

Limited Participation and Local Currency Sovereign Debt *

Nicola Borri

Kirill Shakhnov

August 18, 2020

Abstract

After the Covid-19 shock, investors immediately rushed out of emerging markets causing a massive sell-off of their government and corporate bonds, equities and currencies. We build a model where local (foreign) investors specialize in local (foreign) currency bonds. After paying a fee, foreign investors can also buy local currency bonds. We then use the model to study the determinants, and the consequences, of foreign investors portfolio decision on emerging market economies. After a large shock, our model predicts larger capital outflows for countries with more volatile exchange rates, higher default risk, and a larger fraction of foreign investors holding domestic assets.

Keywords: Covid-19, emerging markets, local currency sovereign bonds, market segmentation, spillovers

JEL Classification: E43, G12, F31, G11

*Borri: Department of Economics and Finance, LUISS University, Viale Romania 32, 00197 Rome, Italy; nborri@luiss.it; Tel: +39 06 85225959; <http://docenti.luiss.it/borri>. Shakhnov: School of Economics, University of Surrey, Guildford, Surrey, GU2 7XH, UK; k.shakhnov@surrey.ac.uk; Tel: +44 (0)1483 689380; <https://sites.google.com/site/kshakhnov>. We thank Andrea Ajello, Matteo Maggiori, Juan Passadore, Volha Audzei, Pierpaolo Benigno, Andrzej Kociecki, Facundo Piguillem, Claudio Michelacci, Denis Gromb and seminar and conference participants at EIEF, LUISS University, FMND 2017, Oxford University, SED 2017 (Edinburgh), CEPR 28th European Summer Symposium in Financial Markets (Gerzensee), Society for the Advancement of Economic Theory Conference (Faro), ADEMU Sovereign Debt Conference (Toulouse), Marrakech 2nd Global Macroeconomic Workshop, Narodowy Bank Polski, Collegio Carlo Alberto, Barcelona GSE Forum International Capital Flows Workshop, CESifo Macro, Money, and International Finance Conference, ICEF, and Nazarbayev University for helpful comments. Nicola Borri acknowledges the generous hospitality of Narodowy Bank Polski.

1 Introduction

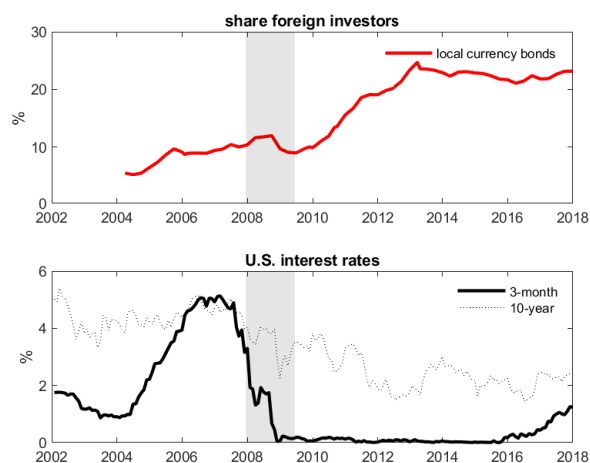
Although the Covid-19 pandemic, after the initial outbreak in China, spread first to advanced economies, investors immediately rushed out of emerging markets causing a massive sell-off of their government and corporate bonds, equities and currencies. For example, bond outflows from emerging markets over the period March 4 to April 24, 2020 totalled 30 billion U.S. dollars, three times those observed during the Great Recession. The sudden portfolio adjustment by foreign investors severely constrained the fiscal space of emerging market governments to fight the pandemic and reduce the economic damage. These facts brought back to the forefront sovereign risk, as Argentina, Ecuador and Lebanon defaulted on their debt, and rating agencies downgraded sovereign debt for a record high number of 29 countries.

This paper builds a model of partially segmented markets for emerging market government bonds where foreign investors specialize in bonds denominated in foreign currency and local investors in local currency. Foreign investors can also invest in local currency bonds, but only after paying a cost. We investigate the hypothesis that the large increase in the share of local currency bonds held by foreign investors since the Great Recession, and up the Covid-19 shock, has been, at least in part, related to the exceptional conditions that have characterized short-term rates in developed countries and to the search for yield of foreign investors. A similar hypothesis has been studied for the U.S. corporate bond market by [Becker and Ivashina \(2015\)](#); [Choi and Kronlund \(2017\)](#). We then use the model to study the determinants, and the consequences, of foreign investors portfolio decision on emerging market economies. After a large shock like the Covid-19 pandemic, our model predicts large capital outflows from emerging markets. However, not all emerging markets are equal. In fact, capital outflows are larger for countries with more volatile exchange rates, higher default risk, and a larger fraction of foreign investors holding domestic assets.

Governments in emerging countries can issue bonds denominated either in foreign or local currency. Historically, the markets for local and foreign currency bonds have been separated: for-

foreign investors, from developed countries, invested in foreign currency bonds, while local investors in local currency bonds. In the last fifteen years, things have started to change. Governments are increasingly issuing bonds denominated in local currencies, and foreign holdings of these bonds, once negligible, have increased from 5 to 25 percent, with most of the increase occurring after the end of the Great Recession. At the end of 2017, local currency sovereign bonds accounted for approximately 70% of total sovereign securities and 25% of total domestic securities (i.e., corporate and sovereign bonds, and equity) in a sample of 16 emerging countries. Figure 1 shows that in the period from 2004 to 2017, the mean foreign holding share of local currency sovereign bonds increased from 5% to 25%. Over the same time, the foreign share of foreign currency bonds stayed flat at around 63%.

Figure 1: Foreign Holdings Shares and U.S. Interest Rates



Notes: The top panel of this figure plots the average share of local currency bonds held by foreign investors in a sample of emerging countries. The countries in the sample are Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Perú, Philippines, Poland, Romania, Russia, South Africa, Thailand. The bottom panel of the figure plots the 3-month (solid line) and 10-year (dotted line) U.S. Treasury bond yields. Data are from [Arslanalp and Tsuda \(2014\)](#) and Datastream for the period 1/2004–12/31/2017.

First, we show that the benefits for foreign investors of entering the local currency bond market are large when their risk aversion, or the short-term interest rates in developed countries, are low. Second, changes in the portfolio positions of foreign investors determine the spillovers of foreign shocks to local markets. Specifically, the larger the share of local currency bonds held by

foreign investors, the larger the spillovers of foreign shocks into the local currency bond market. Third, when we feed to a calibrated version of the model actual U.S. interest rates around the Great Recession, our proxy for the short-term risk-free rate in developed countries, we find it predicts the significant increase in the share of local currency bonds held by foreign investors; the reduction in bond yields; and the increase in the correlation between returns of local and foreign currency bonds, that we document in the data. **Finally, as a consequence of the (increasing) U.S. risk-free rate currently expected by investors, the model predicts sharp reductions in foreign holdings of local currency bonds. However, changes in other factors can mitigate these reductions, for example, an increase in the risk tolerance of foreign investors.**

We build on the literature on segmented markets and limits to arbitrage (as an example, [Vayanos and Vila \(2009\)](#)). We crucially introduce an endogenous number of cross-market investors to a model with two partially segmented markets for defaultable long-term emerging government bonds. Specifically, we start off [Greenwood et al. \(2018\)](#), who consider three different types of investors, two long-term risky assets, and a risk-free short-term asset, all denominated in the same currency. In their model, investors differ because they are either specialized in one of the two risky assets (so-called "specialists") or hold a portfolio of the two risky assets (so-called "generalists"). We propose several key modifications. First, we assume that both risky assets are defaultable long-term sovereign bonds. Second, and more importantly, we introduce exchange rate risk. Specifically, we assume that governments issue bonds denominated in local and foreign currency. If investors have a stochastic discount factor denominated in foreign currency (for example because their consumption basket is also denominated in foreign currency), from their perspective, the two risky bonds have different risk characteristics even when they have exactly the same default probabilities. Third, we assume that foreign investors, henceforth also U.S. investors, are specialized in foreign currency bonds and have also access to a short-term risk-free rate denominated in foreign currency, the U.S. dollar. Local investors are instead specialized in local currency bonds and have also access to a short-term risk-free rate denominated in local currency. In addition, we consider a group of generalists who invests in both markets. We regard generalists

as being foreign investors, for example, U.S. based hedge funds, that have access to the risk-free rate in U.S. dollars and the technical capabilities to operate in both markets. Fourth, we introduce endogenous entry in the pool of generalists by assuming that specialists in foreign currency bonds can become generalists after paying an entry cost. In the model, the key equilibrium condition is the entry condition of foreign investors that equates endogenous benefits and the exogenous cost. These benefits depend on risk-adjusted returns and portfolio diversification, which in turn depend on the composition of local currency bondholders. When the benefits from being a generalist outweigh the cost, the number of generalists increases and the correlation between the two bond returns also increases owing to the fact that foreign shocks become relatively more important for the pricing of local currency bonds (i.e., if markets are perfectly segmented, local currency bonds are directly affected only by local shocks). Therefore, the larger the number of generalists, the lower are the benefits from diversification. We summarize the main results of the model as follows. First, foreign holdings of local currency bonds are determined by foreign investor-specific characteristics, like risk tolerance and funding costs (i.e., the risk-free rate), and country-specific characteristics, like the entry costs and volatility of the exchange rate. Foreign holdings are higher when the foreign risk-free rate is low; investors' risk tolerance is high; entry costs are low; the risks of investing in local currency bonds are low (i.e., exchange and default risk). Second, in response to exogenous shocks, generalists provide insurance by changing their portfolio positions to accommodate changes in the demands of local and foreign specialists. It is exactly this change in portfolio positions by generalists that determines the spillovers of shocks across markets.

We calibrate the model for the average emerging country to quantitatively investigate if the search for yield hypothesis can explain the increase in the share of local currency bonds held by foreign investors. When we feed to the model actual U.S. short-term interest rates after the Great Recession, it predicts the strong increase in the fraction of local currency bonds held by foreign investors. For the model to exactly match the growing share of local currency bonds held by foreigners, investors' risk tolerance needs to be time-varying to partially mitigate the strong impact of the changes in the foreign short-term rate. The resulting risk tolerance is consistent

with the time-series behavior of the Vix index, a standard indicator of investors' risk aversion. The model also predicts changes in yields and the correlation between bond returns, even though the magnitude of these changes is not as large as in the data. We then simulate the model for a panel of 16 emerging countries with common foreign time-varying risk tolerance and short-term risk-free rates. We allow each country to have country-specific fixed entry costs and risk structure. We show that the model can explain more than 50 percent of entry by foreign investors into the local currency bond market. Alternatively, we could fully explain the entry by time-varying country-specific costs. In this case, we show that the dynamic of these costs is related to the World Bank Ease of Doing Business Index, which is our proxy for the legal costs that investors face when deciding to invest in local currency sovereign bonds. The simulated entry costs average around 10% per annum, in line with the estimates from the home-bias literature ([Coeurdacier and Rey, 2013](#)). This literature focuses mostly on equity portfolios. Therefore, we provide novel estimates for transaction costs necessary to rationalize foreign holdings of local currency sovereign bonds issued by emerging countries. Finally, we use the current market expectations of future U.S. short-term interest rates to forecast a strong reduction of foreign holdings of local currency bonds. For the average country, the share of local currency bonds held by foreign investors drops to zero in approximately one year. However, we also show that changes in other factors, like risk tolerance of foreign investors, can mitigate this reduction.

This paper contributes to several strands of the literature. The first, studies partially segmented markets and limits to arbitrage¹. This literature is interested in understanding why financial market anomalies arise and persist, and considers the possibility that sometimes investors lack the capital needed to arbitrage away price discrepancies. [Vayanos and Vila \(2009\)](#) study the effects of demand shocks on the term structure of interest rates when investors have preferences for specific maturities. [Gromb and Vayanos \(2002\)](#) write a model in which capital constrained arbitrageurs cannot fully exploit cross-market discrepancies of identical assets in segmented markets. [Greenwood et al. \(2018\)](#) explain how large supply shocks in one financial market affect asset prices in

¹For example, see the excellent review paper by [Gromb and Vayanos \(2010\)](#) and the references therein.

other markets when some investors are specialized in one market, and the investors active in all markets rebalance their portfolios only gradually. [Gabaix and Maggiori \(2015\)](#); [Camanho et al. \(2018\)](#) show that, in the presence of market imperfections, capital flows determine changes in exchange rates. Our model studies the transmission of shocks between markets when the degree of market integration is determined endogenously. The second strand of the literature studies the determinants of international investment positions. [Coeurdacier and Rey \(2013\)](#) review the large literature on the “home bias” in international portfolios. [Maggiori et al. \(2018\)](#); [Burger et al. \(2018\)](#) show that global portfolios are driven by the currency denomination of assets. [Eichengreen et al. \(2007\)](#); [Burger and Warnock \(2007\)](#) consider emerging markets and explain the lack of foreign investors in the local currency government bonds with the so-called “original sin”, i.e., the lack of commitment by governments not to inflate the debt away. More recently, [Du et al. \(2016\)](#) show that cross-country differences in commitment can explain differences in the currency structure of sovereign debt. The literature also finds that better policies and laws are important in determining foreign inflows ([Alfaro et al., 2008](#)), the size of domestic equity and bond market ([Bekaert and Harvey, 2000](#)), and the fraction of local currency debt issues ([Burger and Warnock, 2006](#)). This paper studies how changes in the characteristics of foreign investors, like funding conditions and risk tolerance, determine global portfolios in local currency sovereign bonds. The third strand of the literature studies how foreign and local shocks affect sovereign bond prices. [Borri and Verdelhan \(2011\)](#) find that a large fraction of the excess returns on foreign currency bonds issued by emerging countries represents compensation for aggregate U.S. market risk. [Longstaff et al. \(2011\)](#) and [Ang and Longstaff \(2013\)](#) study the relative importance of global and local factors in sovereign risk for emerging and developed countries using credit default swaps data. [Borri and Shakhnov \(2018\)](#) find that global factors explain the cross-section of excess returns on portfolios of local currency government bonds sorted according to the exposure to global risk factors in the currency market. [Gilchrist et al. \(2018\)](#) find that that U.S. monetary policy affects differently emerging market bond yields in local currency under a conventional and unconventional policy regime. [Du and Schreger \(2016\)](#) construct a measure of local currency credit spreads and find that

they are 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. [Rigobon \(2002\)](#) surveys the empirical literature on contagion and finds that regional variables, as well as trade linkages, constitute a sizeable explanation of the strength of the propagation of shocks across bond markets. This paper shows that the composition of bondholders is time-varying and important to understand the transmission of shocks across bond markets. Finally, [Borri \(2018\)](#) finds evidence of spillovers of foreign shocks to local markets and, specifically, shows that the larger the share of local currency debt held by foreign investors the more individual countries' local currency government bonds are exposed to systematic tail-risk. In this paper, we find that, when markets become more integrated, foreign shocks become more important and spillovers of foreign shocks across markets increase.

The remainder of this paper is organized as follows. In section [2](#) we present a set of stylized facts on emerging government bonds in local and foreign currency, and on the shares held by foreign investors. In section [3](#) we introduce a model with one country issuing debt both in local and foreign currency and foreign investors that solve an optimal portfolio choice with markets that are possibly segmented. In section [4](#) we present the calibration and simulation of the model. Section [5](#) presents our conclusions.

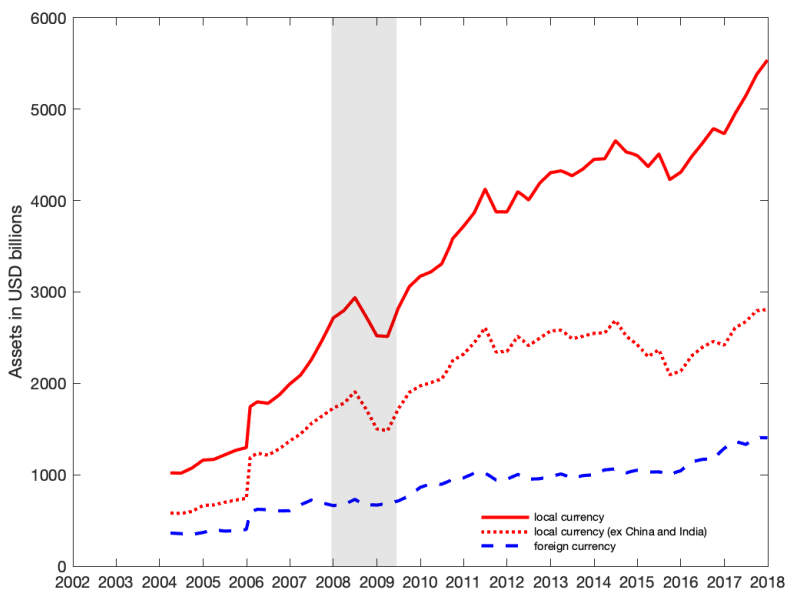
2 Stylized Facts

The previous section documents the large increase of the average foreign holding shares of local currency bonds issued by emerging countries from 5 to 25 percent in the last fifteen years. This section presents a set of additional stylized facts.

First, using data collected by [Arslanalp and Tsuda \(2014\)](#), we describe the evolution of the size of local and foreign currency bonds markets. Figure [2](#) shows that, between 2004:Q1 and 2017:Q4, the aggregate value of the market for local currency bonds increases almost sixfold, from 1 to 5.5 trillions of U.S. dollars; over the same period, the aggregate value of the foreign currency

bond market increased approximately threefold, from 0.35 to 1.4 trillions of U.S. dollars. The large increase in the size of the local currency bond market does not depend on just a few large countries. If we exclude China and India, the aggregate value increased more than fivefold, from 0.5 to 2.8 U.S. dollar trillions. Even though the value of the local currency bond market started to increase at least in 2004:Q1, if not earlier, the share held by foreign investors started to increase at a later date, and in particular starting around 2009:Q2, as illustrated in figure 1. Similarly, [Hale et al. \(2016\)](#) documents an increase in corporate bonds denominated in the issuer’s home currencies, especially after the Great Recession.

Figure 2: Aggregate Value Local and Foreign Currency Bonds



Notes: This figure plots the aggregate U.S. dollar value of the sovereign local (red solid line) and foreign (blue dashed line) currency bonds issued by a sample of 16 emerging countries. The red dotted line denotes the aggregate U.S. dollar value of the sovereign local currency bonds excluding China and India. The grey shadow area corresponds to the last NBER recession. Data are in billions of U.S. dollars from [Arslanalp and Tsuda \(2014\)](#) for the period 2004:Q1 to 2017:Q4.

Second, table 1 presents detailed information on the average total value of the foreign holdings of local (panel A) and foreign (panel B) currency denominated government bonds for a set of 16 emerging countries, along with the average foreign holding shares². We find large cross-country

²The countries in the sample are Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico,

differences in the average foreign holding shares of local currency sovereign bonds. For example, they are smaller than 2% in China and India. On the contrary, they are approximately equal to 30% in Hungary, Perú, Poland and South Africa. The mean share across all emerging countries is equal approximately to 13.5%, and to 25% at the end of the sample in 2017:Q4. For comparison, in 2018, the foreign holding share of U.S. Treasury bonds is approximately equal to 35% (Bloomberg). Table 1 also reports the change of the foreign holding shares between 2009:Q2 and 2013:Q2 (in percentage points). The mean change is approximately equal to 12 percentage points, and as high as 26 in Mexico and South Africa and 35 in Perú. Finally, combining data from [Arslanalp and Tsuda \(2014\)](#) and the Coordinated Portfolio Investment Survey (CPIS) from the IMF, we are able to approximately reconstruct holdings of sovereign local currency bonds by U.S., European, and Japanese investors for each emerging country (see section A of the appendix for further details). The table illustrates how investors in developed countries, and specifically in the U.S., the Euro area and Japan, increased significantly their holdings of local currency bonds and, on average, represent 80% of the aggregate foreign holdings of local currency sovereign bonds issued by emerging countries.

Third, the large increase of both the size and foreign holding shares of the local and foreign currency bonds markets went along an impressive increase in the value of a hypothetical investment in these markets. Figure 3 provides a snapshot of the cumulative returns of a 1 dollar investment in two broad indices of local and foreign currency sovereign bonds started at the beginning of 2002. Specifically, we use the J.P. Morgan GBI-Composite and J.P. Morgan EMBI+ to proxy the investments in local and foreign currency sovereign bonds, respectively. Both indices are in U.S. dollar. As a reference, we also report the returns from an investment in the U.S. equity market, proxied by the S&P 500 index. We find that the initial investment increased fourfold when invested in foreign currency sovereign bonds, threefold in local currency bonds, and twofold in the U.S. equity market. The bottom panel of the figure reports time-varying correlation coefficients between the daily returns on the local and foreign currency bond indices, estimated on rolling windows

Perù, Philippines, Poland, Romania, Russia, South Africa, and Thailand.

Table 1: Foreign Holdings of Local and Foreign Currency Bonds

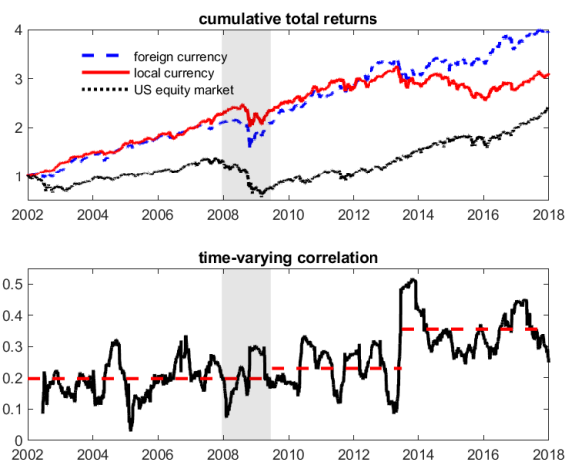
	Panel A: Foreign holdings LC-bonds												Panel B: Foreign holdings FC-bonds		
	Panel A1: U.S. dollar billions				Panel A2: Shares (%)								US dollar billions		%
	Tot	US	EMU	JPN	Tot	Δ^{Tot}	US	Δ^{US}	EMU	Δ^{EMU}	JPN	Δ^{JPN}	Tot	Share	Δ^{Tot}
Brazil	94.69	31.27	8.80	39.75	11.23	7.86	32.58	10.62	8.84	1.92	43.17	-9.09	39.03	12.50	-6.24
Chile	2.08	0.30	0.54	0.13	5.60	NaN	17.69	NaN	32.48	NaN	7.77	NaN	7.20	63.80	NaN
China	14.52	2.00	1.53	6.56	0.99	0.77	21.72	-1.33	10.34	-5.40	50.74	8.57	9.40	12.03	-2.71
Colombia	11.82	4.50	2.53	1.97	14.34	NaN	41.94	NaN	21.01	NaN	20.95	NaN	21.39	91.51	NaN
Hungary	15.52	3.16	7.45	2.62	28.97	20.12	18.21	33.71	47.25	-19.91	17.82	-8.67	20.17	89.39	-16.18
India	10.44	2.88	0.76	4.57	1.63	1.05	27.50	-2.03	7.05	-2.88	47.58	4.18	0.00	NaN	NaN
Indonesia	22.39	7.39	3.06	8.37	24.55	16.09	34.10	-1.40	11.09	2.72	40.55	1.94	21.50	88.19	-2.83
Malaysia	24.96	6.94	2.72	12.21	20.26	20.94	26.64	8.29	8.80	1.04	50.03	-6.74	6.33	94.65	0.00
Mexico	66.21	24.99	9.52	22.32	21.92	26.17	37.63	5.74	12.18	-1.81	33.48	-2.04	37.98	85.87	29.39
Peru	3.89	1.41	1.20	0.45	33.01	35.56	37.03	19.81	26.50	2.85	18.45	-19.88	7.84	61.29	13.49
Philippines	3.86	1.13	0.56	1.51	4.99	9.70	27.22	11.40	14.02	-0.48	38.84	0.22	14.41	66.48	38.95
Poland	40.31	4.93	14.45	14.00	27.41	20.00	10.62	10.13	32.55	-0.23	37.77	-8.38	44.14	99.70	-1.47
Romania	3.54	0.46	2.18	0.17	16.36	19.38	9.37	21.44	69.64	-20.48	3.70	3.82	10.51	66.23	NaN
Russia	10.39	8.74	6.31	3.59	9.52	21.58	38.79	NaN	27.21	NaN	15.13	NaN	22.45	53.69	0.85
South Africa	27.63	6.73	5.48	9.52	25.65	23.81	22.57	14.84	18.77	-3.35	40.56	-8.14	11.04	39.14	-8.06
Thailand	8.78	1.43	1.21	4.89	8.87	15.46	21.18	2.31	11.51	-0.08	53.17	-1.23	0.21	17.56	-0.00
All	277.38	88.47	41.44	100.85	12.99	11.46	26.70	10.78	29.91	-5.01	24.46	-2.62	211.27	64.89	3.19

Notes: This table reports the average foreign holdings in local (panel A) and foreign (panel B) currency sovereign bonds for a set of 16 emerging countries and the sample 2004:Q1 to 2017:Q4. Panel A1 reports data in U.S. dollar billions; panel A2 as a fraction of the total outstanding value. Specifically, Tot denotes the total foreign holdings of local currency sovereign bonds, and US , EMU , and JPN the foreign holdings of U.S., European, and Japanese investors respectively. In panel A2, Δ^i denotes the differences in the foreign holding shares between 2009:Q2 and 2013:Q2, for $i = Tot, US, EMU, JPN$. Panel B reports the total foreign holdings of foreign currency sovereign bonds expressed in both U.S. dollars and as a share of the total outstanding value, along with the difference between the foreign holding share between 2009:Q2 and 2013:Q2. Data are from Arslanalp and Tsuda (2014) and the Coordinate Portfolio Investment Survey (CPIS) by the IMF. Section A of the appendix presents details on the construction of the countries' asset positions.

of 120 days. Correlations between daily returns tend to increase over time, and in particular after 2013:Q2. The figure reports the averages of the correlation coefficients for three sub-periods. The first corresponds to a period in which the foreign holding shares, for most emerging countries, were small and goes from 2002:Q1 to 2009:Q2. The second goes from 2009:Q2 to 2013:Q2 and corresponds to the period in which the foreign holding shares increased the most in the last fifteen years. The third and last period corresponds to end of the sample, from 2013:Q2 to 2017:Q4, when foreign holding shares remained stable and close to the high values reached at the end of 2013:Q2. We cannot reject the null that the correlation coefficients are equal to 0.2 in the first two periods. On the contrary, in the last period, the correlation coefficient is equal to 0.38 and statistically different from the estimates for the first two periods at standard confidence levels.

Fourth, we estimate panel regressions to study the determinants of the foreign holding shares of local currency bonds issued by emerging country governments. Specifically, table 2 reports the

Figure 3: Bond Returns, Yields, and Correlation



Notes: This figure reports cumulative total returns for local and foreign currency sovereign bonds together with the U.S. equity market (top panel); and the time-varying correlation coefficients between local and foreign currency daily bond returns (bottom panel). We use the J.P. Morgan GBI-Composite Index to proxy for local currency bonds and the J.P. Morgan EMBI+ for foreign currency bonds. Both indices are denominated in U.S. dollars and total return, i.e., include dividends and payments from the underlying assets assuming that they are re-invested in the indices. In our sample, the mean annualized daily returns are, respectively, 8.56% for the EMBI+, 7.01% for the GBI-Composite, and 7.0% for the U.S. equity market. The corresponding Sharpe ratios, computed as ratios of annualized returns to annualized standard deviations, are equal to 1.18, 0.99 and 0.38. Time-varying correlation coefficients are estimated using daily returns and rolling windows of 120 days. In the bottom panel, we also report the averages of the time-varying correlation coefficients over three subsamples. The first goes from 2002:Q1 to 2009:Q2. The second goes from 2009:Q2 to 2013:Q2. The third goes from 2013:Q2 to 2017:Q4. The averages are respectively equal to 0.20, 0.22, and 0.38. The average in the last period is statistically different from the averages in the first two periods at standard confidence levels. Data are from Datastream for the period 2002:Q1–2017:Q4.

results for our panel of 16 emerging countries. The dependent variable is the share of local currency bonds held by foreign investors, and the independent variables are the lag of the foreign holding shares, the yield spreads between local and foreign currency sovereign bonds and the U.S. short-term interest rate. For each emerging country, we take the corresponding J.P. Morgan EMBI+ index to proxy for the foreign currency yield, the corresponding J.P. Morgan GBI-EM Broad index for the local currency yield, and the 3-month T-bill rate for the U.S. short-term risk-free rate. We consider three specifications. In the first, we do not include any fixed effects or additional regressors. We find that foreign holding shares of local currency sovereign bonds are very persistent and that they tend to increase when the yield difference between local and foreign currency bond increases, and when the U.S. short-term interest rate declines. In the second specification, we include country fixed effects, and monthly time fixed effects. In this case, we do not include the U.S. short-term

interest rate, whose effect is picked up by the time fixed effect. We find that the coefficients on the lag share and the differences in yields are still positive and statistically significant. Finally, in the third specification, we include a battery of controls. Specifically, we include the total debt-to-gdp ratio; the fraction of local currency debt in total debt; the S&P credit ratings for local and foreign currency government bonds; GDP growth rates; the Chinn-Ito index of financial openness; and the change in the exchange rate. Even after including all these controls, the coefficient on the lag share and differences in yields remain positive, and significant at the 10 percent level.

Table 2: Foreign Holding Shares

	(1)	(2)	(3)
Lag of share	0.987*** (177.90)	0.936*** (55.68)	0.932*** (47.25)
Diff. in yields	0.0682* (2.23)	0.125* (2.76)	0.0955 (2.05)
Risk-free	-0.0978** (-2.88)		
Country_FE		X	X
Monthly_FE		X	X
Controls			X
Observations	575	575	562
R-squared	0.944	0.957	0.956

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table reports the results from panel estimations where the dependent variable is the share of foreign investors in local currency sovereign bonds, and the independent variables are the lag of the share, the spread difference between the yields on a local and foreign currency government bonds and the U.S. short-term interest rate. The panels are estimated at the quarterly frequency for 16 emerging countries for the period 2005:Q1–2017:Q4. When *Controls* are used, we include in the regressions: the total debt-to-gdp ratio; the fraction of local currency debt in total debt; the S&P credit ratings for local and foreign currency government bonds; GDP growth rates; the change in the spot exchange rate, and the Chinn-Ito index of financial openness. Additional details on the data are available in the appendix. *t*-statistics are estimated based on robust standard errors. Data are from [Arslanalp and Tsuda \(2014\)](#), Datastream, and [Chinn and Ito \(2006\)](#). Note that the Chinn-Ito index is at the annual frequency and we keep the index constant over the four quarters of each year.

3 Model

In this section, we present a model of partially segmented markets, defaultable long-term bonds, and endogenous entry of foreign investors. We start off [Greenwood et al. \(2018\)](#) but introduce several key modifications. First, we assume there exist two defaultable nominal long-term bonds. These bonds are sovereign bonds denominated in local and foreign currency. Local and foreign investors are concerned about real returns and maximize a mean-variance objective. Since investors consume different consumption baskets, these two risky bonds have different risk-characteristics even when they have exactly the same default probabilities because of exchange rate risk. Second, we introduce endogenous entry of foreign investors in the market for local currency bonds. Specifically, we assume that foreign investors are specialized in the foreign currency bond, while local investors in the local currency bond. However, foreign investors can become generalists, and invest in both the local and foreign currency bonds, after paying a fee.

In the following sections, we first present a restricted version of the model with only one asset and one type of investors, as an illustrative example; we then present the unrestricted model when the fractions of specialists and generalists is fixed; finally, we extend the model to introduce endogenous entry of foreign investors in the local currency debt market.

3.1 Restricted Model

In order to gain some intuition, it is convenient to first introduce a restricted version of the model. There is a mass 1 of specialized foreign investors with risk tolerance τ_F that purchase risky long-term bonds issued by an emerging sovereign. Specifically, we assume there exists only one risky defaultable long-term bond denominated in local currency and one short-term risk-free rate in foreign currency. Note that we use the expression "local currency" to denote the domestic currency of the emerging country issuing the risky bonds. Investors are foreigners with an objective function in foreign currency, for example, because this is the currency of denomination of their consumption basket. The risky bond is a portfolio of perpetual bonds with per-period

nominal coupon C_L . Every period, a share $h_{L,t}$ of the bonds defaults, and investors, in this case, recover a fraction $\eta_{L,t}$. From the perspective of foreign investors, the relevant holding period real return is then

$$R_{L,t+1}^* = \frac{(1 - Z_{L,t+1})(P_{L,t+1} + C_L)}{P_{L,t}} \frac{S_t}{S_{t+1}} \frac{\Pi_t^*}{\Pi_{t+1}^*}, \quad (1)$$

where $Z_{L,t+1} = h_{L,t+1}\eta_{L,t}$, satisfying $0 \leq Z_{L,t+1} < 1$, is the portfolio default realization at time $t + 1$; S_t is the exchange rate in units of local currency per 1 unit of foreign currency; and Π_t^* is the price index of the foreign consumption basket (a "star" (\star) denotes variables in foreign currency). Applying the classic [Campbell and Shiller \(1988\)](#)'s log-linear approximation to (1) we get

$$r_{L,t+1}^* \approx k_L + \theta_L p_{L,t+1} + (1 - \theta_L)c_L - p_{L,t} - z_{L,t+1} - \Delta s_{t+1} - \pi_{t+1}^*, \quad (2)$$

where lower case variables denote logs (e.g., $p_{L,t} = \log(P_{L,t})$); k_L is a constant of approximation; $\theta_L = 1/(1 + \exp(c_L - \bar{p}_L))$; $z_{L,t+1} = \log(1 - Z_{L,t+1})$; Δs_{t+1} denotes the exchange rate growth (i.e., $\Delta s_{t+1} = \log(S_{t+1}) - \log(S_t)$); and π_{t+1}^* is the foreign inflation rate between t and $t + 1$ (i.e., $\pi_{t+1}^* = \log(\Pi_{t+1}^*) - \log(\Pi_t^*)$). According to equation (2), real returns to foreign investors depend on nominal returns in local currency, and are reduced by the loss given default, the local currency depreciation, and foreign inflation. By solving (2) forward

$$p_{L,t} = \frac{1}{1 - \theta_L} k_L + c_L - \sum_{i=0}^{\infty} \theta_L^i E_t \left[r_{L,t+1+i}^* + z_{L,t+1+i} + \Delta s_{t+1+i} + \pi_{t+1+i}^* \right]. \quad (3)$$

It is convenient to apply (3) to *promised cash flows* (i.e., $z_{L,t+1+i} = 0 \ \forall i = 0, 1, \dots$) to obtain

$$p_{L,t} = \frac{1}{1 - \theta_L} k_L + c_L - \frac{1}{1 - \theta_L} y_{L,t} \quad (4)$$

where $y_{L,t}$ is the bond log yield-to-maturity in local currency. Combining (4) and (2) we get an expression for the return on the risky bond, in foreign currency, as function of the current and future yields, the default realization, the change in the exchange rate, and inflation

$$r_{L,t+1}^* \approx \frac{1}{1 - \theta_L} y_{L,t} - \frac{\theta_L}{1 - \theta_L} y_{L,t+1} - z_{L,t+1} - \Delta s_{t+1} - \pi_{t+1}^*. \quad (5)$$

Investors are myopic and have mean-variance preferences over 1-period log returns³

$$\max_{b_t} \left\{ b_t E_t(r_{L,t+1}^{e,*}) - (2\tau_F)^{-1} b_t^2 \text{Var}_t(r_{L,t+1}^{e,*}) \right\}, \quad (6)$$

where $r_{L,t+1}^{e,*} = r_{L,t+1}^* - (r_{0,t}^* - \pi_{t+1}^*)$ are the real excess returns in foreign currency on investing in the long-term local currency risky bond and borrowing at the foreign currency real risk-free rate $r_0^* - \pi_{t+1}^*$. Note that inflation does not have any direct effect on real excess returns, which are equal to nominal excess returns because the inflation term cancels out. However, inflation might affect excess returns indirectly through its effect on equilibrium nominal prices.

Solving the optimization problem and imposing market-clearing (i.e., $b_t = q_{L,t}$)

$$E_t(r_{L,t+1}^{e,*}) = (1/\tau_F) q_{L,t} V_L^* \quad (7)$$

where $V_L^* = \text{Var}_t(r_{L,t+1}^{e,*})$ is the conditional variance of the holding period real excess returns.

Investors are exposed to five different sources of risk: interest rate risk; default risk; supply risk; exchange rate risk; and inflation risk. We assume a stochastic structure for these risk factors. Specifically, we assume that the foreign currency risk-free rate (r_0^*), the default realization (z_L), the bond supply (q_L), the exchange rate growth (Δs), and the foreign inflation rate (π^*) follow an exogenous multivariate autoregressive processes. In particular, let $\mathbf{x} = \left[r_0^* - \bar{r}_0^* \quad z_L - \bar{z}_L \quad q_L - \bar{q}_L \quad \Delta s - \Delta \bar{s} \quad \pi^* - \bar{\pi}^* \right]'$ and $\epsilon = \left[\epsilon_{r^*} \quad \epsilon_{z_L} \quad \epsilon_{q_L} \quad \epsilon_{\Delta s} \quad \epsilon_{\pi^*} \right]'$. We assume that

$$\mathbf{x}_{t+1} = \mathbf{x}_t \Gamma + \epsilon_{t+1} \quad (8)$$

³Investors make a one-time decision to maximize expected utility over terminal wealth at some future date. Therefore, our problem is static and we do not account for intertemporal hedging motives related to time variation in risk premiums. However, given the mean-reverting structure of our risk factors, incorporating the intertemporal hedging would not qualitatively change our results (Campbell and Viceira, 1999).

where Γ is the time-invariant transition matrix and Σ the time-invariant variance-covariance matrix of the vector of innovations ϵ_{t+1}

$$\Gamma = \begin{bmatrix} \rho_{r^*} & 0 & 0 & 0 & 0 \\ 0 & \rho_{z_L} & 0 & 0 & 0 \\ 0 & 0 & \rho_{q_L} & 0 & 0 \\ 0 & 0 & 0 & \rho_{\Delta s} & 0 \\ 0 & 0 & 0 & 0 & \rho_{\pi^*} \end{bmatrix}, \quad \Sigma = \begin{bmatrix} \sigma_{r^*}^2 & 0 & 0 & 0 & 0 \\ 0 & \sigma_{z_L}^2 & 0 & 0 & 0 \\ 0 & 0 & \sigma_{q_L}^2 & 0 & 0 \\ 0 & 0 & 0 & \sigma_{\Delta s}^2 & 0 \\ 0 & 0 & 0 & 0 & \sigma_{\pi^*}^2 \end{bmatrix}$$

In order to get simple closed-form solutions, it is convenient to take Γ and Σ as diagonal matrices, however, the model can be easily solved under any non-diagonal structure.

We conjecture that equilibrium yield takes a linear form in the vector of state variables \mathbf{x}

$$y_t^* = \alpha_0 + \alpha' \mathbf{x}_t \quad (9)$$

and pick α_0 and α' so that market clearing holds.

Using (9) in (5), we calculate the conditional variance V_L^* as solution to the following quadratic equation

$$\begin{aligned} V_L^* &= \left(\frac{\theta_L}{1 - \rho_{r^*} \theta_L} \sigma_{r^*} \right)^2 + \left(\frac{1}{1 - \rho_{z_L} \theta_L} \sigma_{z_L} \right)^2 + \\ &+ \left(\frac{1}{1 - \rho_{\Delta s} \theta_L} \sigma_{\Delta s} \right)^2 + \left(\tau_F^{-1} \frac{\theta_L}{1 - \rho_{q_L} \theta_L} \sigma_{q_L} \right)^2 (V_L^*)^2 \end{aligned} \quad (10)$$

Given our assumption that asset prices, yields, and expected returns are linear functions of the states and that states follow an autoregressive process with time-invariant variance-covariance structure, the conditional variance of excess returns is time-independent. The linearity assumption is common in rational expectation models with mean-variance investors absorbing stochastic supply shocks. This modelling approach is also used by [Hanson \(2014\)](#), [Hanson and Stein \(2015\)](#), and [Greenwood et al. \(2018\)](#) and allow us to write a discrete-time analog to the continuous-time

term structure modes in [Vayanos and Vila \(2009\)](#) and [Greenwood and Vayanos \(2014\)](#). In addition, note that investors care about *excess* real returns. Therefore, inflation risk is relevant only to the extent that it helps investors forming expectations over the risk factors that directly affect excess returns (i.e., default and exchange rate risk), and this is the case only when Γ is non-diagonal (see equation (A7) in the appendix).

This problem has typically multiple solutions. We focus on the non-explosive solution, which implies that yields are less sensitive to changes in the supply⁴. Combining (7) and (9), we get an expression for the bond yield-to-maturity

$$\begin{aligned}
 y_{L,t} = & \underbrace{\left[\bar{r}^* + \frac{1 - \theta_L}{1 - \rho_{r^*} \theta_L} (r_{0,t}^* - \bar{r}_0^*) \right]}_{\text{expected short rates}} + \underbrace{\left[\bar{z}_L + \frac{1 - \theta}{1 - \rho_{z_L} \theta_L} \rho_{z_L} (z_{L,t} - \bar{z}_L) \right]}_{\text{expected default losses}} + \underbrace{\left[\Delta \bar{s} + \frac{1 - \theta_L}{1 - \rho_{\Delta s} \theta_L} \rho_{\Delta s} (\Delta s_t - \Delta \bar{s}) \right]}_{\text{expected currency depreciation}} \\
 & + \underbrace{\frac{V^{(1)}}{\tau_F} (\bar{q}_L)}_{\text{unconditional risk premium}} + \underbrace{\left[\frac{V^{(1)}}{\tau_F} \frac{1 - \theta_L}{1 - \rho_{q_L} \theta_L} (q_{L,t} - \bar{q}_L) \right]}_{\text{conditional risk premium}} \tag{11}
 \end{aligned}$$

The sensitivity of the yield to changes in the risk factors depends on their persistence. While the first three terms of equation (11) are present also when investors are risk-neutral, the unconditional and conditional risk premia depend on the risk tolerance parameter τ_F . Intuitively, yields are higher if investors expect higher short-term risk-free rates, default losses, local currency depreciation, and bond supply. In section B.I of the appendix we derive the expression for the equilibrium excess returns, which shows that expected risk premia, similarly to the yield-to-maturity, compensate investors for, respectively, interest rate risk, credit risk, exchange rate risk, and supply risk. Differently from the expressions for the yield, the level of bond supply affects all

⁴Note that, as in [Greenwood and Vayanos \(2014\)](#) and [Greenwood et al. \(2018\)](#), a linear equilibrium exists only if investors are sufficiently risk-tolerant (i.e. if τ_F is large enough). When investors are sufficiently risk-tolerant, there are two possible solutions. In the first, yields are highly sensitive to supply shocks and bonds become very risky so that the investors want to be compensated with large returns, i.e., large changes in yields. In the second, on the contrary, yields are less sensitive to supply shocks and bonds less risky, so that investors require smaller returns. It is possible to show that the first root is explosive when $\sigma_{\epsilon_{q_L}} \rightarrow \infty$. Note also that we are implicitly focusing on the solution in which investors go long the risky asset and short the risk-free asset. This is justified as realized excess returns on the risky government bonds of the emerging countries in our sample are large and, in the quantitative exercise, we consider investors with high-risk tolerance.

the components of risk premia, which immediately follows from expressions (5)–(7) and (11).

3.2 Unrestricted Model

We now extend the framework of section 3.1 and consider the unrestricted version of the model with three assets. In particular, there exist two defaultable nominal long-term bonds, issued by the same sovereign, but denominated in local (L-bond) and foreign (F-bond) currency respectively, and two short-term risk-free rates also denominated in local and foreign currency. Investors differ with respect to their source of funding: local investors can borrow at the local risk-free rate, while foreign investors at the foreign risk-free rate. There are three types of investors with mean-variance preferences over real returns. Specialists in L are local investors with mass n_L , risk tolerance τ_L , and an objective function in local currency. Specialists in F are foreign investors, with mass $(1 - \nu)n_F$, risk tolerance τ_F , and an objective function in foreign currency. Generalists are *ex ante* identical to foreign specialists but invest in both L and F , have mass νn_F , same risk tolerance of specialists in F (i.e., τ_F), and an objective function in foreign currency. ν is the fraction of foreign investors who are generalists. The total mass of investors is normalized to one (i.e., $n_L + n_F = 1$).

We follow our discussion of the restricted model and define two real returns: the real return on the local currency bond from the perspective of a local investor; and the real return on the foreign currency bond from the perspective of foreign investors. The real returns on the L- and F-bonds are

$$\begin{aligned} R_{L,t+1} &= \frac{(1 - Z_{L,t+1})(P_{L,t+1} + C_L)}{P_{L,t}} \frac{\Pi_t}{\Pi_{t+1}} \\ R_{F,t+1}^* &= \frac{(1 - Z_{F,t+1})(P_{F,t+1}^* + C_F^*)}{P_{F,t}^*} \frac{\Pi_t^*}{\Pi_{t+1}^*} \end{aligned}$$

where Z_i , with $i = L, F$, are the asset-specific default realizations. Note that if $Z_{i,t+1} \equiv 0$ every period, then bond i is default risk-free. A star-superscript (\star) denotes variable in foreign currency,

which are relevant for the decisions of foreign investors. Following the same steps described in section 3.1 for the case of the model with one risky bond, we use [Campbell and Shiller \(1988\)](#)'s log-linear approximation to derive the excess returns on the L- and F-bonds

$$r_{L,t+1}^e \approx \frac{1}{1 - \theta_L} y_{L,t} - \frac{\theta_L}{1 - \theta_L} y_{L,t+1} - z_{L,t+1} - r_{0,t}, \quad (12)$$

$$r_{F,t+1}^{e,\star} \approx \frac{1}{1 - \theta_F^\star} y_{F,t}^\star - \frac{\theta_F^\star}{1 - \theta_F^\star} y_{F,t+1}^\star - z_{F,t+1} - r_{0,t}^\star, \quad (13)$$

$$r_{L,t+1}^{e,\star} \approx r_{L,t+1}^e + (r_{0,t} - r_{0,t}^\star) - \Delta s_{t+1}, \quad (14)$$

where $r_{L,t+1}^e$ are local currency real excess returns on local currency bonds for local investors that are specialists in L and borrow at the local currency nominal risk-free rate ($r_{0,t}$); $r_{L,t+1}^{e,\star}$ are foreign currency real excess returns on local currency bonds for foreign investors that invest in asset L , borrow at the foreign currency nominal risk-free rate ($r_{0,t}^\star$) and are also subject to changes in the local currency exchange rate (Δs_{t+1}); $r_{F,t+1}^{e,\star}$ are foreign currency excess returns on foreign currency bonds for foreign investors that invest in asset F , borrow at the foreign currency nominal risk-free rate ($r_{0,t}^\star$). Note how excess returns $r_{F,t+1}^{e,\star}$ do not depend on changes in the exchange rate (Δs_{t+1}) because asset F is denominated in foreign currency and investors have a stochastic discount factor denominated in the same, foreign, currency. Finally, we allow for the two long-term bonds to have different default risks, captured by the default realizations $z_{L,t+1}$ and $z_{F,t+1}$.

With respect to the restricted model of section 3.1, the vectors of states \mathbf{x} and the vector of shocks ϵ include now two risk-free rates, two default realizations, two supplies for the L- and F-bonds, two inflation rates, and the change in the exchange rate. We assume that the vector of states follows an exogenous multivariate autoregressive stochastic process as in (8).

Specialists in both assets maximize a quadratic utility function. Therefore, we derive the standard demand functions of a mean-variance investor as in (6) so that their optimality conditions are

$$b_{L,t} = \tau_L \frac{E_t [r_{L,t+1}^e]}{V_L}, \quad b_{F,t} = \tau_F \frac{E_t [r_{F,t+1}^{e,\star}]}{V_F^\star}$$

where $V_L \equiv \text{Var}_t [r_{L,t+1}^e]$ and $V_F^\star \equiv \text{Var}_t [r_{F,t+1}^{e,\star}]$, are the conditional variances of the real excess returns. Generalists also maximize the same quadratic utility function, but with respect to a portfolio containing the L- and F-bonds

$$\max_{d_{L,t}, d_{F,t}} \left\{ E_t[r_{d,t+1}^{e,\star}] - (2\tau_F)^{-1} \text{Var}_t[r_{d,t+1}^{e,\star}] \right\},$$

where $r_{d,t+1}^{e,\star} = d_{L,t}r_{L,t+1}^{e,\star} + d_{F,t}r_{F,t+1}^{e,\star}$ are the excess returns on a portfolio with weights $d_{i,t}$, with $i = L, F$, on the two risky bonds.

The optimality condition for generalists are

$$\begin{bmatrix} d_{L,t} \\ d_{F,t} \end{bmatrix} = \frac{\tau_F}{(1 - \omega^\star)^2 \sqrt{V_L^\star V_F^\star}} \begin{bmatrix} \sqrt{\frac{V_F^\star}{V_L^\star}} E_t[r_{L,t+1}^{e,\star}] - \omega^\star E_t[r_{F,t+1}^{e,\star}] \\ \sqrt{\frac{V_L^\star}{V_F^\star}} E_t[r_{F,t+1}^{e,\star}] - \omega^\star E_t[r_{L,t+1}^{e,\star}] \end{bmatrix} \quad (15)$$

where ω_t^\star denotes the correlation coefficient between the conditional excess returns of the two bonds expressed in foreign currency (see equation (A15) in the appendix for additional details)

$$\omega^\star = \frac{\text{Cov}_t[r_{L,t+1}^{e,\star}, r_{F,t+1}^{e,\star}]}{\sqrt{V_F^\star} \sqrt{V_L^\star}} \quad (16)$$

In order to provide intuition for equation (15) we consider, as an example, the generalists' demand for the L-bond. Their demand is similar to the demand for specialists, in the sense that depends positively on expected returns and negatively on their variance. However, the expected returns are now weighted by a measure of relative variance ($\sqrt{\frac{V_L^\star}{V_F^\star}}$) and by the correlation with the second risky assets (ω^\star). Intuitively, for any level of the expected return on the F-bond, the higher the risk of the F-bond, the higher is the demand for the L-bond; the higher the correlation the lower is the demand for the L-bond.

To close the model we impose the market-clearing conditions

$$(1 - n_F)b_{L,t} + v n_F d_{L,t} = q_{L,t} \quad (17)$$

$$(1 - v)n_F b_{F,t} + v n_F d_{F,t} = q_{F,t}. \quad (18)$$

If investors are sufficiently risk tolerant (i.e., for τ large), and for a given fraction of generalists (ν), it is possible to solve the model conjecturing that equilibrium yields and the generalist demands for L and F are linear functions of the state vector, as for the restricted model of section 3.1. In the next section we endogenize ν , i.e., the fraction of foreign investors who become generalists.

3.3 Endogenous entry

We now extend the model to account for an endogenous fraction of generalists by introducing endogenous entry of foreign investors in the market for local currency long-term bonds⁵. We assume that when generalists invest in the local currency bond, they must pay a per period fix cost ψ_t , that captures the transaction costs they need to face in order to operate in the local market. Specialists in the F-bond every period can decide whether to become generalists, pay the fee ψ_t and invest also in the L-bond. Therefore, the entry condition for specialists in F is

$$\Delta u_t \equiv u_t^g - u_{F,t}^s = \psi_t \quad (19)$$

where u_t^g is the utility for generalists and $u_{F,t}^s$ is the utility of specialists in F in period t . Therefore, the left-hand side of the entry condition is the utility benefit of becoming a generalist, while the right-hand side is the utility cost of buying asset L . The utility of specialists is the function of their risk tolerance and risk-adjusted returns and equal to

$$u_{F,t}^s = \frac{\tau_{F,t}}{2} \tilde{r}_{F,t}^2$$

where

$$\tilde{r}_{F,t} = \frac{E_t[r_{F,t+1}^{e,\star}]}{\sqrt{V_F^\star}}$$

denotes the risk-adjusted returns on the F-bond. The utility of generalists is function of their risk

⁵We do not allow entry of local investors in the market for F-bonds. This choice is motivated by two facts. First, local holdings of F-bonds are small and stable over our sample. Second, non-banks, like domestic households, account for a large fraction of local holders of L-bonds.

tolerance, the risk-adjusted returns on L and F , but also of the correlation between the two assets. Specifically, the utility of generalists is equal to

$$u_t^g = \frac{\tau_{F,t}}{2(1 + \omega_t^*)} \left[\frac{\tilde{r}_L^2 - \tilde{r}_L \tilde{r}_F \omega_t^*}{(1 - \omega_t^*)} + \frac{\tilde{r}_F^2 - \tilde{r}_L \tilde{r}_F \omega_t^*}{(1 - \omega_t^*)} \right]$$

where \tilde{r}_L are the risk-adjusted returns on the L-bond and ω_t^* denotes the correlation coefficient between the conditional excess returns of the two assets expressed in foreign currency. Therefore,

$$\Delta u_t = \frac{\tau_{F,t} (\tilde{r}_{L,t} - \tilde{r}_{F,t} \omega_t^*)^2}{2 [1 - (\omega_t^*)^2]} \quad (20)$$

Note that when the correlation between asset returns is equal to 1, then there are no gains from diversification and $u_t^g = u_{F,t}^s$. On the contrary, when the two bonds are imperfectly correlated, then there are gains from diversification which are inversely related to the correlation between bond returns. According to the entry condition (equation (19)), the fraction of generalists (v_t) is pinned down by investor-specific characteristics, like risk tolerance and borrowing costs; and country-specific characteristics, like entry costs and remaining country-specific risk factors (e.g., inflation, exchange rate, etc.). In the quantitative exercise, we investigate the determinants of the entry of foreign investors in the local currency market and show that the time-variation in both the benefits and the cost could provide an explanation for the observed changes in the fraction of generalists.

3.4 Equilibrium in the Unrestricted Model

We define the rational expectation equilibrium of the unrestricted model with endogenous entry as the set of the following endogenous objects: two demand functions by specialists ($b_L(\mathbf{x}), b_F(\mathbf{x})$), two demand functions by generalists ($d_F(\mathbf{x}), d_L(\mathbf{x})$), two yields ($y_L(\mathbf{x}), y_F^*(\mathbf{x})$), and the fraction of generalists ($v(\mathbf{x})$), where \mathbf{x} is the vector of exogenous states. Given the law of motion of the exogenous state, and taken as given the yields and the fraction of generalists, the demand functions of specialists and generalists satisfy the corresponding first order conditions (equations (15)). Given

the demand functions, and the fraction of generalists, yields must clear the markets for both the L- and F-bonds (equations (17)-(18)). Finally, the entry condition pins down the equilibrium fraction of generalists (equation (19)).

4 Quantitative Analysis

In this section, we present quantitative results based on the solution of the unrestricted model with two risky long-term assets introduced in section 3. We first discuss the model calibration in section 4.1, and then the model simulation in section 4.4.

4.1 Calibration

The calibration proceeds in two steps. First, we calibrate a restricted version of the model with two perfectly segmented markets for the average emerging country. In this version, domestic investors invest only in local currency denominated bonds and foreign investors invest only in foreign currency bonds. Second, we consider the unrestricted model for the average emerging country and feed the realized shocks. Third, we repeat the same exercise for each country.

To calibrate the model, we consider the average emerging country for the period from 1/2002 to 6/2009. First, for the calibration, we consider the period before the end of the Great Recession because it is characterized by low foreign holding shares of local currency sovereign bonds and markets can be considered segmented. Second, by considering moments for the average country, we smooth country-specific characteristics and focus on investors' characteristics and changes in the overall market for emerging governments' bonds. In the restricted version of the model with two perfectly segmented markets, we need to determine the parameters describing four stochastic processes for each market: the risk-free rate, the default realization, inflation, and the bond supply. Each of these processes is characterized by three parameters: mean, standard deviation, and persistence. In addition, we need to determine the parameters capturing the bond maturity and investors' risk tolerance. Therefore, we need to determine a total of 28 parameters. In the

unrestricted version of the model, we additionally need to determine four parameters: i.e., those describing the exchange rate, and the relative mass of foreign investors (n_F). We directly estimate the stochastic processes for the risk-free rates, the inflation rates, and the exchange rate; set the bond maturity parameters so that the average maturity is equal to the data (i.e., 6.4 years for local currency bonds and 10.5 for foreign currency bonds); and calibrate the remaining 15 parameters. We target the mean and standard deviation of bond excess returns, and the mean, standard deviation, and first-order auto-correlation for bond yields. For the remaining five parameters, we target the mean default realizations of the L- and F-bonds and the fact that the persistence and volatility of the default realizations are the same; the ratio between the supplies of L- and F-bonds; and the relative mass of foreign investors.

Directly estimated parameters. In order to pin down the directly estimated parameters, we use the following data. First, the U.S. 3-month Treasury Bill for the foreign risk-free rate. Second, we assume the covered interest parity to obtain local currency risk-free rates (see section [A.IV](#) in the appendix). Forward and spot rates are from Barclays and Thomson Reuters. Third, inflation rates are from the OECD, Bloomberg, and the Inter-American Development Bank. All data are monthly. We refer to the appendix for additional details.

Calibrated parameters. To construct the targets for the mean default realizations, we proceed as follows. First, for all the countries in our sample, we obtain letter credit ratings from S&P for long-term sovereign bonds denominated in local and foreign currency. Default probabilities are constructed converting S&P's letter credit ratings into default realizations using the transition matrix in [Kealhofer \(2003\)](#) and assuming zero recovery rate. In our sample, the mean default realization is equal to 0.5% per annum for local currency denominated bonds, and 0.9% for foreign currency denominated bonds, in line with the literature on sovereign default ([Arellano, 2008](#); [Paczos and Shakhnov, 2016](#); [Jeanneret and Souissi, 2016](#)). We construct the target for the ratio between bond supplies using data from [Arslanalp and Tsuda \(2014\)](#). Specifically, in the calibration period, the ratio between local and foreign currency bonds is equal to 2.2. Finally, we construct

the targets for the relative mass of foreign investors as the average of the following ratio: at the numerator, the sum of the total value of government securities held by foreign investors across all emerging market countries; at the denominator, the sum of the total value of government securities held by foreign investors across all emerging market countries and the local holdings of each emerging countries. In the calibration period, this ratio is equal to 0.82. We refer to the appendix for additional details (table 8).

Table 3 reports all the model parameters for the average country calibrated at the monthly frequency. First, panel A reports the parameters for the risk factors. The mean local (foreign) risk-free rate is equal to 0.51% (0.20%). The foreign risk-free rate is more persistent and less volatile than the local risk-free rate. The mean growth rate in the exchange rate is equal to -0.13%, indicating a small appreciation of the local currency vis-a-vis the U.S. dollar, our proxy for the foreign currency. Exchange rate growth has low persistence and high volatility. The mean local (foreign) inflation rate is equal to 0.47% (0.24%). Both local and foreign inflation rates are highly persistent and have similar volatilities. Therefore, the local (foreign) mean annualized real rates are approximately equal to 0.5% (-0.5%). The implied mean default realization for foreign currency bonds (z_F) is higher than for local currency bonds (z_L). Specifically, the mean annual default realizations, which we target, are approximately equal to 0.84% and 0.48%. Default realizations are persistent and have annualized volatilities of about 1.49% and 0.66%. For all countries, default risk is more important for F-bonds; while the exchange rate is the main risk for foreign investors in L-bonds. The ratio between bond supplies is equal to 1.8, close to our target of 2.2. The bond supplies have similar low persistence, but the F-bond has higher supply volatility. Second, panel B reports the remaining parameters. Local investors are less risk tolerant than foreign investors. This is consistent with the idea that foreign investors and generalists are, for example, hedge funds with a high appetite for risk. Bonds denominated in local and foreign currency have similar maturity. Finally, the relative mass of local and foreign investors is, respectively, equal to 0.20 and 0.80. Additionally, table 10 in the appendix report direct estimates for the exchange rates and default probabilities for the 16 emerging countries in our sample.

Table 3: Model Calibration

	Panel A: risk factors					Panel B: other parameters						
	estimated					calibrated				calibrated		
Moments	r_0	r_0^*	Δs	π	π^*	z_L	z_F	q_L	q_F	Names	L	F
Ex	0.51	0.20	-0.13	0.47	0.24	0.04	0.07	788.00	433.00	τ	180.10	246.01
ρ_x	0.55	0.99	0.19	0.96	0.99	0.98	0.93	0.24	0.11	θ	0.84	0.90
σ_x	0.29	0.02	2.97	0.05	0.06	0.16	0.42	0.03	1.59	n	0.22	0.78

Notes: The table report all the parameters of the unrestricted model, for the average country, calibrated at the monthly frequency. We obtain parameters by direct estimation and by matching several target moments for the average country for the sample from 1/2002 to 6/2009. We report the unconditional mean, the persistence parameter, and the volatility for each of the nine risk factors (panel A), and for the risk tolerance, bond maturity, and market size (panel B). In panel A, with the exception of the bond supplies, we report mean and volatilities in percentages. Data are from various sources and discussed in the appendix.

We simulate the restricted version of the model and report in table 4 the annualized mean, standard deviation and persistence of nominal yields and annualized mean and standard deviation of excess returns for the L- and F-bond. For local currency bonds, we consider both excess returns in local and foreign currency. Note that, despite the fact that in the calibration we target all the moments for the L- and F-bonds, our model does not exactly match the data because we directly estimate some of the parameters that enter the expressions for yields and excess returns (equation (11)). Specifically, for the L-bond, the volatility of returns is not large enough, while yields are too large and volatile. For the F-bond, mean returns are not large enough, and yields are too volatile. The higher auto-correlation of the F-bond with respect to the L-bond is due to the high persistence of the risk-free rates. The excess volatility depends on the fact that the directly estimated risk factors, for which we have reliable data, are very volatile, in particular, the risk-free rates. We further use the shocks obtained from the directly estimated risk factors to explore how the path of shocks to foreign risk-free rate affects the equilibrium of the model. Finally, we do not target the moments for the L-bond in foreign currency. In this case, the model generates mean returns that are close to the data, but not as volatile.

Table 4: Model Simulation

Moments	L-bond		F-bond		L-bond in F currency	
	Data	Model	Data	Model	Data	Model
Erx	2.45	2.61	5.60	2.51	8.25	7.88
std rx	8.09	3.62	11.08	9.41	15.28	11.55
Ey	8.76	14.81	6.34	8.63		
std y	1.88	5.47	1.29	5.12		
AC(1) y	0.92	0.80	0.89	1.20		

Notes: The table report annualized mean, standard deviation and persistence of yields and annualized mean and standard deviation of excess returns for the L- and F-bonds. For local currency denominated bonds, we consider both excess returns in local and foreign currency. We construct excess returns on F-bonds and L-bonds in foreign currency using the U.S. 3-month Treasury bond yield as risk-free rate. For excess returns on L-bonds in local currency we use the local short-term rates as risk-free rate. Local currency risk-free rate is derived from the covered interest rate parity.

4.2 Comparative Statics

We now consider the unrestricted model with two risky bonds, local and foreign investors, and endogenous entry. We fix the parameters as in table 3, and analyze the model for different values of the fixed entry cost. By varying this fixed cost, we can obtain any equilibrium fraction of generalists. For the sake of illustration, in figure 4, we report the mean and standard deviation of excess bond returns, along with the correlation between the local and foreign currency bond returns, and the benefits and the cost of entering the local currency bond market, a function of the fraction of generalists. We denote with a star (\star) variables denominated in foreign currency and relevant for foreign investors and summarize our results as follows. First, on average, the volatility of excess returns on the L-bond in foreign currency is higher than on the F-bond which are higher than on the L-bond in local currency. This ordering depends on the fact that the risk factors affecting the F-bond are more unconditionally volatile (with the exception of the local risk-free rate). Second, the mean of expected excess returns follows the same ordering of the volatilities in order to compensate investors for the higher risk, and because foreign investors face a lower risk-free rate. Third, when the fraction of generalists increases, the volatility of the L-bond excess returns declines. This is because the L-bond's loadings decline with respect to local risk factors, while increase with respect to the foreign risk factors, and the former effect dominates.

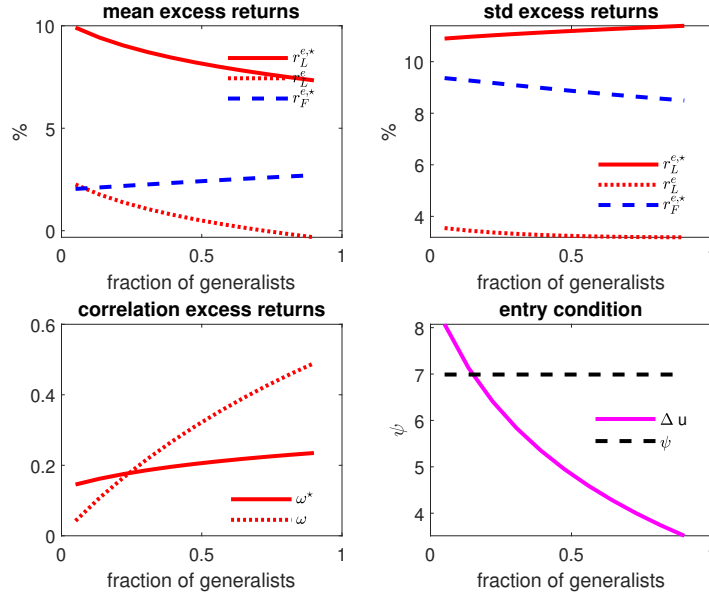
A similar mechanism explains the decline in the volatility of F-bond returns. In this case, the loadings decline with respect to foreign risk factors, while increase with respect to the local risk factors⁶. On the contrary, the volatility of L-bond returns in foreign currency increases with the fraction of generalists, despite the decline in the volatility of L-bond returns in local currency, because of the increase in correlation between the L-bond returns with exchange rate risk and foreign risk-free rate (see equation (14)). To understand the response of mean expected excess returns to an increase in the fraction of generalists, it is convenient to refer to the market clearing conditions. Specifically, when ν increases, the demand for the L-bond increases. In order to satisfy equation (17), expected excess returns on the L-bond should decline to generate an offsetting decline in the bond demand. The mean expected excess return on the L-bond in foreign currency follows the same pattern of the return in local currency, with only a difference in the level given by the mean exchange rate growth. From (18), we observe two effects of an increase in ν going in the opposite direction. Overall, under our parametrization, the mean expected excess returns on the F-bond increase with the fraction of generalists.

The correlation between the F-bond returns and the L-bond returns, either in local (ω) or foreign currency (ω^*), increases with the fraction of generalists. Recall that we assume that shocks are orthogonal. This assumption mechanically implies that, when the ν is zero, ω is also zero, while ω^* is positive because of the common foreign interest rate risk affecting both directly excess returns and indirectly the yield on the F-bond. If we had, instead, co-movement in the shocks to the risk factors, then this co-movement would directly affect the correlation between bond returns.

When ν increases, L-bonds increase their relative loadings on foreign risk factors, while F-bonds on local risk factors. Loadings change because of the changes in the total demand by generalists. Note that as long as the state variables are orthogonal, default or exchange rate risks have a direct impact on the variances of two risky assets, but no direct impact on the conditional

⁶The loadings for the L-bond are the elements of the vector α_L from the equation $y_{L,t} = \alpha_{L,0} + \alpha'_L x_t$. Similarly, the loadings for the F-bond are the elements of the vector α_F from the equation $y_{F,t}^* = \alpha_{F,0} + \alpha'_F x_t$. See figure A6 in the appendix for details. One of the consequences of these findings is that local currency bonds are more affected by foreign shocks the larger the fraction of generalists. This result is in line with [Farhi and Werning \(2012\)](#) who argue that capital controls are particularly effective to address risk-premium shocks because they limit the exposure of local currency bonds to foreign shocks by constraining foreign portfolio flows.

Figure 4: Model Simulation



Notes: This figure plots the mean yields, the standard deviation of asset returns, the correlation between asset returns and the difference in utility of generalists and specialists in asset F (i.e. $\Delta u = u^g - u_F^s$) for different values of the fraction of generalists (ν). The blue lines correspond to asset F , the red solid lines to asset L expressed in foreign currency, and the dotted red lines to asset L expressed in local currency. For correlations, ω^* (solid red line) corresponds to expression (16) and denotes the correlation between the returns on L and F in foreign currency. Instead, ω denotes the correlation between the returns of L in local currency and the returns of F in foreign currency. Parameters are from table 3.

covariance (16). Hence, any increase in the variance of these shocks reduces the correlation between the bond excess returns. Further, ω increases relatively faster with the fraction of generalists because exchange rate risk, the factor with the largest volatility, directly affects only the L -bond returns in foreign currency (see table 3). Finally, in the fourth panel of the figure, we show the entry equilibrium condition, exemplified by the difference in utility of generalists and specialists in asset F (Δu) and the per-period cost of investing in asset L (ψ). Specifically, specialists in asset F enter also the market for asset L as long as the additional utility is greater than the fixed cost. In equilibrium, the fraction of generalists corresponds to the intersection between the two lines. Note that the figure shows a particular equilibrium for ν approximately equal to 0.1. However, different values for the fixed entry cost generate different equilibrium values for the fraction of generalists and, consequently, different utility gains. When the assets are different, there are gains from diversification for generalists. However, when the fraction of generalists increases, the cor-

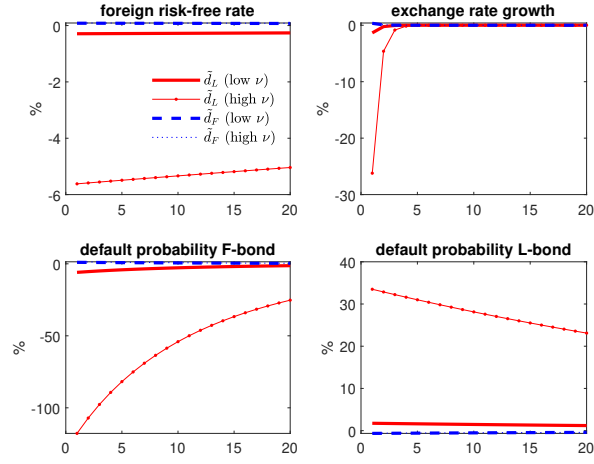
relation between bond returns increases and risk-adjusted returns on the L-bond fall, reducing the gains from diversification.

4.3 Response to shocks

In this section, we assume that the entry decision by foreign investors occurs before the shocks are realized. Specifically, we consider how bond yields, and demands by generalists, respond to unexpected shocks when the fraction of generalists is fixed. We start by computing impulse response functions for fixed values of the fraction of generalists. Specifically, we consider a low (5%) and a high (90%) levels for the fraction of generalists, and the yields and the demands on the local and foreign currency denominated bonds. We compute the yield on the local (foreign) currency bond from the point of view of local (foreign) investors. Recall that bond yields rise (drop) when bond prices decrease (increase). Note that in order to compute the yield on the local currency bond from the point of view of foreign, as opposed to local, investors would require information on the exchange rate at maturity. All the parameters are those presented in section 4.1 and table 3 for the average country.

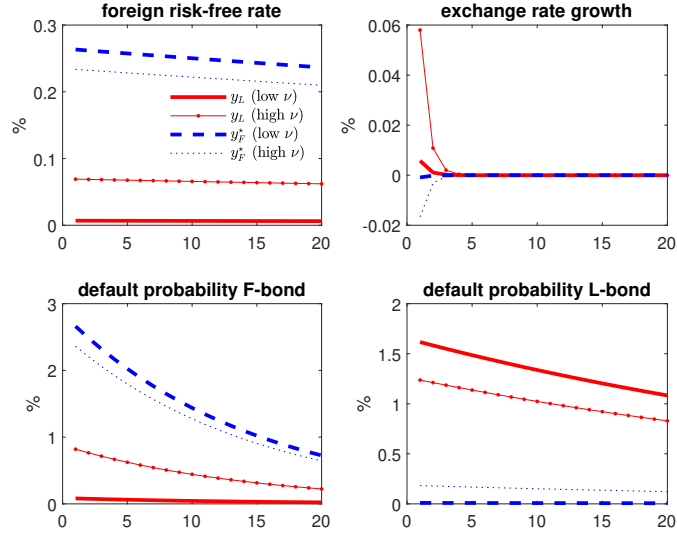
Figure 5 and 6 plot the impulse responses conditional on four shocks: the foreign risk-free rate; the exchange rate growth; and the default realizations of the local and the foreign currency denominated bonds. First, we start by analyzing the effect of foreign shocks on the yield and generalist demand for foreign currency denominated bonds. In the figure, foreign shocks are shocks to the foreign risk-free rate and default probability on the foreign currency denominated bond. Conditional on an unexpected increase in the foreign risk-free rate, both foreign specialists and generalists respond by demanding higher yields from the risky bonds because of the increase in their funding costs. However, generalists can absorb a fraction of the foreign currency bonds that specialists decide to sell by reducing their asset position in local currency bonds because they hold a diversified portfolio. Overall, yields must increase to accommodate the downward demand pressure. A similar argument explains the response of the yield and the demand for foreign currency denominated bonds to an increase in their default probability. Second, we consider the

Figure 5: Impulse Responses (Generalist Demands)



Notes: This figure plots the impulse responses of the demand by generalist investors of local and foreign currency bonds with respect to shocks to the U.S. risk-free rate, the exchange rate growth, and the default probabilities on the two assets. The blue lines denote foreign currency bonds, while the red lines local currency bonds. We distinguish between the case in which the fraction of generalists (ν) is high or low. Changes in the demands by generalists are reported as percentages of the total asset supplies. All the parameters are those presented in section 4.1 and table 3 for the average country. All moments are annualized and in percentage.

Figure 6: Impulse Responses (Bond Yields)



Notes: This figure plots the impulse responses of yields on the local and foreign currency bonds with respect to shocks to the U.S. risk-free rate, the exchange rate growth, and the default probabilities on the two assets. The blue lines denote foreign currency bonds, while the red lines local currency bonds. We distinguish between the case in which the fraction of generalists (ν) is high or low. All the parameters are those presented in section 4.1 and table 3 for the average country. All moments are annualized and in percentage. Figure A7 in the appendix presents the impulse responses with respect to shocks to all the risk factors.

effect of local shocks on the yield and generalist demand of foreign currency denominated bonds. In the figure, local shocks are shocks to the default probability of local currency denominated bonds. Conditional on an unexpected increase in the default probability of the local currency bond, both local specialists and generalists respond by demanding higher yields on local currency bonds. Generalists partially absorb the reduction in demand by local specialists, by selling foreign currency bonds. Overall, the yield of foreign currency bonds increases to accommodate the downward pressure on their demand by generalists. Third, the effect of local shocks to the yield and the generalist demand of local currency bond is the same as the effect of foreign shocks on foreign currency bonds. The effect of foreign shocks to the yield and the generalist demand of local currency bond is the same as the effect of local shocks on foreign currency bonds. Fourth, an unexpected increase in the exchange rate growth directly affects only generalist demand for local currency bonds. Because of the positive, even though small, persistence in the exchange rate process, generalists expect a further depreciation of the local currency and demand higher yields on local currency bonds. Their demand decreases, and the yield on local currency bond increases to accommodate the downward pressure on generalist demand of local currency bonds. Fifth, we consider how different fraction of generalists quantitatively change the responses of demands and yields. As a response to any of the four shocks, the difference in generalist demands for the two risky assets increases with the fraction of generalists, while the difference in bond yields is smaller, with the exception of the response to an exchange shock rate because the latter has a direct impact only on generalists, and not specialists.

We make two additional observations from the analysis of the impulse response functions. First, the persistence of shocks affects both the response of generalist demands and bond yields. Specifically, higher persistence of the shocks corresponds to higher persistence of the generalist demands. The effect on bond yields is more complicated, as it depends directly on the relative persistence of the risk factors, and indirectly on the relative persistence of the generalist demands. Second, the fact that generalists accommodate part of the shocks, at the same time provides insurance to the specialists and contributes to spillovers across markets, even when shocks are

orthogonal. One way to think about these generalists is as global banks playing an important role in transmitting shocks originating in developed countries to emerging markets (Morelli et al., 2019).

4.4 Model Simulation

In this section, we simulate the endogenous entry by foreign investors conditionally on the realization of the risk factors, and unconditionally, i.e., when the risk factors are constant at their unconditional mean. Specifically, in what follows, we consider the realization of only one particular risk-factor, the U.S. risk-free rate. In the appendix, we present additional results conditional on the realizations of the other risk factors.

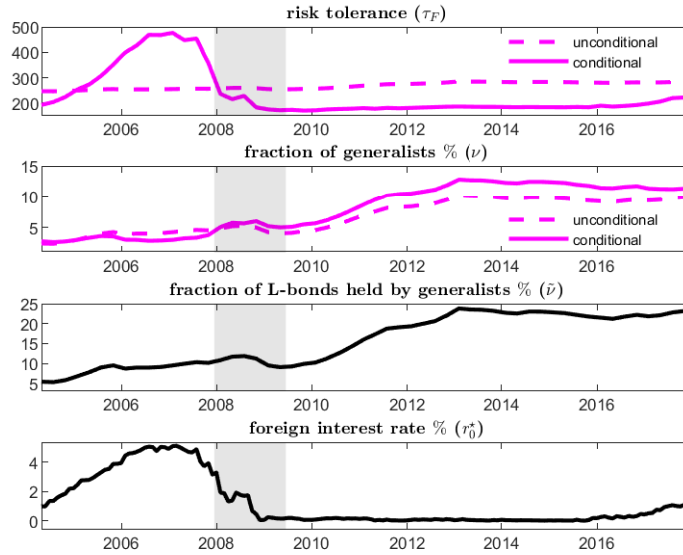
Average country. We simulate the model for the average country under two alternative scenarios, using the parameters from table 3, with the exception of the parameter defining the risk tolerance of foreign investors ($\tau_{F,t}$). While in the first scenario, which we refer to as *unconditional*, all shocks are equal to zero, in the second, which we refer to as *conditional*, all shocks are zero with the exception of the U.S. risk-free rate ($r_{0,t}^*$). In both scenarios, we set $\tau_{F,t}$ in order to match exactly, every period, the average fraction of local currency bonds held by generalists in our sample of emerging countries. Recall that, for the average country, we observe an increase in the foreign holding share of local currency bonds since 2004. Figure 7 plots the simulated paths for the risk tolerance, the fraction of generalist investors, the fraction of local currency bonds held by foreign investors, and the U.S. risk-free rate. Intuitively, in the unconditional simulation, the risk tolerance parameter, which is the only free parameter, must increase to match the growing fraction of assets held by foreigners. If in the conditional simulation, we keep the risk tolerance parameter constant, then the simulated share of foreign investors is first too small and then too large compared to the data (see figure A9 in the appendix.). In order to match the fraction exactly, the risk tolerance of foreign investors must instead adjust to mitigate the effect of the U.S. risk-free rate: first increase, prior to the Great Recession, then fall sharply during the Great Recession, and finally slowly re-

cover afterward. Prior to the Great Recession, the growing short-term interest rate in the U.S. pushes down the demand for local currency bonds by foreign investors. Therefore, for the model to match the increasing share of local currency bonds held by foreigners, investors should be more risk tolerant. On the contrary, during the Great Recession, the U.S. short-term rate dropped approximately to zero. In this case, for the model to match the data, we need a sharp reduction in investors' risk tolerance. The simulated risk tolerance is high before the Great Recession, and then drops dramatically during the crisis period, which is supported by the fact that the simulated risk tolerance closely traces the Vix volatility index, a standard proxy for investors' risk aversion (see figure A10 in the appendix for detail).

These results can be interpreted in light of a *search for yield* story. In the model, a reduction in the U.S. risk-free rate increases foreign demand for risky assets. While in the foreign bond market this results only in a reduction of the yield in order to accommodate the upward pressure in demand, in the local bond market this results not only in a reduction of the yield but also in a change of the investors' composition. Specifically, the overall demand for local currency bonds by generalists increases not only because the number of generalists increases, but also because individual generalist demand increases. The conditional scenario captures the dynamics of the search for yield interpretation of the data.

Figure 8 reports the correlation, for the average country, between the returns on L- and F-bonds. Specifically, the top panel considers the correlation between L- and F-bond returns both in dollars; the bottom panel the correlation between L-bond returns in local currency and F-bond returns in dollars. Each panel reports data (black dotted line), and simulated data for the unconditional (dashed magenta line) and conditional model (solid magenta line). For the data, we consider the average time-varying correlation in our sample of emerging countries using a window of 120 days. Our model qualitatively explains the increase in correlation between returns because of the increasing share of foreign holdings of L-bonds, even though quantitatively the increase in model correlations is smaller than in the data. When the foreign holding share is relatively low, like at the beginning of the sample, model correlation is low because of our assumption of orthogonal shocks.

Figure 7: Model Simulation: Quantities (Average Country)

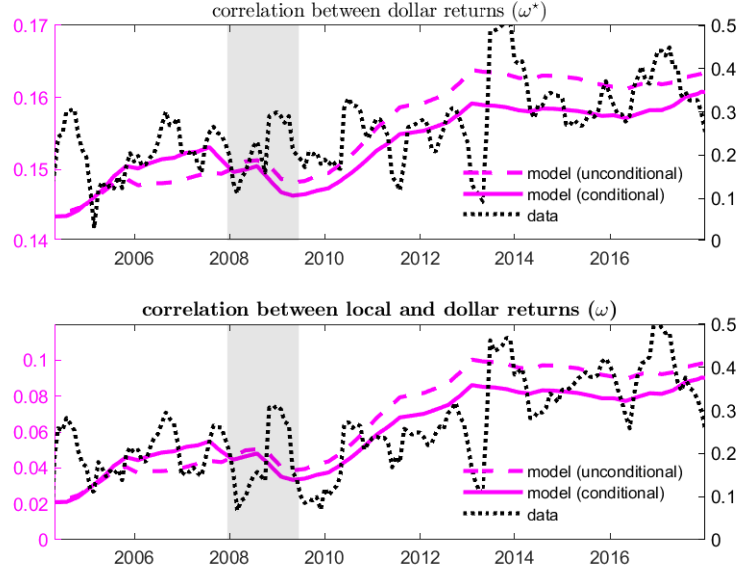


Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., all shocks at their unconditional means with the exception the foreign interest rate shock. The first panel plots the risk tolerance parameter $\tau_{F,t}$ estimated to match the holdings of L-bonds by generalists. The second panel plots the simulated values for the equilibrium fraction of foreign investors. The third panel plots the fraction of L-bonds held by foreign investors. In the model, this fraction is equal to $\tilde{\nu} = (\nu n_F d_{L,t}) / \bar{q}_L$. The fourth panel plots the foreign interest rates shocks for the conditional model. Foreign interest rate shocks are defined as deviations of the U.S. 3-month Treasury bond yield with respect to its means in the period 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

By assuming that shocks are orthogonal, we can isolate the contribution of the increase in the demand by generalists to asset prices and quantities. When the foreign holding share increases, then the correlation between returns increases as well because of the larger portfolio holdings of L-bonds by generalists.

All countries. For each emerging country, we simulate the model by feeding the foreign risk-free rate shocks and the risk tolerance levels τ_t^* , resulting from the simulation of the conditional model for the average country. Under the first scenario, countries are "homogeneous" with respect to the parameters driving the risk factors, while differing with respect to the entry costs. Under the second scenario, countries are "heterogeneous" with respect to these parameters and the entry costs. For each scenario, we simulate the model with both fixed and time-varying entry costs. Panel A of Table 5 reports the results of the simulations under the first scenario, while panel

Figure 8: Model Simulation: Correlations (Average Country)



Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., all shocks at their unconditional means with the exception the foreign interest rate shock. The first panel plots the correlation between returns on L-bonds in dollars and F-bonds, also in dollars (ω^*). The second panel plots the correlation between returns on L-bonds in local currency and F-bonds in dollars (ω). Each panel reports data (black dotted line), and simulated data for the unconditional (dashed magenta line) and conditional model (solid magenta line). We plot data on right y-axis and model correlations on the left y-axis. Empirical correlations are estimated using daily returns and a rolling window of 120 days. The sample period is 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

B under the second scenario. For each country and panel, we report the fixed cost chosen to match the sample average fraction of L-bonds held by foreigners in country i (ψ_i); the average fixed cost expressed in terms of annualized returns ($E(\tilde{\psi}_{it})$); the R^2 of a model with fixed cost ψ_i with respect to a model with time-varying cost $\tilde{\psi}_{it}$ chosen to match the observed fraction of L-bonds held by foreign investors; the standard deviation of the time-varying cost. Note that $\tilde{\psi}_{it}$ is time-varying, as it depends on the time-varying risk tolerance for the average country. In the homogeneous scenario, we observe a small cross-country variation in entry costs, expressed in terms of annualized returns. It varies from 9.19% for Perú to 11.27% for Chile. On average, fixed costs are around 10% per annum. While the level of the simulated cost might seem large, it is in line with the typical estimates, from the home-bias literature, necessary to skew the equity portfolio allocation across developed economies away from the optimal (French and Poterba, 1991;

Jeske, 2001; Cooper and Kaplanis, 1994). More recently, Sercu and Vanpée (2008) find much lower estimates for developed countries and equity portfolios. However, they also find large values for emerging and developing countries. For example, for our sample of countries, their estimate of the average cost for equity portfolios is equal to 10% and ranges from 0.5% (Hungary) to 37% (Indonesia). While with a time-varying cost the model can match exactly the evolution of the fraction of L-bonds held by generalists for each country, this is not the case for the model with a fixed cost. The large R^2 s indicate that the model with fixed cost can explain a large share of the time-variation in the foreign holdings of L-bonds for most countries, with the exception of China, Hungary, and India. China and India are countries with an extremely low fraction of L-bonds held by foreign investors potentially due to restrictions to capital flows and currency interventions. The model requires small time-variation in the entry cost to exactly match the data. In fact, the within-country variation in $\psi_{i,t}$ required by the model with time-varying cost is smaller than the cross-country variation in ψ_i .

In the heterogeneous scenario, the entry cost required by the model to fit the data must balance not only the evolution in the fraction of L-bonds held by foreign investors but also the cross-country heterogeneity in the underlying risk factors. Therefore, as expected, we find a larger cross-country variation in entry cost, from 0.90% for Malaysia to 12.70% for Indonesia. However, accounting for heterogeneity helps to keep the fixed entry cost, on average, at low levels. Finally, in the heterogeneous scenario, the performance of the model with fixed cost drops substantially (i.e., for many countries the R^2 s are negative). While the heterogeneous model with fixed cost can match key moments of bond yields and returns (see table 13 in the appendix), it cannot match the evolution of the foreign holdings of L-bonds for many countries in the sample.

In the model, the entry cost is country-specific, and possibly time-varying ($\psi_{i,t}$), as it is the cost that foreign investors, specialized in F-bonds issued by country i , must pay to also enter the market for L-bonds issued by country i . Then $\psi_{i,t}$ must only be related to L-bonds, and not to F-bonds. L-bonds are typically issued under domestic law, while F-bonds under foreign law. Therefore, we interpret $\psi_{i,t}$ in terms of the legal costs to invest in securities issued under domestic

Table 5: Model Simulation (All Countries)

Countries (i)	Panel A: homogeneous				Panel B: heterogenous			
	ψ_i	$E(\tilde{\psi}_{it})$	R_i^2	$\sigma(\psi_{it})$	ψ_i	$E(\tilde{\psi}_{it})$	R_i^2	$\sigma(\psi_{it})$
Brazil	9.19	9.11	72.84	0.22	3.56	7.37	-460.31	0.41
Chile	9.91	9.94	53.51	0.10	1.74	1.57	-328.67	0.11
China	9.84	9.33	-143.18	0.31	7.40	4.70	-5965.97	4.09
Colombia	9.18	9.69	32.65	0.40	3.84	7.75	8.37	0.57
Hungary	7.92	8.37	-69.06	0.56	2.09	4.66	-134.19	0.37
India	9.79	9.30	-209.06	0.30	10.19	6.10	-4175.55	1.15
Indonesia	8.27	8.55	77.80	0.38	10.31	12.72	52.07	1.18
Malaysia	8.53	8.68	86.55	0.26	1.04	0.90	-106.14	0.50
Mexico	8.44	8.64	80.75	0.34	0.88	3.11	25.76	0.43
Peru	7.75	8.28	59.00	0.56	1.23	3.19	-119.39	0.73
Philippines	9.56	9.19	82.83	0.19	16.33	10.39	80.80	1.69
Poland	8.04	8.43	76.90	0.25	0.81	2.02	-184.08	0.34
Romania	9.09	9.61	39.72	0.21	7.87	1.73	26.65	0.40
Russia	9.27	9.06	68.36	0.40	6.00	1.17	53.76	0.44
South Africa	8.31	8.71	80.24	0.34	3.71	5.56	90.66	0.07
Thailand	9.28	9.06	91.83	0.17	5.97	2.61	-234.48	2.36

Notes: This table reports results from the model simulation for all countries. In panel A we report results for the case in which countries are homogeneous with respect to the stochastic risk structure (i.e., they have the same Γ and Σ); in panel B for the case in which countries are instead heterogeneous with respect to the stochastic risk structure (i.e., they have different Γ_i and Σ_i). When countries are homogeneous, Γ and Σ are those of the *average* country. On the contrary, when countries are heterogeneous we construct Γ_i and Σ_i using the same procedure discussed in section 4.1, but using only data for country i . For each panel, the first column reports the fixed cost chosen to match the sample average fraction of L-bonds held by foreigners for each country i (ψ_i); the second column reports the average fixed cost expressed in annualized returns ($E(\tilde{\psi}_{it})$). Note that $\tilde{\psi}_{it}$ is time-varying, as it depends on the time-varying risk tolerance for the average country; the third column reports the R^2 for a model with fixed cost ψ_i with respect to a model with time-varying cost ψ_{it} chosen to match the observed fraction of L-bonds held by foreign investors; the fourth column reports the standard deviation of the time-varying cost. R^2 and $E(\tilde{\psi}_{it})$ are reported in percentages.

law. As suggested by the "original sin" literature (Eichengreen et al., 2007; Burger and Warnock, 2007), $\psi_{i,t}$ could be related to the lack of commitment by governments not to inflate away debt denominated in local currency. In order to further investigate the nature of the entry cost, we estimate a panel regression of the time-varying entry costs $\psi_{i,t}$, that we obtain from the model simulation for all countries, on the corresponding values of the Ease of Doing Business Index (henceforth DB Index), from the World Bank, which is also time-varying at annual frequency, and measures local regulations for businesses and protection of property rights and investors.

Results are reported in table 6. We find that costs are higher in countries, or periods, where, according to the DB Index, it is more difficult, or expensive, to do business and legal costs are higher because of weak protection of investors. Overall, the variations in the DB index explain about 18% of the time-series variation in entry costs. These results are robust to adding country and year fixed effects. Additionally, we do not find support for alternative interpretations, like the *de jure* financial openness, measured by the Chinn-Ito index (Chinn and Ito, 2006); measures of monetary policy commitment, measured by the monetary independence and exchange rate stability indices (Aizenman et al., 2008). As regarding to the interpretation of the coefficients, a reduction of 10 points of the DB Index, which, for example, corresponds to the distance between Poland (27th position in 2018) to Indonesia (72nd position in 2018), would translate in an increase in the model cost of entry of 0.7, which is approximately 25% of the maximum cross-country difference in entry cost (see table 5, panel A)

Forecasts. We first estimate the model with data up to 12/2017 and then simulate the model using as inputs: the realized U.S. 3-month Libor rate for the period 1/2018 to 12/2018; and the current expectations up to 3/2021 for the U.S. 3-month Libor taken from the Bloomberg survey of professional forecasters. The first panel of figure 9 plots the time series for the U.S. risk-free rate, and the shaded-pink area denotes the beginning of the forecast period in 1/2018. We consider two scenarios. In the first, we assume that risk tolerance ($\tau_{F,t}$) stays constant in the forecast period and equal to the last value in the estimation period in 12/2017 (red-dashed line); in the second, we assume that risk tolerance is time-varying, and estimated as function of the U.S. risk-free rate on the sample up to 12/2017 using the model (blue-dashed-dotted line). Panel 3 and panel 4 of figure 9 plot the simulated and forecast data for the fraction of L-bonds held by generalists and L-bond yield. When we feed to the model the increasing U.S. short-term rates, it predicts a sharp reduction in foreign holdings of L-bonds, unless the response is mitigated by a corresponding increase in investors' risk tolerance. As regards to the response of bond yields, the drop in the demand for L-bonds by generalists determines an increase in the L-bond (bottom panel) and F-bond yields,

Table 6: Explaining Costs (All Countries)

	(1)	(2)	(3)	(4)
Doing Business Index	-0.0360*** (-3.51)	-0.0349** (-3.22)	-0.0698* (-2.59)	-0.0725*** (-4.65)
Chinn-Ito Index				0.480 (0.86)
Monetary Independence				-0.224 (-0.93)
FX Stability				1.217 (1.92)
Country_FE		X	X	X
Year_FE			X	X
Observations	293	293	293	293
R-squared	0.0732	0.0732	0.176	0.268

t statistics in parentheses

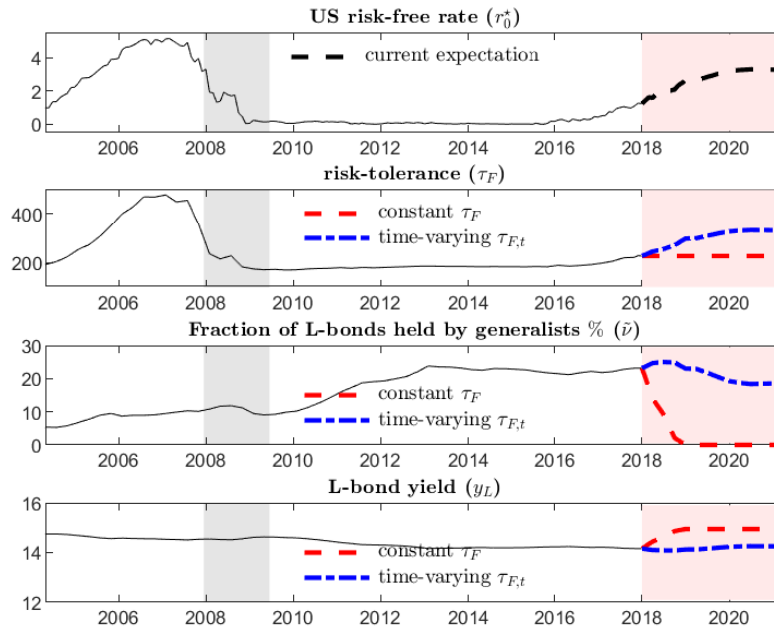
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table reports results from a panel estimation of the entry costs from the model simulation for all countries (homogeneous scenario) on the Ease to Do Business Index from the World Bank (2018); the Chinn-Ito index (Chinn and Ito, 2006); and the monetary independence and exchange rate stability indices (Aizenman et al., 2008). Data are from Datastream, the World Bank, and the simulation of the model for all countries for the period 4/2004–12/2017.

while the correlation between L- and F-bond returns drops.

Robustness. We investigate the robustness of our results with respect to several dimensions. First, we show that model parameters are robust to a different calibration period. Second, we show that a conditional unrestricted model with constant risk tolerance can qualitatively explain the dynamics of the entry of foreign investors. Third, we show that the simulated path of the risk tolerance required to match the fraction of L-bonds held by foreign investors follows the dynamics of the Vix volatility index, a standard proxy for the risk tolerance of foreign investors. Fourth, we show that a version of the unrestricted model conditional on all shocks can generate higher return volatility. Fifth, we explore the alternative hypothesis that changes in the foreign holdings of

Figure 9: Model Simulation (Forecast)



Notes: This figure plots the results of the conditional model simulation simulated using data up to 12/2017 to estimate the entry cost required to exactly match the share of local currency bonds held by foreign investors, and then additionally feeding U.S. short-term rates from 1/2018 to 3/2021. The gray shaded area denotes the last U.S. official NBER recession. The pink shaded area denotes the instead the out-of-sample period. Parameters are from table 3.

L-bonds depend on changes in country-specific characteristics, and in particular the reduction in exchange rate risk. In section C of the appendix we report the details of these robustness checks.

5 Conclusions

This paper interprets recent developments regarding the markets for local and foreign currency denominated government bonds issued by emerging countries with a simple model of partially segmented markets. While local investors specialize in local currency denominated bonds, foreign investors can either specialize in foreign currency denominated bonds, or choose to invest in both bonds, but only after paying a fee. First, our model explains the documented entry of foreign investors into the local currency sovereign bond market using a search for yield story. When short-term rates in developed countries are low, foreign investors look for investment opportunities in new markets, like the market for local currency sovereign bonds issued by emerging countries. Second, the model describes a possible channel to explain the observed increase in correlation between the returns of local and foreign currency denominated bonds, as well as the reduction in the average yields, as a result of the change in the investors' composition in the market for local currency bonds. Third, we use the calibrated model to study counterfactual scenarios for a panel of 16 emerging economies. The model predicts a large reduction in the foreign holdings of local currency bonds as a result of the expected increase in short-term rates in developed countries. We leave for future research the analysis of the implications for emerging economies of these large outflows of foreign capital, as well as the policy prescriptions to curb the possible negative effects. For example, our model could be used to study sudden stops.

References

- Aizenman, J., M. D. Chinn, and H. Ito. 2008. Assessing the emerging global financial architecture: measuring the trilemma's configurations over time. NBER Working Paper No. 14533.
- Alfaro, L., S. Kalemli-Ozcan, and V. Volosovych. 2008. Why doesn't capital flow from rich to poor countries? An empirical investigation. *The Review of Economics and Statistics* 90:347–368.
- Ang, A., and F. A. Longstaff. 2013. Systemic sovereign credit risk: Lessons from the US and Europe. *Journal of Monetary Economics* 60:493–510.
- Arellano, C. 2008. Default risk and income fluctuations in emerging economies. *American Economic Review* 98:690–712.
- Arslanalp, M. S., and M. T. Tsuda. 2014. *Tracking global demand for emerging market sovereign debt*. 14-39. International Monetary Fund.
- Becker, B., and V. Ivashina. 2015. Reaching for yield in the bond market. *The Journal of Finance* 70:1863–1902.
- Bekaert, G., and C. R. Harvey. 2000. Foreign speculators and emerging equity markets. *The Journal of Finance* 55:565–613.
- Borri, N. 2018. Local currency systemic risk. *Emerging Markets Review* 34:111–123.
- Borri, N., and K. Shakhnov. 2018. Global Risk in Long-Term Sovereign Debt.
- Borri, N., and A. Verdelhan. 2011. Sovereign Risk Premia.
- Burger, J. D., and F. E. Warnock. 2006. Local currency bond markets. NBER Working Paper No. 12552.
- Burger, J. D., and F. E. Warnock. 2007. Foreign participation in local currency bond markets. *Review of Financial Economics* 16:291–304.
- Burger, J. D., F. E. Warnock, and V. C. Warnock. 2018. Currency matters: Analyzing international bond portfolios. *Journal of International Economics* 114:376–388.
- Camanho, N., H. Hau, and H. Rey. 2018. Global Portfolio Rebalancing and Exchange Rates. NBER Working Paper No. 24320.
- Campbell, J. Y., and R. J. Shiller. 1988. Stock prices, earnings, and expected dividends. *The Journal of Finance* 43:661–676.

- Campbell, J. Y., and L. M. Viceira. 1999. Consumption and portfolio decisions when expected returns are time varying. *The Quarterly Journal of Economics* 114:433–495.
- Chinn, M. D., and H. Ito. 2006. What matters for financial development? Capital controls, institutions, and interactions. *Journal of Development Economics* 81:163–192.
- Choi, J., and M. Kronlund. 2017. Reaching for Yield in Corporate Bond Mutual Funds. *The Review of Financial Studies* 31:1930–1965.
- Coeurdacier, N., and H. Rey. 2013. Home bias in open economy financial macroeconomics. *Journal of Economic Literature* 51:63–115.
- Cooper, I., and E. Kaplanis. 1994. Home bias in equity portfolios, inflation hedging, and international capital market equilibrium. *The Review of Financial Studies* 7:45–60.
- Del Negro, M., D. Giannone, M. P. Giannoni, and A. Tambalotti. 2017. Safety, liquidity, and the natural rate of interest. *Brookings Papers on Economic Activity* 2017:235–316.
- Du, W., C. E. Pflueger, and J. Schreger. 2016. Sovereign debt portfolios, bond risks, and the credibility of monetary policy. NBER Working Paper No. 22592.
- Du, W., and J. Schreger. 2016. Local currency sovereign risk. *The Journal of Finance* 71:1027–1070.
- Eichengreen, B., R. Hausmann, and U. Panizza. 2007. Currency mismatches, debt intolerance, and the original sin: Why they are not the same and why it matters. In *Capital controls and capital flows in emerging economies: Policies, practices and consequences*, pp. 121–170. University of Chicago Press.
- Farhi, E., and I. Werning. 2012. Dealing with the trilemma: Optimal capital controls with fixed exchange rates. NBER Working Paper No. 18199.
- French, K. R., and J. M. Poterba. 1991. Investor diversification and international equity markets. NBER Working Paper No. 3609.
- Gabaix, X., and M. Maggiori. 2015. International liquidity and exchange rate dynamics. *The Quarterly Journal of Economics* 130:1369–1420.
- Gilchrist, S., V. Z. Yue, and E. Zakrajsek. 2018. US Monetary Policy and International Bond Markets. Finance and Economics Discussion Series 2018-014.
- Greenwood, R., S. G. Hanson, and G. Y. Liao. 2018. Asset price dynamics in partially segmented markets. *The Review of Financial Studies* 31:3307–3343.

- Greenwood, R., and D. Vayanos. 2014. Bond supply and excess bond returns. *The Review of Financial Studies* 27:663–713.
- Gromb, D., and D. Vayanos. 2002. Equilibrium and welfare in markets with financially constrained arbitrageurs. *Journal of Financial Economics* 66:361–407.
- Gromb, D., and D. Vayanos. 2010. Limits of arbitrage. *Annu. Rev. Financ. Econ.* 2:251–275.
- 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.
- Hanson, S. G. 2014. Mortgage convexity. *Journal of Financial Economics* 113:270–299.
- Hanson, S. G., and J. C. Stein. 2015. Monetary policy and long-term real rates. *Journal of Financial Economics* 115:429–448.
- Jeanneret, A., and S. Souissi. 2016. Sovereign defaults by currency denomination. *Journal of International Money and Finance* 60:197–222.
- Jeske, K. 2001. Equity home bias: Can information cost explain the puzzle? *Economic Review-Federal Reserve Bank of Atlanta* 86:31.
- Kealhofer, S. 2003. Quantifying credit risk I: default prediction. *Financial Analysts Journal* pp. 30–44.
- Longstaff, F. A., J. Pan, L. H. Pedersen, and K. J. Singleton. 2011. How sovereign is sovereign credit risk? *American Economic Journal: Macroeconomics* 3:75–103.
- Maggiori, M., B. Neiman, and J. Schreger. 2018. International currencies and capital allocation. NBER Working Paper No. 24673.
- Morelli, J. M., P. Ottonello, and D. Perez. 2019. Global Banks and Systemic Debt Crises.
- Paczos, W., and K. Shakhnov. 2016. Sovereign Debt Issuance and Selective Default. European University Institute Working Paper.
- Rigobon, R. 2002. Contagion: how to measure it? In *Preventing currency crises in emerging markets*, pp. 269–334. University of Chicago Press.
- Sercu, P., and R. Vanpée. 2008. Estimating the costs of international equity investments. *Review of Finance* 12:587–634.
- Vayanos, D., and J.-L. Vila. 2009. A Preferred-Habitat Model of the Term Structure of Interest Rates. NBER Working Paper No. 15487.

Appendix (not for publication)

A Data

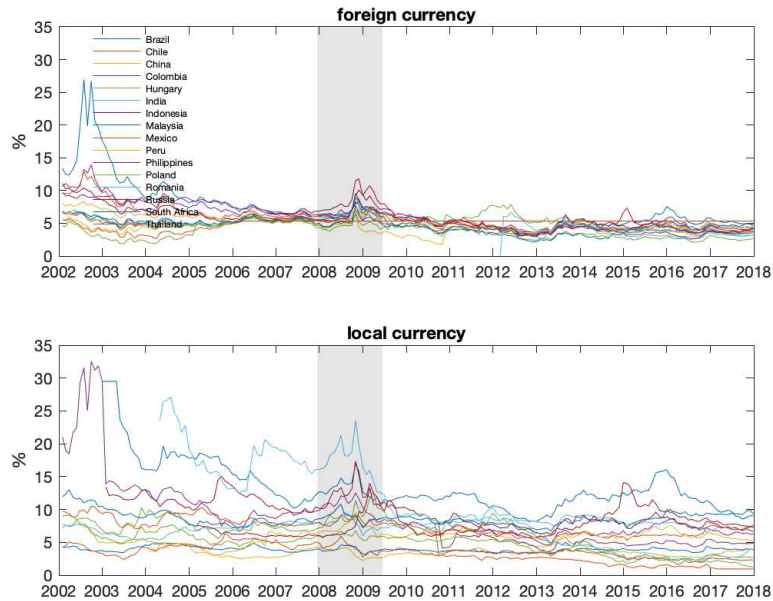
In this section, we provide details on the data construction and additional stylized facts on the emerging market countries considered in this paper. Section [A.I](#) presents additional details on the local and foreign currency government bond indices; section [A.II](#) presents additional details on the data on foreign holding shares; section [A.III](#) describes the construction of the global portfolio positions of U.S., European, and Japanese investors using the IMF CPIS database; section [A.IV](#) provides details on short-term interest rates in emerging and advanced economies; finally, section [A.V](#) provides details on the evolution of exchange rates between the emerging countries in our sample and the U.S. dollar.

A.I Emerging Bond Indices

We collect daily data of foreign and local currency denominated sovereign bond indices from J.P. Morgan for each emerging country in our sample. The countries in our sample are Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Perú, Philippines, Poland, Romania, Russia, South Africa, and Thailand. The sample starts 29/2/2002 and ends on 31/12/2017. Specifically, we use the J.P. Morgan EMBI+ indices for foreign currency denominated government bonds (mostly U.S. dollar denominated), and the J.P. Morgan GBI-EM Broad indices for local currency denominated government bonds. The family of J.P. Morgan Emerging Market Bond Indices (EMBI) was formed in the early 1990s after the issuance of the first Brady bonds and has become the most widely published and referenced index family of its kind. The J.P. Morgan GBI-EM indices track local currency bonds issued by emerging market governments and include all eligible countries regardless of capital controls and/or regulatory and tax hurdles for foreign investors.

Figure [A1](#) plots the evolution of the bond yields in local and foreign currency and table [7](#) presents additional descriptive statistics. On average, annual yields of local currency government bond indices are higher and more volatile than for foreign currency bonds. Specifically, the average yield is approximately equal to 7.2% for local currency government bonds, and 5.1% for foreign currency government bonds. The average volatilities are, respectively, equal to 2.3% and 1.4%. There are large differences in average yields across countries. For example, yields on foreign currency bonds can be as high as 7.2% for Brazil, and as low as 3.4% for India. Similarly, average yields on local currency bonds can be as high as 14.1% for Brazil, and as low as 3.5% for China. Figure [A1](#) indicates the high-degree of co-movement across emerging country foreign bond yields. Despite the large dispersion in average local bond yields, also, in this case, we observe a relatively high-degree of co-movement and, in particular, during the Great Recession.

Figure A1: Yields on Local and Foreign Currency Government Bonds



Notes: This figure plots the yield-to-maturities on the J.P. Morgan EMBI (top panel) and GBI-EM Broad (bottom panel) bond indices for the following countries: Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, and Thailand. The J.P. Morgan EMBI bond indices collect government bonds in foreign currency. The J.P. Morgan GBI-EM Broad bond indices collect government bonds in local currency. Yields are annual and reported in percentages. Data are daily from J.P. Morgan through Datastream for the period 2/2002–12/2017. The shaded area corresponds to the official NBER U.S. recession.

A.II Foreign Holding Shares

We build quarterly data on the shares of local and foreign currency bonds held by foreigners using data collected by [Arslanalp and Tsuda \(2014\)](#) for the period 2004:Q1–2017:Q4. We present foreign holding shares of foreign and local currency bonds in table 8 (panel A). We can summarize the information in the table as follows. First, on average, foreign holding shares of foreign currency bonds are larger than for local currency bonds. Second, there are large differences in foreign holding shares across countries and across currency of denomination. For example, for local currency bonds, average foreign holding shares can be as high as 33% for Peru and as low as 1% for China. Similarly, for foreign currency bonds, average foreign holding shares can be as high as 100% for India and Poland, and as low as 11% for China. Third, we observe countries in which the foreign holding shares of local and foreign currency bonds are similar, like Brazil (11.37% and 12.23% respectively) and countries where, at the contrary, are very different, like Chile (63.49% and 5.47% respectively). In addition, table 8 also presents data on the relative market size (panel B) of emerging country. The relative market size, for each country, is the ratio between the total value

Table 7: Government Bond Yields

	Mean	Std	Skewness	Kurtosis	AC(1)	obs	Mean	Std	Skewness	Kurtosis	AC(1)	obs
	EMBI (foreign currency)						GBI-Broad (local currency)					
Brazil	7.21	3.71	2.74	12.20	0.95	192	14.12	5.04	1.85	6.48	0.97	192
Chile	4.60	0.87	0.37	2.43	0.95	192	5.72	3.63	-0.02	1.39	0.99	192
China	4.14	0.80	-0.07	3.26	0.92	192	3.49	0.59	0.23	2.32	0.95	168
Colombia	6.09	2.09	1.14	4.26	0.97	192	9.54	5.04	2.82	11.77	0.95	192
Hungary	4.65	1.36	0.06	2.60	0.95	192	6.33	2.47	-0.44	2.44	0.97	192
India	3.42	0.75	1.59	4.83	0.91	63	7.61	0.87	-0.57	3.26	0.95	192
Indonesia	5.56	1.59	1.57	5.80	0.95	135	9.51	2.29	0.48	2.77	0.95	180
Malaysia	4.49	1.11	-0.02	2.39	0.95	192	3.91	0.37	0.76	3.31	0.90	192
Mexico	5.84	1.84	1.26	4.75	0.97	192	7.41	1.28	0.37	2.30	0.96	192
Peru	5.36	1.08	0.52	2.73	0.97	192	5.76	1.10	-0.14	3.59	0.95	186
Philippines	5.87	2.09	0.19	1.62	0.99	192	7.11	2.19	0.30	2.09	0.98	192
Poland	4.11	1.14	0.10	2.17	0.96	192	4.83	1.62	0.04	2.67	0.98	192
Romania	4.17	0.87	-0.69	10.01	0.54	71	10.27	6.72	0.53	2.16	0.99	165
Russia	5.67	1.72	0.98	3.62	0.97	192	7.76	1.79	1.37	4.65	0.94	155
South Africa	4.92	0.95	1.05	6.26	0.92	189	8.66	1.08	1.16	5.07	0.94	192
Thailand	4.98	0.71	-1.79	4.79	0.97	192	3.68	0.96	0.25	2.58	0.96	192
All countries	5.07	1.42	0.56	4.61	0.93	173	7.23	2.32	0.56	3.68	0.96	185

Notes: This table reports descriptive statistics of the monthly yields-to-maturity of the J.P. Morgan GBI-Broad local currency government bond indices, and the J.P. Morgan EMBI foreign currency government bond indices for the following countries: Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, and Thailand. Specifically, we report the mean (annualized and in percentage), the standard deviation (annualized and in percentage), the skewness, the kurtosis, the first order autocorrelation coefficient and the total number of available observations. Data monthly from J.P. Morgan and Datastream. The longest sample is 3/2002-12/2017. For some countries, the sample is the longest available.

of government securities held by local investors and the sum of the total value of government securities held by local and foreign investors across all emerging market countries. We observe large differences in the cross-country relative market size. For example, for Brazil is approximately 60%, while for Peru is less than 2%.

A.III IMF CPIS

The Coordinated Portfolio Investment Survey (CPIS) is a voluntary data collection exercise conducted under the auspices of the IMF that collects an economy's data on its holdings of portfolio investment securities. Data are separately requested for equity and investment fund shares, long- and short-term debt securities and all economies are encouraged to participate. CPIS provides a currency breakdown of investment assets for 54 countries from 2001 to 2018, including the U.S., Japan, and several European countries. Unfortunately, CPIS does not provide a currency break-

Table 8: Foreign Holding Shares, Relative Market Size

	Panel A: foreign holding shares (%)						Panel B: relative market size (%)
	foreign currency			local currency			local vis-a-vis total
	Min	Max	Mean	Min	Max	Mean	Mean
Brazil	5.37	33.54	12.23	1.46	20.27	11.37	59.47
Chile	48.56	85.63	63.49	3.14	12.00	5.47	3.54
China	1.61	100.00	11.69	0.00	3.93	0.98	59.75
Colombia	73.59	100.00	91.50	4.46	28.07	14.28	7.75
Hungary	75.54	100.00	89.30	17.26	43.65	29.04	6.92
India	NaN	NaN	NaN	0.12	4.36	1.63	41.99
Indonesia	67.93	100.00	88.24	1.63	40.02	24.59	8.74
Malaysia	63.11	100.00	94.81	2.14	35.74	20.31	11.36
Mexico	57.95	100.00	85.94	4.36	37.99	21.94	24.08
Peru	46.99	73.31	61.31	0.00	56.61	33.14	1.76
Philippines	40.22	100.00	66.47	0.00	10.97	4.99	10.28
Poland	97.33	100.00	99.70	13.33	41.89	27.43	15.49
Romania	42.12	78.91	66.33	5.45	22.35	16.46	2.85
Russia	25.43	83.53	53.64	0.12	30.84	9.44	11.92
South Africa	28.60	54.00	39.07	6.54	41.39	25.67	11.15
Thailand	10.59	34.96	17.54	0.50	18.30	8.87	10.38

Notes: This table presents information on foreign holding shares and default probabilities of emerging countries' sovereign bonds. Panel A reports the minimum, maximum and mean value of the foreign holdings share of the stock of sovereign bonds denominated in foreign and local currency for the following countries: Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, and Thailand. Data are quarterly from [Arslanalp and Tsuda \(2014\)](#) for the period 2004:Q1 – 2017:Q4. Note that for some countries data start after 2004:Q1. Panel B reports the relative market size of local investors. The relative market size of local investors is the ratio between the total value of government securities held by local investors and the sum of the total value of government securities held by local and foreign investors across all emerging market countries. Foreign holding shares are in percentages.

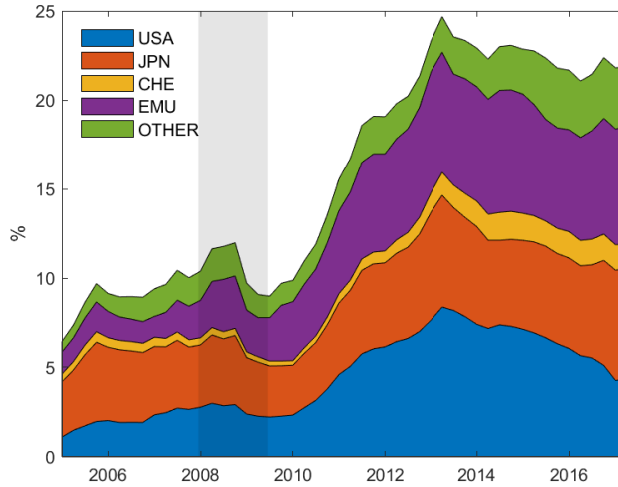
down for China, the U.K., and Gulf Countries. The currency breakdown is at the country level and covers different asset classes: equity, long-term and short-term debt securities. The currencies covered are not the same throughout the whole sample. In particular, at the beginning of the sample, the only currencies are the U.S. dollar, the euro, the Japanese yen, the British pound, and the Swiss franc, while the information corresponding to the remaining currencies is aggregated under a general category "other". In the more recent part of the sample, the Chinese renminbi and the Australian and Canadian dollar are included.

We want to build a measure of advanced economy holdings of local currency sovereign bonds of emerging countries. For the sake of illustration, consider investors in the U.S. and Brazilian local currency sovereign bonds (L-bonds). First, we obtain from CPIS the U.S. investor holdings of long-term debt securities denominated in the U.S. dollar, the euro, the Japanese yen, the British pound, and the Swiss franc, while the information corresponding to the remaining currencies

is aggregated under a general category "other". U.S. investor holdings denominated in "other" currencies aggregate investments in long-term debt securities denominated in different currencies, including the Brazilian real. Note that CPIS currency breakdown data are not bilateral, and there is no split in terms of sovereign and corporate debt securities. In fact, data are aggregated at the currency, rather than country level (for example, we assume that all bonds denominated in Brazilian real are issued by Brazilian entities). In addition, the long-term debt securities category includes both sovereign and corporate bonds. To build the U.S. holdings of Brazilian L-bonds, we additionally approximate the bilateral country positions in corporate and sovereign debt using data on the split in U.S. investor holdings of Brazilian sovereign and corporate bonds (both denominated in any currencies); and on the share of Brazilian long-term debt securities in the portfolio of Brazilian assets held by U.S. investors. Table 1 in the paper, and figure A2 summarize the information on advanced economy holdings of local currency sovereign bonds of emerging countries that we construct. Specifically, figure A2 plots the evolution of the average foreign holding shares of L-bonds for investors in the U.S., Japan, Switzerland, EMU countries, while the "other" category includes remaining countries for which we have data. We normalize the shares using data from Arslanalp and Tsuda (2014) on the foreign holding shares of L-bonds for our set of emerging countries. At the beginning of the sample, in 2004, most of the foreign holdings of L-bonds belonged to U.S. and Japanese investors. Over time, the relative importance of investors from EMU countries increased, while that of Japanese declined.

For our emerging countries, we also construct the foreign holdings shares of different asset classes. Specifically, we consider all domestic bonds (sovereign and corporate); sovereign bonds in local currency; sovereign bonds in foreign currency; and equity. In order to construct these shares, we start from CPIS data to obtain foreign holdings of equity and foreign holdings of debt securities; then, we use data from the BIS debt securities statistics to build the size of the domestic bond market for each country and from the World Federation of Exchanges to build the size of the domestic equity market for each country; finally, we include data from Arslanalp and Tsuda (2014) to build the shares of local and foreign currency sovereign bonds. For the sake of illustration, in figure A3 we plot these shares for a subset of our countries that includes Brazil; Russia; China; India; South Africa; and Mexico. We observe that foreign holdings shares of local currency bonds were low in all countries at the beginning of the sample, and lower than the shares in the other asset classes. Interestingly, since 2004, while the foreign holding shares of L-bonds increased in all countries, the foreign holding shares for the other asset classes did not increase, and, in fact, mostly decreased or did not change much, despite the recent increase in corporate bonds denominated in the issuer's home currencies, especially after the Great Recession (Hale et al., 2016).

Figure A2: Developed Country Investors in L-Bonds



Notes: This picture plots the average shares of L-bonds held by investors in developed countries. Shares are estimated starting with CPIS data. Investors are from the US, Japan, Switzerland, the European Monetary Union. Refer to section A.III for details on the construction of the shares. By construction the sum of the shares equals the average foreign holding share in L-bonds from Arslanalp and Tsuda (2014). The shaded area corresponds to the last NBER recession.

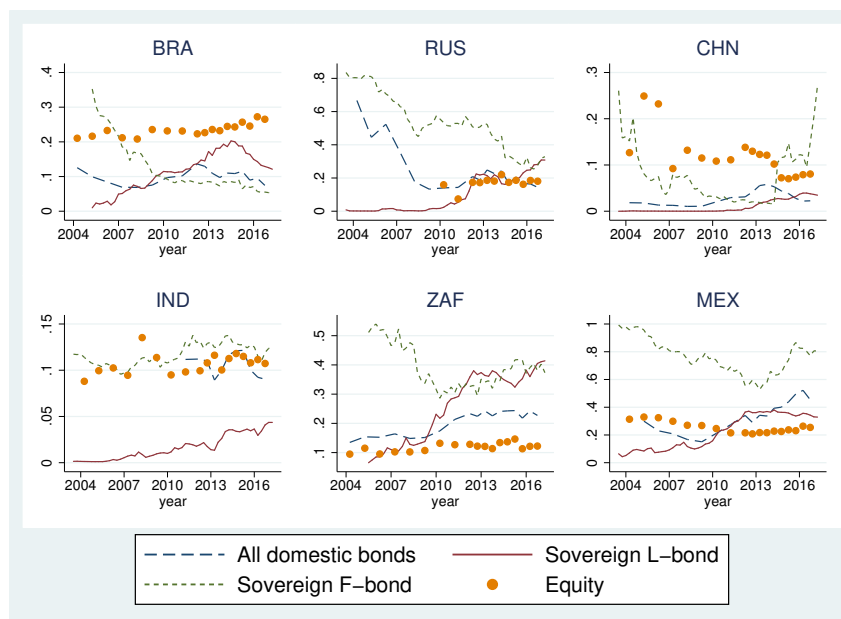
A.IV Risk-free Rates in Emerging and Advanced Economies

We collect daily data on spot exchange rates and 1-month forward rates from Barclays and WM/Reuters through Datastream; on interest rate yields for the U.S. benchmark 3-month Treasury Bill from Thomson Reuters. We construct the local currency risk-free rates for country i by assuming that the covered interest parity holds

$$r_t^i = f_t^i - s_t^i + r_t^{us} \quad (\text{A1})$$

where f and s are, respectively, the log forward and spot rates expressed in units of local currency of country i per one unit of foreign currency (i.e., the U.S. dollar), and r^{us} is the U.S. risk-free rate. Alternatively, we also directly collect local short-term rates from different sources. The average risk-free rates are similar between these two strategies. However, we prefer using risk-free rates derived from (A1), as the directly collected data, corresponds to different instruments for different countries (i.e., repo rates, short-term government yields, inter-bank rates, etc.). In table 9 we report the mean, standard deviation, maximum and minimum of the annualized short-term interest rates for each of the emerging countries in our sample constructed using the covered interest parity (panel A) and obtained from different local sources and with different definitions (panel B). We observe that, for each country, the mean and standard deviations are very similar

Figure A3: Foreign Holdings of Emerging Market Assets



Notes: This figure reports, for a selected sample of emerging markets, the evolution of foreign holding shares of all domestic bonds (including corporate bonds); sovereign L-bonds; sovereign F-bonds; and equity. Refer to section A.III for details on the construction of the shares and the data sources. The countries considered are Brazil (BRA); Russia (RUS); China (CHN); India (IND); South Africa (ZAF); and Mexico (MEX).

across the two measures.

In addition, we also collect interest rate yields for the 3-month Treasury bonds for the U.K., Japan, and Germany. Figure A4 plots the annual short-term interest rate yields for these three developed countries along with the U.S. rate for the sample 2/2002 to 12/2017. The figure shows that all interest rates increased on the onset of the Great Recession (denoted with a gray shaded area), then declined sharply during the Great Recession, and stayed at very low levels afterward. Note that German rates started to increase in 2011 but then reverted downward and became negative. Note that short-term rates for these countries are highly influenced by the interest rate setting decisions by central banks. Finally, starting in 2016, U.S. rates started to increase following the actions of the Fed, while the rates for the U.K., Germany, and Japan stayed close to zero (or were even negative, as for Germany). Note that real interest rates have been declining globally since the 1980s. The 2008-2009 drop of nominal (and real, given the low inflation rates) interest rates was particularly large and specific for some advanced economies, such as the US, the EMU, and the UK (Del Negro et al., 2017). In fact, in section A.III we show that changes in the holdings of U.S. and European, but not Japanese, investors account for most of the increase in total foreign holdings of local currency bonds of emerging markets.

Table 9: Short-term Rates in Emerging Economies

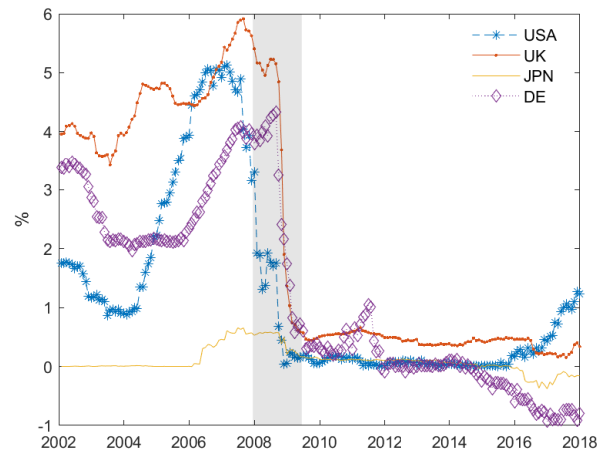
	Panel A: CIP				Panel B: Alternative			
	Mean	Std	Max	Min	Mean	Std	Max	Min
Brazil	10.79	1.66	36.11	-6.28	13.38	4.38	26.32	6.90
Chile	3.46	2.22	24.84	-18.08	3.79	1.68	8.38	0.36
China	1.02	0.81	12.65	-11.81	2.74	1.16	8.13	0.94
Colombia	4.52	2.53	33.01	-34.32	5.89	1.94	10.01	2.97
Hungary	4.70	2.65	37.11	-43.55	5.00	3.23	11.50	-0.15
India	6.00	0.69	12.55	-1.23	6.97	1.03	9.00	4.75
Indonesia	6.39	0.73	21.87	3.36	4.80	0.38	5.50	4.25
Malaysia	2.46	0.21	3.49	-3.16	2.95	0.38	3.51	1.99
Mexico	5.95	1.33	19.73	-8.00	5.32	1.76	9.50	3.00
Peru	3.45	0.82	18.44	-8.94	3.77	1.11	7.18	1.14
Philippines	3.86	0.73	9.18	-2.10	5.11	1.60	7.75	3.00
Poland	3.65	0.58	10.44	0.28	3.45	1.52	6.60	1.22
Romania	5.74	1.46	20.32	-0.80	8.41	7.58	35.81	0.25
Russia	7.76	2.20	62.35	0.80	7.74	2.70	17.00	5.00
South Africa	7.81	0.65	14.25	4.63	6.79	2.02	11.87	4.73
Thailand	2.41	0.59	16.48	0.14	2.01	0.68	3.48	1.13

Notes: This table report mean, standard deviation, maximum and minimum of the annualized short-term interest rates for each of the emerging countries in our sample. Panel A reports short-term rates based on the assumption that the covered interest parity (CIP) holds: $r_t^i = f_t^i - s_t^i + r_t^{US}$, where f and s are, respectively, the log forward and spot rates expressed in units of local currency per one unit of foreign currency (i.e., the U.S. dollar). Panel B reports short-term rates based on different local sources and definitions, like, repo rates, short-term government yields, and inter-bank rates. Data are monthly for the sample 1/2002 to 12/2017. Interest rates are reported in percentages.

A.V Exchange Rates

We summarize the evolution of the exchange rates between the currencies of the emerging countries in our sample and the U.S. dollar by constructing a measure of the value of the U.S. dollar relative to the basket of emerging country currencies (with equal weights). We refer to this measure as the “Dollar Index”. We plot the Dollar Index in figure A5 (top panel), along with two measure of average exchange rate volatility. Specifically, we report both the time-varying volatility of the log changes in the Dollar Index, and the average time-varying volatility of the log changes in the exchange rates for the 16 emerging countries in our panel. First, we observe that prior to the Great Recession emerging country currencies gradually appreciated vis-a-vis the U.S. dollar; during the Great Recession, emerging country currencies sharply depreciated; then, gradually recovered up to 2012; finally, sharply depreciated in the period from 2014 to 2016. The sharp depreciation

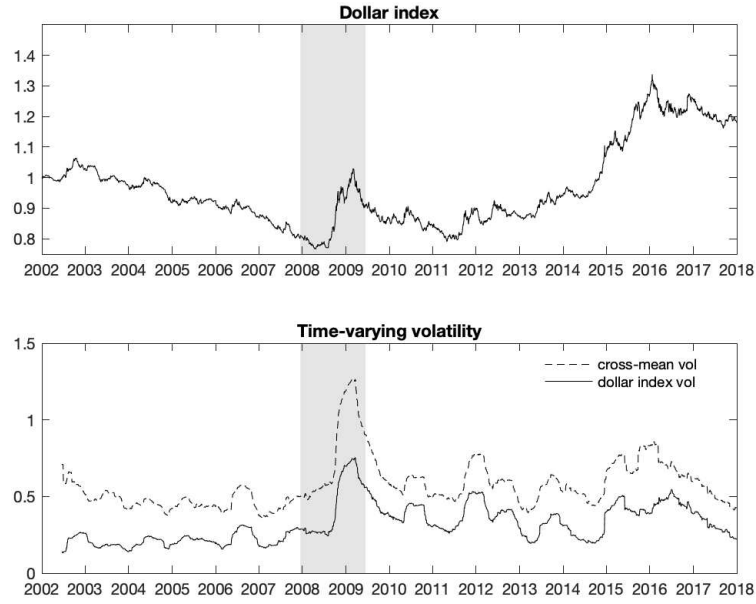
Figure A4: Short-term Rates in Developed Countries



Notes: This figure plots the yield-to-maturity on 3-month benchmark Treasury bonds for the U.S., the U.K., Japan, and Germany. Data are monthly from Datastream for the period 2/2002–12/2017. The shaded area corresponds to the official NBER U.S. recession.

between 2014 and 2016 contributes to the decoupling of total cumulative returns for local and foreign currency bond returns that we describe in figure 3. These swings in emerging country currencies exchange rate might be related to the changes in the foreign flows in local currency bonds (see for example [Gabaix and Maggiori \(2015\)](#)). We leave for future research further analysis of this possibility. We also collect credit ratings, issued by Standard & Poor's (henceforth S&P), for long-term government bonds denominated in local and foreign currency from Bloomberg. We converted letter ratings into annual default probabilities using the transition matrix in [Kealhofer \(2003\)](#) and assuming zero recovery rate in case of default. Panel B of table 10 presents these default probabilities, for the emerging countries in our sample, for two periods. The first is the period that goes from 2002:Q2 to 2009:Q2, in which the foreign holding shares of local currency bonds were small in most countries. The second is the period that goes from 2009:Q2 to 2017:Q4, in which foreign holding shares of local currency bonds are higher. We take the second period as a time of higher integration between the local and foreign currency bond markets. We can summarize the information presented in Panel B as follows. First, on average, default probabilities on foreign currency denominated bonds are higher than for local currency denominated bonds. This is explained by the observation that while government can monetize local currency denominated debt, they do not have the same option for foreign currency denominated debt and are more likely to choose to default when they cannot (or do not want to) repay it. Second, default probabilities are higher, on average, in the pre-2009:Q2 period, reflecting the higher default risk during the Great Recession.

Figure A5: Dollar Index



Notes: This figure plots Dollar Index (top panel) and time-varying exchange rate volatility (bottom panel). We report both the time-varying volatility of the log changes in the Dollar Index, and the average time-varying volatility of the log changes in the exchange rates for the 16 emerging countries in our panel. Data are daily from Datastream for the period 2/2002–12/2017. The shaded area corresponds to the official NBER U.S. recession.

B Model

In this section, we present additional results and derivations of the model discussed in section 3 of the paper.

B.I Restricted model

Combining (7)–(9) we get an expression for the excess holding period return for foreign investors

$$\begin{aligned}
 E_t[r_{L,t+1}^{e,\star}] = & \underbrace{\tau_F^{-1} \left(\frac{\theta_L}{1 - \rho_{r^*} \theta_L} \sigma_{r^*} \right)^2}_{\text{interest rate risk premium}} q_{L,t} + \underbrace{\tau_F^{-1} \left(\frac{1}{1 - \rho_{z_L} \theta_L} \sigma_{z_L} \right)^2}_{\text{credit risk premium}} q_{L,t} + \\
 & + \underbrace{\tau^{-1} \left(\frac{1}{1 - \rho_{\Delta s} \theta_L} \sigma_{\Delta s} \right)^2}_{\text{exchange rate risk premium}} q_{L,t} + \underbrace{\left(\tau_F^{-1} \frac{\theta_L}{1 - \rho_{q_L} \theta} \sigma_{q_L} \right)^2 (V_L^*)^2}_{\text{supply risk premium}} q_{L,t}
 \end{aligned} \tag{A2}$$

Table 10: Exchange Rates and Default Probabilities in Emerging Economies

	Panel A: exchange rate				Panel B: default probabilities			
	Mean	Std	Max	Min	foreign currency		local currency	
					Pre-2009:Q2	Post-2009:Q2	Pre-2009:Q2	Post-2009:Q2
Brazil	0.18	5.14	25.37	-14.87	1.13	0.39	0.39	0.28
Chile	-0.03	3.29	18.53	-6.99	0.07	0.05	0.02	0.02
China	-0.13	0.63	2.68	-2.09	0.13	0.04	0.09	0.08
Colombia	0.14	3.83	13.08	-11.20	0.47	0.24	0.17	0.12
Hungary	-0.04	4.26	20.08	-10.75	0.10	0.38	0.08	0.12
India	0.15	2.23	8.30	-7.14	0.44	0.18	0.32	0.31
Indonesia	0.14	2.72	14.49	-9.82	4.59	0.42	3.39	0.35
Malaysia	0.03	2.03	9.37	-7.49	0.11	0.07	0.07	0.06
Mexico	0.40	3.03	16.03	-7.28	0.25	0.15	0.08	0.08
Peru	-0.03	1.53	4.85	-5.74	0.68	0.17	0.33	0.31
Philippines	-0.02	1.60	4.00	-3.57	0.69	0.40	0.24	0.35
Poland	-0.07	4.10	16.03	-9.47	0.11	0.07	0.07	0.08
Romania	0.11	3.37	14.43	-10.65	2.08	0.35	1.15	0.18
Russia	0.33	4.10	19.29	-12.90	3.66	0.26	1.43	0.07
South Africa	0.02	4.81	17.35	-11.51	0.20	0.22	0.07	0.06
Thailand	-0.16	1.63	4.26	-5.19	0.20	0.12	0.08	0.08

Notes: Panel A report the monthly means, standard deviations, maximum and minimum values for the growth rate in the exchange rates between the currencies of the emerging countries in our sample vis-a-vis the U.S. dollar. Data are monthly, in percentages, from Thomson Reuters for the sample 1/2002 to 12/2017. Panel B reports annual default probabilities for sovereign bonds denominated in foreign and local currency for the periods 2002:Q2 to 2009:Q2 and 2009:Q2 to 2017:Q4. Default probabilities are constructed converting S&P letter credit ratings on long-term sovereign debt in foreign and local currency into default realizations using the transition matrix in Kealhofer (2003) and assuming zero recovery rate. S&P credit ratings are from Bloomberg. Default probabilities are in percentages

Note how the supply shocks q_L multiply each of the four terms in equation (A2). All the components of total risk premium move together in the restricted model. For a given level of the supply, the expected excess returns are larger the higher the variances of the risk factors, and the lower is the risk tolerance of investors.

B.II Unrestricted model

In this section we present the derivations for the unrestricted model with two risky assets. There are nine exogenous risk factors, including two risk-free rates, one in foreign ($r_{0,t+1}^*$) and one in local currency $r_{0,t+1}$, two default processes $z_{L,t}$ for the L-bond and $z_{F,t}$ for the F-bond, two inflation rates, one foreign (π_t^*) and one local (π_t), two supply shocks for $q_{L,t}$ and $q_{F,t}$ and the exchange rate shock Δs_t . We assume they are driven by orthogonal shocks $\mathbf{x}_{t+1} = \Gamma \mathbf{x}_t + \boldsymbol{\epsilon}_{t+1}$. As in the restricted

model, we conjecture the equilibrium objects as an affine function of states. This time we need to conjecture four equilibrium objects: two yields and two generalist demands for the L- and F-bonds are *linear* functions of a state vector. In the presence of supply shocks, a solution only exists if investors are sufficiently risk tolerant (i.e., for τ_i large, $i = L, F$). Formally, we conjecture that the long-term yields in market for the two bonds are

$$y_{L,t} = \alpha_{L,0} + \boldsymbol{\alpha}'_L \mathbf{x}_t, \quad (\text{A3})$$

$$y_{F,t}^* = \alpha_{F,0} + \boldsymbol{\alpha}'_F \mathbf{x}_t, \quad (\text{A4})$$

the demands of generalists are

$$d_{L,t} = \delta_{L,0} + \boldsymbol{\delta}'_L \mathbf{x}_t, \quad (\text{A5})$$

$$d_{F,t} = \delta_{F,0} + \boldsymbol{\delta}'_F \mathbf{x}_t, \quad (\text{A6})$$

In addition, even though we have only two assets, we have to keep track of three conditional variances, which corresponds to three excess returns (12-14) and one covariance between two conditional excesses returns for foreign investors (13-14).

B.III Specialists demands

Combining equation (12) and the conjecture of equilibrium yield from equation (A3), we have

$$r_{L,t+1}^e = (\alpha_{L,0} - \bar{r}_0 - \bar{z}_L) + \left(\frac{1}{1 - \theta_L} \boldsymbol{\alpha}_L - \mathbf{e}_r \right)' \mathbf{x}_t - \left(\frac{\theta_L}{1 - \theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)' \mathbf{x}_{t+1}. \quad (\text{A7})$$

where \mathbf{e}_1 is a selection vector of zeros and ones. It contains a “one” in the position corresponding to states from extra terms of excess returns (12-14). For example, in the vector \mathbf{x}_t the local risk-free rate r_0 is in the fifth position. In this case, \mathbf{e}_r is a vector of all zeros, with the exception of a 1 in the fifth position. Note that the inflation term does not show up directly in the expression of excess returns as real excess returns are identical to nominal excess returns. However, inflation risk might directly affect nominal yields, and therefore indirectly both nominal and real excess returns. However, given our assumption of diagonal Γ , inflation risk does not affect neither bond yields nor excess bond returns.

From (A7) we have

$$E_t[r_{L,t+1}^{e,*}] = (\alpha_{L,0} - \bar{r} - \bar{z}_L) + \left(\frac{1}{1 - \theta_L} \boldsymbol{\alpha}_L - \mathbf{e}_r \right)' \mathbf{x}_t - \left(\frac{\theta_L}{1 - \theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)' \Gamma \mathbf{x}_t,$$

and

$$V_L \equiv Var_t[r_{L,t+1}^e] = \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)' \Sigma \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right). \quad (\text{A8})$$

The demand for the L-bond from the investors specialized in the local currency bond market is then

$$b_{L,t} = \tau_L \frac{E_t[r_{L,t+1}^e]}{V_L} = \left[\frac{\alpha_{L,0} - \bar{r} - \bar{z}_L}{\left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)' \Sigma \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)} \right] + \left[\frac{\left(\frac{1}{1-\theta_L} \boldsymbol{\alpha}_L - \mathbf{e}_r \right)' - \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \Gamma}{\left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)' \Sigma \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} \right)} \right] \mathbf{x}_t \quad (\text{A9})$$

We proceed in a similar way for foreign specialists in the F-bond, who face different default (z_F) and interest rate risk (r_0^*). Given the conjecture form of equilibrium yields we have

$$r_{F,t+1}^{e,*} = (\alpha_{F,0} - \bar{r}^* - \bar{z}_F) + \left(\frac{1}{1-\theta_F^*} \boldsymbol{\alpha}_F - \mathbf{e}_{r^*} \right)' \mathbf{x}_t - \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \mathbf{x}_{t+1}. \quad (\text{A10})$$

Therefore, the expected excess return on the F-bond are

$$E_t[r_{F,t+1}^{e,*}] = (\alpha_{F,0} - \bar{r}^* - \bar{z}_F) + \left(\frac{1}{1-\theta_F^*} \boldsymbol{\alpha}_F - \mathbf{e}_{r^*} \right)' \mathbf{x}_t - \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \Gamma \mathbf{x}_t, \quad (\text{A11})$$

and the variance of excess return is

$$V_F^* \equiv Var_t[r_{F,t+1}^{e,*}] = \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \Sigma \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right), \quad (\text{A12})$$

The demand for the F-, the portfolio of long-term bonds denominated in foreign currency, from the investors specialized in the market for foreign currency denominated bond is then

$$b_{F,t} = \tau_F \frac{E_t[r_{F,t+1}^{e,*}]}{V_F^*} = \left[\frac{\alpha_{F,0} - \bar{r}^* - \bar{z}_F}{\left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \Sigma \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)} \right] + \left[\frac{\left(\frac{1}{1-\theta_F^*} \boldsymbol{\alpha}_F - \mathbf{e}_{r^*} \right)' - \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \Gamma}{\left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \Sigma \left(\frac{\theta_F^*}{1-\theta_F^*} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)} \right] \mathbf{x}_t \quad (\text{A13})$$

Below we define the mean excess returns and conditional variance for foreign investors who invest in the L-bond. These conditions are used to solve the problem of foreign generalists that

we discuss in the next section. The excess returns and the variance are similar to those derived for the local investors, with the exception of exchange rate risk.

$$E_t[r_{L,t+1}^{e,\star}] = (\alpha_{L,0} - \bar{r}^\star - \bar{z}_L - \Delta\bar{s}) + \left(\frac{1}{1-\theta_L} \boldsymbol{\alpha}_L - \mathbf{e}_{r^\star} \right)' \mathbf{x}_t - \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \boldsymbol{\Gamma} \mathbf{x}_t,$$

and

$$V_L^\star \equiv \text{Var}_t[r_{L,t+1}^{e,\star}] = \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \boldsymbol{\Sigma} \left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right). \quad (\text{A14})$$

B.IV Generalist demand

The generalists solve the maximization problem in equation (15). In the discussion of the problem of specialists we have derived the expressions for the expected excess returns and the conditional variances for the two risky assets from the point of view of foreign investors. In order to complete the description of the problem of generalists, we only need to derive the expression for the conditional correlation (16)

$$\text{Cov}_t[r_{L,t+1}^{e,\star}, r_{F,t+1}^{e,\star}] = \text{Cov}_t \left[\left(\frac{\theta_L}{1-\theta_L} \boldsymbol{\alpha}_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \mathbf{x}_{t+1}, \left(\frac{\theta_F^\star}{1-\theta_F^\star} \boldsymbol{\alpha}_F + \mathbf{e}_{z_F} \right)' \mathbf{x}_{t+1} \right] \quad (\text{A15})$$

Note that as long as the state variables are orthogonal, default or exchange rate risks have a direct impact on the variances of two risky assets, but no direct impact on the conditional covariance (A15). Hence, any increase in the variance for any of these shocks reduces the correlation between the excess returns for two assets.

Similarly to the expression (16), we determine the correlation between L-bond returns in local currency and F-bond returns in foreign currency (ω), which we use in the quantitative section

$$\omega = \frac{\text{Cov}_t[r_{L,t+1}^e, r_{F,t+1}^{e,\star}]}{\sqrt{V_F^\star} \sqrt{V_L}} \quad (\text{A16})$$

We now derive the coefficients for our conjectures of the demands for generalist investors using the conjectures for the yields (A3)–(A4). Given our conjectures, the generalist demands will take the following affine forms. We start with the constant terms

$$\delta_{L,0} = \frac{\tau_F}{(1-\omega^\star)^2 \sqrt{V_L^\star V_F^\star}} \left[\sqrt{\frac{V_F^\star}{V_L^\star}} (\alpha_{L,0} - \bar{r}^\star - \bar{z}^A - \Delta\bar{s}) - \omega^\star (\alpha_{F,0} - \bar{r}^\star - \bar{z}_F) \right] \quad (\text{A17})$$

$$\delta_{F,0} = \frac{\tau_F}{(1 - \omega^*)^2 \sqrt{V_L^* V_F^*}} \left[\sqrt{\frac{V_L^*}{V_F^*}} (\alpha_{F,0} - \bar{r}^* - \bar{z}_F) - \omega^* (\alpha_{L,0} - \bar{r}^* - \bar{z}^A - \Delta \bar{s}) \right] \quad (\text{A18})$$

In order to provide intuition for equations (A17) and (A18) we consider, as an example, the demand for generalists of the L-bond. Their demand is similar to the demand for specialists, in the sense that depends positively on expected returns and negatively on their variance. However, the expected returns are now weighted by a measure of relative variance ($\sqrt{\frac{V_L^*}{V_F^*}}$) and by the correlation with the second risky assets (ω^*). Intuitively, the higher the risk of the F-bond, the higher the demand for the L-bond. For any level of the expected return on the F-bond, the higher the correlation the lower the demand for the L-bond.

The loadings on the risk factors are

$$\delta'_L = \frac{\tau_F}{(1 - \omega^*)^2 \sqrt{V_L^* V_F^*}} \left(\begin{array}{l} \sqrt{\frac{V_F^*}{V_L^*}} \left[\left(\frac{1}{1-\theta_L} \alpha_L - \mathbf{e}_{r^*} \right)' - \left(\frac{\theta_L}{1-\theta_L} \alpha_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \Gamma \right] \\ -\omega^* \left[\left(\frac{1}{1-\theta_F^*} \alpha_F - \mathbf{e}_{r^*} \right)' - \left(\frac{\theta_F^*}{1-\theta_F^*} \alpha_F + \mathbf{e}_{z_F} \right)' \Gamma \right] \end{array} \right) \quad (\text{A19})$$

$$\delta'_F = \frac{\tau_F}{(1 - \omega^*)^2 \sqrt{V_L^* V_F^*}} \left(\begin{array}{l} \sqrt{\frac{V_L^*}{V_F^*}} \left[\left(\frac{1}{1-\theta_F^*} \alpha_F - \mathbf{e}_{r^*} \right)' - \left(\frac{\theta_F^*}{1-\theta_F^*} \alpha_F + \mathbf{e}_{z_F} \right)' \Gamma \right] \\ -\omega^* \left[\left(\frac{1}{1-\theta_L} \alpha_L - \mathbf{e}_{r^*} \right)' - \left(\frac{\theta_L}{1-\theta_L} \alpha_L + \mathbf{e}_{z_L} + \mathbf{e}_{\Delta s} \right)' \Gamma \right] \end{array} \right) \quad (\text{A20})$$

The interpretation of equations (A19) and (A20) is similar to that of the constant terms. However, the expressions now contain terms that depend on the autoregressive structure of the risk factors.

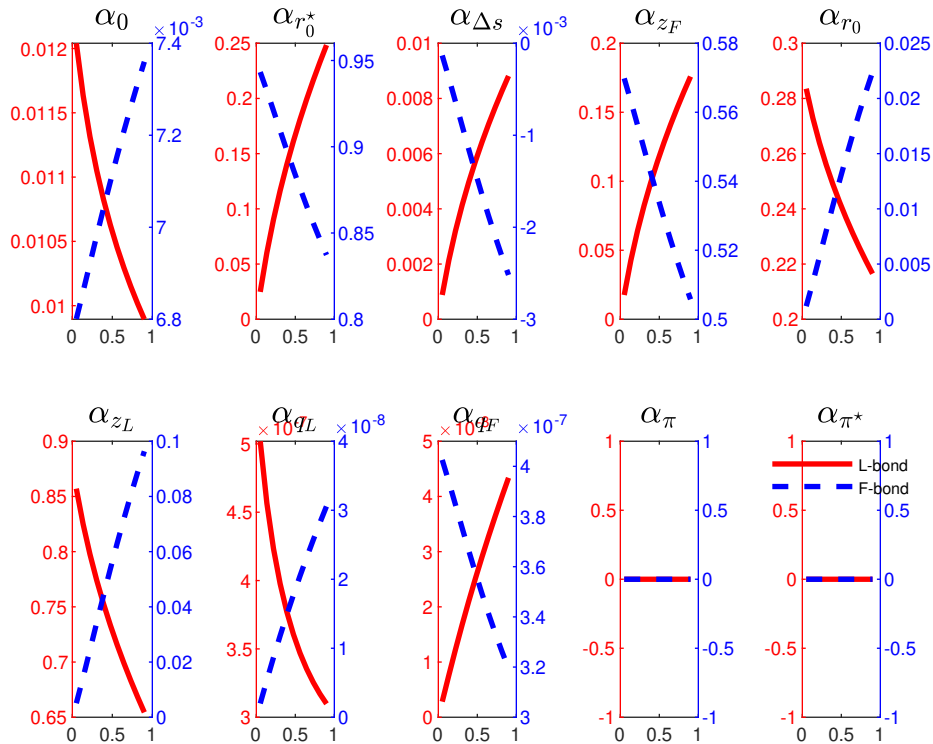
B.V Solving the equilibrium

Solving the model involves finding a solution to a system of 40 linear quadratic equations (20 market-clearing conditions and the expressions from the solution of the optimization problem of generalist investors) in 40 unknowns. For each of the two yields we need to determine 10 coefficients (9 loadings on the risk factors plus a constant); for each demand by generalists we also need to determine 10 coefficients (9 loadings on the risk factors plus a constant). This problem typically has multiple solutions. We refer to [Greenwood et al. \(2018\)](#) for a detailed discussion of the selection criterion for a non-explosive solution. To solve the problem, we first derive the closed-form solution for the restricted model. Then, we use this solution as the initial guess for

the unrestricted model. The loading on exchange rate risk follows the same pattern of foreign risk factors, as it directly affects only foreign investors. Note that the constant α_0 is the unconditional mean yield. When the number of generalists increases, the overall demand for the L-bond increases, its price increases, and its yield declines.

In figure A6 we plot the loadings of the yields of the L-bond (red solid line, left axis) and F-bond (blue-dashed line, right axis) as a function of the fraction of generalists (ν). The loadings are the elements of the vector α and the constant (α_0) from equation (9) applied to the L- and F-bond. As the fraction of generalists increases, the L-bond's loadings decline with respect to local risk factors, while increase with respect to the foreign risk factors. For the F-bond, the loadings decline with respect to foreign risk factors and increase with respect to the local risk factors. The local (foreign) risk factors are the risk factors that affect the local (foreign) bond market in the restricted model. Note how the loadings on the local and foreign inflation are constant at zero. This is because our assumption of diagonal Γ implies that inflation risk affects neither bond yields nor excess bond returns.

Figure A6: Risk Factors Loadings (Yields)

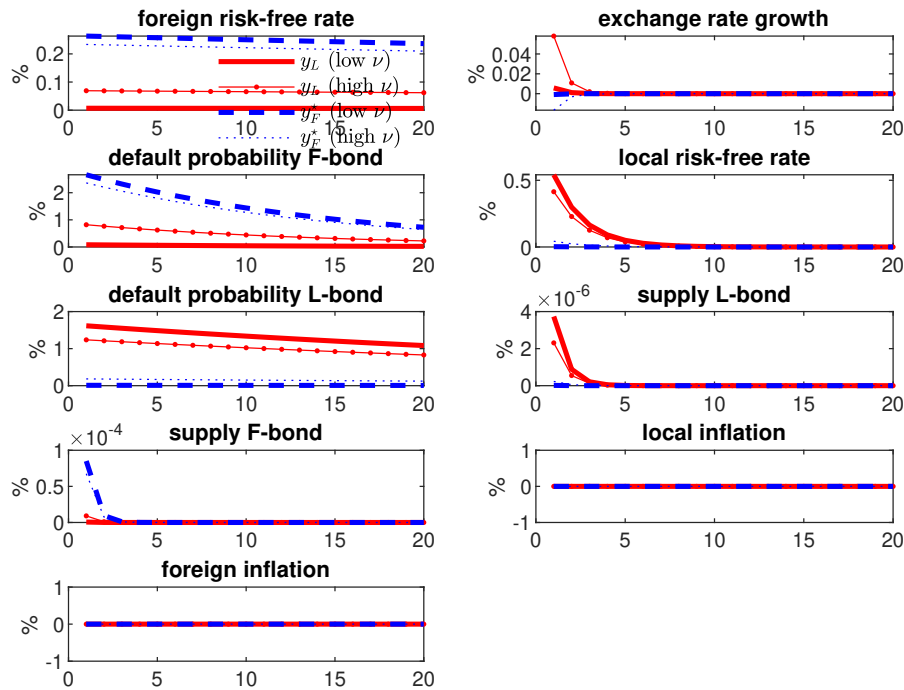


Notes: This figure plots the loadings of the yields of the L-bond (red solid line, left axis) and F-bond (blue-dashed line, right axis) as a function of the fraction of generalists (ν). The loadings are the elements of the vector α and the constant from equation (9) applied to the L- and F-bond. Parameters are from table 3.

In figure A7 we plot the impulse responses for the bond yields with respect to shocks to all

the risk factors to complement the results presented in figure 6 in the paper. The blue lines denote foreign currency bonds, while the red lines local currency bonds. We distinguish between the case in which the fraction of generalists (ν) is high or low. All the parameters are those presented in section 4.1 and table 3 for the average country. Note how shocks to the local risk-free rate and L-bond supply affect mostly the yield of the L-bond, while shocks to the supply of the F-bond affect mostly the yield of the F-bond. The higher the fraction of generalists, the larger the spillover across markets. Finally, as discussed in the paper, shocks to local and foreign inflation have no impact on the yields because of our assumption of diagonal Γ .

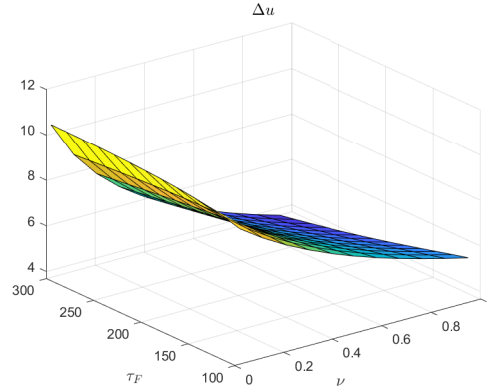
Figure A7: Impulse Responses (Bond Yields, All Shocks)



Notes: This figure plots the impulse responses of yields on the local and foreign currency bonds with respect to shocks to all the risk factors. The blue lines denote foreign currency bonds, while the red lines local currency bonds. We distinguish between the case in which the fraction of generalists (ν) is high or low. All the parameters are those presented in section 4.1 and table 3 for the average country. All moments are annualized and in percentage.

In order to study the endogenous entry of foreign investors in the model, we first look at the difference in the utility of generalists and specialists in asset F . Figure A8 shows that the additional utility of generalists is higher the larger is their number. For a given fraction of generalists, an increase in the risk tolerance causes the utility to decline because of the increase in correlation between bond returns. To keep the same level of utility, a larger number of specialists in F must become generalists. By changing the fixed entry cost, we can obtain any level for the fraction of generalists.

Figure A8: Endogenous Entry



Notes: This figure plots the difference in the utility levels of generalists and specialists in asset F (Δu) for different values of the fraction of generalists (ν) and risk tolerance (τ_F). Parameters are from table 3.

B.VI Entry cost

In the unrestricted model, we allow foreign specialists to enter the market for L-bonds and become foreign generalists. Equation (19) describes the entry condition and equates the endogenous utility benefit to becoming a generalist to the exogenous entry cost (ψ). It is convenient to also express the entry cost in terms of returns using the following transformation

$$\tilde{\psi}_t = \sqrt{\psi_t \frac{2V_L^*}{\tau_{F,t}}} \quad (\text{A21})$$

C Quantitative Analysis

In this section we report additional quantitative results and robustness checks to support our results of section 4.

Different calibration sample The calibration period we use in the paper ends on 6/2009, before the documented significant increase in foreign holdings of L-bonds. Table 11 reports the model parameters obtained in a longer calibration period, which ends on 12/2017. Overall, we find small changes in the parameters. Both foreign and local risk-free rates and inflation rates are slightly lower. In addition, while in the shorter calibration period the average exchange rate growth is negative (i.e., average U.S. dollar depreciation), it is positive in the longer calibration period (i.e., average U.S. dollar appreciation).

Table 11: Model Calibration (Long Calibration Sample)

	Panel A: risk factors					Panel B: other parameters						
	estimated					calibrated				calibrated		
Moments	r_0	r_0^*	Δs	π	π^*	z_L	z_F	q_L	q_F	Names	L	F
E_x	0.42	0.10	0.06	0.39	0.18	0.04	0.07	787.98	432.99	τ	179.88	246.01
ρ_x	0.61	0.99	0.08	0.96	0.95	0.99	0.94	0.16	0.14	θ	0.84	0.90
σ_x	0.27	0.02	3.00	0.05	0.05	0.17	0.34	0.02	1.56	n	0.26	0.74

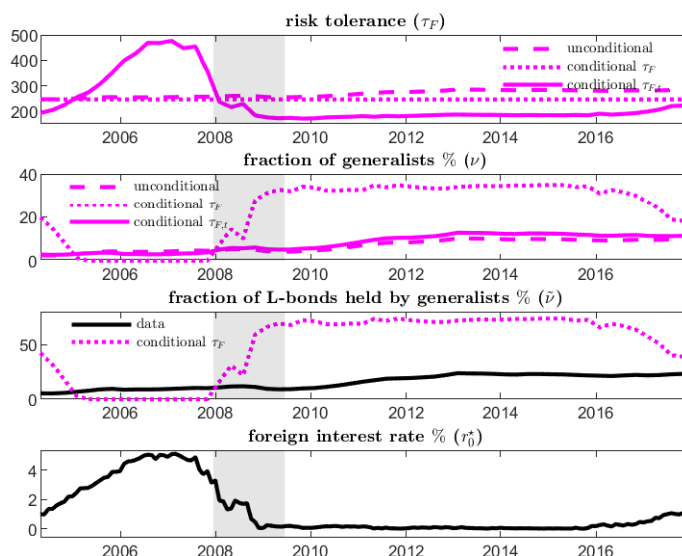
Notes: The table report all the parameters of the unrestricted model, for the average country, calibrated at the monthly frequency. We obtain parameters by direct estimation and by matching several target moments for the average country for the sample from 1/2002 to 12/2017. We report the unconditional mean, the persistence parameter, and the volatility for each of the nine risk factors (panel A), and for the risk tolerance, bond maturity, and market size (panel B). In panel A, with the exception of the bond supplies, we report mean and volatilities in percentages. Data are from various sources and discussed in the appendix.

Constant risk tolerance. To complement our discussion of figure 7, in figure A9 we additionally report the model simulation under a third scenario. In this scenario, we consider the conditional model, i.e., all shocks at their unconditional means with the exception the foreign interest rate shock, with a constant risk tolerance equal to the calibrated value from table 3 ($\tau_F = 246$). While the results are qualitatively similar to those of the conditional model with time-varying $\tau_{F,t}$, the model generates an excessive entry of foreign investors in response to the drop of the U.S. risk-free rate after the Great Recession.

Risk tolerance and VIX. The simulated path of the risk tolerance required to match the fraction of L-bonds held by foreign investors by the conditional model is supported by the fact that the simulated risk tolerance closely tracks the Vix volatility index around the Great Recession (see figure A10). The Vix volatility index is often considered a proxy for the risk tolerance of investors. Recall that higher values of the Vix index are typically associated with lower risk tolerance. Figure A10 plots the inverse of the Vix index along the risk tolerance levels required to match the average fraction of local currency bonds held by foreign investors. The fact that two lines move very closely together around the Great Recession supports the results of our model and, in particular, that time-varying risk tolerance is one of the factors influencing the distribution of local and foreign bond holdings.

Bond yields and returns. Figure A11 and figure A12 report the bond yields and returns for the model simulation under the unconditional and conditional scenarios discussed in section 4 of the paper. The model qualitatively captures the decline in the bond yields, as a result of the decline in the U.S. risk-rate, but quantitatively underestimate the magnitude. Similarly, the model, on average, captures well the conditional mean returns and conditional volatilities for both the

Figure A9: Model Simulation: Quantities (Average Country)



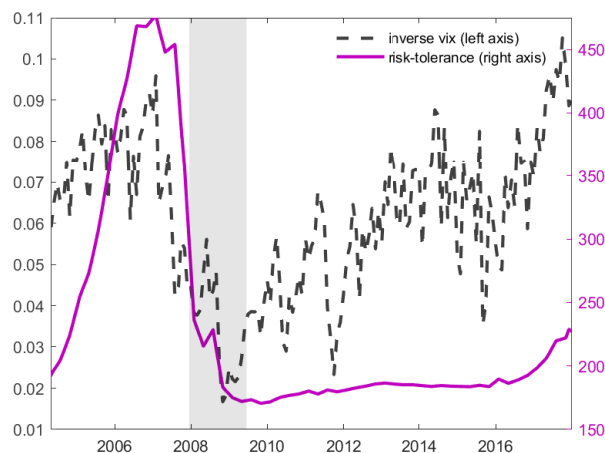
Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., all shocks at their unconditional means with the exception the foreign interest rate shock. The first panel plots the risk tolerance parameter τ^* estimated to match the asset holding of foreign generalist investors. The second panel plots the simulated values for the equilibrium fraction of foreign investors. The third panel plots the fraction of assets denominated in local currency held by foreign investors. The fourth panel plots the foreign interest rates shocks for the conditional model. Foreign interest rate shocks are defined as deviations of the yield on the U.S. 3-month Treasury bond with respect to its means in the period 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

L- and F-bonds. However, the model cannot generate the same variation we observe in the data. One of the reason is that the conditional returns and volatilities are obtained when all shocks are at their unconditional means with the exception of the foreign interest rate shock.

Conditional on all shocks. Figure A13 generalizes, for the average country, the results reported in figure A12 to the case in which we feed the realized dynamics of all the directly estimated shocks (i.e., two risk-free rates, two inflation rates, and the exchange rate). Intuitively, the model simulation contains now more variability as it accounts for the variability of all the shocks.

Time-varying correlation between risk factors The increase in the correlation of bond returns that we document can be potentially explained by an increase in the correlation between risk factors, which we do not observe in the data. For example, in figure A14 we plot the time-varying correlation coefficient between the U.S. risk-free rate and the average emerging country risk-free rate constructed either by assuming that the covered interest parity holds (black solid line, our benchmark), or using alternative measures (black-dashed line). We observe large swings in the

Figure A10: Risk Tolerance and Vix



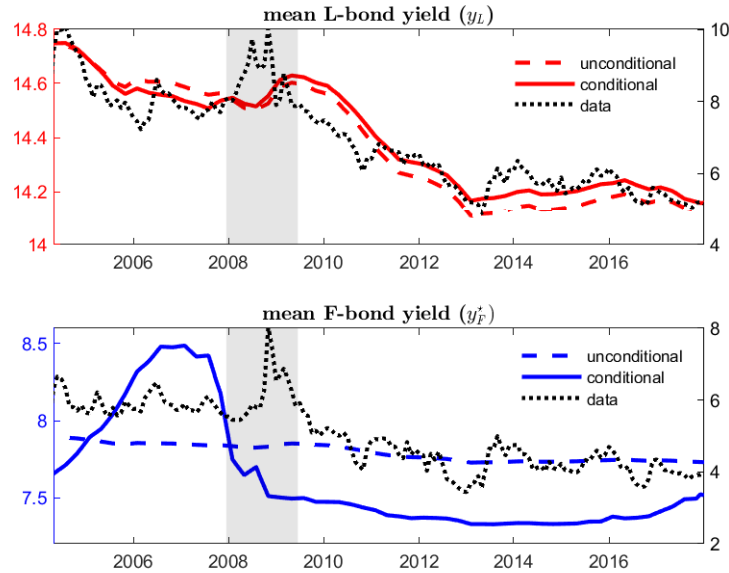
Notes: This figure plots the inverse of the CBOE Vix index (dashed-black line, left axis) along the risk tolerance levels required to exactly match the foreign holding shares of local currency bonds for the average country in the simulation of the conditional version of the model (solid magenta line). In the conditional simulation, all risk factors are at the unconditional mean, with the exception of the risk tolerance.

correlation coefficients, from -0.5 to 0.7 for our benchmark, but no upward trend.

Exchange rate volatility. In the quantitative analysis of section 4 we have explored changes in foreign investor-specific characteristics in order to explain the evolution of the foreign holding of L-bonds. We now consider, as an alternative explanation, changes in country-specific characteristics, like risks and costs of investing in L-bonds. We postpone the analysis of entry costs to the next paragraph, and consider now exchange rate risk, as the main risk for foreign investors in L-bonds. Figure A15 plots the volatility of exchange rate growth required by the conditional version of the model to match the observed fraction of L-bonds held by foreign investors along the time-varying volatility of the average exchange rate changes in the panel of 16 emerging economies. In the data, average exchange rate volatility was relatively low before the Great Recession, then first spiked up around the Great Recession, and then declined but stayed, on average, at a level which is higher than at the beginning of the sample. In the model, we only capture the rapid increase on the onset of the Great Recession.

Heterogenous countries. We use the same procedure used for the average country, to estimate and calibrate the parameters that define the dynamic of the risk factors separately for each country. In addition, we force the risk tolerance of foreign investors to be almost identical to the calibrated value for the average country (i.e., $\tau_F = 246$), and the risk tolerance of local investors

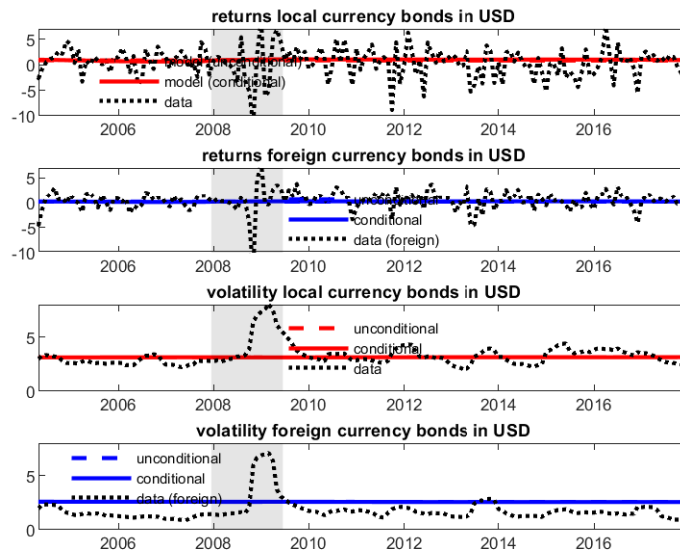
Figure A11: Model Simulation: Yields (Average Country)



Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., all shocks at their unconditional means with the exception the foreign interest rate shock. The first panel plots the yields on the local currency denominated bonds. The second panel plots the yields on the foreign currency denominated bonds. The third panel plots the correlation between returns on local and foreign currency denominated bonds, both expressed in foreign currency. Empirical correlations are estimated using daily returns and a rolling window of 120 days. The fourth panel plots the foreign interest rates shocks for the conditional model. Foreign interest rate shocks are defined as deviations of the yield on the U.S. 3-month Treasury bond with respect to its means in the period 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

not to be too different across countries. Table 12 reports the unconditional mean (panel A); the persistence (panel B); and the unconditional volatility (panel C) of the risk factors. Finally, panel D reports the values of the remaining model parameters. We observe a large degree of cross-country heterogeneity in the data, which corresponds in heterogeneity in the model parameters for different countries. In table 10 we additionally report descriptive statistics on the exchange rates and default probabilities using data for the sample of 16 emerging countries. Naturally, the parameters corresponding to foreign investors are the same for all countries (e.g., r_0^* , π^*). Also, we keep constant across countries the parameters that pin down the maturity of both L- and F-bonds. With the exception of exchange rate growth, all factors are relatively persistent. For most countries, exchange rate growth is the most volatile directly estimated risk factor, while supplies are the most volatile calibrated risk factors. Local investors are, for most countries, less risk tolerant than foreign investors. The relatively large markets for L-bonds are Brazil, Mexico, India, and China. Figure 13 reports the mean and volatility of excess returns and yields for L- and F-bonds both in the data and in the model simulated with heterogenous risk structure (i.e., for each country, we use the parameters from table 12. For most countries, the performance of

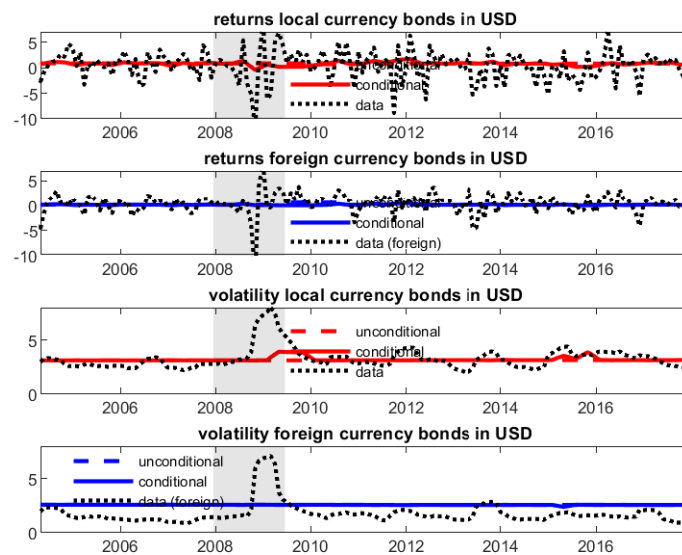
Figure A12: Model Simulation: Returns (Average Country)



Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., all shocks at their unconditional means with the exception the foreign interest rate shock. The first panel plots excess returns on local currency bonds expressed in foreign currency. The second panel plots excess returns on foreign currency bonds. The third panel plots the volatility of excess returns on local currency bonds expressed in foreign currency. The fourth panel plots the volatility of excess returns on foreign currency bonds. Empirical returns and volatilities are estimated using daily frequency data and a rolling window of 120 days. Foreign interest rate shocks are defined as deviations of the yield on the U.S. 3-month Treasury bond with respect to its means in the period 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

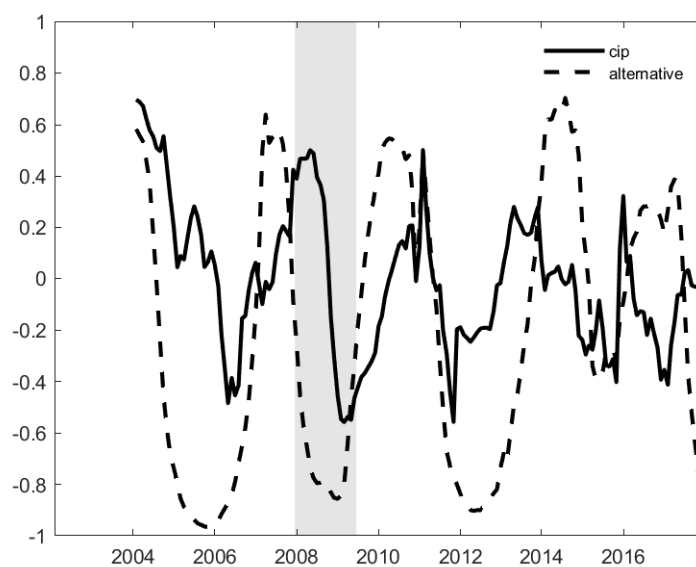
the model with heterogeneous countries is as good as that of the average country. Recall that, in segmented markets, exchange rate risk plays no role. For bond yields, the contribution of risk premia is small (see equation (11) and consider that risk tolerance is large) and the contribution of default risk is small and similar across countries. On the contrary, for bond returns, the level of bond supply affects all the components of risk premia. Because the foreign risk-free rate is common across all countries, the volatility of the F-bond yield generated by the model is very similar, but not identical, across all countries.

Figure A13: Model Simulation: Returns (Average Country, All Shocks)



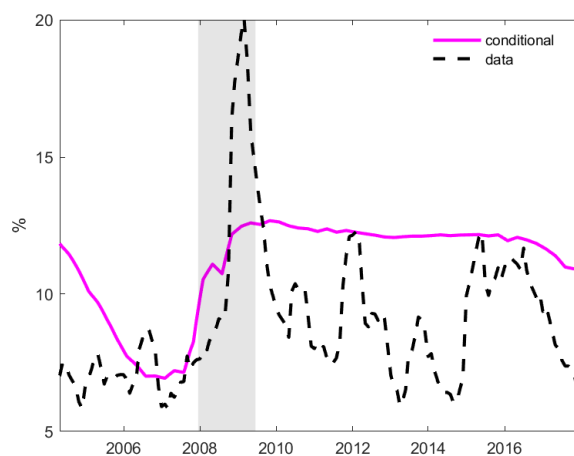
Notes: We consider two scenarios: "unconditional", i.e., all shocks are at their unconditional means; "conditional", i.e., feeding the realized dynamics of all the directly estimated shocks. The first panel plots excess returns on local currency bonds expressed in foreign currency. The second panel plots excess returns on foreign currency bonds. The third panel plots the volatility of excess returns on local currency bonds expressed in foreign currency. The fourth panel plots the volatility of excess returns on foreign currency bonds. Empirical returns and volatilities are estimated using daily frequency data and a rolling window of 120 days. Foreign interest rate shocks are defined as deviations of the yield on the U.S. 3-month Treasury bond with respect to its means in the period 4/2004–12/2017. The shaded area denotes the last U.S. official NBER recession. Parameters are from table 3.

Figure A14: Risk-free Rates in Developed and Emerging Countries



Notes: This figure plots the time-varying correlation coefficients between the U.S. risk-free rate and either by assuming that the covered interest parity holds (black solid line, our benchmark), or using alternative measures (black-dashed line). The U.S. risk-free rate is the yield on the U.S. 3-month T-bill. Emerging countries risk-free rates are constructed by assuming that the covered interest parity holds or using different local sources and debt instruments. Time-varying correlation coefficients are estimated on rolling windows of 24 months. Data are monthly for the period 4/2004–12/2017. The shaded area denotes the last NBER US recession.

Figure A15: Exchange Rate Volatility



Notes: This figure plots the volatility of exchange rate growth required by the conditional version of the model to match the observed fraction of local assets held by foreign investors along the time-varying volatility of the average exchange rate changes in the panel of 16 emerging economies. Empirical time-varying volatility is estimated using daily changes in the exchange rates and a rolling window of 120 days. Data are from Datastream and from the simulation of the conditional version of the model, where the foreign short-term interest rate is the only shock not at the unconditional mean. Data are monthly for the period 4/2004–12/2017. The shaded area denotes the last NBER US recession.

Table 12: Model Parameters (All Countries)

Country	Panel A: mean risk factors									Panel B: persistence risk factors								
	r_0	r_0^*	Δs	π	π^*	z_L	z_F	q_L	q_F	r_0	r_0^*	Δs	π	π^*	z_L	z_F	q_L	q_F
Brazil	0.90	0.10	0.18	0.55	0.18	0.03	0.09	820.47	382.47	0.31	0.99	-0.06	0.99	0.95	0.65	0.81	0.30	0.37
Chile	0.29	0.10	-0.03	0.26	0.18	0.00	0.01	879.18	157.93	0.11	0.99	0.07	0.97	0.95	0.95	0.62	0.07	0.00
China	0.08	0.10	-0.13	0.20	0.18	0.01	0.01	927.61	122.62	0.70	0.99	0.30	0.95	0.95	0.80	0.81	0.11	0.52
Colombia	0.38	0.10	0.14	0.40	0.18	0.01	0.04	851.30	369.45	0.05	0.99	0.07	0.98	0.95	0.68	0.88	0.52	0.42
Hungary	0.39	0.10	-0.04	0.32	0.18	0.01	0.01	816.61	433.12	0.04	0.99	-0.04	0.98	0.95	0.85	0.79	0.66	0.62
India	0.50	0.10	0.15	0.56	0.18	0.03	0.03	637.05	682.62	0.77	0.99	0.11	0.96	0.95	0.74	0.74	0.57	0.46
Indonesia	0.53	0.10	0.14	0.58	0.18	0.18	0.24	798.58	259.19	0.68	0.99	0.14	0.94	0.95	0.61	0.87	0.50	0.03
Malaysia	0.21	0.10	0.03	0.20	0.18	0.01	0.01	894.47	33.99	0.61	0.99	0.02	0.92	0.95	0.57	0.81	0.71	0.48
Mexico	0.50	0.10	0.40	0.35	0.18	0.01	0.02	876.61	152.01	0.46	0.99	0.10	0.97	0.95	0.60	0.84	0.33	0.16
Peru	0.29	0.10	-0.03	0.23	0.18	0.03	0.05	41.61	758.26	0.79	0.99	-0.02	0.31	0.95	0.97	0.90	0.46	0.00
Philippines	0.32	0.10	-0.02	0.32	0.18	0.02	0.06	829.89	391.30	0.92	0.99	0.07	0.97	0.95	0.61	0.83	0.46	0.58
Poland	0.30	0.10	-0.07	0.17	0.18	0.01	0.01	858.81	313.55	0.93	0.99	0.07	0.97	0.95	0.62	0.82	0.47	0.31
Romania	0.48	0.10	0.11	0.54	0.18	0.09	0.14	870.04	292.07	0.94	0.99	0.02	0.96	0.95	0.73	0.67	0.03	0.07
Russia	0.65	0.10	0.33	0.83	0.18	0.09	0.19	84.11	4459.70	0.85	0.99	0.35	0.98	0.95	0.55	0.73	0.00	0.86
SouthAfrica	0.65	0.10	0.02	0.45	0.18	0.01	0.02	855.10	345.52	0.96	0.99	-0.04	0.98	0.95	0.54	0.85	0.02	0.40
Turkey	1.28	0.10	0.50	0.98	0.18	0.16	0.23	867.53	265.90	0.95	0.99	0.07	0.90	0.95	0.62	0.88	0.24	0.04
Thailand	0.20	0.10	-0.16	0.18	0.18	0.01	0.02	864.45	11.27	0.66	0.99	0.14	0.95	0.95	0.79	0.79	0.31	0.80
Country	Panel C: volatility risk factors									Panel D: other risk factors								
	r_0	r_0^*	Δs	π	π^*	z_L	z_F	q_L	q_F	τ_L	τ_F	θ_L	θ_F	n_L	n_F			
Brazil	0.46	0.02	5.13	0.04	0.05	0.73	0.91	1.10	0.40	204.51	245.93	0.84	0.90	0.61	0.39			
Chile	0.63	0.02	3.28	0.04	0.05	0.01	0.01	0.01	0.01	161.02	250.84	0.84	0.90	0.07	0.93			
China	0.17	0.02	0.60	0.05	0.05	0.35	0.40	0.62	2.56	159.20	245.92	0.84	0.90	0.63	0.37			
Colombia	0.73	0.02	3.83	0.03	0.05	0.28	0.65	0.03	1.97	174.99	245.52	0.84	0.90	0.10	0.90			
Hungary	0.77	0.02	4.27	0.04	0.05	0.10	0.81	0.01	0.40	223.76	244.10	0.84	0.90	0.09	0.91			
India	0.13	0.02	2.22	0.07	0.05	0.46	0.50	2.45	2.26	192.28	245.96	0.84	0.90	0.46	0.54			
Indonesia	0.16	0.02	2.70	0.09	0.05	0.44	0.74	3.77	1.52	249.18	245.84	0.84	0.90	0.11	0.89			
Malaysia	0.05	0.02	2.03	0.05	0.05	0.32	0.41	0.06	1.87	244.73	245.94	0.84	0.90	0.14	0.86			
Mexico	0.34	0.02	3.02	0.03	0.05	0.57	0.75	0.50	0.56	247.44	245.69	0.84	0.90	0.30	0.70			
Peru	0.15	0.02	1.53	0.25	0.05	0.26	0.46	0.04	0.10	228.53	246.11	0.84	0.90	0.02	0.98			
Philippines	0.08	0.02	1.60	0.04	0.05	0.49	0.61	3.26	4.94	239.51	245.54	0.84	0.90	0.12	0.88			
Poland	0.05	0.02	4.08	0.03	0.05	0.40	0.51	0.22	0.46	200.61	245.69	0.84	0.90	0.18	0.82			
Romania	0.12	0.02	3.38	0.05	0.05	0.08	0.59	4.31	0.01	144.13	250.58	0.84	0.90	0.04	0.96			
Russia	0.34	0.02	3.85	0.06	0.05	0.39	0.39	0.01	0.17	249.80	246.59	0.84	0.90	0.13	0.87			
SouthAfrica	0.05	0.02	4.80	0.05	0.05	0.35	0.57	0.14	2.13	234.64	245.57	0.84	0.90	0.14	0.86			
Turkey	0.14	0.02	4.07	0.09	0.05	0.34	0.66	0.76	0.44	247.67	245.70	0.84	0.90	0.31	0.69			
Thailand	0.13	0.02	1.62	0.05	0.05	0.21	0.23	2.13	0.51	246.40	246.13	0.84	0.90	0.12	0.88			

Notes: This table reports the calibration parameters for the individual countries. Panel A reports the mean of the risk factors. Panel B the persistence of the risk factors. Panel C the volatility of the risk factors. Finally, panel D the remaining parameters corresponding to risk tolerance of local and foreign investors; L- and F-bond maturity; and the number of local and foreign investors. The calibration follows the steps described in section 4.1 for the average country, using individual country data.

Table 13: Model Simulation (All Countries)

Country	Panel A: L-bond								Panel B: F-bond							
	Er_L^e		std r_L^e		Ey_L		std y_L		$Er_F^{e,*}$		std $r_F^{e,*}$		Ey_F^*		std y_F^*	
	DATA	MODEL	DATA	MODEL	DATA	MODEL	DATA	MODEL	DATA	MODEL	DATA	MODEL	DATA	MODEL	DATA	MODEL
Brazil	2.34	2.29	5.46	5.92	14.12	20.09	5.04	4.91	8.86	5.19	15.60	11.92	7.21	9.71	3.71	4.12
Chile	2.25	3.97	5.10	2.22	5.72	10.63	3.63	4.74	5.17	0.01	6.40	1.44	4.60	3.52	0.87	4.12
China	2.43	1.53	3.48	4.07	3.49	5.05	0.59	5.41	4.18	2.30	5.82	5.37	4.14	5.86	0.80	4.12
Colombia	4.80	5.15	6.76	3.24	9.54	14.59	5.04	4.82	7.48	3.01	10.23	11.16	6.09	6.92	2.09	4.12
Hungary	3.11	3.11	7.32	2.73	6.33	11.72	2.47	4.89	5.02	2.70	9.48	9.88	4.65	6.24	1.36	4.12
India	1.55	1.49	6.18	4.56	7.61	14.56	0.87	5.47	3.61	1.51	5.92	5.43	3.42	5.35	0.75	4.12
Indonesia	4.86	3.91	12.56	3.61	9.51	19.38	2.29	5.02	6.76	1.88	15.39	12.25	5.56	8.17	1.59	4.12
Malaysia	1.45	1.39	2.98	2.31	3.91	6.36	0.37	2.43	5.06	2.70	6.89	5.55	4.49	6.24	1.11	4.12
Mexico	2.25	2.23	5.74	4.36	7.41	12.48	1.28	5.13	7.81	3.53	10.76	11.00	5.84	7.22	1.84	4.12
Peru	3.31	2.98	9.21	5.27	5.76	9.54	1.10	6.24	6.10	2.52	8.04	8.54	5.36	6.61	1.08	4.12
Philippines	4.87	3.93	7.69	3.75	7.11	11.92	2.19	6.88	7.89	2.11	7.46	8.64	5.87	6.23	2.09	4.12
Poland	2.61	2.21	3.61	3.06	4.83	7.92	1.62	5.48	4.77	1.11	6.36	7.00	4.11	4.65	1.14	4.12
Romania	6.84	6.39	5.79	2.06	10.27	19.65	6.72	8.94	8.29	0.41	7.15	5.43	4.17	5.55	0.87	4.12
Russia	0.54	0.50	6.95	4.44	7.76	19.24	1.79	10.97	7.86	3.46	9.22	4.19	5.67	9.13	1.72	4.12
SouthAfrica	1.58	1.75	6.92	2.58	8.66	15.04	1.08	6.53	5.21	2.00	7.80	8.60	4.92	5.63	0.95	4.12
Turkey	1.18	1.40	7.43	3.50	12.46	30.45	4.86	10.13	7.92	2.60	12.11	11.14	6.58	8.79	2.04	4.12
Thailand	2.31	1.79	5.52	2.49	3.68	6.50	0.96	4.37	3.61	0.01	3.78	3.20	4.98	3.64	0.71	4.12

Notes: This table reports the mean and volatility of excess returns and yields for L-bonds (panel A) and F-bonds (panel B) both in the data and in the model simulated with heterogeneous risk structure (i.e., for each country, we use the parameters from table 12).