

Dollar Liquidity Flows in Small-Open Economies

by Saki Bigio · Paul Castillo · Seungyub Han (UCLA · Peru Central Bank · LSU)
on May 7, 2026

Motivation

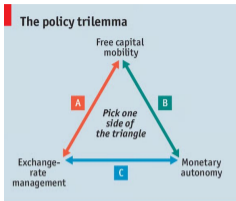
Evidence: Peru

Model

Quantitative Analysis

Counterfactuals

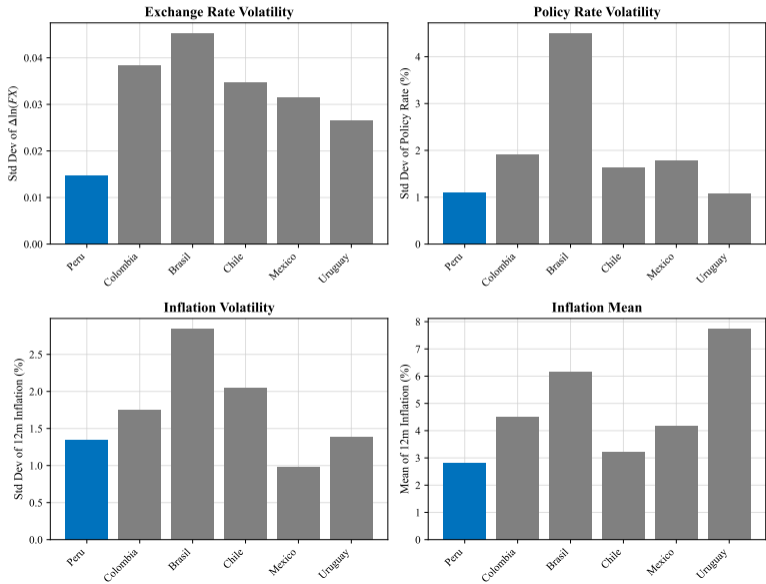
Theory



Economist.com

Practice

Cross-Country Volatility and Mean — 6 Countries



The Question

Can a SOE jointly stabilize FX, inflation, and interest rates?

Quantity Tools: sterilized FX interventions, reserve requirements, forward limits

Textbook view (Impossible Trinity):

No: Tools offset by capital mobility.



Our answer:

Yes: Settlement frictions & slow capital mobility enable tools.

Standard View Misses Something

- **International payments system runs on dollars**

Standard View Misses Something

- **International payments system runs on dollars**
 - Non-US banks **issue dollar liabilities that circulate**
 - Must hold **dollar reserves** at US correspondent banks to **settle**
 - Possible: **dollar reserve shortage** upon large flows
- **Settlement risk**
 - If **reserve shortage** expensive dollar interbank or credit line
- **Dollar reserve position determines FX**
 - reserve holdings limited by past current account or current capital account flows
 - If reserves small, **risk anticipation** depreciates local currency
- **Capital moves slowly**, does not undo depreciates quickly

A Framework to Evaluate Quantity-Based Tools

Risk-absorption models miss the channel

Gabaix and Maggiori 2015; Itskhoki and Mukhin 2021; Cavallino 2019

- Asset–liability matching \neq liquid dollar reserves
- Silent on sterilization, reserve requirements, Fed swap lines
- “International intermediaries”—who are they? Evidence?

Build on Bianchi, Bigio and Engel 2024 (BBE): dual-currency banking

- BBE: one world, two currencies
 - Here: **SOE** \Rightarrow **current account** + **slow-moving capital** endogenous flows
- Focus: quantity-based tools
- **Evidence:** local sol/dollar liquidity drives FX (not global)

This Paper

1. Empirics (Peru, 2002–2019)

- Four facts
- local bank dollar liquidity \Rightarrow FX / CIP

2. Model: SOE + banking liquidity

- FX = relative price of liquidity services by currency
- External dollar flows vs. quantity-based tools

3. Quantitative validation

- Filtering: recover latent funding-shocks
- Validation: CIP deviations, borrowing/lending rate by currency

4. Counterfactuals

- No FX intervention \Rightarrow volatility equal to Peru peers

Motivation

Evidence: Peru

- * Why Peru?
- * Four Facts

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Why Peru?

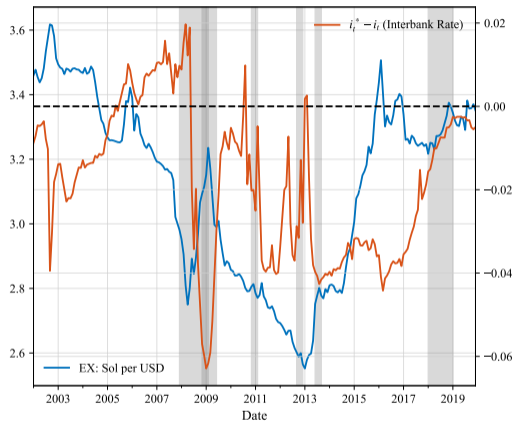
Ideal lab

- Banks: operate dual-currency balance sheets
- **Local dollar interbank market**
- Commodities / pension funds / political unrest \Rightarrow **large \$ reserve swings**
- BCRP: active & creative use of q-tools

Outcome

- Sol volatility $\approx \frac{1}{3}$ of Colombia, Brazil, Chile, Uruguay, Mexico
- Despite: **notoriously unstable domestic politics**
- No inflation cost

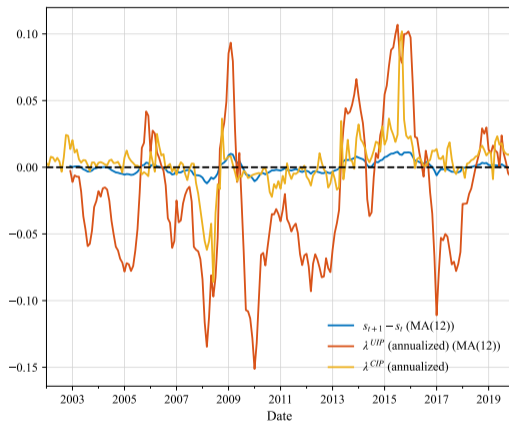
Fact 1: Exchange rates do not track interest differentials



Sol/USD and rate differential (**policy rate targets** and **effective interbank rate**).

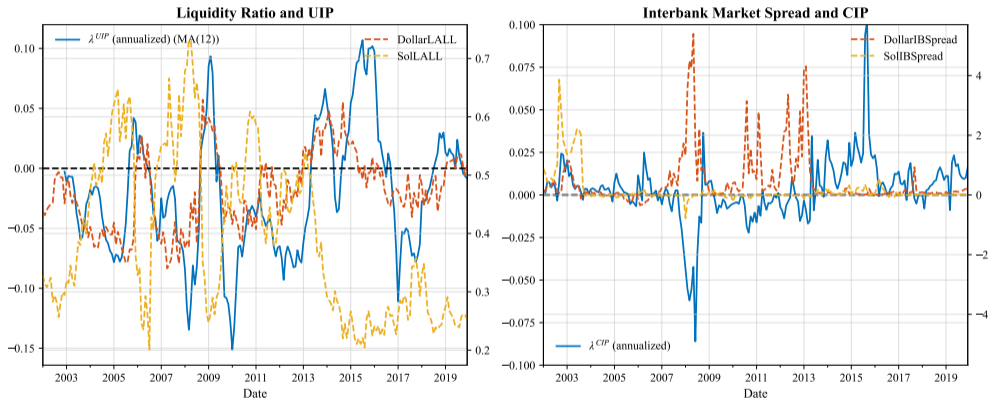
Shaded: GFC, QE episodes, Taper Tantrum, Trade War, COVID.

Fact 2: CIP deviations are large, persistent, and change sign in 2013



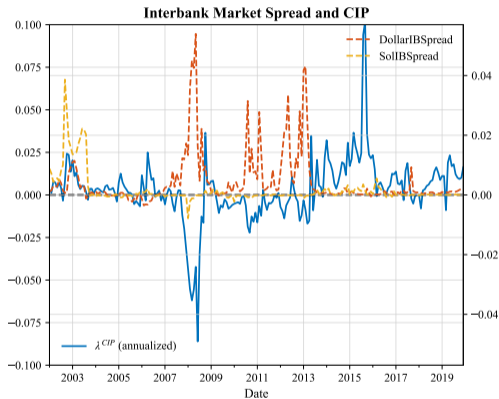
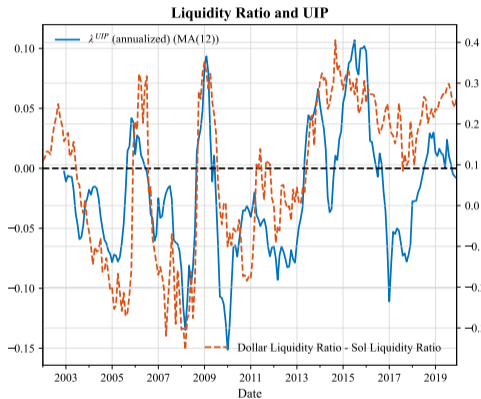
UIP and CIP deviations, annualized. Right panel: 12-month MA.

Fact 3: Dollar liquidity moves one-for-one with CIP deviations



Left: dollar liquidity ratio vs. UIP deviation. Right: dollar interbank spread vs. CIP deviation.

Fact 3: Dollar liquidity moves one-for-one with CIP deviations



Left: dollar liquidity ratio vs. UIP deviation. Right: dollar interbank spread vs. CIP deviation.

Fact 4: Local \$ liquidity: independent explanatory power for FX

$$\Delta FX_t = \alpha + \beta_1 \Delta i_t + \beta_2 (\text{risk premia}) + \beta_3 (\text{G10 CIP}) + \beta_4 (\text{VIX}) + \gamma (\text{local dollar liquidity}) + \varepsilon_t$$

	EW2023	+GL	+GL/VIX	+GL/VIX/LR	+GL/VIX/LR/LI
q_{t-1}	-0.012 (0.008)	-0.013 (0.009)	-0.011 (0.008)	-0.028*** (0.010)	-0.021* (0.011)
$\Delta(i_t - i_t^*)$	0.449** (0.182)	0.415** (0.172)	0.369** (0.158)	0.275* (0.150)	0.363*** (0.118)
$\Delta \lambda_t^{CIP}$	0.098 (0.068)	0.098 (0.068)	0.066 (0.064)	0.013 (0.054)	0.042 (0.043)
$\Delta \eta_t^{G10}$		-0.656 (0.529)	-0.141 (0.513)	0.135 (0.416)	0.812 (0.503)
$\Delta \ln(VIX)$			0.015*** (0.005)	0.003 (0.005)	0.006 (0.005)
$\Delta \zeta$				1.257*** (0.301)	0.991*** (0.251)
ΔNLR					0.114*** (0.028)
R-squared Adj.	0.109	0.109	0.142	0.242	0.308
N	215	215	215	215	215

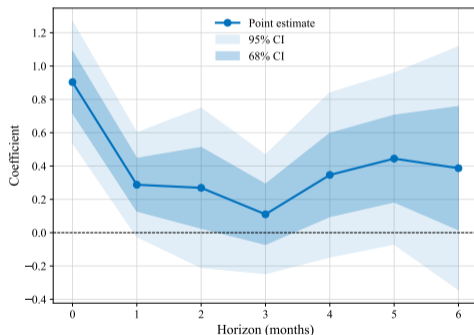
Causality: Demand-Driven Dollar Shock \Rightarrow Depreciates the Sol

Instrument: Unexpected Marginal \$ Reserve Requirement (Gutierrez, Ivashina and Salomao, 2023):

- Dec 2014 – Feb 2015: MGRR raised 50% \rightarrow 70% (unprecedented +21.5 pp in two months)
- Dec 2016: cut 70% \rightarrow 48%

	2002–2019 (OLS)	2002–2019 (IV)
q_{t-1}	-0.021* (0.011)	0.005 (0.028)
$\Delta(i_t - i_t^*)$	0.364*** (0.118)	0.790*** (0.236)
$\Delta\lambda_t^{CIP}$	0.041 (0.043)	0.141 (0.129)
$\Delta\eta_t^{G10}$	0.836* (0.504)	4.841** (1.951)
$\Delta \ln(VIX)$	0.006 (0.005)	0.023** (0.012)
$\Delta\zeta$	1.023*** (0.262)	-0.614 (0.515)
ΔNLR	0.114*** (0.028)	0.904*** (0.184)
N	211	211
R-squared Adj.	0.309	—

HAC s.e. 2002–2019. IV coeff = 0.904 (s.e. 0.184).



Local projection $\hat{\beta}_{t+h}^{IV}$

Motivation

Evidence: Peru

Model

Quantitative Analysis

Counterfactuals

Model in Words: BBE Logic

Bank balance sheets — by currency

- Deposits fund loans and reserves
- Without frictions: rates equate across currencies \Rightarrow irrelevance

Liquidity friction

- Stochastic deposit outflows to other banks or abroad (**scale** σ_t, σ_t^*)
- Settle in *same-currency* reserves (loans illiquid)
- Deficit banks borrow:
 - \rightarrow from surplus banks via frictional OTC trade
 - \rightarrow lender of last resort: central bank (Sol) or foreign credit line (\$)

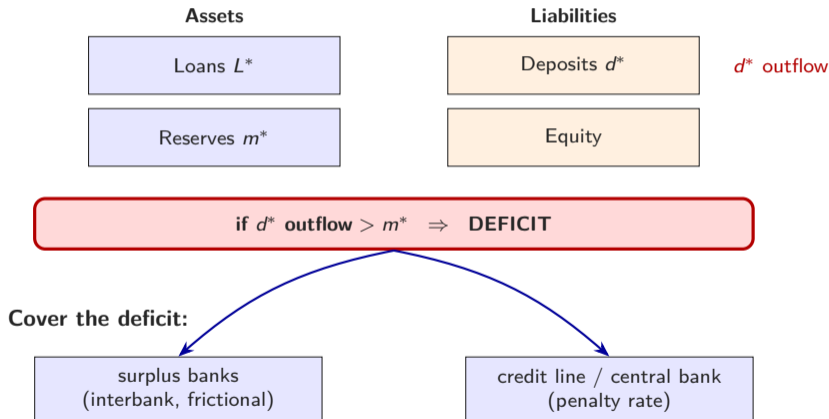
Equilibrium

- Portfolio choice equates total returns across currencies, *including shadow cost of liquidity*

\Rightarrow **pure quantity channel for FX / distinct from interest differentials and currency risk**

Bank Settlement Friction

Balance Sheet—dollar side (same logic for sol)



Shadow cost \mathcal{L}^{m^*} : expected marginal cost of covering the deficit—rises when reserves are scarce.

Model: 3 Equation Summary

(I) Liquidity-adjusted UIP (banks' portfolio optimality)

$$\mathbb{E} \left[\frac{e_t}{e_{t+1}} \right] (1 + i_t^m) - (1 + i_t^{m*}) = \underbrace{\mathcal{L}_t^{m*}(\mu_t^*, \sigma_t^*) - \mathcal{L}_t^m(\mu_t, \sigma_t)}_{\text{relative liquidity premium}} + \underbrace{\xi_t}_{\text{currency risk}}$$

(II) External dollar funding constraint (the SOE real limit)

$$\underbrace{m_t^{B*} - d_t^{f*}}_{\text{private NFA}} = \underbrace{NX_t + NII_t}_{\text{current account}} + \underbrace{(m_{t-1}^{B*} - d_{t-1}^{f*})}_{\text{inherited NFA}} - \underbrace{\Delta m_t^{CB*}}_{\text{FX intervention}}$$

(III) Exchange rate = relative money demand

$$e_t = \frac{M_t / m_t^B}{P_t^*} \quad \Leftarrow \text{dollar price level fixed for SOE}$$

Why Quantity-Based Tools Work?

SOE constraint: dollars limited by current account + capital flows + NFA.

Sterilized FX intervention (supply side)

BCRP buys dollars \Rightarrow aggregate m^* shrinks $\Rightarrow \mathcal{L}^{m^*} \uparrow \Rightarrow$ Sol depreciates

$$\left. \frac{de_t}{dm_t^{CB^*}} \right|_{\text{FXI}} = \frac{\overbrace{\alpha_{L,t}}^{\text{liquidity channel}}}{\underbrace{1 + \alpha_{F,t}}_{\text{capital offset}}} > 0$$

Forward-position surcharge (demand side, Sol channel)

Excess short-\$ forward \Rightarrow Sol RR surcharge $\Rightarrow \mathcal{L}^m \uparrow \Rightarrow$ Sol appreciates, CIP widens

$$\frac{de_t}{dq_t^f} = \underbrace{-\frac{e_t}{m_t^B} \phi_{q^f,t}}_{\text{Sol liquidity channel only}} < 0$$

Vanish $\bar{\mathcal{L}} = \bar{\mathcal{L}}^* = 0$: settlement frictions are *necessary* for quantity tools.

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Filtering and Validation

Observables by currency: liquidity ratio μ_t , Res Req ρ_t , policy & interbank rates i_t^m, i_t^f

Unobservable: Sol and \$ payment risks σ_t, σ_t^*

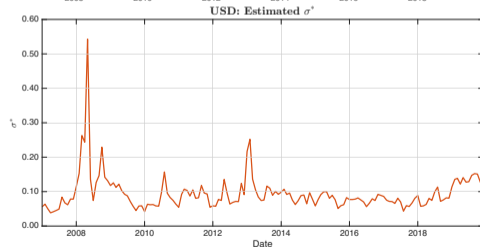
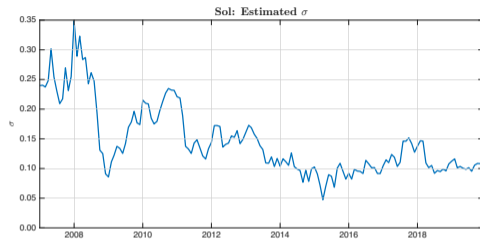
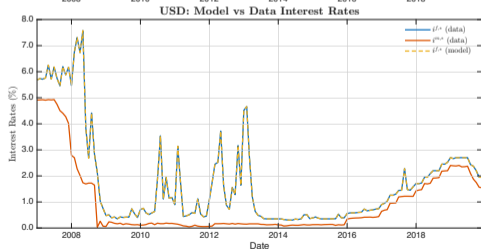
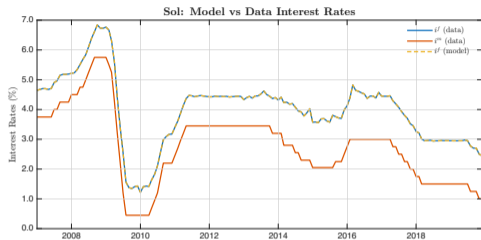
Filter: one equation per unobservable, inverted period-by-period:

$$i_t^f = F(\mu_t, \rho_t, \sigma_t) \qquad i_t^{f*} = F^*(\mu_t^*, \rho_t^*, \sigma_t^*)$$

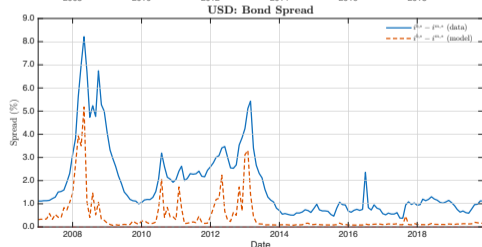
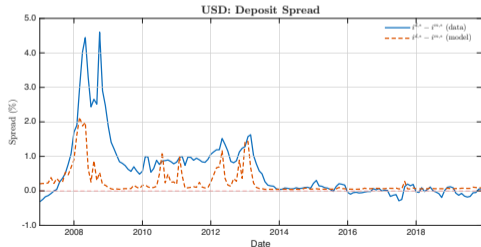
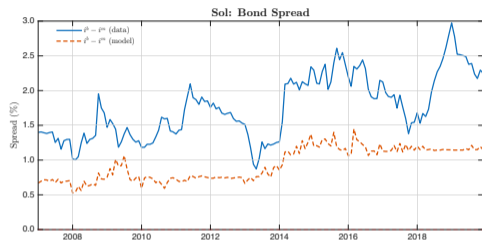
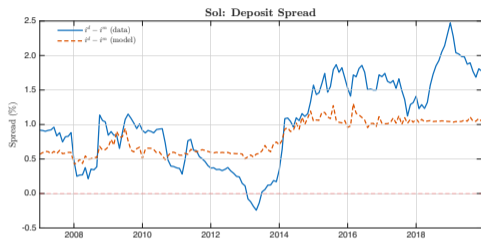
Validation:

- feed $\hat{\sigma}_t, \hat{\sigma}_t^*$ back into the model
- **check fit by currency:**
 - CIP deviations
 - loan & deposit rates

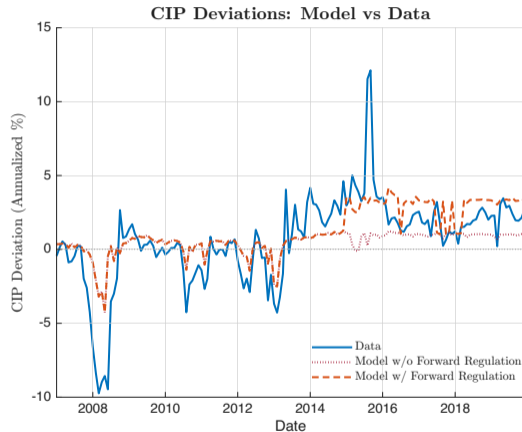
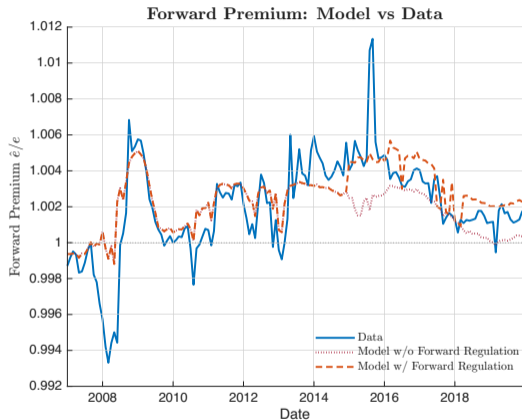
Model Fit: Filtered $\hat{\sigma}_t$ and $\hat{\sigma}_t^*$



Model Fit: Predicted Loan/Deposit Spreads by Currency



Model Fit: CIP Deviations Incl. Forward Regulation



Data (black), model without forward regulation (red dashed), model with forward regulation (blue dashed).

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Two Counterfactuals

Question: How much of Peru's FX stability comes from BCRP quantity-based tools?

Approach: Feed model with

- **data:** US and Peru policy rates, requirements, liquidity ratios by currency
- **inferred shocks:** sol and dollar payment shocks σ , σ^*
- **estimates:** foreign capital response, expectations

Two experiments

- **No sterilized FX intervention**
- **No forward-position surcharge (post-2014)**

External Dollar Funding: How Slow are Capital Inflows?

Counterfactuals: hinge on elasticity of capital flows ϵ_f to rates:

OLS specification:

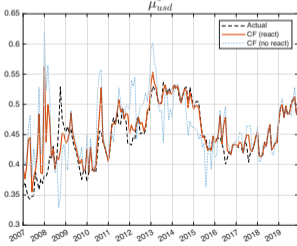
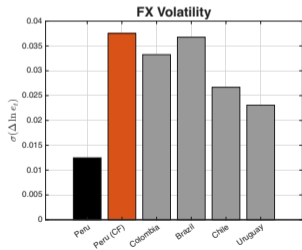
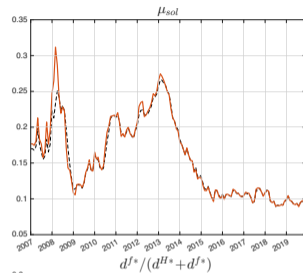
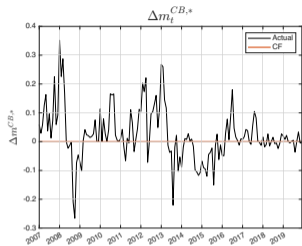
$$\ln\left(\frac{d_t^{f,*}}{d_t^{H,*}}\right) = \alpha + (\beta_1 + \beta_2 \mathbf{1}\{t \geq 2014\}) \ln(i_t^{d*} - i_t^{if*}) + \text{risk controls} + u_t$$

- Dependent variable: external / domestic \$ deposits
- Spread: 3-month deposit vs. US T-bill
- Post-2014: Basel III + BCRP regulation

Estimated elasticity:

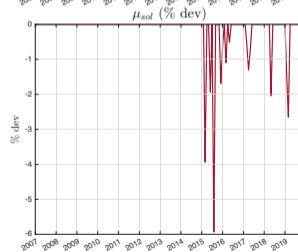
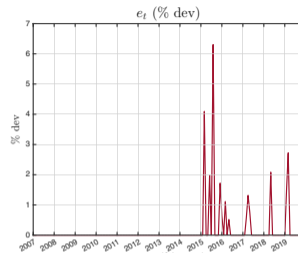
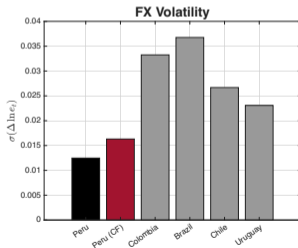
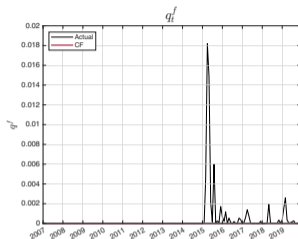
- Pre-2014: $\hat{\epsilon}_f = 1.347$
- Post-2014: $\hat{\epsilon}_f = 0.975$

CF 1: No Sterilized FX Intervention



Counterfactual paths under no FX intervention.

CF 3: No Forward-Position Surcharge



Counterfactual paths under removal of the post-2014 forward-position Sol reserve surcharge.

The Answer...

Yes. Quantity tools stabilize FX in dollarized SOEs because settlement frictions and slow-moving capital.

What the experiments show

- **FX intervention:** without it, sample-average Sol volatility matches regional peers;
- **Forward surcharge:** pure Sol-liquidity wedge; targets the Sol without disturbing dollar liquidity

Broader lesson

- Central bank gains an extra degree of freedom: rates for inflation, quantity tools for FX
- Advantage weakens with capital-flow elasticity / frictionless OTC market
- ...but also dollar shocks offset
- While not offset, CB should offset

Appendix

G10 CIP from Du, Im and Schreger 2018 vs. local dollar liquidity ratio. Local liquidity has independent explanatory power after controlling for global factors.

Literature

- **Intermediaries, liquidity, exchange rates**

Gabaix and Maggiori 2015; Ivashina, Scharfstein and Stein 2015; Itskhoki and Mukhin 2021; Engel and Wu 2023; Bianchi, Bigio and Engel 2024; Leo, Zou and Keller 2024

- **Dollar specialty / convenience yields**

Jiang, Krishnamurthy and Lustig 2021; Jiang, Krishnamurthy and Lustig 2023; Devereux, Engel and Wu 2023; Valchev 2020

- **CIP deviations**

Du, Tepper and Verdelhan 2018; Du, Im and Schreger 2018; Dao and Gourinchas 2025; Eugenio M Cerutti 2023

- **Emerging markets: UIP, CIP, FX**

Kalemli-Özcan and Varela 2024; Keller 2024; Leo, Zou and Keller 2024

- **FX intervention theory**

Cavallino 2019; Fanelli and Straub 2021

- **Peru identification**

Gutierrez, Ivashina and Salomao 2023

Institutional Background: Three Quantity Tools

Reserve Requirements

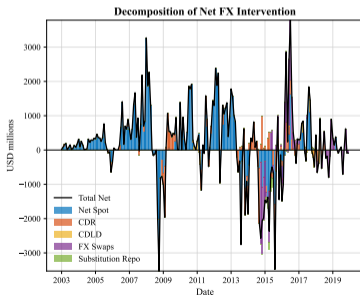
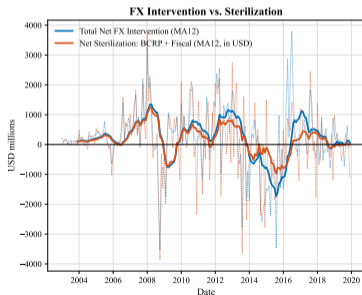
Separate Sol and USD ratios; unremunerated. Marginal RR (MGRR) applies to liabilities above a threshold, creating a convex cost of balance-sheet expansion. Average USD RR historically higher than Sol.

FX Intervention

Outright spot and swap operations. Sterilized: only dollar liquidity channel. Unsterilized: also loosens Sol liquidity. BCRP purchased avg. USD 6bn/yr 2005–2013.

Forward Position Limits

Since Dec 2014: gross short USD forward $>$ limit \Rightarrow Sol RR surcharge of $2\times$ excess. Highly punitive and non-linear. Introduced in response to post-Taper Tantrum depreciation pressure.



Calibration and Estimation

Parameter	Sol	USD
Liquidity penalty i^w	5%	5%
Matching efficiency λ	2.0	1.0
Borrower bargaining power η	0.50	0.50

Higher Sol matching efficiency reflects Peru's deeper domestic interbank market. Penalty rate matches BCRP discount window and emergency foreign credit line costs.

External dollar supply elasticity (estimated from data): Pre-2014 $\hat{\epsilon}_f = 1.347$; post-2014 $\hat{\epsilon}_f = 0.975$ — Basel III and BCRP regulations significantly reduced capital mobility after 2014.

Model: Interbank Market Mechanics

- Banks receive mean-zero idiosyncratic withdrawal shocks $\omega_{t,j}$ on deposits in each currency
- Surplus banks ($\tilde{s} > 0$) and deficit banks ($\tilde{s} < 0$) trade in a Cobb-Douglas OTC matching market, extending Bianchi–Bigio (2022) from Leontief matching
- Market tightness $\theta_t = S_t^- / S_t^+$ depends on aggregate liquidity ratio μ_t and shock volatility σ_t ; separate markets by currency
- Unmatched deficit banks borrow at discount window rate i^w (Sol) or from foreign credit lines (USD)

CIP formula from model:

$$\text{CIP}_t = (1 + i_t^{m*}) \cdot \underbrace{\frac{1 + i_t^m + \mathcal{L}_t^m}{1 + i_t^{m*} + \mathcal{L}_t^{m*}}}_{\text{relative total return}} - (1 + i_t^m)$$

Deviations vanish only when liquidity premia are equal across currencies.

Effectiveness of Instruments: Analytical Summary

From Propositions 1 and 3 (full proofs in paper):

CF 1 — Sterilized FX Intervention

$$\left. \frac{de_t}{d\delta} \right|_{\text{FXI}} = \frac{\alpha_{L,t}}{1 + \alpha_{F,t}} > 0$$

$\alpha_{L,t}$: *relative liquidity channel* (numerator). $\alpha_{F,t}$: *external funding channel* (denominator) attenuates the effect; $\alpha_{F,t} \rightarrow \infty \Rightarrow$ effect vanishes.

CF 3 — Forward-Position Sol Reserve Surcharge

$$\frac{de_t}{dq_t^f} = - \frac{e_t}{m_t^B} \phi_{q^f,t} < 0$$

Single channel. No α_F term: the surcharge does not move the dollar deposit rate, so external funding does not respond. The surcharge *appreciates* the Sol; removing it *depreciates*.

Common requirement: both effects vanish when liquidity frictions vanish ($\bar{\mathcal{L}} = \bar{\mathcal{L}}^* = 0$). *Settlement frictions are necessary for any quantity tool to move the exchange rate.*

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