Inelastic Financial Markets and Foreign Exchange Interventions[1]

Paula Beltran Chang He

February, 2024

[1] Beltran (PBeltranSaavedra2@imf.org): IMF. He (hec@ucla.edu): UCLA.

Disclaimer: the views expressed herein are those of the authors and should not be attributed to the IMF, its executive board, or its management.

FX Interventions meet Inelastic Financial Markets

- Foreign Exchange (FX) interventions can come in large magnitudes:

FX Interventions meet Inelastic Financial Markets

- Foreign Exchange (FX) interventions can come in large magnitudes:
  After the Fed tapers down QE (post-“taper tantrum”) in 2014:

FX Interventions meet Inelastic Financial Markets

- Foreign Exchange (FX) interventions can come in large magnitudes:

  After the Fed tapers down QE (post-“taper tantrum”) in 2014:
  - Mexico sold 30+ billion USD reserves (3% GDP); Peru 10+ billion (5% GDP) Figure

FX Interventions meet Inelastic Financial Markets

- Foreign Exchange (FX) interventions can come in large magnitudes:

  After the Fed tapers down QE (post-"taper tantrum") in 2014:
  - Mexico sold 30+ billion USD reserves (3% GDP); Peru 10+ billion (5% GDP) Figure

- Standard textbook macro-literature assumes perfectly elastic financial market (Mundell 1962; Obstfeld-Rogoff 1995; Gali-Monacelli 2005)

FX Interventions meet Inelastic Financial Markets

- Foreign Exchange (FX) interventions can come in large magnitudes:

  After the Fed tapers down QE (post-"taper tantrum") in 2014:
  - Mexico sold 30+ billion USD reserves (3% GDP); Peru 10+ billion (5% GDP) Figure

- Standard textbook macro-literature assumes perfectly elastic financial market (Mundell 1962; Obstfeld-Rogoff 1995; Gali-Monacelli 2005)

- Asset-pricing literature suggests otherwise:
  - Domestic and foreign currency assets are *not* perfect substitutes (Rogoff 1984; Camanho-Hau-Rey 2022)
  - Financial market is *not* perfectly elastic (Shleifer 1986; Gabaix-Koijen 2022)

The Challenge in Identifying the Effects of FX Intervention

- **Research Question**: How effective are FX interventions (or capital flows) at stabilizing exchange rates?

The Challenge in Identifying the Effects of FX Intervention

- **Research Question**: How effective are FX interventions (or capital flows) at stabilizing exchange rates?
- Inherent endogeneity problem in estimating the effects of the intervention on exchange rates:
  - Classic demand-supply simultaneity that bias OLS

The Challenge in Identifying the Effects of FX Intervention

- **Research Question**: How effective are FX interventions (or capital flows) at stabilizing exchange rates?
- Inherent endogeneity problem in estimating the effects of the intervention on exchange rates:
  - Classic demand-supply simultaneity that bias OLS
- A valid identification calls for a natural experiment that **exogenously** changes the **demand on currency-composition** of government bonds

This Paper

- **Research Question**:
  - How effective are foreign exchange interventions (or capital flows) at stabilizing exchange rates?

This Paper

- **Research Question**:
  - How effective are foreign exchange interventions (or capital flows) at stabilizing exchange rates?
- **What we do**:
  - Leverage the mechanical rebalancings of the largest local-currency government bonds index for emerging countries

This Paper

- **Research Question**:
  - How effective are foreign exchange interventions (or capital flows) at stabilizing exchange rates?
- **What we do**:
  - Leverage the mechanical rebalancings of the largest local-currency government bonds index for emerging countries
  - Show the index rebalancings resemble an exogenous currency demand shock in an inelastic financial market model

This Paper

- **Research Question**:
  - How effective are foreign exchange interventions (or capital flows) at stabilizing exchange rates?
- **What we do**:
  - Leverage the mechanical rebalancings of the largest local-currency government bonds index for emerging countries
  - Show the index rebalancings resemble an exogenous currency demand shock in an inelastic financial market model
  - Identify the elasticity of exchange rates and estimate the required size of foreign exchange intervention through the lens of an inelastic financial market model

This Paper: Preview of Results

- Currency demand shock moves exchange rates significantly:

This Paper: Preview of Results

- Currency demand shock moves exchange rates significantly:
  - One std. dev. of the shock ($\sim$ 2.5 bn. USD) moves exchange rate by 1% (median country)
  - Persistent effects on exchange rates for about 3 months

This Paper: Preview of Results

- Currency demand shock moves exchange rates significantly:
  - One std. dev. of the shock ($\sim$ 2.5 bn. USD) moves exchange rate by 1% (median country)
  - Persistent effects on exchange rates for about 3 months
- Evidence that supports models of inelastic financial markets where FX interventions are effective at stabilizing exchange rates (the “relaxed” Trilemma)

This Paper: Preview of Results

- Currency demand shock moves exchange rates significantly:
  - One std. dev. of the shock ($\sim$ 2.5 bn. USD) moves exchange rate by 1% (median country)
  - Persistent effects on exchange rates for about 3 months
- Evidence that supports models of inelastic financial markets where FX interventions are effective at stabilizing exchange rates (the “relaxed” Trilemma)
- The more inelastic the financial markets, the most effective FX interventions:

This Paper: Preview of Results

- Currency demand shock moves exchange rates significantly:
  - One std. dev. of the shock ($\sim$ 2.5 bn. USD) moves exchange rate by 1% (median country)
  - Persistent effects on exchange rates for about 3 months
- Evidence that supports models of inelastic financial markets where FX interventions are effective at stabilizing exchange rates (the “relaxed” Trilemma)
- The more inelastic the financial markets, the most effective FX interventions:
  - Intervention three-times more effective for free-floaters than peggers (or managed-floaters)
  - 1 % appreciation $\Leftrightarrow$ central bank sell foreign reserves worth 0.4% of GDP (average effect)

Related Literature

- **Foreign Exchange Interventions (FXI).** Fatum-Hutchison (2003); Jeanne (2012); Fratzscher-Gloede-Menkhoff-Sarno-Stohr (2019); Adler-Lisack-Mano (2019); Itskhoki-Mukhin (2023); Amador-Bianchi-Bocola-Perri (2019); Cavallino (2019); Fanelli-Straub (2021)
  We find a clean identification to estimate the effects of FXI
- **Index Rebalancing and Asset Demand.** Shleifer (1986); Hau-Massa-Peress (2009); Lou (2012); Chang-Hong-Liskovich (2014); Koijen-Yogo (2019, 2020); Pandolfi-Williams (2019); Camanho-Hau-Rey (2021); Bacchetta-Tieche-Wincoop (2023); Kashyap-Kovrijnykh-Li-Pavlova (2023)
  We focus on the macro-elasticity of the FX markets and speak about the effects of FXI
- **Models of Exchange Rates in a Segmented/Inelastic Financial Market.** Alvarez-Atkeson-Kehoe (2009); Gabaix-Maggiori (2015); Gourinchas-Ray-Vayanos (2019); Cavallino (2019); Greenwood-Hanson-Stein-Sunderam (2020); Gabaix-Koijen (2022); Itskhoki-Mukhin (2021, 2022).
  We provide empirical evidence supporting models of inelastic financial markets
- **Exchange Rates Predictability.** Fama (1984); Evans-Lyons (2002); Tornell-Gourinchas (2004); Lustig-Verdelhan (2007); Engel (2016); Jiang-Krishnamurthy-Lustig (2022); Pandolfi-Williams (2019)
  We employ a quantity (rather than price) shock to predict exchange rates

Outline

1 Introducing the Currency Demand Shock

2 Currency Demand Shocks in Inelastic Financial Market

3 FX Interventions in Inelastic Financial Markets

Government Bond Index (GBI) EM Global Diversified

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019
  - $\sim$ 90% of the funds in EPFR dataset that follows local-currency EM gov. bonds are tracking a GBI-EM index

performance R^2

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019
  - $\sim$ 90% of the funds in EPFR dataset that follows local-currency EM gov. bonds are tracking a GBI-EM index

performance R^2

- Monthly rebalancings by JP Morgan that caps country weight at 10%:

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019
  - $\sim$ 90% of the funds in EPFR dataset that follows local-currency EM gov. bonds are tracking a GBI-EM index

performance R^2

- Monthly rebalancings by JP Morgan that caps country weight at 10%:
  - Use change in weights for countries ***not*** at the cap for identification

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019
  - $\sim$ 90% of the funds in EPFR dataset that follows local-currency EM gov. bonds are tracking a GBI-EM index

performance R^2

- Monthly rebalancings by JP Morgan that caps country weight at 10%:
  - Use change in weights for countries ***not*** at the cap for identification
  - JP Morgan includes part of country's sovereign bonds outstanding ($Q_{c,t}$) into the index ($\hat{Q}_{c,t}$)

Government Bond Index (GBI) EM Global Diversified

- The ***largest*** emerging market local-currency gov. bonds index:
  - Asset under management over 200 billion USD. in 2019
  - $\sim$ 90% of the funds in EPFR dataset that follows local-currency EM gov. bonds are tracking a GBI-EM index

performance R^2

- Monthly rebalancings by JP Morgan that caps country weight at 10%:
  - Use change in weights for countries ***not*** at the cap for identification
  - JP Morgan includes part of country's sovereign bonds outstanding ($Q_{c,t}$) into the index ($\hat{Q}_{c,t}$)
  - Caps country weight $\omega_{c,t} = \frac{P_{c,t}\hat{Q}_{c,t}}{\sum_c P_{c,t}\hat{Q}_{c,t}}$ at 10% while $\sum_c \omega_{c,t} = 1$ at the rebal. date

A simplified rebalancing example at 10% weight cap

$$\omega_{c,t}^{before} = \frac{P_{c,t}\,\hat{Q}_{c,t-1}}{\sum P_{c',t}\,\hat{Q}_{c',t-1}}$$

Brazil	**15**
Colombia	**4**
Peru	**1**

- Assume the remaining countries are all at 10% cap

A simplified rebalancing example at 10% weight cap

$$\omega_{c,t}^{before} = \frac{P_{c,t}\,\hat{Q}_{c,t-1}}{\sum P_{c',t}\,\hat{Q}_{c',t-1}}$$

$$\omega_{c,t}^{after} = \frac{P_{c,t}\,\hat{Q}_{c,t}}{\sum P_{c',t}\,\hat{Q}_{c',t}}$$

Brazil	**15**	**10**
Colombia	**4**	**8**
Peru	**1**	**2**

- Assume the remaining countries are all at 10% cap

A simplified rebalancing example at 10% weight cap

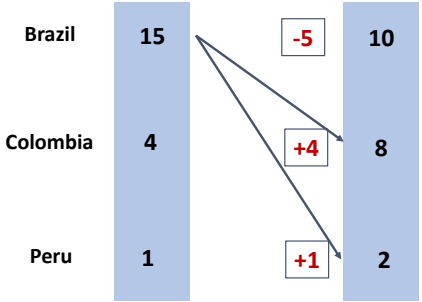
$$\omega_{c,t}^{before} = \frac{P_{c,t}\,\hat{Q}_{c,t-1}}{\sum P_{c',t}\,\hat{Q}_{c',t-1}} \qquad \omega_{c,t}^{after} = \frac{P_{c,t}\,\hat{Q}_{c,t}}{\sum P_{c',t}\,\hat{Q}_{c',t}}$$

Brazil	**15**	**-5**	**10**
Colombia	**4**		**8**
Peru	**1**		**2**

- Assume the remaining countries are all at 10% cap

A simplified rebalancing example at 10% weight cap

$$\omega_{c,t}^{before} = \frac{P_{c,t}\,\hat{Q}_{c,t-1}}{\sum P_{c',t}\,\hat{Q}_{c',t-1}} \qquad \omega_{c,t}^{after} = \frac{P_{c,t}\,\hat{Q}_{c,t}}{\sum P_{c',t}\,\hat{Q}_{c',t}}$$



- Assume the remaining countries are all at 10% cap

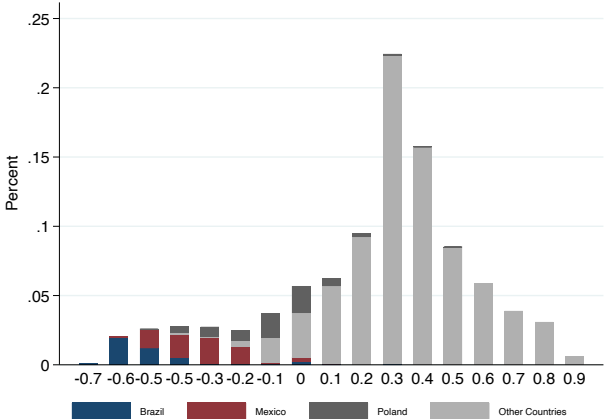
A simplified rebalancing example at 10% weight cap

	$\omega_{c,t}^{before}$		$\omega_{c,t}^{after}$	$\mu_{c,t}$
Brazil	15	-5	10	-
Colombia	4	+4	8	1/2
Peru	1	+1	2	1/2

- $\mu_{c,t} \equiv \frac{(\omega_{c,t}^{\text{before}} - \omega_{c,t}^{\text{after}})}{\omega_{c,t}^{\text{after}}} \perp$ macro-conditions

price corr. matrix

Plots of Currency Demand Shock by Country (Actual Data)



- Big countries (e.g. Brazil) hit the 10% cap and have $\mu_{c,t} < 0$
- Countries *not* at the cap have $\mu_{c,t} > 0$ (what we use for identification)

full dist. time series

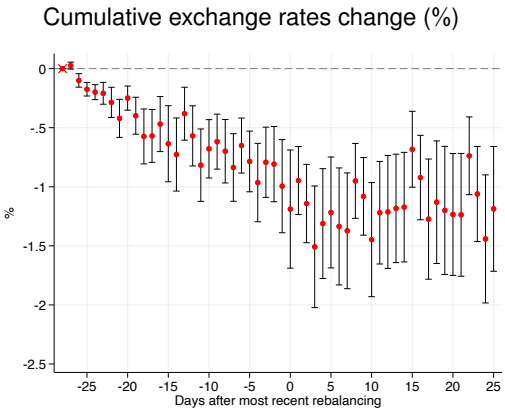
Outline

1 Introducing the Currency Demand Shock

2 Currency Demand Shocks in Inelastic Financial Market

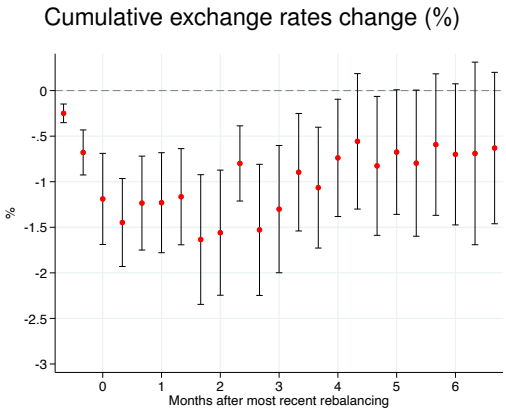
3 FX Interventions in Inelastic Financial Markets

Fact I: Demand shock moves exchange rates in the short run



- A one std. $\uparrow$ $\mu_{c,t}$ ($\sim$ 2.5 bn. USD) leads to 1% exchange rates appreciation
- $\Delta e_{c,t+d} = \beta_0 + \beta_\mu \, \mu_{c,t} + \phi \, X_{c,t} + \epsilon_{c,t}$
- $\Delta e_{c,t+d}$ in local currency per USD; d days since -28 days of rebal. date (0); $X_{c,t}$ is country, year, and month FE.

Fact II: Demand shock effect on exchange rates is persistent



- Exchange rate responses are significant up to about 3 months
- $\Delta e_{c,t+m} = \beta_0 + \beta_\mu \, \mu_{c,t} + \phi \, X_{c,t} + \epsilon_{c,t}$
- $\Delta e_{c,t+m}$ in local currency per USD; m months from -1 month of first rebal; $X_{c,t}$ is country, year, and month FE.

Summary on Concerns for Endogeneity

- Why do exchange rates start to move before the rebalancing date 0?
  - Efficient market hypothesis; consistent with other index-rebalancing studies.

Summary on Concerns for Endogeneity

- Why do exchange rates start to move before the rebalancing date 0?
  - Efficient market hypothesis; consistent with other index-rebalancing studies.
- Can other indices contribute to the observed exchange rate movements?
  - Possible but negligible.

Summary on Concerns for Endogeneity

- Why do exchange rates start to move before the rebalancing date 0?
  - Efficient market hypothesis; consistent with other index-rebalancing studies.
- Can other indices contribute to the observed exchange rate movements?
  - Possible but negligible.
- Can co-movement of macro-fundamentals across countries contaminate the identification?
  - Unlikely since they would have to co-move together every single month.

price corr. matrix

Summary on Concerns for Endogeneity

- Why do exchange rates start to move before the rebalancing date 0?
  - Efficient market hypothesis; consistent with other index-rebalancing studies.
- Can other indices contribute to the observed exchange rate movements?
  - Possible but negligible.
- Can co-movement of macro-fundamentals across countries contaminate the identification?
  - Unlikely since they would have to co-move together every single month.

price corr. matrix

- Can monetary policy rates contaminate the identification?
  - No; shown in Fact III.

Fact III: Policy rates and Yields do not respond to the shock

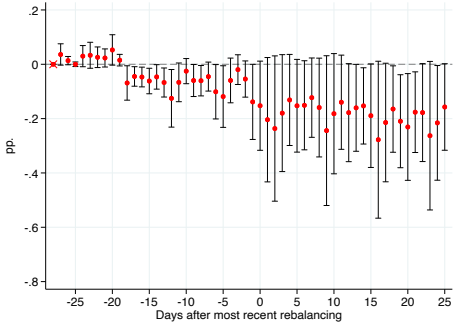
- Policy rates/yields do not contaminate identification.

Fact III: Policy rates and Yields do not respond to the shock

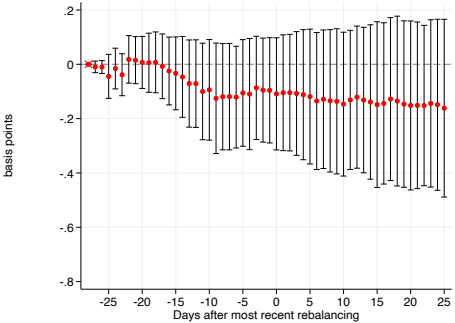
- Policy rates/yields do not contaminate identification.

country-specific plot

(a) Policy Rates



(b) Short-term Yields



Fact IV: Floats are more responsive to the currency demand shocks

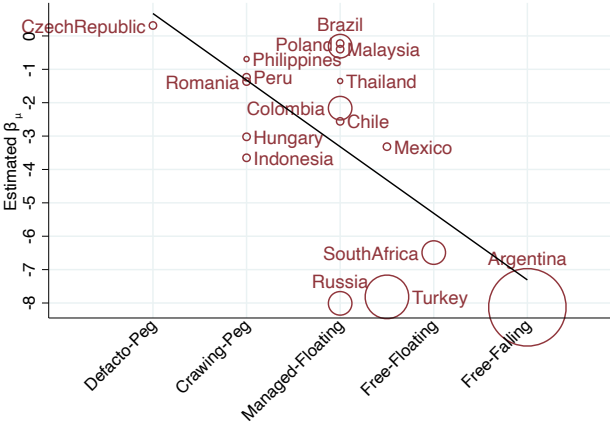
- $\Delta e_{c,t+d} = \beta_{0,c} + \beta_{\mu,c}\ \mu_{c,t} + \phi\ X_{c,t} + \epsilon_{c,t}$
- Country-specific response does not correlate with macro/financial metrics
  show

Fact IV: Floats are more responsive to the currency demand shocks

- $\Delta e_{c,t+d} = \beta_{0,c} + \beta_{\mu,c}\ \mu_{c,t} + \phi\ X_{c,t} + \epsilon_{c,t}$
- Country-specific response does not correlate with macro/financial metrics
  show
- Country-specific response strongly correlates with exchange rates regimes and volatility

Fact IV: Floats are more responsive to the currency demand shocks

- $\Delta e_{c,t+d} = \beta_{0,c} + \beta_{\mu,c}\ \mu_{c,t} + \phi\ X_{c,t} + \epsilon_{c,t}$
- Country-specific response does not correlate with macro/financial metrics show
- Country-specific response strongly correlates with exchange rates regimes and volatility
  - ER volatility ↑, the more inelastic the market



Outline

1 Introducing the Currency Demand Shock

2 Currency Demand Shocks in Inelastic Financial Market

3 FX Interventions in Inelastic Financial Markets

A framework on Uncovered Interest Parity (UIP)

- UIP condition holds if $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t})$.

A framework on Uncovered Interest Parity (UIP)

- UIP condition holds if $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t})$.
- Modified UIP: $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t}) + \underbrace{\tau_{c,t} + \psi_{c,t}}_{\text{exog.}} + \underbrace{\Lambda_{c,t}}_{\text{endog.}}$.

UIP deviation from: $\begin{cases} \text{“exogenous” shock: capital taxes } \tau_{c,t}\text{, risk-premium shock } \psi_{c,t} \\ \text{“endogenous” shock: changes in portfolio holdings } \Lambda_{c,t} \end{cases}$

A framework on Uncovered Interest Parity (UIP)

- UIP condition holds if $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t})$.
- Modified UIP: $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t}) + \underbrace{\tau_{c,t} + \psi_{c,t}}_{\text{exog.}} + \underbrace{\Lambda_{c,t}}_{\text{endog.}}$.

UIP deviation from: $\begin{cases} \text{“exogenous” shock: capital taxes } \tau_{c,t}\text{, risk-premium shock } \psi_{c,t} \\ \text{“endogenous” shock: changes in portfolio holdings } \Lambda_{c,t} \end{cases}$

- Both $\tau_{c,t}$ and $\psi_{c,t}$ are slow-moving wrt. the currency demand shock $\mu_{c,t}$.

show

A framework on Uncovered Interest Parity (UIP)

- UIP condition holds if $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t})$.
- Modified UIP: $\mathbb{E}_t \Delta e_{c,t+1} = (i_{c,t} - i^*_{c,t}) + \underbrace{\tau_{c,t} + \psi_{c,t}}_{\text{exog.}} + \underbrace{\Lambda_{c,t}}_{\text{endog.}}$.

UIP deviation from: $\begin{cases} \text{“exogenous” shock: capital taxes } \tau_{c,t}\text{, risk-premium shock } \psi_{c,t} \\ \text{“endogenous” shock: changes in portfolio holdings } \Lambda_{c,t} \end{cases}$

- Both $\tau_{c,t}$ and $\psi_{c,t}$ are slow-moving wrt. the currency demand shock $\mu_{c,t}$. show
- The currency demand shock moves the endogenous UIP shock through changing portfolio holdings of arbitrageurs.

Model Arbitrageurs' Holdings

- Risk-averse arbitrageurs in country c hold zero-capital portfolio and choose $(d_{c,t}, d^*_{c,t})$ to maximize mean-variance preference over profits:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\left(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\right)$$

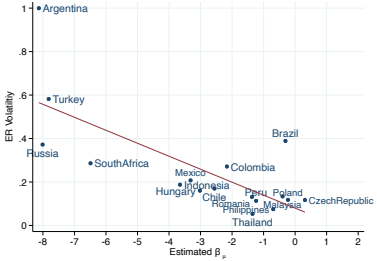
  - Risk-bearing capacity $\lambda_{c,t}(.) = \omega\ \sigma^2_{e_{c,t}}$, where $\sigma^2_{e_{c,t}}$ = ER volatility
  - ER volatility $\uparrow$, $\lambda_{c,t}(.)\ \uparrow$, risk-bearing capacity $\downarrow$ (Fact IV)

Model Arbitrageurs' Holdings

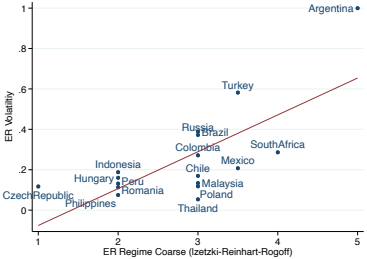
- Risk-averse arbitrageurs in country c hold zero-capital portfolio and choose $(d_{c,t}, d^*_{c,t})$ to maximize mean-variance preference over profits:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\Big(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\Big)$$

  - Risk-bearing capacity $\lambda_{c,t}(.) = \omega\ \sigma^2_{e_{c,t}}$, where $\sigma^2_{e_{c,t}}$ = ER volatility
  - ER volatility $\uparrow$, $\lambda_{c,t}(.)\ \uparrow$, risk-bearing capacity $\downarrow$ (Fact IV)



(a) ER Vol. against β_{μ_c}



(b) ER Vol. against Regime

Introducing FXI into a model with endogenous UIP Deviation

- Risk-averse arbitrageurs' holdings:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\left(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\right) \tag{1}$$

Introducing FXI into a model with endogenous UIP Deviation

- Risk-averse arbitrageurs' holdings:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\left(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\right) \tag{1}$$

- Market clearing conditions with FX intervention: diagram

$$0 = \underbrace{b_{c,t}}_{\text{H/H holdings}} + \underbrace{f_{c,t}}_{\text{FX interventions}} + \underbrace{n_{c,t}}_{\text{noise traders}} + d_{c,t} \tag{2}$$

Introducing FXI into a model with endogenous UIP Deviation

- Risk-averse arbitrageurs' holdings:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\left(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\right) \tag{1}$$

- Market clearing conditions with FX intervention: diagram

$$0 = \underbrace{b_{c,t}}_{\text{H/H holdings}} + \underbrace{f_{c,t}}_{\text{FX interventions}} + \underbrace{n_{c,t}}_{\text{noise traders}} + d_{c,t} \tag{2}$$

- $\Rightarrow \quad \mathbb{E}_t \Delta e_{c,t+1} = i_{c,t} - i^*_{c,t} + (\psi_{c,t} + \tau_{c,t}) + \underbrace{\lambda_{c,t}\left(b_{c,t} + n_{c,t} + f_{c,t}\right)}_{\text{endog. } \Lambda_{c,t}}$

Introducing FXI into a model with endogenous UIP Deviation

- Risk-averse arbitrageurs' holdings:

$$-d_{c,t} = \frac{1}{\lambda_{c,t}}\left(\mathbb{E}_t \Delta e_{c,t+1} - (i_{c,t} - i^*_{c,t}) - \underbrace{(\psi_{c,t} + \tau_{c,t})}_{\text{exog.}}\right) \tag{1}$$

- Market clearing conditions with FX intervention: diagram

$$0 = \underbrace{b_{c,t}}_{\text{H/H holdings}} + \underbrace{f_{c,t}}_{\text{FX interventions}} + \underbrace{n_{c,t}}_{\text{noise traders}} + d_{c,t} \tag{2}$$

- $\Rightarrow \quad \mathbb{E}_t \Delta e_{c,t+1} = i_{c,t} - i^*_{c,t} + (\psi_{c,t} + \tau_{c,t}) + \underbrace{\lambda_{c,t}\left(b_{c,t} + n_{c,t} + f_{c,t}\right)}_{\text{endog. } \Lambda_{c,t}}$

- Identify $\lambda_{c,t} = \frac{\partial e_{c,t}}{\partial n_{c,t}} = \frac{\partial e_{c,t}}{\partial f_{c,t}}$ = (counterfactual) required size of FXI to stabilize exchange rates

show $f \perp n$ IRF data

Foreign Exchange Interventions and (Relaxed) Trilemma

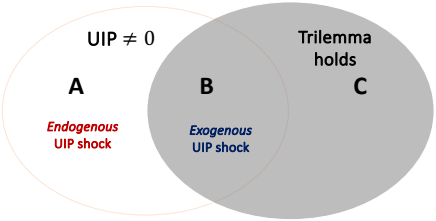
- **Definition**: The “relaxed” Trilemma constraint states that it’s **possible** to have **all three** of the following simultaneously:
  1. An independent monetary policy (inward-focused)
  2. Free capital mobility (absence of capital control taxes)
  3. A managed exchange rate

Foreign Exchange Interventions and (Relaxed) Trilemma

- **Definition**: The "relaxed" Trilemma constraint states that it's **possible** to have **all three** of the following simultaneously:
  1. An independent monetary policy (inward-focused)
  2. Free capital mobility (absence of capital control taxes)
  3. A managed exchange rate
- Under inelastic financial market (with endog. UIP), FX intervention serves as an additional policy instrument to stabilize exchange rates
- Even with free capital flows, a fixed exchange rate doesn't have to compromise monetary policy independence, relaxing the Trilemma

data

Models of Trilemma Constraint and UIP



Model	Financial market	Papers
endogenous UIP shock	(imperfectly) inelastic	Gabaix and Maggiori (2015), Cavallino (2019), Itskhoki and Mukhin (2021), Fanelli and Straub (2021), Basu et al. (2023)
exogenous UIP shock	perfectly elastic	Devereux and Engel (2002), Farhi and Werning (2012), Jiang, Krishnamurthy and Lustig (2018)
classic trilemma (UIP = 0)	perfectly elastic	Mundell (1962), Dornbusch (1976), Obstfeld and Rogoff (1995), Gali and Monacelli (2005)

Summary of results: FXI much more Effective for Free-Floaters

- Average FX intervention required to induce 1 % exchange rate change

Average by ER regime group	ER Vol.	Required FXI	**FXI over GDP (%)**
crawling peg	0.13	0.65	0.21
managed floating	0.22	1.02	0.22
free floating/falling	0.52	0.56	**0.07**

Summary of results: FXI much more Effective for Free-Floaters

- Average FX intervention required to induce 1 % exchange rate change

Average by ER regime group	ER Vol.	Required FXI	**FXI over GDP (%)**
crawling peg	0.13	0.65	0.21
managed floating	0.22	1.02	0.22
free floating/falling	0.52	0.56	**0.07**

  - For example, the required FXI as % of GDP is *more than 3 times smaller* for South Africa (free-floater) than for Peru (crawling-pegger).

- A pegged exchange rates implies infinite risk-bearing capacity of the arbitrageurs as ER volatility is zero

Summary of results: FXI much more Effective for Free-Floaters

- Average FX intervention required to induce 1 % exchange rate change

Average by ER regime group	ER Vol.	Required FXI	**FXI over GDP (%)**
crawling peg	0.13	0.65	0.21
managed floating	0.22	1.02	0.22
free floating/falling	0.52	0.56	**0.07**

  - For example, the required FXI as % of GDP is *more than 3 times smaller* for South Africa (free-floater) than for Peru (crawling-pegger).

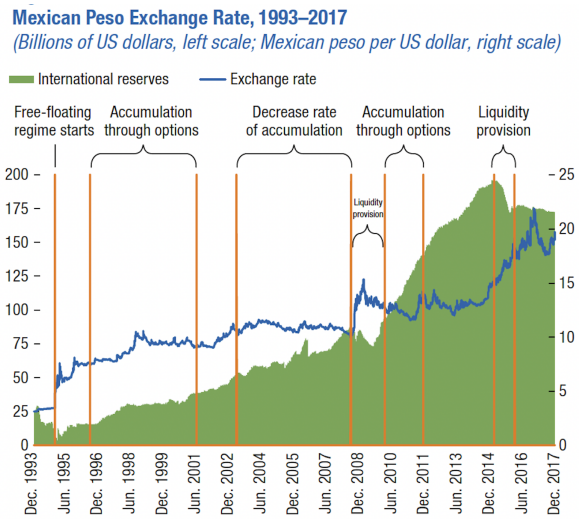
- A pegged exchange rates implies infinite risk-bearing capacity of the arbitrageurs as ER volatility is zero
- We are back to the Trilemma constraint with perfectly elastic market where FXI doesn't work

Conclusion

- We use a well-identified demand shock that exogenously changes the currency composition of government bonds.
- We show the shock moves exchange rates both in the short- and long-run and have heterogenous responses across countries.
- We identify the required size of FX intervention to stabilize exchange rates through a segmented financial market model.
- Our results contribute to the various literature including the FX intervention and asset demand and are informative to policy makers.

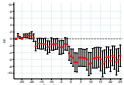
Appendix

Reserves of Mexico and Peso Movements

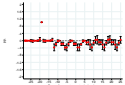


Source: Bank of Mexico and IMF.

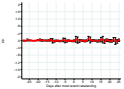
Monetary policy rates (pp.) response to $\mu_{c,t}$



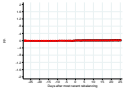
(a) Argentina



(b) Brazil

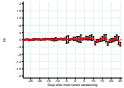


(c) Chile

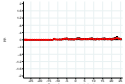


(d) Colombia

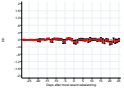
Back



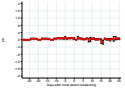
(e) Czech Republic



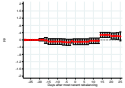
(f) Hungary



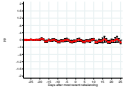
(g) Indonesia



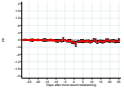
(h) Malaysia



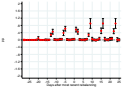
(i) Mexico



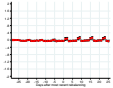
(j) Peru



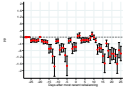
(k) Philippines



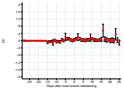
(l) Poland



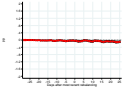
(m) Romania



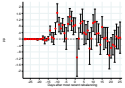
(n) Russia



(o) South Africa

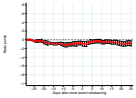


(p) Thailand

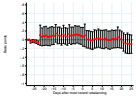


(q) Turkey

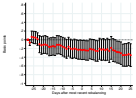
Three-month yield difference (in b.p) response to μ_{ct}



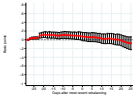
(a) Brazil



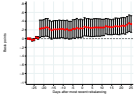
(b) Chile



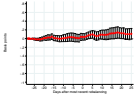
(c) Colombia



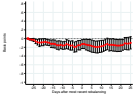
(d) Hungary



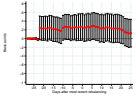
(e) Indonesia



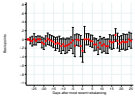
(f) Malaysia



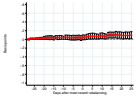
(g) Mexico



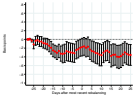
(h) Peru



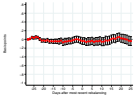
(i) Philippines



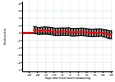
(j) Poland



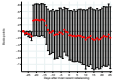
(k) Russia



(l) South Africa



(m) Thailand

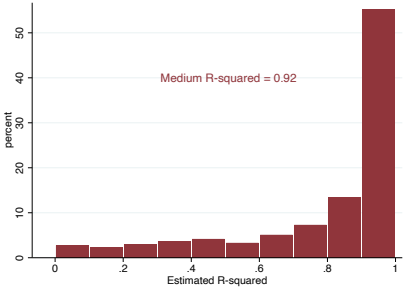


(n) Turkey

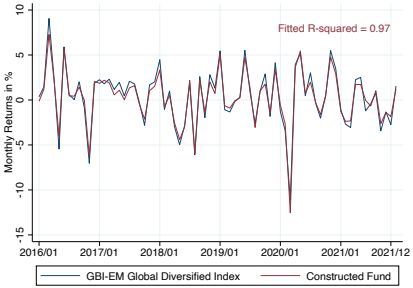
Back

Remark: How do the rebalancings move exchange rates?

- Rebalancings create large demand shocks on government bonds



(a) Histogram of fund performance R^2



(b) Weighted (by positions) average returns

Note: The left panel reports the histogram of estimated R-squared of regressing monthly fund returns from EPFR dataset on the returns of the index. The right panel reports returns of the weighted (by AUM) average returns of all mutual fund the EPFR dataset identified as closely tracking the index.

Back

Correlation matrix of sovereign bond price

Table 6: Correlation matrix of sovereign bond prices across countries

	Argentina	Brazil	Chile	Colombia	Czech Republic	Hungary	Indonesia	Malaysia	Mexico	Peru	Phillippines	Poland	Romania	Russia	South Africa	Thailand	Turkey
Argentina	1	-0.8667	-0.8342	0.2055	0.5164	0.1163	0.4792	-0.8014	-0.0187	-0.3778	-0.0916	-0.8158	0.4812	-0.152	0.119	-0.569	0.4134
Brazil	-0.8667	1	0.8659	0.1942	-0.0728	-0.1368	0.1808	0.6966	-0.3609	0.7603	0.4262	-0.0838	-0.7315	0.7327	-0.2318	0.4274	-0.2363
Chile	-0.8342	0.8659	1	-0.1281	-0.0991	0.2982	0.0342	0.7773	0.2081	0.5126	0.6267	0.606	-0.1286	0.6171	-0.3057	0.6206	0.0442
Colombia	0.2055	0.1942	-0.1281	1	0.4053	-0.6548	0.7185	0.3287	0.477	0.6826	0.1958	-0.0446	-0.2871	0.4116	0.803	-0.5452	0.4848
Czech Republic	0.5164	-0.0728	-0.0991	0.4053	1	0.5746	0.5731	-0.0654	0.2933	0.0762	0.1848	-0.0742	0.7641	0.0734	0.0455	0.0894	0.5688
Hungary	0.1163	-0.1368	0.2982	-0.6548	0.5746	1	-0.6249	-0.306	-0.117	-0.3587	0.2331	0.5308	0.6694	-0.4758	-0.5827	0.3045	-0.1248
Indonesia	0.4792	0.1808	0.0342	0.7185	0.5731	-0.6249	1	0.494	0.4165	0.605	0.1923	-0.2212	-0.058	0.4223	0.6708	-0.1097	0.4343
Malaysia	-0.8014	0.6966	0.7773	0.3287	-0.0654	-0.306	0.494	1	0.3731	0.6203	0.5879	0.1779	-0.2167	0.6014	0.075	0.3943	0.1972
Mexico	-0.0187	-0.3609	0.2081	0.477	0.2933	-0.117	0.4165	0.3731	1	0.3078	0.5318	0.5108	0.5711	-0.09	0.5411	-0.057	0.7291
Peru	-0.3778	0.7603	0.5126	0.6826	0.0762	-0.3587	0.605	0.6203	0.3078	1	0.5845	0.1084	-0.5196	0.6308	0.4414	-0.1035	0.3259
Phillippines	-0.0916	0.4262	0.6267	0.1958	0.1848	0.2331	0.1923	0.5879	0.5318	0.5845	1	0.6392	0.1009	0.3058	0.043	0.3197	0.4332
Poland	-0.8158	-0.0838	0.606	-0.0446	-0.0742	0.5308	-0.2212	0.1779	0.5108	0.1084	0.6392	1	0.4257	-0.3521	-0.1133	0.0005	0.2222
Romania	0.4812	-0.7315	-0.1286	-0.2871	0.7641	0.6694	-0.058	-0.2167	0.5711	-0.5196	0.1009	0.4257	1	-0.7123	0.2355	0.1476	0.6135
Russia	-0.152	0.7327	0.6171	0.4116	0.0734	-0.4758	0.4223	0.6014	-0.09	0.6308	0.3058	-0.3521	-0.7123	1	0.0026	0.1857	-0.0248
South Africa	0.119	-0.2318	-0.3057	0.803	0.0455	-0.5827	0.6708	0.075	0.5411	0.4414	0.043	-0.1133	0.2355	0.0026	1	-0.423	0.5578
Thailand	-0.569	0.4274	0.6206	-0.5452	0.0894	0.3045	-0.1097	0.3943	-0.057	-0.1035	0.3197	0.0005	0.1476	0.1857	-0.423	1	-0.0057
Turkey	0.4134	-0.2363	0.0442	0.4848	0.5688	-0.1248	0.4343	0.1972	0.7291	0.3259	0.4332	0.2222	0.6135	-0.0248	0.5578	-0.423	1

Back1 Back2

Additional Regressions

Table 7: Capital controls and macro-fundamentals are not responsive to $\mu_{c,t}$

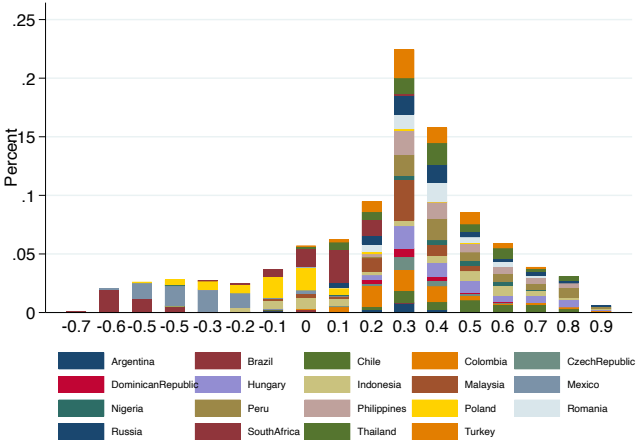
	(1) Capital controls	(2) GDP	(3) Consumption	(4) NFA	(5) Net exports	(6) Inflation
$\mu_{c,t}$	0.0111	-2.000	-435.8	7.671	-1.735	0.1710
	(0.0212)	(1.697)	(338.0)	(6.058)	(1.801)	(0.1151)
Constant	0.516***	1.373***	339.4***	1.940	0.759	0.2865***
	(0.00579)	(0.478)	(90.03)	(1.685)	(0.495)	(9.0320)
Observations	1956	2170	1241	1777	1675	1777
R^2	0.9779	0.9310	0.9415	0.8715	0.1629	0.0815
Adjusted R^2	0.978	0.930	0.940	0.870	0.149	0.0673

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.02$, *** $p < 0.01$

back

Distribution of Currency Demand Shock

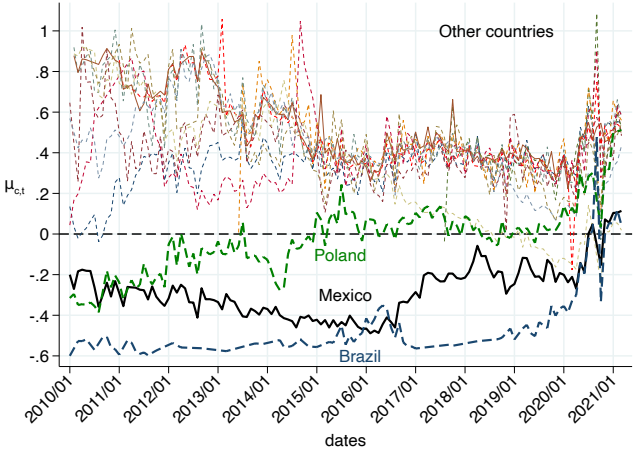
Table 8: Histogram for the Country-Specific Currency Demand Shock $\mu_{c,t}$



back

Time Series of Currency Demand Shock

Table 9: Time Series for the Country-Specific Currency Demand Shock $\mu_{c,t}$



back

FXI data do not comove with the currency demand shock μ_{ct}

Table 10: FX Interventions are not responsive to $\mu_{c,t}$

	FXI over GDP
Currency Demand Shock ($\mu_{c,t}$)	0.124
	(0.109)
Constant	0.0447*
	(0.0314)
Observations	2144
R^2	0.0315
Adjusted R^2	0.024

Standard errors in parentheses

* $p < 0.2$, ** $p < 0.10$, *** $p < 0.05$

Note: This table shows the OLS regression results of the FX interventions data on the currency demand shock ($\mu_{c,t}$): capital control measures (Fernandez et. al., 2016), net foreign asset positions and nominal GDP. Interventions data are measured in spot FX interventions over GDP at monthly frequency. The regression includes country fixed effects with standard errors clustered at the country level.

back

Connect Noise trader shocks with MIR

- Break noise trader positions into $\tilde{n}_t$ (GBI-EM index) and residual $\tilde{e}_t^n$:

$$n_t = \tilde{n}_t + \tilde{e}_t^n, \qquad \text{where} \quad \tilde{n}_t \perp \tilde{e}_t^n$$

- At the rebalancing date, observe:

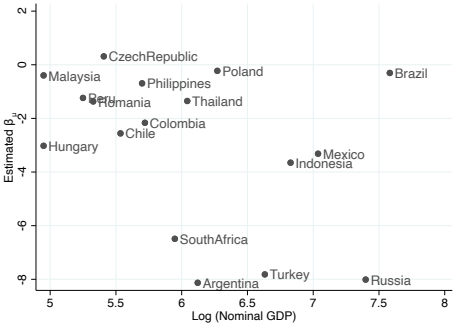
$$\begin{aligned}\tilde{n}_t &= \underbrace{\tilde{n}_t - \left(\frac{\tilde{n}_{t-1}}{R_{t-1}}\right) R_t}_{\text{noise trader shocks}} + \underbrace{\left(\frac{\tilde{n}_{t-1}}{R_{t-1}}\right) R_t}_{\text{market value before rebal.}} \\ &= \underbrace{\text{MIR}_{c,t} \times \frac{\text{AUM}_t}{\sum_{c'} \text{MV}_{c',t}}}_{\text{flows in USD}} + \underbrace{\text{MV}_{c,t}^{BH}}_{\text{market value before rebal.}}\end{aligned}$$

- $\boxed{\text{Estimated } \beta_{MIR} \text{ in OLS} \propto \frac{\partial e_t}{\partial n_t}}$

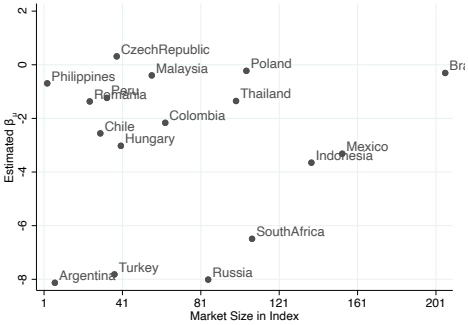
back

Estimated β_{μ_c} and other variables

- Country-specific β_{μ_c} do not correlates with GDP nor market size



(a) Nominal GDP

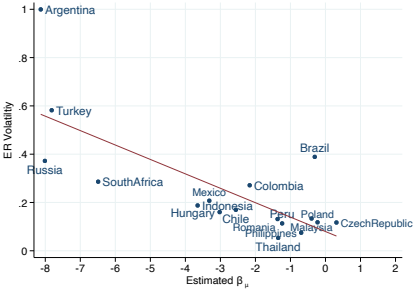


(b) Sovereign bond market size

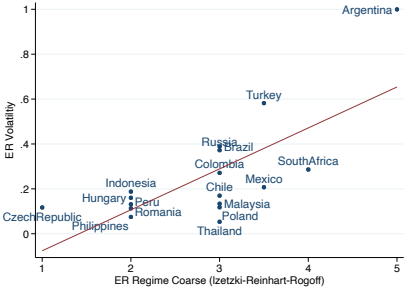
back

Exchange rates volatility strongly correlates with exchange rates response

- Exchange rates volatility strongly correlates with exchange rates response:



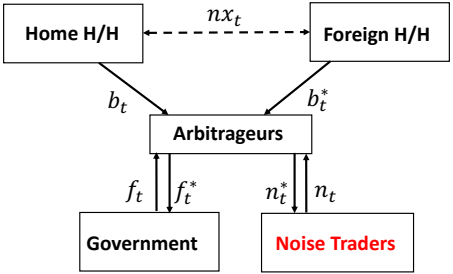
(a) ER Vol. against $\beta_{\mu c}$



(b) ER Vol. against Regime

back

A model with endogenous UIP Deviation



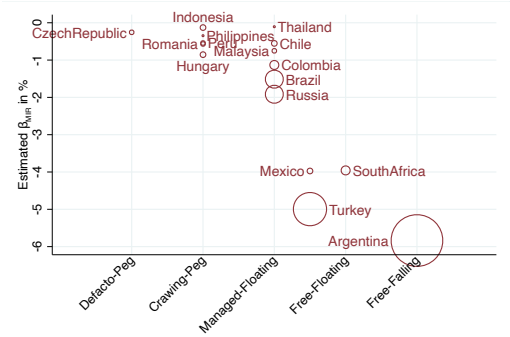
- Segmented international bonds market for home and foreign h/h
- b_t = home h/h holdings; b_t^* = net foreign asset position of home h/h
- f_t, f_t^* = open market operations in home and foreign currency
- n_t, n_t^* = noise trader positions in home and foreign currency
  - noise traders subject to currency demand shocks ($\perp$ macro-condition)

Back

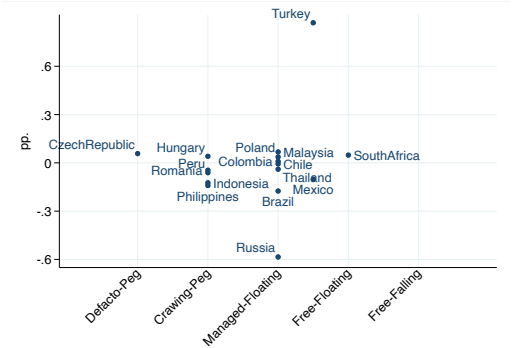
Remark: Evidence on "Relaxed" Trilemma

- No direct policy tradeoffs between policy rates and exchange rates, regardless of the capital controls

(a) exchange rates



(b) policy rates



Note: Scatter plot of country-specific exchange rates (left) and policy rates (right) response to MIR against the the exchange rates regime (from strict to relaxed) as classified by Ilzetzki, Reinhart and Rogoff (2021).

back

Examples for IRF $\frac{\partial \mathbf{e_t}}{\partial \mathbf{n_t}}$

Macro model

- UIP equation + country budget constraint (Itskhoki-Mukhin 2021):
  - Impose NPGC $\lim_{T\to\infty} \beta^T b_{t+T-1} = 0$ and iterate:

$$\beta b_t^* - b_{t-1}^* = nx_t = \gamma e_t + \xi_t$$

$$(i_t - i_t^*) - \mathbb{E}_t \Delta e_t = \tau_t + \mu_t + \lambda_t \left(b_t^* - f_t^* - n_t^*\right)$$

- IRF $\boxed{\frac{\partial e_t}{\partial n_t^*} = \frac{\beta\ \lambda_t}{1-\rho\beta}} > 0$, if $n_t^* \sim$ AR(1) and $n_t^* \perp f_t^*$.

Taylor-Rule model

- UIP equation + $\lim_{j\to\infty} e_\infty = 0$ and Taylor rule (Engel-West 2009):
  - Home: $i_t = \beta_0(e_t - \bar{e}_t) + \beta_1 y_t + \beta_2 \pi_t + \nu_t$, where $\beta \in (0,1)$
  - Foreign: $i_t^* = \beta_1 y_t^* + \beta_2 \pi_t^* + \nu_t^*$
- IRF $\boxed{\frac{\partial e_t}{\partial n_t^*} = \frac{\lambda_t}{1-\beta_0-\rho}} > 0$, if $n_t^* \sim$ AR(1) and $n_t^* \perp f_t^*$.

back