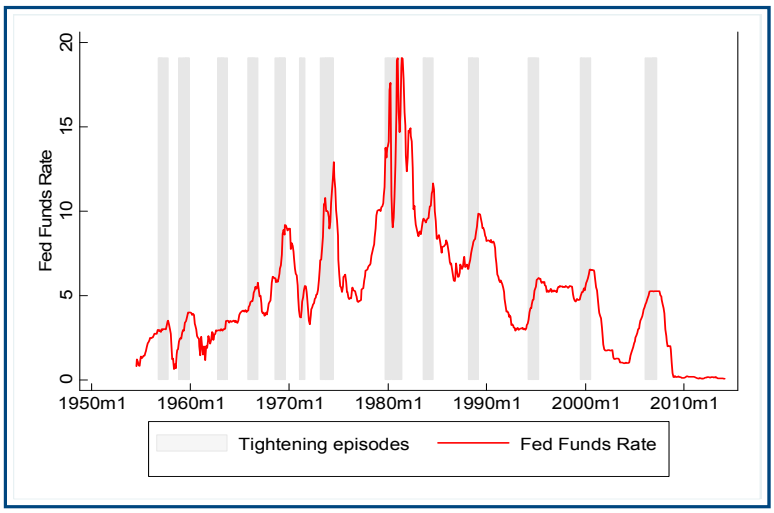
Identification of tightening cycles

Adrian and Estrella (2008) defined a procedure to identifying the "end" of tightening cycles in U.S. monetary policy and applied it to the period prior to the global financial crisis. The authors assume that a cycle ends when either of the following criteria is met: (i) the Fed funds rate is higher than at any time from 12 months before to 9 months after and is at least 50 basis points higher than at the beginning of this period; or (ii) the Fed funds rate is higher than at any time from six months before to six months after and is 150 basis points higher than the average at these endpoints. Given that we are interested in the entire duration of tightening episodes (not just in their beginning or their end), we complement the above procedure by also identifying the "beginning" of tightening cycles, following the same logic. We also extend the sample to cover the post-crisis era (Adrian and Estrella (2008) sample ends in 2006). Our sample, however, is capped by the information on sovereign debt crises, available only through 2010. The shaded areas in Figure 6 represent our identified tightening episodes in U.S. monetary policy. The identified episodes are consistent with those obtained by Romer and Romer (1989) for the corresponding sub-sample, using the narrative approach.[15]

[15] Relying on non-statistical procedures, the authors use the historical record such as the description of the rationale behind Fed's policy actions to identify episodes when monetary policy decisions were not driven by developments in the real economy. In particular, they count as a shock only episodes in which the Federal Reserve attempted to exert a contractionary influence on the economy in order to reduce inflation. They therefore capture episodes during which concerns about the level of inflation led the Federal Reserve to attempt to induce a recession.

(continued)

Figure 6. U.S. Monetary Tightening Cycles



Source: Federal Reserve Board and authors' computations.

Model specification

To investigate the link between tightening and the occurrence of sovereign debt crises, we estimate the following *Poisson* count model for the number of sovereign debt crises in emerging economies:[16]

$$Pr(N_t = k \mid X_t) = \frac{\lambda(X_t)^k e^{-\lambda(X_t)}}{k!} \quad (4)$$

$$X_t = [FFR_t;\ Tight_t;\ Spread_t^{US};\ Tight_t.Spread_t^{US}] \quad (5)$$

$$\lambda(X_t) = exp\{\alpha + \beta_1.FFR_t + \beta_2.Tight_t + \beta_3.Spread_t^{US} + \gamma.(Tight_t.Spread_t^{US})\} \quad (6)$$

Where N_t is the number of sovereign debt crises across EMs in a given year t, *FFR* is the Fed funds rate, "*Tight*" is a dummy variable that takes the value 1 at the beginning of the tightening cycle, and "*Spread*" is the term spread, obtained as the difference between the 10-year long-term rate and the Fed funds rate.

[16] We also run a *negative binomial* model for robustness and the results are very similar. In fact, there is no strong evidence of over-dispersion, which favors the *Poisson* specification. Also, there is no apparent inflation at the zero count, which obviates the need to recourse to the *Zero-Inflated Poisson* specification.

Estimation results

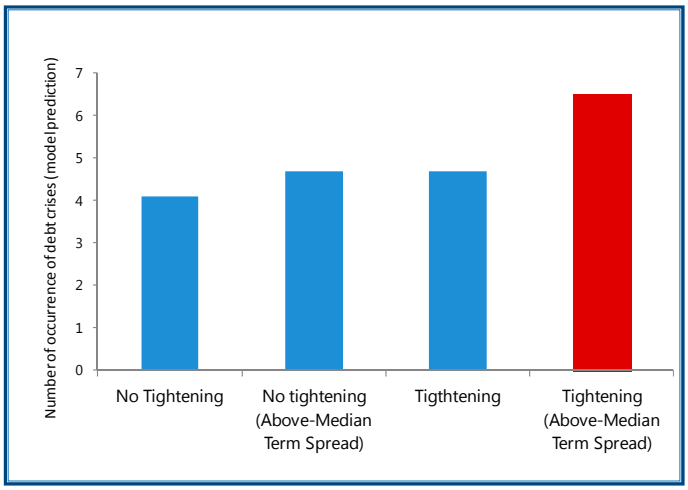
Estimations suggest that the frequency of sovereign debt crises tends to increase across EMs at the beginning of tightening cycles in U.S. monetary policy, especially when the tightening is accompanied by a rise in the term spread.

$$\widehat{N_t} = \underset{(0.17)}{0.44^{***}} + \underset{(0.02)}{0.13^{***}} FFR_t + \underset{(0.15)}{0.1} Tight_t + \underset{(0.04)}{0.21^{***}} Spread_t + \underset{(0.08)}{0.26^{***}} Tight_t.Spread_t \qquad (7)$$

The timing of events may be related to abrupt switches of expectations about the future course of policy in the early stages of a tightening cycle.[17] Eichengreen and Rose (1998) finding that high global interest rates are strongly associated with the onset of banking crises in developing countries suggests that financial stress could be one channel through which tighter monetary conditions in the U.S. increase fiscal stress in EMs.

Figure 7 summarizes the estimate count of sovereign debt crises across the 22 emerging economies in our sample over the U.S. monetary cycle. It highlights the our finding that the term spread helps discriminate between tightening episodes: the frequency of sovereign debt crises in EMs tends to be higher at the beginning of tightening cycles when the term spread rises; the change in the frequency of debt crises is less perceptible when the term spread remains at its historical average level.

Figure 7. U.S. Monetary Policy Tightening and Frequency of Sovereign Crises in Emerging Economies



[17] We ran a similar regression in which the dummy variable *Tight* takes the value 1 over the entire tightening episode and the impact of tightening was lower.

More specifically, using the estimates provided in Equation (7), the frequency of sovereign debt crises is estimated to be higher by about 15 percent at the beginning of U.S. monetary tightening cycles, and by an additional 20 percent if the term spread rises above its historical median value.

Robustness check

We perform a number of sensitivity analyses to assess the robustness of the above result whereby the beginning of a U.S. tightening cycle increases the frequency of sovereign crises in EMs when the term spread rises.

One concern is that the finding could be driven by the Volker disinflation episode, which indeed partially falls in our identified set of tightening cycles. U.S. inflation was unusually high when Volker became the Fed's Chairman in 1979, picking-up at 13.5 percent in 1981. Following decisive rate hikes (from 11.2 percent in 1979 to 20 percent in 1981), inflation went down to around 3 percent in 1983. Although the Volker disinflation meets the definition of monetary policy tightening by Romer and Romer (1989), we re-ran the above regression with an additional dummy variable to the list of controls, taking the value 1 between 1980 and 1983 and the value 0 otherwise. Estimation results (not reported) suggest little changes to our quantitative results—we found no evidence that sovereign debt crises were more frequent in emerging economies during the Volker disinflation episode.

Another concern is that our results could be driven by the Latin America region. We therefore re-estimate the Poisson *Count model* on emerging economies, excluding Latin American countries. The effects of tightening identified above remain significant, although their magnitude is slightly lower. We then re-estimate the model for Latin American countries[18] alone and find a higher impact of US tightening on sovereign debt distress, especially when the term spread is high and at the beginning of tightening cycles.[19] The latter result is consistent with the finding in the above section on public debt dynamics whereby Latin America is one of the regions that would be hit hardest by US monetary policy tightening.

V. Conclusion and Policy Implications

This paper examines the impact of tightening in global liquidity conditions on public debt dynamics and the occurrence of fiscal stress episodes in emerging economies. We find that a tightening in global monetary conditions can adversely affect public debt dynamics, especially in Latin America and in Emerging Europe: A unit permanent increase in U.S.

[18] The following Latin American countries were included, based on data availability: Argentina, Bolivia, Brazil, Chile, Columbia, Honduras, Mexico, Nicaragua, and Peru.

[19] Estimations also suggest that the beginning of the tightening does not matter in the LAC region on average, unless coupled with a high term spread.

long-term bond yields would increase the IRGD based on effective interest rates by 0.8 percentage points. Holding everything else equal, this translates into an increase of public debt by about 4½ percentage points of GDP for countries in Latin America (and by 3½ percent of GDP in Emerging Europe) over a 5-year horizon at times of high global risk aversion.

The paper also finds that global monetary tightening could lead to more disruptive fiscal events. Our estimations, using a Poisson count model, suggest that the frequency of sovereign debt crises tends to increase in emerging economies at the early stages of U.S. monetary policy tightening, when tightening takes the shape of a steepening in the yield curve. The timing of these events may be related to abrupt switches of expectations about the future course of policy in the early stages of tightening cycles. These findings are robust to a number of sensitivity analyses.

The above results highlight the role of expectations in the transmission of tighter global monetary conditions to emerging economies and have important policy implications for emerging economies and source economies alike. They suggest that policy makers in emerging economies should stand ready to withstand potential disruptions that may be brought about by a shift in monetary policy stance in source economies, especially after a prolonged period of accommodation. Given that most of the impact of tightening would occur at the early stage of the tightening cycle (as suggested by our empirical analysis), emphasis should be put on strengthening macroeconomic fundamentals early on. In source countries, managing expectations, for instance through a well-articulated forward guidance and enhanced monetary policy communication, would prevent a bumpy exit from unconventional monetary policy and limit the spillovers to the rest of the world.

Although the above findings provide some insights on the spillovers from U.S. monetary policy normalization on EMs, this time might be different for a number of reasons. First, the beginning of a tightening episode is only well identified ex-post—it is for instance not clear yet whether the Fed tapering of asset purchases marks the beginning of a tightening cycle or not. Second, the Zero Lower Bound (ZLB) on the nominal interest rate was binding during none of the episodes covered in our estimations, unlike today, a concern that we partly mitigated by controlling for the level of the short-term rate.

Relatedly, although historical data provides estimates of the average impact of US monetary tightening (supposedly in normal times), the exit from unconventional monetary policy would occur in an environment of unprecedented leveraging and excess lending, limiting the information content of historical data. Finally, although the analysis of sovereign debt crises focuses on the (average) incidence across emerging economies, countries with different economic fundamentals would face varying risk of fiscal stress following an abrupt shift in U.S. monetary policy. Investors are indeed likely to discriminate more along countries macroeconomic fundamentals at times of tighter liquidity conditions and high global risk aversion.

APPENDIX TABLES

Table A1: Country groups

Asia	Latin America	Europe	Middle East
China	Argentina	Bulgaria	Egypt
India	Brazil	Hungary	Jordan
Indonesia	Chile	Latvia	Kazakhstan
Malaysia	Colombia	Lithuania	Morocco
Philippines	Mexico	Poland	Pakistan
Thailand	Peru	Romania	Saudi Arabia
		Russia	
		Turkey	
		Ukraine	

Table A2: CBOE Volatility Index

Year	VIX
1990	19.10
1991	21.05
1992	19.75
1993	14.08
1994	14.26
1995	14.22
1996	16.49
1997	19.32
1998	19.14
1999	24.08
2000	24.31
2001	24.12
2002	20.04
2003	31.08
2004	14.48
2005	12.26
2006	12.66
2007	15.24
2008	27.49
2009	49.33
2010	17.42
2011	20.66
2012	19.07
2013	13.06
2014	14.11

Statistics	
Percentiles	
1%	12.3
5%	12.7
10%	13.1
25%	14.3
50%	19.1
75%	21.1
90%	27.5
95%	31.1
99%	49.3
Obs	775
Smallest	12.3
Largest	49.3
Mean	19.9
Std. Dev.	7.7

Source: CBOE, own calculations

Table A3. Data Sources

Data	Source
EM macroeconomic and fiscal data	April 2014 *Fiscal Monitor*
U.S. nominal GDP	Bureau of Economic Analysis (BEA)
U.S. GDP deflator	BEA
U.S. 10-year government bond yield	Federal Reserve Board
Fed funds rate	Federal Reserve Board
EMBIG yield to maturity	JPMorgan
Domestic bond yields	Bloomberg
CBOE Volatility Index	Chicago Board Exchange (CBOE)
Degree of openness (= (imports+exports)/GDP)	April 2014 *Fiscal Monitor*
Exchange rate arrangement	Ilzetzki (year), Reinhart and Rogoff (year) dataset
Financial openness	Chinn and Ito dataset
Non-resident debt	Joint External Debt Hub (JEDH)
Foreign public sector debt	IMF data
Non-resident holdings of domestic public debt	IMF data
Real effective exchange rate	International Financial Statistics (IFS)
International reserves (foreign reserves)	IFS
Domestic credit to private sector (% of GDP)	World Development Indicators (WDI)
Market capitalization of listed companies	WDI
External debt stocks, total (DOD)	WDI
Sovereign debt crises	Reinhart and Rogoff (2011)

REFERENCES

Adrian, T., and A. Estrella, 2008, "Monetary Tightening Cycles and the Predictability of Economic Activity," *Economics Letters*, *Vol.* 99, pp. 260–64.

Akitoby, B., and T. Stratmann, 2006, "Fiscal Policy and Financial Markets," IMF Working Paper 06/16 (Washington: International Monetary Fund).

Baldacci, E., and M. Kumar, 2010, "Fiscal Deficits, Public Debt, and Sovereign Bond Yields," IMF Working Paper 10/184 (Washington: International Monetary Fund).

Baldacci, E., I. Petrova, N. Belhocine, G. Dobrescu, and S. Mazraani, 2011, "Assessing Fiscal Stress," IMF Working Paper 11/100 (Washington: International Monetary Fund).

Calvo, G., 1998, "Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops," *Journal of Applied Economics*, Vol. 0, pp. 35–54.

Cruces, J., and C. Trebesch, 2013, "Sovereign Defaults: The Price of Haircuts," *American Economic Journal: Macroeconomics*, Vol. 5, No. 3, pp. 85–117.

Eichengreen, B., and A.K., Rose, 1998, "Staying a Float When the Wind Shifts: External Factors and Emerging-Market Banking Crises," NBER Working Paper No. 6310 (Cambridge: National Bureau for Economic Research).

———, 1998, "Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises," CEPR Discussion Papers No. 1828 (Washington: Center for Economic and Policy Research).

Eichengreen, B., and A. Mody, 2000, "What Explains Changing Spreads on Emerging Market Debt?" NBER Chapters, in *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies* (Cambridge: National Bureau for Economic Research).

Eichengreen, B., and P. Gupta, 2014, "Tapering talk: the impact of expectations of reduced federal reserve security purchases on emerging markets," Policy Research Working Paper Series No. 6754 (Washington: World Bank).

Felices, G., C. Grisse, and J. Yang, 2009, "International Financial Transmission: Emerging and Mature Markets," Bank of England Working Paper No. 373 (London: Bank of England).

Fratzscher, M., M. Lo Duca, and R. Straub, 2013, "On the international spillovers of U.S. quantitative easing," ECB Working Paper Series No. 1557 (Frankfurt: European Central Bank).

Hartelius, K., K. Kashiwase, and L. Kodres, 2008, "Emerging Market Spread Compression: Is it Real or is it Liquidity?" IMF Working Paper 08/10 (Washington: International Monetary Fund).

International Monetary Fund (IMF), 2014a, *Fiscal Monitor—Public Expenditure Reform: Making Difficult Choices*, IMF World Economic and Financial Surveys, April.

———, 2014b, "IMF Multilateral Policy Issues Report 2014—Spillover Report," IMF Policy Paper, July (Washington).

———, 2014c, "Emerging Market Volatility: Lessons from the Taper Tantrum," IMF Staff Discussion Note 14/09, September (Washington).

———, 2014d, *Global Financial Stability Report*, IMF World Economic and Financial Surveys, October (Washington).

Jaramillo, L., and A. Weber, 2013, "Bond Yields in Emerging Economies: It Matters What State You Are In," *Emerging Markets Review*, Vol. 17, (C), pp. 169–85.

Kamin, S., and K. von Kleist, 1999, "The Evolution and Determinants of Emerging Market Credit Spreads in the 1990s," International Finance Working Paper No. 653 (Washington: U.S. Federal Reserve).

Laeven, L., and F. Valencia, 2012, "Systemic Banking Crises Database: An Update," IMF Working Paper 12/163 (Washington: International Monetary Fund).

Lizarazo, S., 2010, "Default Risk and Risk Averse International Investors," MPRA Paper No. 20794 (Munich: Munich Personal RePEc Archive).

Miyajima, K., M. Madhusudan, and T. Chan, 2012, "Emerging Market Local Currency Bonds: Diversification and Stability," BIS Working Papers No. 391 (Basel: Bank for International Settlements).

Neumeyer, P. A., and F. Perri, 2005, "Business Cycles in Emerging Economies: the Role of Interest rates," *Journal of Monetary Economics*, Vol. 52, No. 2, pp. 345–80.

Peiris, S., 2010, "Foreign Participation in Emerging Markets' Local Currency Bond Markets," IMF Working Paper 10/88 (Washington: International Monetary Fund).

Reinhart, C., and K. Rogoff, 2011, "From Financial Crash to Debt Crisis," *American Economic Review*, Vol. 101, pp. 1676–706.

Romer, C.D., and D.H. Romer, 1989, "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz," *NBER Macroeconomics Annual,* Vol. 4, pp. 121–70.

Rothenberg, A., and F. Warnock, 2011, "Sudden Flight and True Sudden Stops," *Review of International Economics*, Vol. 19, pp. 509–24.

Uribe, M., and V. Yue, 2006, "Country Spreads and Emerging Countries: Who Drives Whom?" *Journal of International Economics*, Vol. 69, No. 1, pp. 6–36.

Veldkamp, L., 2006, "Information Markets and the Comovement of Asset Prices," *Review of Economic Studies*, Vol. 73, No. 3, pp. 823–45.