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LOCAL CURRENCY RISK

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Local currency systemic risk *

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Abstract

Emerging country governments increasingly issue local currency denominated bonds and foreign investors have been increasing their holdings of these assets. By issuing debt denominated in local currency, emerging country governments eliminate exchange rate risk. The growing stock of local currency government debt in the financial portfolios of foreign investors increases their diversification and exposure to fast growing economies. In this paper, we highlight some of the risks associated to this recent trend. First, we adopt the $CoVaR$ risk-measure to estimate the vulnerability of individual countries to systemic risk in the market for local currency government debt. Second, we show that our country-level estimates of vulnerability are higher the larger the share of local currency debt held by foreign investors. A version of the old adage "When New York sneezes, London catches a cold," used to describe the relationship between the stock markets in these two cities, still applies between individual emerging countries and the aggregate market for local currency government debt.

Keywords: CoVaR, emerging markets, local currency debt, contagion, systemic risk
JEL Classification: C58, F21, F34, G11, G15, G32

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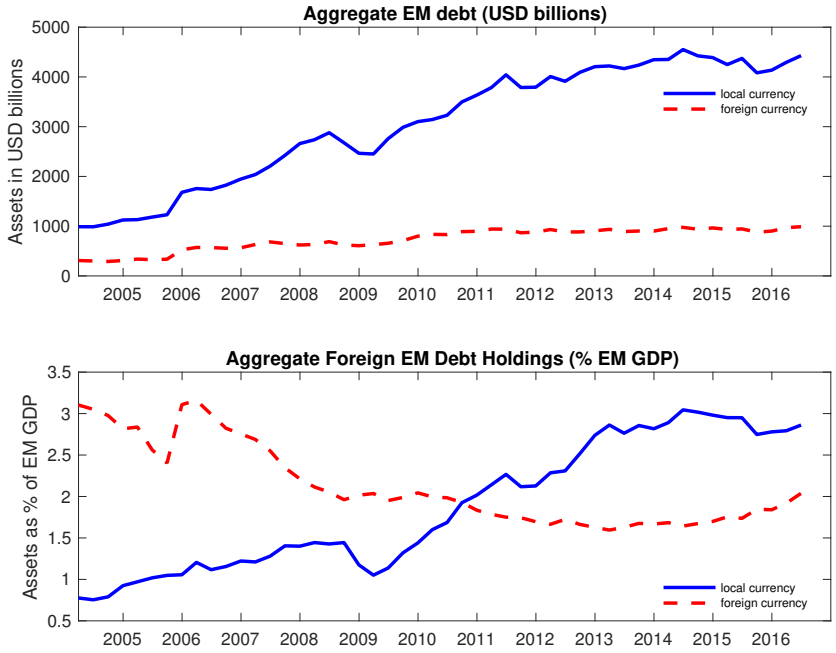
1 Introduction

Emerging countries increasingly issue government bonds denominated in local currency and foreign investors share of this market has been progressively growing. By issuing debt in local currency, emerging country governments can eliminate exchange rate risk which, instead, is typical of debt denominated in foreign currency (for example, Eichengreen et al. (2003) and Margolin (2007)). By investing in local currency denominated bonds, foreign investors can increase the diversification of their financial portfolios and gain exposure to fast growing economies. In this paper, we highlight some of the risks associated to this recent trend. In fact, we show that individual country vulnerability to systemic risk in the market for local currency government debt increases with the share held by foreign investors. In some sense, a version of the old adage "When New York sneezes, London catches a cold", used to describe the stock markets in these two cities, still applies between individual emerging countries and the overall market for local currency government debt.

The stock of debt, issued by emerging country governments and denominated in local currency, expressed in U.S. dollars, increased by a factor of 4 since 2002 and it is currently worth over 4 trillions of U.S. dollars. Over the same period, the stock of debt denominated in foreign currency was never above the 1 U.S. dollar trillion mark (see figure 1). The growing stock of debt denominated in local currency shows that emerging countries are breaking free from the so called "original sin" (i.e, the difficulty emerging country governments face when attempting to borrow abroad in their own currencies). Foreign investors are also progressively becoming more relevant players in the market for local currency debt. In the bottom panel of the figure 1, we report the foreign holdings of aggregate debt issued by emerging country governments, as a percentage of emerging countries GDP. While the foreign holdings of debt in local currency have been progressively increasing, reaching approximately 3 percent of emerging countries GDP in 2016, the holdings of debt denominated in foreign currency have been declining and were approximately 2 percent in 2016. The increased share of local currency debt held by foreigners is a potential source of transmission of shocks both globally, and across different emerging markets. For example, Kaminsky et al. (2004) show that active trading strategies of equity mutual fund investors, like momentum strategies, spread contagion across emerging markets. Beirne et al. (2013) find volatility spillovers from mature to emerging stock markets. Borri and Verdelhan (2011) find that global factors explain a large share of the variability of returns on foreign currency denominated emerging countries government bonds. To the best of our knowledge, this is the first paper that studies the risk of contagion in the market for emerging countries' local currency government debt.

We estimate the vulnerability to systemic risk in the market for local currency debt with

Figure 1: Aggregate Emerging Countries Government Debt



Notes: The top panel of this figure reports aggregate emerging countries government debt in U.S. billions. The blue line is debt denominated in local currency. The dashed red line debt denominated in foreign currency. Local currency debt is converted in U.S. dollars using the market exchange rate. The bottom panel of this figure reports the aggregate foreign investors holdings of emerging countries government debt denominated in local currency (blue line) and foreign currency (dashed red line). The aggregate holdings are reported as share of aggregate emerging countries government GDP. Data are from Arslanalp and Tsuda (2014) for the period 2002:Q1–2016:Q2 at quarterly frequency.

the reduced-form risk-measure $CoVaR$, first proposed by Adrian and Brunnermeier (2016)[1]. Systemic risk measures the increase in tail comovement that can arise due to the spreading of distress across different financial markets. $CoVaR$ is a measure of risk conditional upon an adverse shock, where risk is the standard value-at-risk (VaR). The VaR measures risk in terms of returns at a given probability: for example, a VaR of -10% at the 1% confidence level indicates that there is a probability of 1% of a return that is lower or equal to -10 percent. Adrian and Brunnermeier use CoVaR to estimate the systemic risk of financial institutions using a combination of market and balance sheet data. Fong and Wong (2012) adopt a similar approach to estimate bi-lateral systemic risk in the Eurozone using sovereign CDS data. In this paper, we find that emerging countries differ substantially in terms of their vulnerability to systemic risk in the local currency government debt market. In addition, countries with a larger share of local currency debt held by foreign investors are

[1]There exist several alternative measures of systemic risk. Many of them rely on CDS data. For example, Acharya et al. (2012) focus on high-frequency marginal expected shortfall; Acharya et al. (2017) and Brownlees and Engle (2016) develop SRISK, which measures capital shortfall conditional on market stress; Billio et al. (2012) builds a risk-measure based on Granger causality across institutions.

more vulnerable suggesting that increasing integration of capital markets could exacerbate the risk of contagion across emerging countries. These results have important implications for governments and financial institutions both in terms of optimal currency denomination of debt and risk management, and in terms of provisions to curb the volatility of foreign investors portfolio allocations. In addition, these results are valuable for foreign investors to correctly measure the risk and diversification of their financial portfolios, as also argued by Das and Uppal (2004) for international equity portfolios.

This paper contributes to two strands of the literature. The first studies contagion in emerging markets. Contagion is usually defined as correlation between markets in excess of what would be implied by economic fundamentals (Bekaert and Harvey, 2003a). Most of the research in this strand of the literature has focused on equity markets, and on large financial and economic crises, like the 1994 Mexican and the 1997 Asian crises. Calvo and Reinhart (1996) find evidence of increased comovement across world equity and Brady bonds during the Mexican crisis and argue that contagion is more regional than global. Calvo and Mendoza (2000) is a classic model in which globalization may promote contagion by weakening incentives for gathering costly information. Edwards and Susmel (2001) find strong evidence of stock market volatility co-movements across countries. Forbes and Rigobon (2002) argue that it is important to correctly account for heteroskedasticy when measuring contagion with correlation coefficients and find, on one hand, little evidence of contagion during major financial crises, and, on the other, a high level of market comovements in normal times. Bekaert and Harvey (2003b) estimate contagion as correlation across residuals of a two-factor model with time-varying betas applied to stock returns in three different regions – Europe, South-East Asia, and Latin America – and find no evidence of contagion from the Mexican crisis, but find evidence of contagion during the Asian crisis. Tai (2007) finds that Asian emerging stock markets become integrated into world capital markets since their official liberalization, and that there is evidence of contagion from stock to foreign exchange markets during the Asian crisis. Dell'Ariccia et al. (2016) study systemic risk for firms in emerging markets that borrow in foreign currency and that have, typically, income in local currency and argue for regulatory measures to limit currency mismatches. The second strand of the literature studies the growing market for local currency sovereign and corporate debt in emerging countries. Peiris (2010) finds that higher foreign participation reduces long-term local currency government bond yields and volatility in a group of 10 emerging countries for the period 2000–2009. Miyajima et al. (2015) argue that local factors, rather than global factors, are the main drivers of local currency bond yields. Du and Schreger (2016) construct a measure of local currency credit spread as the yield difference between the rate on local currency bonds and a synthetic local currency risk-free rate computed using cross-currency

swaps. The authors find that the local currency spread is positive, and sizable and, contrary to foreign currency credit spreads, depend more on domestic, than global, conditions and have lower means and cross-country correlations. Hale et al. (2016) look at individual private, rather than sovereign, bonds issued in local currency. Borri and Shakhnov (2017) build a model with two partially segmented markets for local and foreign currency denominated government debt and show that the larger the share of foreign investors the higher the degree of integration across the two markets and globally.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 introduces our conditional measure of vulnerability to systematic risk. Section 4 presents the results of our estimations. Section 5 concludes.

2 Data

We collect daily frequency total return indices of local currency debt issued by emerging governments from J.P. Morgan through Datastream. In particular, we use the J.P. Morgan GBI-EM indices for local currency denominated debt. The JPM GBI-EM indices track local currency bonds issued by emerging market governments. The countries in our sample are Argentina, Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Perù, Philippines, Poland, Romania, Russia, South Africa, and Turkey. The longest sample is 31/12/2002–30/6/2016, but the size of the cross-section progressively increases as more countries enter the indices. In particular, there are 7 countries at the beginning of the sample and 17 at the end. Bonds included in the J.P. Morgan GBI-EM indices had an average maturity of 5 years at the end of 2015. We build daily and weekly returns as log differences in the total return price indices. J.P. Morgan also publishes two additional families of emerging market bond indices. The classic EMBI indices, formed in the early 1990s after the issuance of the first Brady bonds, collect foreign currency denominated debt (mostly U.S. dollar denominated). The ELMI+ indices also collect local currency debt, but for the money market and therefore have a very short duration (on average, 0.15 years). Note that J.P. Morgan includes in the indices individual bonds that meet specified criteria in terms of liquidity and reliability of market prices. For the countries in the sample, we additionally collect exchange rate data with respect to the U.S. dollar from Reuters and Barclays through Datastream (exchange rates are in units of foreign currency per U.S. dollar). We also collect daily frequency total return indices on the S&P500 Composite, the CBOE VIX, the Bank of America Merrill Lynch US Corporate Bond Index, and the Bloomberg Commodity Index from Datastream. Finally, we collect quarterly data on the shares of local currency and total government debt held by foreigners, nominal GDP, and shares of local currency and total government debt

over GDP from Arslanalp and Tsuda (2014) for the period 2002:Q1–2016:Q2; annual values of the KAOPEN index by Chinn and Ito (2006) measuring a country's degree of capital account openness; sovereign credit ratings on local currency debt from Standard & Poor's[2]. Standard & Poor's assigns letter credit ratings on local currency government debt (i.e., AAA corresponds to the highest credit worthiness, and SD to selective default). We convert the letter ratings in a numerical ordering, with a lower number corresponding to a higher credit worthiness.

We report in tables 1 and 2 descriptive statistics on the data. In panel A and C of table 1 we report mean, standard deviation, skeweness, minimum and maximum values for the log returns on the local currency bond indices and the state variables used in the estimation of $\Delta CoVaR$ of section 4. The mean daily returns in local currency are all positive and range from 0.011% for Chile to 0.051% percent for Turkey. Also volatilities differ substantially across countries: for example, in the period 31/12/2002–30/6/2016, Argentina registered a minimum daily return of -14% and a maximum daily return of 10%. Brazil, Indonesia and Russia also experienced large swings in the prices of their local currency government debt. Foreign investors buying bonds denominated in local currency also face exchange rate risk. In panel B we report the mean and standard deviation of the daily log changes in the exchange rates with respect to the U.S. dollar. For most countries, the mean exchange rate growth is positive indicating a depreciation of the local currency with respect to the U.S. dollar. Therefore, from the perspective of foreign investors, the investment in local currency bonds suffered a capital loss once converted back into dollars. In table 2 we report descriptive statistics on the shares of local currency, and total, government debt held by foreigners, and on the local currency and total government debt over GDP. On average, foreign investors held 15 percent of emerging countries government debt denominated in local currency, and 30 percent of the total (i.e., local and foreign currency denominated). However, there exist both large differences across countries, and over time within a country. Foreign investors held only a small fraction of the local currency denominated debt issued by China and India (0.7% and 1.4% on average, respectively). On the contrary, foreign investors held a large fraction of local currency debt issued by countries like Hungary (average 30.2%, maximum 43.6%), Perù (average 32.0%, maximum 56.6%), Argentina (average 10.6%, maximum 40.3%), or Indonesia (average 22.8%, maximum 39.6%). Most of the government debt of emerging country governments is denominated in local currency. On average, government debt in local currency was about 22 percent of GDP, while the total debt (i.e., local and foreign

[2]The Chinn-Ito KAOPEN index is a number in between zero and one and it is equal to 1 for the U.S. For additional details on the data you can refer to the separate online appendix to this paper and to Arslanalp and Tsuda (2014) and Chinn and Ito (2006).

Table 1: Descriptive Statistics: financial data

	Panel A: local currency returns					Panel B: exchange rates	
	mean (%)	std.dev (%)	skew	min (%)	max (%)	mean (%)	std.dev (%)
Argentina	0.027	1.183	-1.185	-14.063	10.213	0.042	0.943
Brazil	0.048	0.316	-8.546	-9.626	2.174	-0.003	0.924
Chile	0.011	0.124	-0.127	-0.799	0.987	-0.002	0.620
China	0.015	0.213	-1.865	-3.968	3.434	-0.006	0.108
Colombia	0.038	0.292	-0.798	-2.927	2.355	0.001	0.700
Hungary	0.030	0.407	-0.983	-5.218	3.737	0.007	0.984
India	0.026	0.304	-0.756	-4.804	3.719	0.010	0.426
Indonesia	0.048	0.692	-1.007	-11.121	8.912	0.011	0.486
Malaysia	0.015	0.142	-0.558	-1.426	1.322	0.001	0.394
Mexico	0.034	0.325	0.518	-2.563	4.061	0.016	0.717
Peru	0.027	0.423	1.973	-3.209	7.012	-0.002	0.295
Philippines	0.027	0.433	-0.814	-3.806	2.577	-0.004	0.331
Poland	0.023	0.195	-0.841	-2.458	1.348	0.001	0.913
Romania	0.027	0.145	-0.737	-0.746	0.565	0.005	0.786
Russia	0.030	0.539	-2.007	-10.369	8.320	0.020	0.851
South Africa	0.034	0.399	-1.331	-6.516	2.819	0.015	1.079
Turkey	0.051	0.372	-0.496	-3.196	2.591	0.016	0.825
Mean	0.030	0.372	-1.151	-5.107	3.891	0.008	0.825
	Panel C: state variables						
S&P 500	0.032	1.186	-0.318	-9.460	10.958		
CBOE VIX	-0.016	6.725	0.729	-35.059	49.601		
U.S. Corporate	0.016	0.648	-0.546	-5.674	4.100		
Commodities	-0.002	1.085	-0.230	-6.401	5.650		

Notes: This table reports descriptive statistics on the financial data described in section 2. Panel A reports mean, standard deviation, skewness, minimum and maximum for the log returns on local currency government bond indices. Panel B reports mean and standard deviations for the log changes in exchange rate with respect to the U.S. dollar (exchange rates are expressed in units of local currency per U.S. dollar). Panel C reports mean, standard deviation, skewness, minimum and maximum for the log returns on the state variables used in the conditional estimation of $CoVaR$ described in section 4. The sample is 31/12/2002–30/6/2016. Data are from Datastream at daily frequency.

currency denominated) was only a bit larger and approximately equal to 30 percent.

3 Model

In this paper we follow Adrian and Brunnermeier (2016) and estimate $\Delta CoVaR$ with quantile regressions (Koenker and Bassett Jr, 1978; Koenker, 2005). This is not the only possible estimation technique. For example, $\Delta CoVaR$ can also be estimated with generalized autoregressive heteroskedasticy (GARCH) models. We leave the interested reader to the detailed

discussion in Adrian and Brunnermeier (2016) for further details and proofs. We denote with r^i the log returns on the local currency bond index of country i, and with

$$r^m = \sum_{j=1}^{N} \omega_j r^j$$

the log returns on the (value-weighted) aggregate market for local currency debt issued by emerging countries, where ω_j are weights that sum up to 1. Define with VaR_q^m the maximum market return at a confidence level of $1-q$

$$Pr(r^m \leq VaR_q^m) = q. \tag{1}$$

Intuitively, VaR^m (i.e., the value-at-risk) corresponds to the maximum return in a bad state of the world, i.e., in a situation of aggregate distress for emerging countries. We define $CoVaR_q^{i|m}$ as the VaR of country i conditional upon the aggregate market m being in a state of distress (i.e., being at VaR_q^m)

$$Pr(r^i \leq CoVaR_q^{i|m} \mid r^m = VaR_q^m) = q \tag{2}$$

In order to estimate the conditional risk we use the following quantile regression

$$r_{t+1}^i = \beta_{0,q}^{i|m} + \beta_{1,q}^{i|m} r_{t+1}^m + \sum_{k=1}^{K} \gamma_{k,q}^{i|m} r_t^k + \epsilon_{t+1}^{i|m}, \tag{3}$$

where r^k are the lagged returns on a set of common factors that we use as conditioning variables[3]. The coefficient $\beta_{1,q}^{i|m}$ measures how vulnerable country i is with respect to a state of distress of the aggregate market for local currency government debt issued by emerging countries. $CoVaR$ is then obtained as fitted value of the quantile regression (3)

$$CoVaR_q^{i|r^m=VaR_q^m} = \beta_{0,q}^{i|m} + \beta_{1,q}^{i|m} VaR_q^m + \sum_{k=1}^{K} \gamma_{k,q}^{i|m} \tilde{r}^k, \tag{4}$$

where the values of the common factors $\tilde{r}^k$ in (4) are those on the date when VaR_q^m is observed. We measure the vulnerability of country i to systemic risk in the local currency government debt market with $\Delta CoVaR_q^{i|m}$

$$\Delta CoVaR_q^{i|m} = CoVaR_q^{i|r^m=VaR_q^m} - CoVaR_q^{i|r^m=VaR_{0.5}^m}. \tag{5}$$

[3]In the estimation of the quantile regression (3) for country i, we exclude country's i returns from the computation of the aggregate market return r^m. In the empirical estimation, the weight ω_j corresponds to the relative GDP of country j.

$\Delta CoVaR$ measures the difference between the $CoVaR$ of country i conditional on a state of aggregate distress in the market and the $CoVaR$ of country i conditional on the *median* state of the market (i.e., $q = 0.5\%$). Therefore, the lager the $\Delta CoVaR$, the higher the vulnerability of country i to systemic risk in the market for local currency government debt. Note that we use $\Delta CoVaR$ as a measure of vulnerability of individual countries. On the contrary, Adrian and Brunnermeier (2016) use $\Delta CoVaR$ to measure the systemic risk of individual financial institutions, i.e., the vulnerability of the entire financial market with respect to a state of distress of a single financial institution.

4 Estimation Results

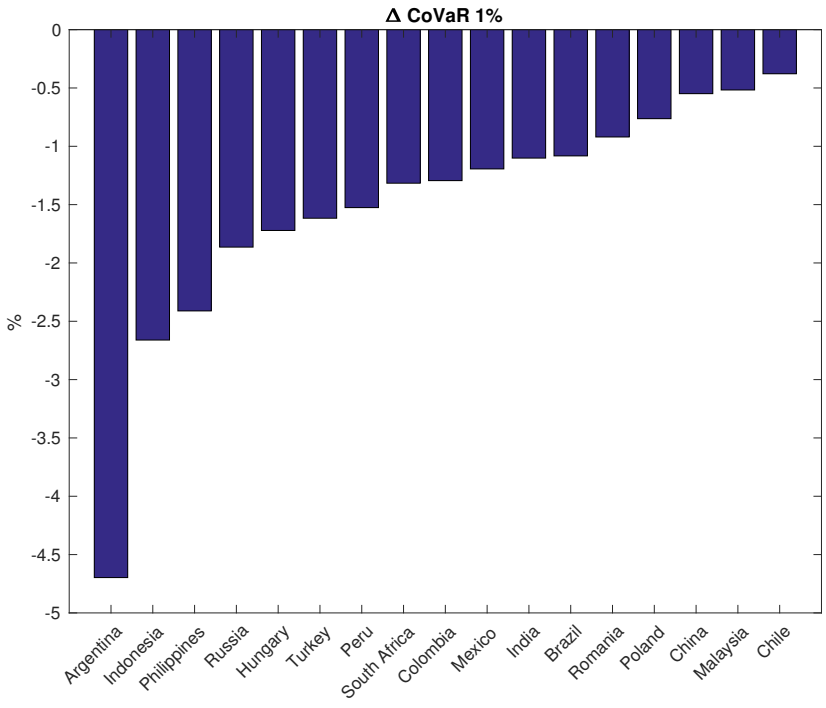
We start by estimating the conditional $\Delta CoVaR^i_{q,t}$ for country $i = 1, \ldots$ and confidence level $1 - q$ over the full sample period 31/12/2002–30/06/2016 on daily frequency data[4]. Considering a long sample is important as we are trying to estimate conditional tail events which, by definition, occur rarely. As in Adrian and Brunnermeier (2016), we include in the estimation state variables that capture time variation in the conditional moments of asset returns. Including the state variables is important to disentangle the vulnerability of each country with respect to the aggregate market for local currency government debt from the more general vulnerability with respect to global factors. The set of state variables includes: the returns on the US market, proxied by the S&P500; the log changes in the CBOE VIX; the returns on a broad US corporate bond index, and the returns on a broad index for the commodity market. Note that the state variables are not aggregate risk factors (in fact, they are lagged), but rather variables that condition the mean and the volatility of the $\Delta CoVaR^i_{q,t}$. The returns on the aggregate market for local currency government debt are a GDP-weighted average of the individual countries local currency returns[5]. Note that in the estimation of the $\Delta CoVaR^i_{q,t}$ for country i, we exclude country i from the set of countries used to form the aggregate market returns r^m. We set the confidence level $1 - q$ to 1%. Figure 2 plots the estimates of the conditional daily $\Delta CoVaR_q$. Argentina is by

[4]We focus on returns in local currency. In the appendix, we show that our results extend to returns on local currency bonds converted in U.S. dollars. Brusa et al. (2014) show evidence that foreign investors are compensated for bearing currency risk when investing in local equity markets. For most countries, the share of local currency government debt held by foreigners is small so that currency premia are likely to be less relevant. Borri and Shakhnov (2017) consider a model with partially segmented markets for local and foreign currency denominated government debt. We leave for future research the exploration of additional systemic risk transmission channels in the market for local currency government debt operating through changes in the exchange rate.

[5]An alternative is to weigh returns by the relative stock of local currency government debt, or by the relative stock of local currency returns held by foreign investors. Results with these alternative weights are similar to those obtained by GDP-weighting.

far the most vulnerable country, with a $\Delta CoVaR_q$ of about -4.5%. This means that, in a situation of particular distress in the market for local currency government debt, we should expect a maximum return, at the 1 percent confidence level, on local currency Argentinian bonds, of -4.5%, after controlling for global state variables. Indonesia, the Philippines and Russia have all $\Delta CoVaR$ of approximately -2%. Malaysia, China, Chile and Poland are the less vulnerable countries, all with daily $\Delta CoVaR$ larger than -1%. In table 3 we report our estimates for the conditional and unconditional $\Delta CoVaR$ over the full sample. We also report bootstrap standard errors that show that our estimates are generally highly significant. For most countries, the conditional and unconditional point estimates are very close suggesting that conditional factors are not particularly influential.

Figure 2: $\Delta CoVaR$ 1% (conditional)



Notes: In this figure we report the estimates for the weekly $\Delta CoVaR_q$ at the confidence level $1-q=1\%$ for all the countries in the sample. Countries are sorted, from left to right, in order of smaller $\Delta CoVaR$. The sample period is 31/12/2002–30/06/2016, or the longest available for countries included in the J.P Morgan GBI-EM index after the beginning of our sample. The conditional $\Delta CoVaR$ is estimated using as state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. Data are from Datastream.

We next study the determinants of $\Delta CoVaR^i_{q,t}$ and in particular its possible relation with the share of local currency debt held by foreign investors. The assumption we test is whether countries with a larger share of local currency government debt held by foreign investors are more vulnerable, for example because of their exposure to changes in investors' views and

portfolio allocations (for example, Aggarwal et al. (1999); Chari and Kehoe (2003)). First, we repeat the estimation of the $\Delta CoVaR^i_{q,t}$ over non-overlapping quarters over the sample 2003:Q1–2016:Q3, using daily frequency data. Therefore, we obtain end-of-quarter-day estimates for the conditional $\Delta CoVaR^i_{q,t}$, where we use the values of the state variables on the dates when the VaR^m_q are observed[6]. Second, we estimate a panel where the dependent variables are the $\Delta CoVaR^i_{q,t}$ (with $1-q = 1\%$). Results are reported in table 4, where each column corresponds to a different specification of the estimation equation, and standard errors are always robust and clustered at the country level, in order to account for possible auto-correlation and heteroskedasticy of the residuals. We start with a simple OLS specification, with no fixed effects and where the only explanatory variables are the foreign holdings of local currency government debt. The estimated coefficient is negative and statically significant at the 10 percent level. Note that the coefficient is also significant from an economic point of view: in fact, a 1 percentage point increase in the share of local currency debt held by foreigners is associated with a decrease in the daily $\Delta CoVaR^i_{q,t}$ by approximately 2 percentage points, i.e., with an economically significant increase in the loss conditional on a situation of distress in the market for local currency government debt. In the second and third columns we add, first, time fixed effect to control for common factors across countries that change over time, and, second, country fixed effect to account for county-level characteristics that are constant over the sample (for example, reputation, or quality of the institutions). Including the fixed effects increases the size (in absolute value) of the coefficient attached to the share of local currency debt held by foreigners which is now equal to approximately -6 percent. In columns 4 to 7 we experiment adding additional explanatory variables. We start by including the log of the GDP (to proxy for the size of the economies), the ratios between total and local currency debt and GDP, and the foreign holdings of total government debt. While these coefficients are not statistically significant, our estimate for the impact of the share of local currency government debt held by foreign investors does not change and remains significant (now at the 5 percent confidence level). We then include the Chinn-Ito KAOPEN index, measuring a country's degree of capital account openness. A higher index number corresponds to a more open and integrated economy. However, also for this additional variable, the estimated coefficient is not statistically significant. In column 6 we include country credit ratings on sovereign debt denominated in local currency by Standard&Poor's. Credit ratings are supposed to capture the risk of default of an issuer, but are

[6]Estimating $\Delta CoVaR^i_{q,t}$ over non-overlapping quarters, rather than over the full sample, is problematic as the likelihood of observing a tail event is small. However, this choice gives us the possibility of relating our estimates to the quarterly data on foreign holdings of local currency government debt. In the online appendix, we show that our results are robust to different windows of estimation and confidence levels, and on using weekly rather than daily returns.

updated infrequently and, therefore, are not suited to explain a high frequency measure of risk. In fact, according to our results, the coefficient on the credit ratings is not statistically significant. In column 7 we include the quarterly growth rate in the exchange rates with respect to the U.S. dollar (an increase in the exchange rate implies a depreciation of the local currency). The coefficient is negative and statistically significant, and approximately equal to -3%. Also for this general specification, the coefficient attached to the foreign holdings of local currency government debt is significant and approximately equal to -5%, while all the remaining explanatory variables are not significantly different from zero. In the appendix to this paper we perform a battery of robustness checks: different confidence levels; weekly in place of daily returns; local currency returns converted in U.S. dollars; and equally weighted aggregate market returns. In all cases, results confirm those of our baseline specification.

5 Conclusions

Emerging countries increasingly issue government bonds denominated in local currency and foreign investors share of this market has been progressively growing. By issuing debt in local currency, emerging country governments can eliminate exchange rate risk which, instead, is typical of debt denominated in foreign currency. By investing in local currency denominated debt, foreign investors can increase the diversification of their financial portfolios and gain exposure to fast growing economies. However, foreign investors could act as a channel of transmission of shocks, globally and across emerging markets. In this paper we focus on the latter possibility, and find that the share of local currency debt held by foreign investors positively affects the vulnerability of individual countries to systemic risk in the market for local currency government dent. These results have interesting implications for governments and financial institutions both in terms of optimal currency denomination of debt and risk management, and in terms of provisions to curb the volatility of foreign investors portfolio allocations. In addition, these results are important for foreign investors in correctly measuring the risk of their financial portfolios. We leave for future research an in-depth analysis of the policy implications of these results.

References

Acharya, V., R. Engle, and M. Richardson (2012): "Capital shortfall: A new approach to ranking and regulating systemic risks," *The American Economic Review*, 102, 59–64.

Acharya, V. V., L. H. Pedersen, T. Philippon, and M. Richardson (2017): "Measuring systemic risk," *Review of Financial Studies*, 30, 2–47.

Adrian, T. and M. K. Brunnermeier (2016): "CoVaR," *The American Economic Review*, 106, 1705–1741.

Aggarwal, R., C. Inclan, and R. Leal (1999): "Volatility in emerging stock markets," *Journal of Financial and Quantitative Analysis*, 34, 33–55.

Arslanalp, S. and T. Tsuda (2014): "Tracking global demand for advanced economy sovereign debt," *IMF Economic Review*, 62, 430–464.

Beirne, J., G. M. Caporale, M. Schulze-Ghattas, and N. Spagnolo (2013): "Volatility spillovers and contagion from mature to emerging stock markets," *Review of International Economics*, 21, 1060–1075.

Bekaert, G. and C. R. Harvey (2003a): "Emerging markets finance," *Journal of Empirical Finance*, 10, 3–55.

——— (2003b): "Market integration and contagion," Tech. rep., National Bureau of Economic Research.

Billio, M., M. Getmansky, A. W. Lo, and L. Pelizzon (2012): "Econometric measures of connectedness and systemic risk in the finance and insurance sectors," *Journal of Financial Economics*, 104, 535–559.

Borri, N. and K. Shakhnov (2017): "Limited arbitrage and local currency government debt," Mimeo.

Borri, N. and A. Verdelhan (2011): "Sovereign risk premia," Mimeo.

Brownlees, C. and R. F. Engle (2016): "SRISK: A conditional capital shortfall measure of systemic risk," *Review of Financial Studies*.

Brusa, F., T. Ramadorai, and A. Verdelhan (2014): "The international CAPM redux," Mimeo.

Calvo, G. A. and E. G. Mendoza (2000): "Rational contagion and the globalization of securities markets," *Journal of International Economics*, 51, 79–113.

Calvo, S. G. and C. M. Reinhart (1996): "Capital flows to Latin America: is there evidence of contagion effects?" World Bank Working Paper.

Chari, V. V. and P. J. Kehoe (2003): "Hot money," *Journal of Political Economy*, 111, 1262–1292.

Chinn, M. D. and H. Ito (2006): "What matters for financial development? Capital controls, institutions, and interactions," *Journal of development economics*, 81, 163–192.

Das, S. R. and R. Uppal (2004): "Systemic risk and international portfolio choice," *The Journal of Finance*, 59, 2809–2834.

Dell'Ariccia, G., L. Laeven, and R. Marquez (2016): "Financial frictions, foreign currency borrowing, and systemic risk," Mimeo.

Du, W. and J. Schreger (2016): "Local currency sovereign risk," *The Journal of Finance*.

Edwards, S. and R. Susmel (2001): "Volatility dependence and contagion in emerging equity markets," *Journal of Development Economics*, 66, 505–532.

Eichengreen, B., R. Hausmann, and U. Panizza (2003): "The pain of original sin," *Other people's money: Debt denomination and financial instability in emerging market economies*, 1–49.

Fong, T. P. W. and A. Y. Wong (2012): "Gauging potential sovereign risk contagion in Europe," *Economics Letters*, 115, 496–499.

Forbes, K. J. and R. Rigobon (2002): "No contagion, only interdependence: measuring stock market comovements," *The Journal of Finance*, 57, 2223–2261.

Hale, G. B., P. Jones, and M. M. Spiegel (2016): "The rise in home currency issuance," *Federal Reserve Bank of San Francisco Working Paper*, 19.

Kaminsky, G., R. K. Lyons, and S. L. Schmukler (2004): "Managers, investors, and crises: mutual fund strategies in emerging markets," *Journal of International Economics*, 64, 113–134.

Koenker, R. (2005): *Quantile regression*, 38, Cambridge university press.

Koenker, R. and G. Bassett Jr (1978): "Regression quantiles," *Econometrica: journal of the Econometric Society*, 33–50.

Margolin, D. (2007): "Financial stability and local currency bond markets," *CGFS Papers*, 28, 1–142.

Miyajima, K., M. S. Mohanty, and T. Chan (2015): "Emerging market local currency bonds: diversification and stability," *Emerging Markets Review*, 22, 126–139.

Peiris, S. J. (2010): "Foreign participation in emerging markets' local currency bond markets," *IMF Working Papers*, 1–19.

Tai, C.-S. (2007): "Market integration and contagion: Evidence from Asian emerging stock and foreign exchange markets," *Emerging Markets Review*, 8, 264–283.

Table 2: Descriptive Statistics: debt and macro data

	for. holdings local cur. debt			for. holdings total debt			local debt to GDP			total debt to GDP		
%	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Argentina	10.6	0.0	40.3	38.9	21.4	57.6	9.9	1.8	16.0	32.0	23.7	54.3
Brazil	10.9	1.0	20.3	11.6	7.9	16.3	41.8	36.6	47.1	61.3	55.2	70.1
Chile	5.2	3.1	8.9	35.5	12.9	93.8	6.3	0.5	16.7	8.2	2.6	20.3
China	0.7	0.0	3.2	1.5	0.4	4.0	14.0	12.3	17.0	16.1	14.3	19.3
Colombia	11.5	4.5	22.3	29.7	23.3	51.0	24.1	18.3	27.8	30.6	28.1	34.8
Hungary	30.2	21.0	43.6	47.6	39.5	56.0	41.6	34.7	49.4	59.7	50.4	67.9
India	1.4	0.1	4.0	1.4	0.1	4.0	31.2	27.8	35.3	31.2	27.8	35.3
Indonesia	22.8	1.6	39.6	35.3	4.6	61.6	12.1	9.2	18.9	14.6	11.6	19.6
Malaysia	25.0	12.4	37.3	28.0	14.3	37.0	40.7	32.2	50.6	42.2	33.7	50.3
Mexico	20.4	4.4	38.0	38.1	22.9	60.0	22.0	11.9	32.6	22.3	16.4	28.9
Peru	32.0	0.0	56.6	52.2	39.9	68.7	5.6	1.3	8.4	15.2	12.4	20.0
Philippines	6.0	0.0	14.6	27.5	23.3	34.7	32.2	27.7	38.9	35.3	28.3	46.9
Poland	26.7	13.3	41.9	43.3	31.8	59.0	32.3	27.8	36.2	41.5	34.7	47.2
Romania	15.9	5.4	22.4	43.5	22.2	73.9	13.7	8.2	15.8	14.6	3.5	27.5
Russia	7.3	0.1	23.1	29.0	17.9	50.3	5.1	3.4	7.2	8.5	5.8	12.6
South Africa	23.7	6.5	38.0	25.4	14.4	38.2	26.7	18.3	38.1	34.6	23.8	48.6
Turkey	14.7	5.1	24.5	25.2	13.3	37.2	28.5	22.3	34.6	36.6	28.2	53.5
Mean	15.6	4.6	28.2	30.2	18.2	47.3	22.8	17.3	28.9	29.7	23.6	38.7

Notes: This table reports mean, min and max values for the share of local currency government debt held by foreigners, the share of total government debt (i.e., local and foreign currency denominated) held by foreigners, the ratio between local currency government debt and GDP, the ratio between total government debt and GDP. The sample is 31/12/2002–30/6/2016. Data are from Arslanalp and Tsuda (2014) at quarterly frequency.

Table 3: Full sample $\Delta CoVaR$ 1%

	$\Delta CoVaR$ 1% conditional	s.e	$\Delta CoVaR$ 1% unconditional	s.e
Argentina	-4.697	2.556	-4.672	2.124
Brazil	-1.082	0.180	-1.134	0.133
Chile	-0.378	0.129	-0.235	0.082
China	-0.549	0.151	-0.586	0.075
Colombia	-1.294	0.246	-1.152	0.131
Hungary	-1.721	0.402	-1.712	0.182
India	-1.101	0.284	-0.962	0.086
Indonesia	-2.661	0.859	-2.734	0.360
Malaysia	-0.517	0.141	-0.540	0.053
Mexico	-1.194	0.188	-1.238	0.093
Peru	-1.526	0.569	-1.764	0.303
Philippines	-2.411	0.736	-2.113	0.309
Poland	-0.763	0.142	-0.742	0.065
Romania	-0.920	0.114	-0.759	0.050
Russia	-1.864	0.663	-1.774	0.255
South Africa	-1.316	0.411	-1.314	0.112
Turkey	-1.617	0.340	-1.711	0.104

Notes: In this table we report estimates for the $\Delta CoVaR_q$ with 1% confidence over the full sample 31/12/2002–30/6/2016 using daily frequency returns. The conditional $\Delta CoVaR_q$ is estimated using as lagged state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. The estimation of the unconditional $\Delta CoVaR$ does not include state variables. Standard errors are by bootstrap. All numbers are reported in percentages. Data are from Datastream

Table 4: Determinants of $\Delta CoVaR_{99\%}$

VARIABLES	(1) $\Delta CoVaR$	(2) $\Delta CoVaR$	(3) $\Delta CoVaR$	(4) $\Delta CoVaR$	(5) $\Delta CoVaR$	(6) $\Delta CoVaR$	(7) $\Delta CoVaR$
foreign holdings local cur. debt	-0.019*	-0.037**	-0.067*	-0.059**	-0.049**	-0.043*	-0.052**
	(0.010)	(0.017)	(0.033)	(0.024)	(0.021)	(0.022)	(0.021)
log GDP				0.009	0.006	0.007	0.004
				(0.005)	(0.006)	(0.005)	(0.006)
local cur. debt to GDP				-0.016	-0.001	-0.024	-0.001
				(0.057)	(0.052)	(0.062)	(0.050)
foreign holdings total debt				0.001	-0.011	-0.009	-0.011
				(0.022)	(0.025)	(0.023)	(0.024)
total debt to GDP				-0.013	-0.039	-0.019	-0.041
				(0.039)	(0.039)	(0.054)	(0.038)
Chinn-Ito Index					-0.017	-0.019	-0.017
					(0.015)	(0.015)	(0.015)
S&P rating						-0.000	
						(0.001)	
Δs							-0.033*
							(0.016)
Observations	683	683	683	683	683	519	683
R-squared			0.255	0.272	0.279	0.256	0.290
Number of countries	17	17	17	17	17	17	17
Country FE	NO	NO	YES	YES	YES	YES	YES
TIME FE	NO	YES	YES	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES	YES	YES	YES

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

Notes: In this table we report results of the panel estimation described in section 4. The dependent variables are always the $\Delta CoVaR_{99\%}$ of country i, with confidence level 1%, conditional on the value-weighted aggregate local currency government debt market being in a situation of distress (i.e., at $VaR^m_{99\%}$) and estimated using as state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. The $\Delta CoVaR$s are computed over non-overlapping quarters from 2003:Q1 to 2016:Q3. The values of the state variables are those on the dates when the $VaR^m_{99\%}$ have been observed for every quarter. The independent variables are: foreign holdings of local currency government debt; log of GDP; local currency government debt as a share of GDP; total government debt as a share of GDP; the Chinn-Ito Index; the growth rate in the exchange rate with respect to the U.S dollar; sovereign credit ratings on local currency debt. Standard errors are always robust and clustered at the country level. Data are from Datastream, Arslanalp and Tsuda (2014), Chinn and Ito (2006) and Standard&Poor's.

Appendix

A Estimation of $\Delta CoVaR_q$

In order to estimate the conditional and unconditional $\Delta CoVaR_q$ we follow the algorithm described in Fong and Wong (2012), which is itself based on the general model in Adrian and Brunnermeier (2016). We use the `quantreg` Matlab function written by Aslak Grinsted (2008) for the quantile regression estimation. When, for a country, we have missing values for the returns in local currency we follow the rule of estimating the $\Delta CoVaR_q$ only if we have at least 1/5 of the observations for a given window (i.e., full sample or quarter). For the baseline estimations, we construct returns on the aggregate market for local currency bonds as a weighted average of country-level returns, where the weights are obtained by dividing the country-GDP (converted in U.S. dollars) by the aggregate GDP of the countries in the sample (converted in U.S. dollars). By construction, the weights sum up to 1. Results are robust to using weights based on relative stock of local currency debt (converted in U.S. dollars).

B Robustness Checks

In this section we show several robustness checks with respect to the results presented in section 4. First, we start by experimenting with different confidence levels (i.e., values of q) and frequency of the data. Second, we check whether our results are robust to considering returns on local currency bonds converted in U.S. dollars, and equally weighted aggregate market.

B.I Quarterly windows, daily returns, $q = 95\%$

In table A1 we present results with a higher confidence level of 5%. Results are very similar to those of table 4. The magnitude of the coefficients attached to the share of local currency debt held by foreign investors is a bit smaller (in absolute value). The growth rate in exchange rate is not significant at standard confidence levels.

B.II Quarterly windows, U.S. dollar daily returns, $q = 99\%$

In this section, we check whether our results are robust to considering returns on local currency bonds converted in U.S. dollars. U.S. dollar returns are computed from the perspective of foreign investors who first convert dollars into local currency, then buy the local currency bond, and finally convert the proceeds back in U.S. dollars. We denote with $r_{t+1}^{i,usd}$ the U.S. dollar return on local currency bonds

$$r_{t+1}^{i,usd} = r^i t + 1 - \Delta s_{t+1}^i, \tag{A1}$$

where Δs_{t+1}^i is the log change in exchange rate for country i with respect to the U.S. dollar and $r^i t + 1$ the returns in local currency. Note that we define the exchange rate in units of local currency for one U.S. dollar. Therefore, if $\Delta s > 0$ the local currency depreciates with respect to the U.S. dollar and foreign investors face a capital loss and a lower return on their investment. Results are again similar to those in table 4. The coefficients on the share of

Table A1: Determinants of $\Delta CoVaR_q$: quarterly windows, $q = 95\%$

VARIABLES	(1) $\Delta CoVaR$	(2) $\Delta CoVaR$	(3) $\Delta CoVaR$	(4) $\Delta CoVaR$	(5) $\Delta CoVaR$	(6) $\Delta CoVaR$	(7) $\Delta CoVaR$
foreign holdings local cur. debt	-0.010***	-0.023**	-0.034**	-0.031**	-0.028**	-0.025*	-0.029**
	(0.003)	(0.010)	(0.016)	(0.014)	(0.012)	(0.014)	(0.012)
log GDP				0.002	0.001	0.001	0.000
				(0.002)	(0.003)	(0.003)	(0.002)
local cur. debt to GDP				-0.005	-0.000	-0.012	-0.000
				(0.021)	(0.019)	(0.024)	(0.018)
foreign holdings total debt				-0.002	-0.005	-0.009	-0.005
				(0.009)	(0.011)	(0.009)	(0.010)
total debt to GDP				0.006	-0.001	0.007	-0.003
				(0.012)	(0.012)	(0.015)	(0.012)
Chinn-Ito Index					-0.005	-0.006	-0.005
					(0.006)	(0.006)	(0.006)
S&P rating						-0.000	
						(0.000)	
Δs							-0.018
							(0.014)
Observations	683	683	683	683	683	519	683
R-squared			0.312	0.314	0.317	0.310	0.332
Number of countries	17	17	17	17	17	17	17
Country FE	NO	NO	YES	YES	YES	YES	YES
TIME FE	NO	YES	YES	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES	YES	YES	YES

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

Notes: In this table we report, for robustness, results of the panel estimation over quarterly non-overlapping windows and we set $q = 5\%$. The dependent variables are always the $\Delta CoVaR$ of country i conditional on the overall market for local currency debt issued by emerging markets being in a situation of distress (i.e., at VaR^m with confidence level 5%) and estimated using as state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. The $\Delta CoVaR$ are computed over non-overlapping quarters from 2003:Q1 to 2016:Q3. The values of the state variables are those on the dates when the VaR^m has been observed for every quarter. The independent variables are: foreign holdings of local currency government debt; log of GDP; local currency government debt as a share of GDP; total government debt as a share of GDP; the Chinn-Ito Index; the growth rate in the exchange rate with respect to the U.S. dollar. Standard errors are clustered at the country level. Data are from Datastream, Arslanalp and Tsuda (2014), Chinn and Ito (2006) and Standard&Poor's.

local currency debt held by foreign investors are significant at the 5 percent level, and larger in magnitude (in absolute values) with respect to those of the baseline panel estimation. This result reflects the additional risk for foreign investors posed by the depreciation of the local currency in a situation of distress.

B.III Quarterly windows, daily returns, $q = 99\%$, equally-weighted aggregate market

In table A3 we present results with confidence level of 1% and equally weighted aggregate market returns. Results are very similar to those of table 4. The magnitude of the coefficients attached to the share of local currency debt held by foreign investors is a bit smaller (in absolute value).

Table A2: Determinants of $\Delta CoVaR_q$: quarterly windows, U.S. dollar daily returns, $q = 99\%$

VARIABLES	(1) $\Delta CoVaR$	(2) $\Delta CoVaR$	(3) $\Delta CoVaR$	(4) $\Delta CoVaR$	(5) $\Delta CoVaR$	(6) $\Delta CoVaR$	(7) $\Delta CoVaR$
foreign holdings local cur. debt	-0.022	-0.032**	-0.039**	-0.088**	-0.089**	-0.057	-0.098**
	(0.014)	(0.014)	(0.017)	(0.037)	(0.038)	(0.040)	(0.039)
log GDP				0.014	0.014	0.012	0.008
				(0.008)	(0.008)	(0.008)	(0.006)
local cur. debt to GDP				-0.022	-0.024	-0.021	-0.024
				(0.043)	(0.045)	(0.065)	(0.039)
foreign holdings total debt				0.066*	0.068*	0.049	0.070*
				(0.036)	(0.036)	(0.032)	(0.034)
total debt to GDP				0.031	0.034	0.015	0.026
				(0.033)	(0.037)	(0.047)	(0.028)
Chinn-Ito Index					0.002	-0.005	0.001
					(0.010)	(0.013)	(0.011)
S&P rating						0.002***	
						(0.001)	
Δs							-0.101**
							(0.043)
Observations	683	683	683	683	683	519	683
R-squared			0.292	0.319	0.319	0.301	0.361
Number of countries	17	17	17	17	17	17	17
Country FE	NO	NO	YES	YES	YES	YES	YES
TIME FE	NO	YES	YES	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES	YES	YES	YES

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

Notes: In this table we report, for robustness, results of the panel estimation for U.S. dollar returns on local currency bonds. U.S. dollar returns are computed from the perspective of foreign investors who first convert dollars for local currency, then buy the local currency bond, and finally convert the proceeds back in U.S. dollars (i.e., $r^{i,usd} = r^i - \Delta s^i_{t+1}$ where r^i are the log returns in local currency and Δs^i_{t+1} the log change in exchange rate for country i with respect to the U.S. dollar). The estimation is over quarterly non-overlapping windows and we set $1 - q = 1\%$. The dependent variables are always the $\Delta CoVaR$ of country i conditional on the overall market for local currency debt issued by emerging markets being in a situation of distress (i.e., at VaR^m with confidence level 1%) and estimated using as state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. The $\Delta CoVaR$ are computed over non-overlapping quarters from 2003:Q1 to 2016:Q3. The values of the state variables are those on the dates when the VaR^m has been observed for every quarter. The independent variables are: foreign holdings of local currency government debt; log of GDP; local currency government debt as a share of GDP; total government debt as a share of GDP; the Chinn-Ito Index; the growth rate in the exchange rate with respect to the U.S. dollar. Standard errors are clustered at the country level. Data are from Datastream, Arslanalp and Tsuda (2014), Chinn and Ito (2006) and Standard&Poor's.

Table A3: Determinants of $\Delta CoVaR_q$: quarterly windows, daily returns, $q = 99\%$, equally-weighted market returns

VARIABLES	(1) $\Delta CoVaR$	(2) $\Delta CoVaR$	(3) $\Delta CoVaR$	(4) $\Delta CoVaR$	(5) $\Delta CoVaR$	(6) $\Delta CoVaR$	(7) $\Delta CoVaR$
foreign holdings local cur. debt	-0.018**	-0.038**	-0.052*	-0.052*	-0.043*	-0.033	-0.045*
	(0.009)	(0.017)	(0.026)	(0.026)	(0.023)	(0.023)	(0.023)
log GDP				0.008	0.006	0.007	0.004
				(0.005)	(0.005)	(0.006)	(0.005)
local cur. debt to GDP				-0.001	0.011	0.005	0.011
				(0.042)	(0.041)	(0.051)	(0.039)
foreign holdings total debt				0.007	-0.003	-0.003	-0.003
				(0.022)	(0.023)	(0.019)	(0.023)
total debt to GDP				-0.019	-0.042	-0.041	-0.044
				(0.028)	(0.032)	(0.043)	(0.031)
Chinn-Ito Index					-0.015	-0.016	-0.015
					(0.014)	(0.015)	(0.014)
S&P rating						0.001	
						(0.001)	
Δs							-0.030*
							(0.016)
Observations	683	683	683	683	683	519	683
R-squared			0.259	0.275	0.281	0.261	0.291
Number of countries	17	17	17	17	17	17	17
Country FE	NO	NO	YES	YES	YES	YES	YES
TIME FE	NO	YES	YES	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES	YES	YES	YES

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

Notes: In this table we report, for robustness, results of the panel estimation over quarterly non-overlapping windows with $q = 1\%$ and equally-weighted aggregate market returns. The dependent variables are always the $\Delta CoVaR$ of country i conditional on the overall market for local currency debt issued by emerging markets being in a situation of distress (i.e., at VaR^m with confidence level 1%) and estimated using as state variables the returns on the S&P500, a U.S. corporate bond index, the CBOE VIX, and a commodity index. The $\Delta CoVaR$ are computed over non-overlapping quarters from 2003:Q1 to 2016:Q3. The values of the state variables are those on the dates when the VaR^m has been observed for every quarter. The independent variables are: foreign holdings of local currency government debt; log of GDP; local currency government debt as a share of GDP; total government debt as a share of GDP; the Chinn-Ito Index; the growth rate in the exchange rate with respect to the U.S. dollar. Standard errors are clustered at the country level. Data are from Datastream, Arslanalp and Tsuda (2014), Chinn and Ito (2006) and Standard&Poor's.