Why Do Emerging Economies Borrow in Foreign Currency? The Role of Exchange Rate Risk

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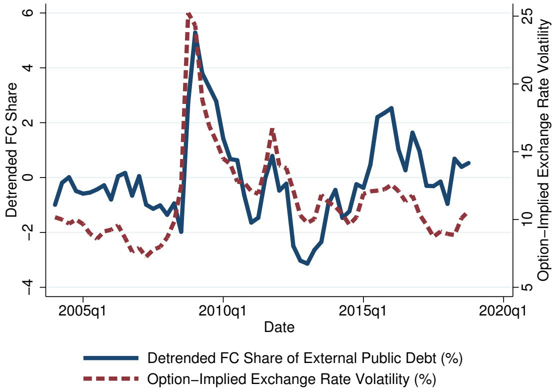
- A **currency mismatch** coming from $ liabilities + exchange rate fluctuations
  $\Rightarrow$ a source of **financial instability** and subsequent economic crisis (e.g. Asian Financial Crisis).
- Now, EMs gained credibility in their monetary policy and started borrowing from abroad in LC.
- Nonetheless, EM govts **still borrow substantially in FC**.
  - The average FC share of external sovereign debt in emerging economies is 80% in 2004 – 2018.

The currency composition shifts more to FC when it is riskier to do so

- In fact, emerging economies borrow *even more* in FC than in LC when exchange rate volatility $\uparrow$.



▸ Alt. FX Risk Measure ▸ FX-Adjusted ▸ LC Share Trend

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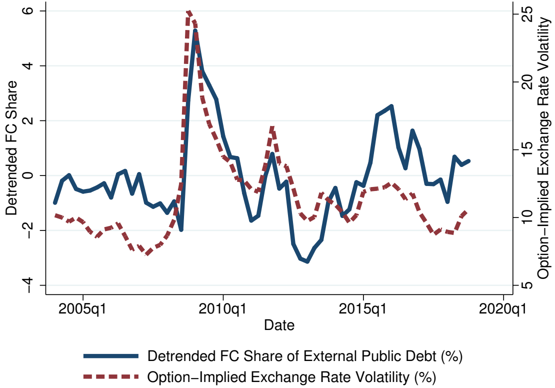

Alt. FX Risk Measure | FX-Adjusted | LC Share Trend

- High positive correlation between FC share and exchange rate volatility: 0.65

Research Questions

1. Why do emerging market sovereigns still borrow substantially in FC?
2. Why do they borrow *even more* in FC than in LC when exchange rate volatility is *higher*?
3. How large is the welfare gain from exchange rate stabilization?

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- The currency composition of EM external sovereign debt is the outcome of choosing
  how much risk EM sovereign bears oneself & **how much risk it shifts to foreign investors**.
  (how much risk EM sovereign bears oneself: **cheap but risky FC debt**; how much risk it shifts to foreign investors: **expensive but not risky LC debt**)

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  $\underbrace{\textbf{how much risk EM sovereign bears oneself}}_{\textbf{cheap but risky FC debt}}$ & $\underbrace{\textbf{how much risk it shifts to foreign investors}}_{\textbf{expensive but not risky LC debt}}$.
- When the **risk aversion** of international lenders is high,
  EM borrows substantially in FC & bears exchange rate risk because borrowing in LC is expensive.

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  (i) **For the EM govt, FC debt riskier** $\Rightarrow$ EM govt wants to **borrow less in FC**

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  $\Rightarrow$ When (ii) is larger than (i), i.e., the **risk aversion** of international lenders is high, EM borrows even more in FC as FX volatility $\uparrow$.
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★ **This paper captures how one asset can be risky to one agent but not to the other as their preferences concern their consumption evaluated in different units**
($\neq$ many open macro models w/ PPP or a single good)

Literature Review

Currency Composition of Sovereign Debt

- Monetary policy commitment:

  Ottonello, Perez (2019), Engel, Park (2018), Du, Pfluger, Schreger (2021)

FX Risk Premium

- Many papers are devoted to explain Fama (1984) puzzle.
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- Deviation from the UIP and global risk measure, VIX

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(1) **Documents two new empirical relationships**:

  (i) When FX volatility $\uparrow$, EM borrows more in FC than in LC

  (ii) When FX volatility $\uparrow$, the cost of borrowing in LC relative to FC $\uparrow$

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Outline

(1) Establish that **two new empirical relationships** are robust:

(i) +ve assoc. between the FC share of external public debt and FX volatility.

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(4) Measure the **welfare gain** of stabilizing the exchange rate.

  ◇ The welfare gain for the EM sovereign of shutting down the exchange rate volatility to zero is **0.35% in c.e.**

Empirical Analysis

Empirical Set-up

- 18 EM countries in 2004 – 2018:
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  Brazil, Bulgaria, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand and Turkey.
- I run two sets of panel regressions & establish two empirical patterns.

EM borrows relatively more in FC as FX volatility increases

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \epsilon_{it}$$

- Country i, quarterly date t.
- Cyclical component of the external public debt in FC, FC Share$_{it}$.
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- Macro variables X_{it} are included: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP, external public debt/GDP, default prob.

EM borrows relatively more in FC as FX volatility increases

- FC Share$_{it}$: detrended FC Share of the public external debt.

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)			
$\sigma_{FX,IMPLIED}$	0.321***	0.324***		
	(0.054)	(0.058)		
$\sigma_{FX,REALIZED}$			0.310***	0.331***
			(0.057)	(0.061)
Macro Controls	No	Yes	No	Yes
R^2	0.095	0.128	0.102	0.140
N	909	793	982	862

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP, external public debt/GDP, default prob.

Robust to (1) post-GFC sample ▸ PostGFC, (2) FX-adjusted FC Share of external public debt ▸ FXadj (3) controlling global factors. ▸ GlobalControls, (4) Time FE ▸ TimeFE, (5) linear-detrending ▸ LinearDetrending

Relative cost of borrowing in LC over FC increases with higher FX volatility

$$\underbrace{y_{i,t}^{LC}}_{\text{one-year LC interest rate}} - \underbrace{\left(y_{i,t}^{FC} + s_{i,t+12} - s_{i,t}\right)}_{\text{one-year FC interest rate in units of LC}} = \alpha_1 \sigma_{FX,it} + \Omega' X_{it} + \omega_i + \omega_t + \epsilon_{it}$$

- country i, monthly date t.
- LC one-year interest rate y_{it}^{LC} : 1-year zero coupon LC yields from Bloomberg Fair Value Curve
- FC one-year interest rate y_{it}^{FC} : 1-year USD denominated CDS spread + US 1-year treasury rate
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- $s_{i,t}$ is the log of the exchange rate, defined as LC price of dollar.

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	Relative Cost of Borrowing in LC over FC (%)			
$\sigma_{FX,IMPLIED}$	0.894***	0.659***		
	(0.178)	(0.192)		
$\sigma_{FX,REALIZED}$			0.664***	0.450**
			(0.196)	(0.222)
Macro Controls	No	Yes	No	Yes
R^2	0.613	0.655	0.603	0.647
N	1768	1587	1866	1680

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X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP, external public debt/GDP, default prob.

▸ Figure ▸ Separate ▸ Ex-ante

Model

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- Maximize the expected utility from their investment over one period.

Myopic

Exogenous Shocks

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$$X = \{y, S, \nu\}$$

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$$\begin{pmatrix} \log(y_t) \\ \log(S_t) \end{pmatrix} = \begin{pmatrix} \mu_y \\ \mu_s \end{pmatrix} + \begin{pmatrix} \rho_y & 0 \\ 0 & \rho_s \end{pmatrix} \begin{pmatrix} \log(y_{t-1}) \\ \log(S_{t-1}) \end{pmatrix} + \begin{pmatrix} \epsilon_t^y \\ \epsilon_t^s \end{pmatrix} \text{ where } \begin{pmatrix} \epsilon_t^y \\ \epsilon_t^s \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_y^2 & \rho_{y,s}\sigma_y\sigma_s \\ \rho_{y,s}\sigma_y\sigma_s & \sigma_s^2 \end{pmatrix} \right)$$

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- Sovereign default cost shocks are not correlated with other shocks:

$$\nu_t = \mu_\nu + \rho_\nu \nu_{t-1} + \epsilon_t^\nu, \text{ where } \epsilon_t^\nu \sim N(0, \sigma_\nu^2)$$

as in Arellano, Bai, Bocola (2019) and Arellano, Bai, Mihalache (2018)

EM Sovereign Borrower

- Maximizes the expected life-time utility and has a CRRA utility with risk aversion γ.

$$U_t = \mathbb{E}_t \sum_{j=t}^{\infty} \beta^{j-t} \big(u(c_j) - D_j \nu_j \big)$$

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- b_{t+1}^{LC} and b_{t+1}^{FC} denote how much the sovereign borrows in LC and in FC.
- S_t is the LC price of dollar.
- When the sovereign does not default, the period budget constraint is:

$$c_t + b_t^{LC} + b_t^{FC} S_t = q_t^{LC} b_{t+1}^{LC} + q_t^{FC} b_{t+1}^{FC} S_t + y_t$$

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- When the sovereign defaults, the period budget constraint is:

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▸ Recursive ▸ Markov Perfect Equilibrium

Risk-averse Foreign Investors

- Risk-averse investors endowed with 1 unit of FC every period, taking the price of debt as given.
- CRRA utility with risk-aversion α, with second order Taylor approximation, equivalent of maximizing mean-variance of one-period return.
- Each investor maximizes mean-variance utility over their portfolio returns in units of FC.

$$\max_{B^{FC}_{t+1} \geq 0, B^{LC}_{t+1} \geq 0} \mathbb{E}_t(\tilde{R}_{t+1}) - \frac{\alpha}{2} \mathrm{Var}_t(\tilde{R}_{t+1})$$

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$$\tilde{R}_{t+1} = \underbrace{(1 - B^{FC}_{t+1} - B^{LC}_{t+1})(1 + r_f)}_{\text{US treasury}} + \underbrace{\frac{B^{FC}_{t+1}}{q^{FC}_t}(1 - D_{t+1})}_{\text{EM FC debt}} + \underbrace{\frac{B^{LC}_{t+1}}{q^{LC}_t}\left(\frac{S_t}{S_{t+1}}(1 - D_{t+1})\right)}_{\text{EM LC debt}}$$

▸ Markov Perfect Equilibrium ▸ Mechanism

Quantitative Analysis

Calibration

- One period is a year, calibrated to Colombia in 2004–18.

Parameters	Description	Values	Notes
Parameters from the literature			
γ	Risk aversion of the sovereign	1.0	Literature
Parameters from the data			
ρ_y	Persistence of output shock	0.9	AR(1), Colombia
σ_y	Std of output shock	0.03	AR(1), Colombia
ρ_s	Persistence of exchange rate shock	0.99	AR(1), Colombia
σ_s	Std of exchange rate shock	0.13	AR(1), Colombia
$\rho_{y,s}$	Correlation of output and exchange rate shocks	-0.11	AR(1), Colombia
r_f	Risk-free rate	0.5%	mean 5-year US real rate
Parameters from moment matching			
β	Time discount factor	0.93	External Debt to GDP (14.8%)
α	Risk aversion of the global investors	51	mean LC spread (1.63%)
μ_ν	Mean sovereign default cost	0.59	mean FC spread (0.66%)
σ_ν	Std sovereign default cost	0.16	std FC spread (0.54%)

- The spread is against the US treasury taking into account of inflation.
- c.f. Hatchondo, Martinez and Sosa-Padilla (JPE, 2016), $\gamma = 2$, $\alpha = 59$.

Quantitative Model: Targeted and Untargeted Moments

	Data %	Model %
Targeted moments		
Mean LC Spread	1.63	1.63
Mean FC Spread	0.66	0.64
Std of FC Spread	0.54	0.53
Mean External Debt to GDP	14.8	13.2
Untargeted moments		
Mean FC Share	82.0	86.7
Std of LC Spread	2.30	2.00

Counterfactual Analysis

Experiment # 1: Higher FX Volatility

- Increase the FX volatility from 13% to 14%.
- Compute how the mean of the following variables have changed:
  (i) FC share of external debt
  (ii) Relative cost of borrowing in LC over FC: $y_{i,t}^{LC} - \left(y_{i,t}^{FC} + s_{i,t+12} - s_{i,t}\right)$
- Compare them with the data counter-part: untargeted moments.

Untargeted Moments

- With higher FX volatility, the relative cost of borrowing in LC over FC increases.
- With higher FX risk premium, the sovereign shifts its currency composition towards FC.

	Baseline $\sigma_s = 13\%$	Counterfactual Higher $\sigma_s = 14\%$	Higher FX Volatility $\Delta\sigma_s = +1\%$	
			Δ in Model	Δ in Data
Relative cost: $y_t^{LC} - (y_t^{FC} + s_t - s_{t+12})$	0.99%	1.30%	+0.31%	+0.45%
FC Share	86.70%	87.07%	+0.37%	+0.33%

▸ LargerIncreaseFXVol ▸ LargerDecreaseFXVol

Experiment # 2: Measuring Welfare Cost of Currency Mismatch

- Drive down the exchange rate volatility to zero: LC and FC debt are perfect substitutes.
- Compute the welfare gain for the EM sovereign of removing exchange rate volatility.

Rationalizing Fear of Floating

When there is no exchange rate shock ($\sigma_S = 0$),

- The interest rate spread goes down.
- The welfare gain, measured as the consumption equivalence, is 0.35%.
- It rationalizes the fear of floating even when emerging market can borrow in their own currencies.

	Baseline	$\sigma_s = 0$
Relative cost	0.99%	0%
$y^{LC} - r_f$	1.63%	0.57%
$y^{FC} - r_f$	0.66%	0.57%
Welfare		+0.35% c.e.

Conclusion

- This paper documents two new empirical facts:

(i) a positive co-movement between FX volatility and FC share.

(ii) a positive co-movement between FX volatility and the relative cost of borrowing in LC over FC.

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- This paper highlights how the **currency mismatch on lenders** determines the FX risk-premium and the currency composition of EM external sovereign debt.

Conclusion

- This paper documents two new empirical facts:

(i) a positive co-movement between FX volatility and FC share.

(ii) a positive co-movement between FX volatility and the relative cost of borrowing in LC over FC.

- This paper highlights how the **currency mismatch on lenders** determines the FX risk-premium and the currency composition of EM external sovereign debt.
- The welfare cost of the exchange rate risk sheds light on the optimal exchange rate policy.

THANK YOU!

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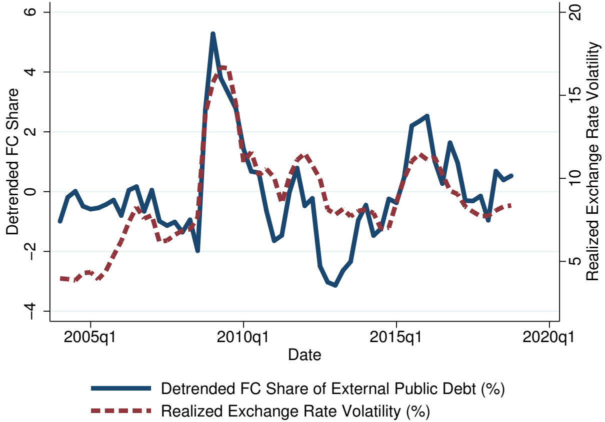
Appendix

#2 with alternative FX volatility measure: Figure

- Alternative FX volatility measure:
  Annualized volatility of daily exchange rate returns against $ in the past 4 quarters.

Back



#2 with FX-adjusted measure of FC share: Figures

- FX-adjusted measure of FC Share is used:

$$\text{FC Share}_{it} = \frac{S_{i,2006Q1}F_{it}}{D_{it} + S_{i,2006Q1}F_{it}}$$

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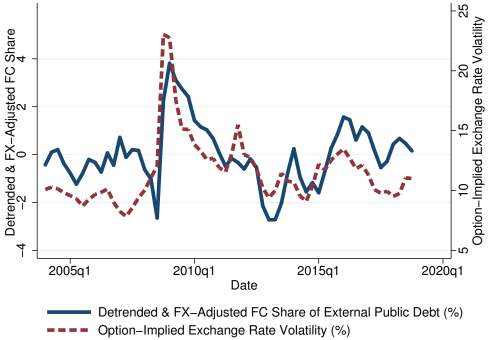
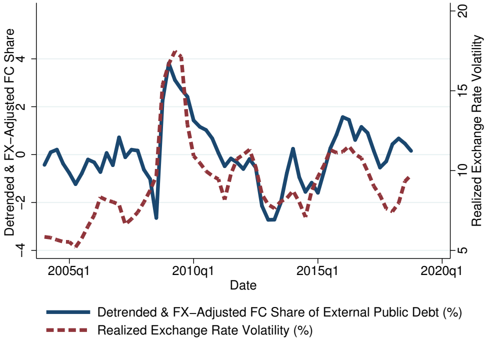
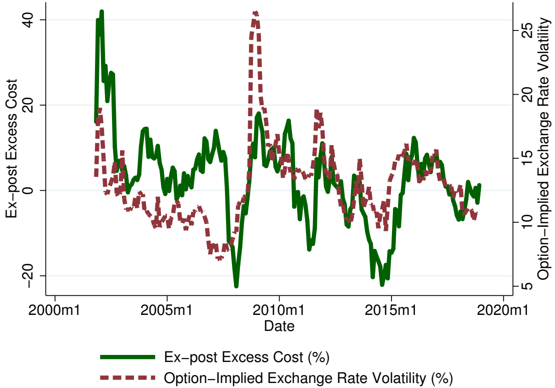
LHS: Implied FX Volatility, RHS: Realized FX Volatility





Relative Cost of Borrowing in LC over FC ↑ as FX volatility ↑

- **The relative cost of borrowing in LC over FC increases with higher exchange rate volatility.**
- The required FX risk premium ↑ as the exchange rate risk that lenders bear ↑.



Alt.FX Risk Measure

- There is a positive correlation of 0.4.

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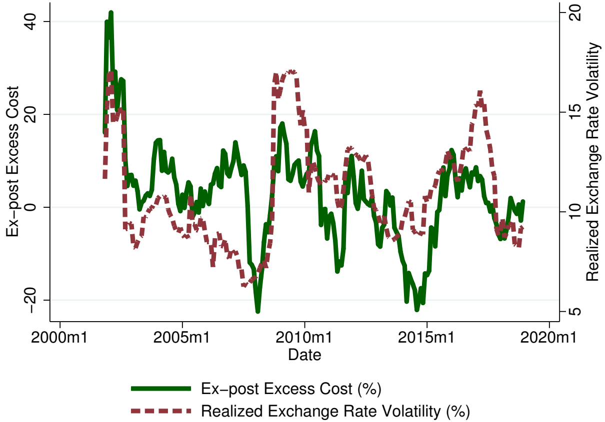
#1 with alternative FX volatility measure : Figure

- Dependent variable is: $\underbrace{y^{LC}_{i,t}}_{\text{Cost of Borrowing in LC}} - \underbrace{(y^{FC}_{i,t} + s_{i,t+12} - s_{i,t})}_{\text{Cost of Borrowing in FC in units of LC}}$ for country i at month t.
- The correlation in the whole sample is 0.4. ▸ Back



EM borrows relatively more in FC as FX volatility increases

- Post-GFC sample period ▸ Back

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)	
$\sigma_{FX,IMPLIED}$	0.428***	
	(0.059)	
$\sigma_{FX,REALIZED}$		0.333***
		(0.044)
Macro Controls	Yes	Yes
R^2	0.204	0.187
N	593	629

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP external public debt/GDP, default prob.

EM borrows relatvely more in FC as FX volatility increases

- FX-adjusted FC Share: ▸ Back

$$\text{FX-adj FC Share}_{it} = \frac{S_{i,2006Q1} F_{it}}{D_{it} + S_{i,2006Q1} F_{it}}$$

$$\text{FX-adj FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)	
$\sigma_{FX,IMPLIED}$	0.167***	
	(0.046)	
$\sigma_{FX,REALIZED}$		0.164**
		(0.065)
Macro Controls	Yes	Yes
R^2	0.069	0.067
N	793	862

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP external public debt/GDP, default prob.

EM borrows relatvely more in FC as FX volatility increases

- Control global factors: VIX Index, the 10-Year Treasury yield, the TED spread, and the US Federal Funds Rate. Back

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + GC_t + \gamma_i + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)	
$\sigma_{FX,IMPLIED}$	0.405***	
	(0.079)	
$\sigma_{FX,REALIZED}$		0.334***
		(0.064)
Macro Controls	Yes	Yes
R^2	0.162	0.164
N	793	862

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP external public debt/GDP, default prob.

EM borrows relatvely more in FC as FX volatility increases

- Include quarterly time FE. Back

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \gamma_t + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)	
$\sigma_{FX,IMPLIED}$	0.263***	
	(0.077)	
$\sigma_{FX,REALIZED}$		0.180***
		(0.048)
Macro Controls	Yes	Yes
R^2	0.285	0.264
N	861	934

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP external public debt/GDP, default prob.

EM borrows relatvely more in FC as FX volatility increases

- Linear detrending. ▸ Back

$$\text{FC Share}_{it} = \beta_1 \sigma_{FX,it} + \Gamma' X_{it} + \gamma_i + \gamma_t + \epsilon_{it}$$

	Detrended FC Share of Public External Debt (%)	
$\sigma_{FX,IMPLIED}$	0.278***	
	(0.083)	
$\sigma_{FX,REALIZED}$		0.227**
		(0.107)
Macro Controls	Yes	Yes
R^2	0.088	0.089
N	745	814

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP external public debt/GDP, default prob.

Result # 1: Relative cost of borrowing in LC over FC increases with higher FX volatility.

$$y_{it}^{j} = \gamma_1 \sigma_{FX,it} + \Theta' X_{it} + \theta_i + \theta_t + e_{it}, \quad \text{where } j = \{LC, FC\}$$

Dependent Variable:	LC interest Rate	FC interest rate	LC interest Rate	FC interest rate
$\sigma_{FX,IMPLIED}$	0.224***	0.080***		
	(0.024)	(0.022)		
$\sigma_{FX,REALIZED}$			0.147***	0.009
			(0.025)	(0.009)
Macro Controls	Yes	Yes	Yes	Yes
R^2	0.631	0.871	0.627	0.846
N	2437	1745	2575	1980

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index, private credit/GDP, external public debt/GDP default prob.

Back

Relative cost of borrowing in LC over FC increases with higher FX volatility.

$$\underbrace{y_{i,t}^{LC}}_{\text{one-year LC interest rate}} - \underbrace{\left(y_{i,t}^{FC} + E_t(s_{i,t+12} - s_{i,t})\right)}_{\text{one-year FC interest rate in units of LC}} = \alpha_1 \sigma_{FX,it} + \Omega' X_{it} + \alpha_i + \alpha_t + \epsilon_{it}$$

Dependent Variable:	Relative Cost of Borrowing in LC over FC (%)			
$\sigma_{FX,IMPLIED}$	0.114**	0.113**		
	(0.052)	(0.048)		
$\sigma_{FX,REALIZED}$			0.103**	0.087***
			(0.044)	(0.033)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro Controls	No	Yes	No	Yes
R^2	0.365	0.869	0.359	0.870
N	1768	1587	1866	1680

* Driscoll and Kraay (1998) standard errors are reported in the parentheses.

X_{it}: expected depreciation, inflation, real GDP growth, capital control index private credit/GDP, external public debt/GDP, default prob.

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Discussion of Assumption: Myopic Investors

1. In the real world, quarterly/annual regulatory requirements on institutional investors.
2. For tractability, no need to carry investors' aggregate wealth as an additional state variable.
3. Allow an analytical illustration of the mechanism.

▸ Back

Recursive Problem of EM Sovereign Borrower

- $X = \{y, S, \nu\}$ is a set of exogenous states.
- **Sovereign** maximizes:

$$V(b^{LC}, b^{FC}; X) = \max_{c \geq 0, b'^{LC}, b'^{FC}} \{u(c) + \beta E_{X'|X} W(b'^{LC}, b'^{FC}; X')\}$$

$$c + b^{LC} + b^{FC} S = q^{LC}(b'^{LC}, b'^{FC}; X) b'^{LC} + q^{FC}(b'^{LC}, b'^{FC}; X) b'^{FC} S + y$$

Recursive Problem of EM Sovereign Borrower

- $X = \{y, S, \nu\}$ is a set of exogenous states.
- **Sovereign** maximizes:

$$V(b^{LC}, b^{FC}; X) = \max_{c \geq 0, b'^{LC}, b'^{FC}} \{u(c) + \beta E_{X'|X} W(b'^{LC}, b'^{FC}; X')\}$$

$$c + b^{LC} + b^{FC} S = q^{LC}(b'^{LC}, b'^{FC}; X) b'^{LC} + q^{FC}(b'^{LC}, b'^{FC}; X) b'^{FC} S + y$$

- **Sovereign** chooses to default $(D = 1)$ or not $(D = 0)$:

$$W(b^{LC}, b^{FC}; X) = \max_{D=\{0,1\}} \{(1 - D) V(b^{LC}, b^{FC}; X) + D\big[V(0, 0; X) - \underbrace{\nu}_{\text{Default Disutility Costs}}\big]\}$$

Back

Markov Perfect Equilibrium

- State variables are:

$$\{b^{LC}, b^{FC}; X\}$$

- Choice variables are:

$$D(b^{LC}, b^{FC}; X), b'^{LC}(b^{LC}, b^{FC}; X), b'^{FC}(b^{LC}, b^{FC}; X)$$

- Bond markets clear:

$$b'^{LC} = B'^{LC} \cdot S, \;\; b'^{FC} = B'^{FC}$$

- Bond price schedules:

$$q^{LC}(b'^{LC}, b'^{FC}; X), q^{FC}(b'^{LC}, b'^{FC}; X)$$

▸ Back

Mechanism

As FX volatility ↑, Relative Price of FC over LC debt ↑

- Assume there is no default risk $D_{t+1} = 0$.
- The relative price of FC over LC debt:

$$q_t^{FC} - q_t^{LC} = \frac{1}{1+r_f} - \underbrace{\frac{\mathbb{E}_t\left(\frac{S_t}{S_{t+1}}\right)}{1+r_f}}_{q^{LC}_{RN,t}\ :\ \textbf{Risk Neutral LC Bond Price}} \times \underbrace{\left(\frac{1}{2} + \frac{1}{2}\sqrt{1 - 4B'^{LC}(1+r_f)\alpha\underbrace{\mathrm{Var}_t\left(\frac{S_t}{S_{t+1}}\right)}_{\propto \sigma_S^2}}\right)}_{\Psi_t^{LC}\ :\ \textbf{Risk Premium on LC Bond}\ <1}$$

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- Relative price of FC over LC debt increases with $\sigma_S^2 \uparrow$,
  i.e. **the interest rate on LC over FC debt is higher with** $\sigma_S^2 \uparrow$:

$$\frac{\partial(q^{FC} - q^{LC})}{\partial \sigma_S^2} > 0$$

As FX volatility ↑, Relative Price of FC over LC debt ↑

- Assume there is no default risk $D_{t+1} = 0$.
- The relative price of FC over LC debt:

$$q_t^{FC} - q_t^{LC} = \frac{1}{1+r_f} - \underbrace{\frac{\mathbb{E}_t\left(\frac{S_t}{S_{t+1}}\right)}{1+r_f}}_{q^{LC}_{RN,t}\ :\ \textbf{Risk Neutral LC Bond Price}} \times \underbrace{\left(\frac{1}{2} + \frac{1}{2}\sqrt{1 - 4B'^{LC}(1+r_f)\alpha\, \underbrace{\mathrm{Var}_t\left(\frac{S_t}{S_{t+1}}\right)}_{\propto \sigma_S^2}}\right)}_{\Psi_t^{LC}\ :\ \textbf{Risk Premium on LC Bond}\ <1}$$

- Relative price of FC over LC debt increases with $\sigma_S^2 \uparrow$, i.e. **the interest rate on LC over FC debt is higher with** $\sigma_S^2 \uparrow$:

$$\frac{\partial(q^{FC} - q^{LC})}{\partial \sigma_S^2} > 0$$

- The increase is larger as the risk aversion of lender α, is larger.

As FX volatility ↑, Relative Price of FC over LC debt ↑

- Assume there is no default risk $D_{t+1} = 0$.
- The relative price of FC over LC debt:

$$q_t^{FC} - q_t^{LC} = \frac{1}{1+r_f} - \underbrace{\frac{\mathbb{E}_t\left(\frac{S_t}{S_{t+1}}\right)}{1+r_f}}_{q_{RN,t}^{LC} \;:\; \textbf{Risk Neutral LC Bond Price}} \times \underbrace{\left(\frac{1}{2} + \frac{1}{2}\sqrt{1 - 4B'^{LC}(1+r_f)\alpha \underbrace{\mathrm{Var}_t\left(\frac{S_t}{S_{t+1}}\right)}_{\propto \sigma_S^2}}\right)}_{\Psi_t^{LC} \;:\; \textbf{Risk Premium on LC Bond} \;<1}$$

- Relative price of FC over LC debt increases with $\sigma_S^2 \uparrow$,
  i.e. **the interest rate on LC over FC debt is higher with** $\sigma_S^2 \uparrow$:

$$\frac{\partial(q^{FC} - q^{LC})}{\partial \sigma_S^2} > 0$$

- The increase is larger as the risk aversion of lender α, is larger.
- Specifically, when $\alpha = 0$,

$$q_t^{FC} - q_t^{LC} = \frac{1}{1+r_f} - \frac{\mathbb{E}_t\left(\frac{S_t}{S_{t+1}}\right)}{1+r_f} \Longrightarrow \frac{\partial(q^{FC} - q^{LC})}{\partial \sigma_S^2} = 0 \ll 0.4 \;\; \text{(Data)}$$

As FX volatility ↑, EM borrows more in FC

- Assume there is no default risk $D_{t+1} = 0$ and $E_t\left(\frac{S_{t+1}}{S_t}\right) = 1$.
- Then, EM's currency composition of external borrowing will be determined by:

$$u'(c_t) \underbrace{\left[q_t^{FC} - \left(q_t^{LC} + \frac{\partial q_t^{LC}}{\partial b_{t+1}^{LC}}\right)\right]}_{\textbf{MB} \text{ of one more FC debt and one less LC debt}} = \underbrace{\beta \mathrm{Cov}\left(u'(c_{t+1}), \frac{S_{t+1}}{S_t}\right)}_{\textbf{MC} \text{ of one more FC debt and one less LC debt}}$$

As FX volatility ↑, EM borrows more in FC

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- With a large enough lenders' risk aversion α ,

$$\sigma_S^2 \uparrow \implies q^{FC} - q^{LC} \Uparrow$$

As FX volatility ↑, EM borrows more in FC

- Assume there is no default risk $D_{t+1} = 0$ and $E_t\left(\frac{S_{t+1}}{S_t}\right) = 1$.
- Then, EM's currency composition of external borrowing will be determined by:

$$u'(c_t) \underbrace{\left[q_t^{FC} - \left(q_t^{LC} + \frac{\partial q_t^{LC}}{\partial b_{t+1}^{LC}}\right)\right]}_{\textbf{MB} \text{ of one more FC debt and one less LC debt}} = \underbrace{\beta \mathrm{Cov}\left(u'(c_{t+1}), \frac{S_{t+1}}{S_t}\right)}_{\textbf{MC} \text{ of one more FC debt and one less LC debt}}$$

- With a large enough lenders' risk aversion α ,

$$\sigma_S^2 \uparrow \implies q^{FC} - q^{LC} \Uparrow$$

- It implies then,

$$u'(c_t) \underbrace{\left[q_t^{FC} - \left(q_t^{LC} + \frac{\partial q_t^{LC}}{\partial b_{t+1}^{LC}}\right)\right]}_{\text{LC MORE EXPENSIVE } \Uparrow} = \underbrace{\beta \mathrm{Cov}\left(u'(c_{t+1}), \frac{S_{t+1}}{S_t}\right)}_{\text{FC MORE RISKY } \Uparrow}$$

- The sovereign **borrows more in FC and less in LC**.

back

Untargeted Moments : Higher FX Volatility

Model With Default	Targeted $\sigma_s = 13\%$	Counterfactual Higher $\sigma_s = 15\%$	Higher FX Volatility $\Delta\sigma_s = +2\%$	
			Δ in Model	Δ in Data
Relative cost: $y^{LC}_{i,t} - \left(y^{FC}_{i,t} + s_{i,t} - s_{i,t+12}\right)$	0.99%	1.73%	+0.74%	+0.90%
FC Share	86.70%	87.3%	+0.60%	+0.66%

Back

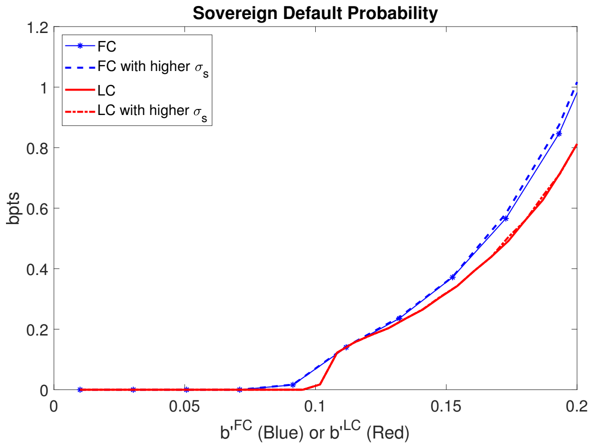
Untargeted Moments : Lower FX Volatility

Model With Default	Targeted $\sigma_s = 13\%$	Counterfactual Lower $\sigma_s = 11\%$	Lower FX Volatility $\Delta\sigma_s = -2\%$	
			Δ in Model	Δ in Data
Relative cost: $y_{i,t}^{LC} - \left(y_{i,t}^{FC} + s_{i,t} - s_{i,t+12}\right)$	0.99%	0.73%	−0.27%	−0.90%
FC Share	86.70%	85.63%	−1.07%	−0.66%

Back

Model Mechanism: Default Probability with Higher σ_s

- The default prob. is slightly higher with higher exchange rate volatility for a given level of FC debt.



The other choice variable fixed at zero. Exogenous variables are held at their mean e.g. $S = 1$. Back