Foreign Exchange Interventions, Signaling and Intermediary Constraints

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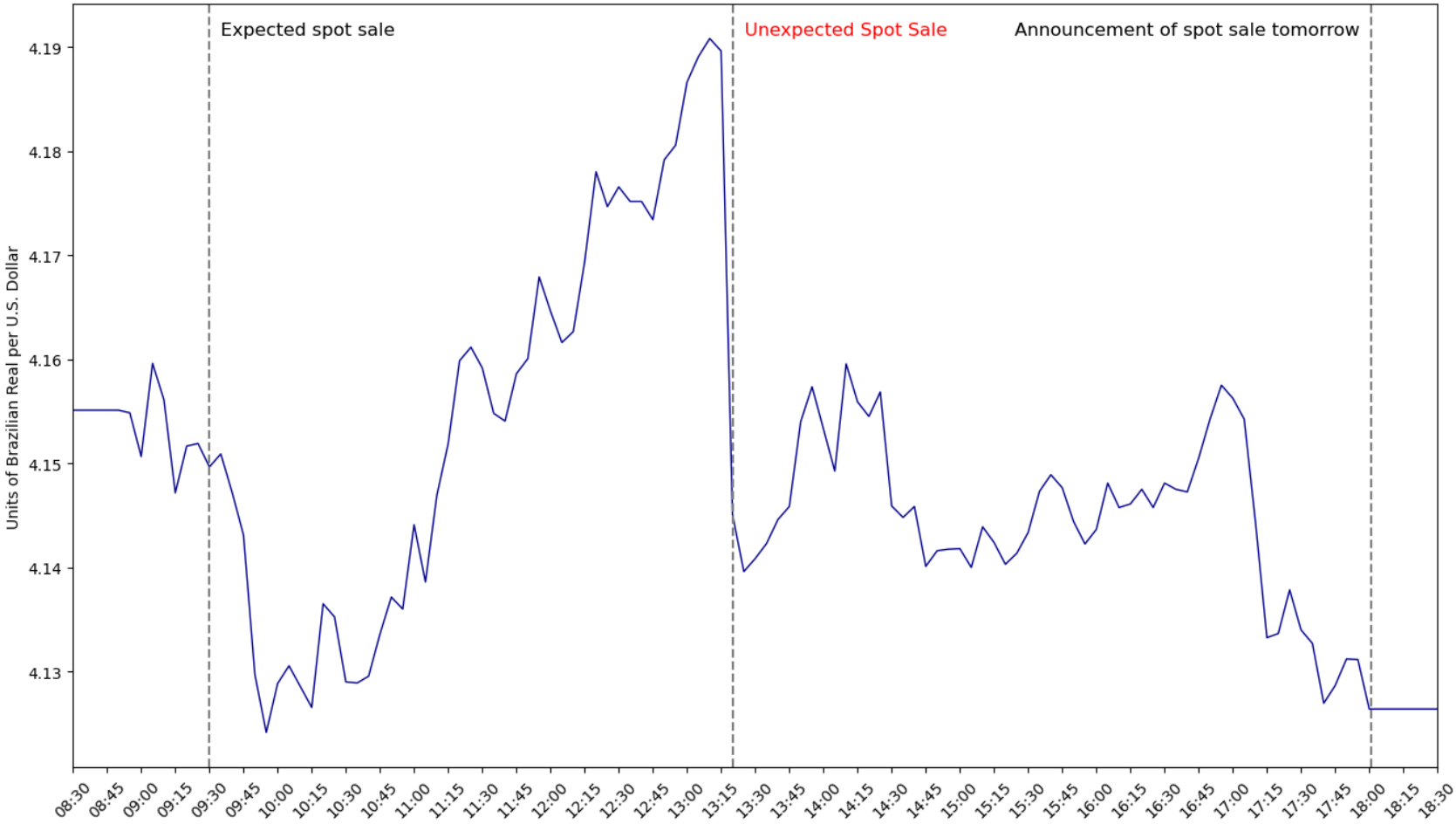
Motivation

- Extensive empirical literature on foreign exchange intervention (FXI) impact on currency markets.
- Less explored: Effect of FXI during periods of constrained USD liquidity supply by global intermediaries.
- **Contribution**: testing *dollar intermediation* channel of how intermediation constraints amplify FXI impact.
- **Brazil Case study**: Focus on a comprehensive database on Brazilian Central Bank (BCB) FXI to test its impact on spot rate and Covered Interest Rate Parity (CIP) deviations.
- Findings consistent with a simple model of FXI on dollar intermediation and how it has more impact during periods of tight intermediary constraints.

Motivation: BRL/USD Spot Rate on August 27, 2019

- Expected FXI: 550 USD Million Reserve sales (announced 6pm previous day)
- Unexpected FXI: 560 USD Million Reserve sales 1:20pm



Research Questions

1. How does FXI impact spot rates, particularly during periods of tight intermediary constraints?
2. What is the influence of unanticipated FXI on cross-border funding, measured by CIP deviations?
3. Are the effects of FXI more pronounced during periods of tight intermediary constraints?
4. Which channel is quantitatvely more important, the portfolio balance or signaling channels?

Preview of Findings

- **Spot Rates**:
  - Unanticipated sell interventions lead to a significant appreciation of BRL, with limited effects from buy interventions.
  - Spot FXI effects more pronounced than swap FXI.
- **Cross-Border Funding**:
  - Unanticipated sell interventions result in a decline in (absolute) CIP deviations, improving efficiency in cross-border markets.
- **Intermediary Constraints**:
  - Spot sales exhibit stronger effects during tight intermediary constraints, contrasting with limited effects during slack constraints.
  - Similar patterns observed for swap FXI.

Related literature

Our contribution: (i) Intra-day identification of FXI effects using new comprehensive dataset on Brazil FXI (1999-2023). (ii) Testing *dollar intermediation channel* by showing how effectiveness of FXI is conditional on degree of intermediary constraints.

- **FXI event studies**: Payne and Vitale 2003; Dominguez 2003; Kearns and Rigobon 2005; Menkhoff and Taylor 2007, Menkhoff, Rieth, and Sto Ìhr 2021; Fratzscher et al. 2019; Fratzscher et al. 2020; Fratzscher et al. 2022; Naef 2023; Naef and Weber 2023 and others.
- **FXI Brazil**: Nakashima 2012; Kohlscheen and Andrade 2013; Janot and Macedo 2016; Santos 2021, Sandri, 2023 and others.
- **Theory of FXI and financial frictions**: Gabaix and Maggiori 2015, Fanelli and Straub 2021, Pelin 2023, Mukhin and Itskohi 2023 and others.
- **CIP and emerging markets**: Du and Schreger 2016; Cerutti, Cerutti, and Zhou 2023; Hartley 2020, Dao, Gourinchas, Mano and Yogo, 2023 and others.

Model Framework: household

- Based on the Gamma model by Gabaix and Maggiori (2015).
- Two countries: US (Home) and Brazil (Foreign) and two periods: $t = 0$ and $t = 1$.
- Households maximize the expected present value of lifetime utility by choosing consumption of non-tradables (NT), Home tradables (H), and Foreign tradables (F) subject to an intertemporal budget constraint.

$$C_t \equiv \left[\left(C_{NT,t} \right)^{\chi_t} \left(C_{H,t} \right)^{a_t} \left(C_{F,t} \right)^{\iota_t} \right]^{\frac{1}{\theta_t}}$$

- import and export shares of goods in the home country:

$$p_{F,t} C_{F,t} = \iota_t \quad \text{and} \quad p^*_{H,t} C_{H,t} = \xi_t$$

- Euler equations govern risk-free interest rates:

$$1 = \mathbb{E}\left[\beta R \frac{\chi_1 / C_{NT,1}}{\chi_0 / C_{NT,0}} \right] \quad \text{and} \quad 1 = \mathbb{E}\left[\beta R^* \frac{\chi^*_1 / C^*_{NT,1}}{\chi^*_0 / C^*_{NT,0}} \right].$$

Model Framework: financiers

- Financiers maximize the value of their intermediation profits by trading in risk-free bonds of home and foreign.

$$V_0 = E\left[\Lambda\left(\frac{R^*}{R}\frac{e_1}{e_0} - 1\right)\right] Q_0\,,$$

- Fnanciers face borrowing constraints (Γ). Low Γ implies high capacity, resembling interest parity. High Γ approaches financial autarky.

$$\frac{V_0}{e_0} \geq \underbrace{\left|\frac{Q_0}{e_0}\right|}_{\substack{\text{Claims to}\\ \text{Creditors}}} \times \underbrace{\Gamma\left|\frac{Q_0}{e_0}\right|}_{\substack{\text{Diverted}\\ \text{Portion}}}.$$

- The net demand for Foreign bonds is determined by Γ and expected exchange rate movements.

$$Q_0 = \frac{1}{\Gamma}\mathbb{E}\left[\frac{R^*}{R}e_1 - e_0\right]$$

Model: Balance of Payments (BOP)

- BOP constraint: current account+capital account=0

$$e_0\xi_0 - \iota_0 - FXI - Q_0 = 0 \quad \text{and} \quad e_1\xi_1 - \iota_1 + \eta FXI + Q_0 = 0$$

- FXI and η are exogenous parameters modeling foreign exchange interventions by the Brazilian Central Bank.
- $\eta = 0$: Spot sale of USD.
- $\eta = 1$: Swap FXI, where the sale of USD in period 0 is reversed in period 1.
- Equilibrium exchange rate ($R = R^* = \psi = \iota = 1$)

$$e_0 = \begin{cases} 1 + FXI\frac{\Gamma+1}{\Gamma+2} & \text{if } \eta = 0 \text{ (spot FXI)}, \\ 1 + FXI\frac{\Gamma}{\Gamma+2} & \text{if } \eta = 1 \text{ (swap FXI)}, \end{cases}$$

$$\mathbb{E}[e_1] = \begin{cases} 1 + FXI\frac{1}{\Gamma+2} & \text{if } \eta = 0 \text{ (spot FXI)}, \\ 1 - FXI\frac{\Gamma}{\Gamma+2} & \text{if } \eta = 1 \text{ (swap FXI)}. \end{cases}$$

Model: Spot and Swap FXI

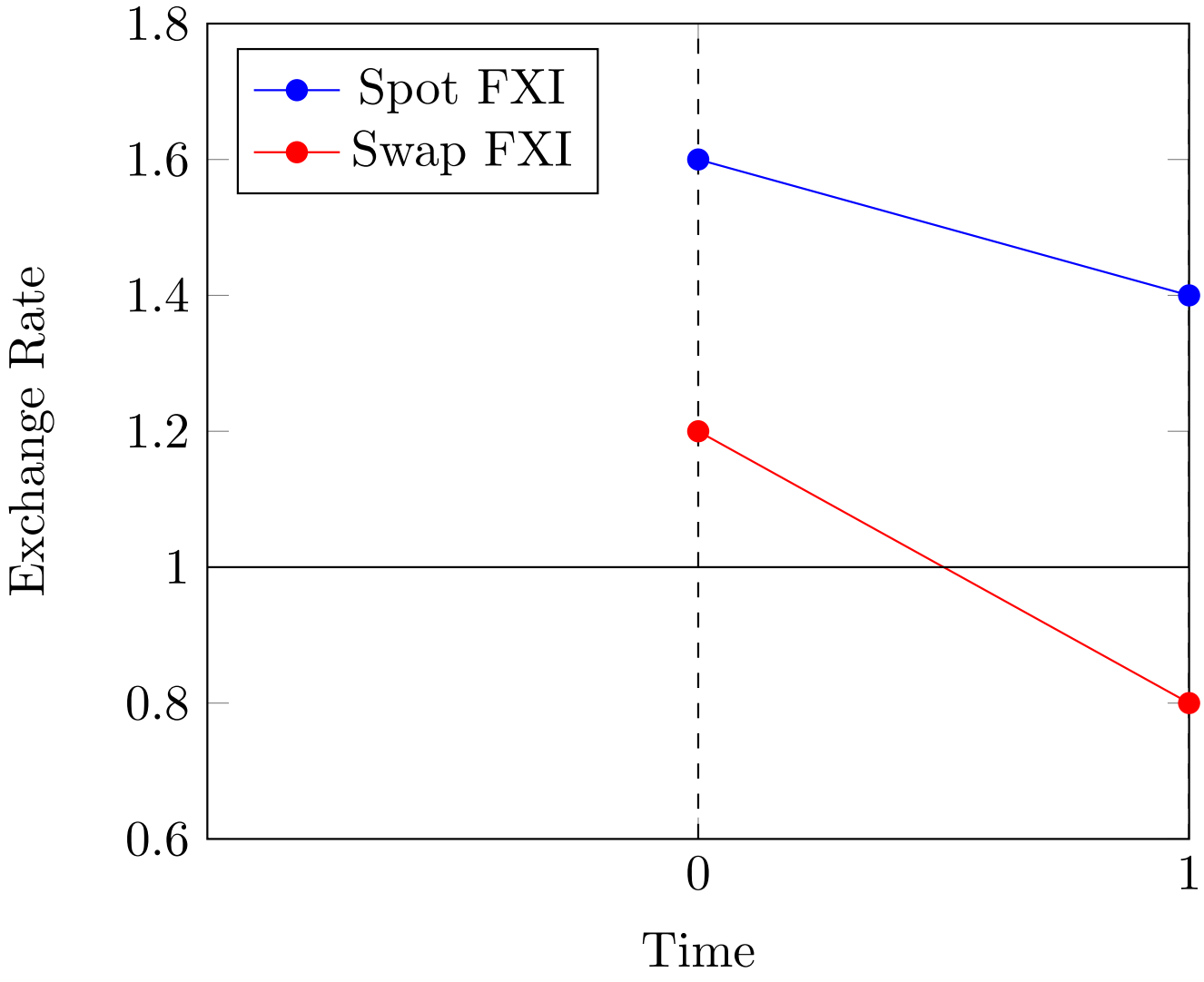


Figure: **Exchange rates.** Plots e_0 and $\mathbb{E}[e_1]$ for spot and swap FXI. Parameter calibration: $\Gamma = 0.5$, $FXI = 1$.

Model: Testable Implications

Prediction 1: FXI effects on spot rate

- An FXI of selling USD reserves and buying BRL leads to BRL appreciation (USD depreciation) at $t = 0$.
- Effectiveness is increasing in intermediation constraints and more effective for spot than swap FXI.

$$\frac{\partial e_0}{\partial FXI} = \begin{cases} \frac{\Gamma+1}{\Gamma+2} & \text{if } \eta = 0 \text{ (spot FXI)}, \\ \frac{\Gamma}{\Gamma+2} & \text{if } \eta = 1 \text{ (swap FXI)}. \end{cases}$$

Model: Testable Implications

Prediction 2: FXI effects on CIP

- An FXI of selling USD reserves and buying BRL reduces the size of the dollar intermediation by financiers.

$$Q_0 = \begin{cases} -FXI \frac{1}{\Gamma+2} & \text{if } \eta = 0 \text{ (spot FXI)}, \\ -FXI \frac{2}{\Gamma+2} & \text{if } \eta = 1 \text{ (swap FXI)}. \end{cases}$$

- Indirectly test dollar intermediation through measuring covered interest rate parity deviations in the BRL/USD pair.
- Assumption: forward market efficiency: $f = \mathbb{E}[e_1]$
- CIP violation is proportional to the net intermediation of dollars.

$$Q_0 \propto \underbrace{R^* \frac{f}{e_0}}_{\text{synthetic}} - \underbrace{R}_{\text{direct}}$$

Covered Interest Rate Parity

- Investor with 1 USD at time t can
  a) Invest in the US at a risk-free interest rate.
  b) Exchange USD for foreign currency at spot S_t per USD, then use a forward $F_{t,t+n}$ to convert back at $t+n$.
- CIP is a no-arbitrage condition which states the interest rates across currencies are equalized after hedging exchange rate risk with a forward contract.

$$(1 + r_{t,t+n})^n = (1 + r^*_{t,t+n})^n \frac{S_t}{F_{t,t+n}}$$

- CIP violation is equivalent to a wedge $x_{t,t+n}$.

$$(1 + r_{t,t+n})^n = (1 + r^*_{t,t+n} + x_{t,t+n})^n \frac{S_t}{F_{t,t+n}}$$

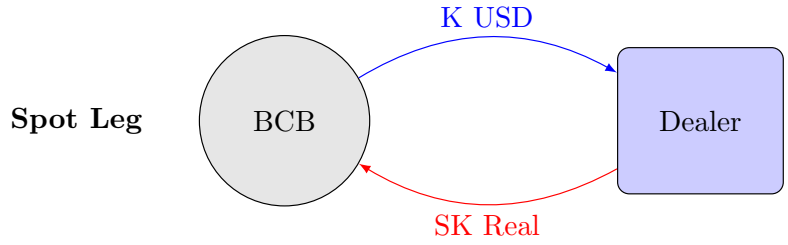
- In log terms:

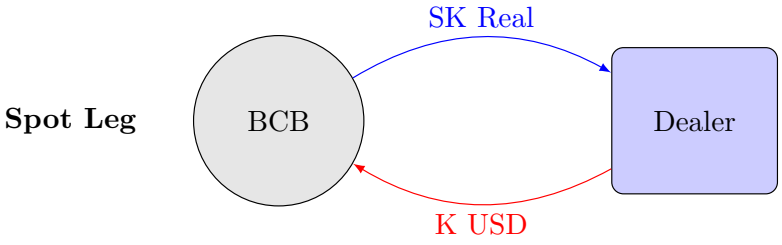
$$x_{t,t+n} = \underbrace{r_{t,t+n}}_{\text{direct}} - \underbrace{r^*_{t,t+n} + \frac{1}{n}(f^{bid}_{t,t+n} - s^{ask}_t)}_{\text{synthetic}}$$

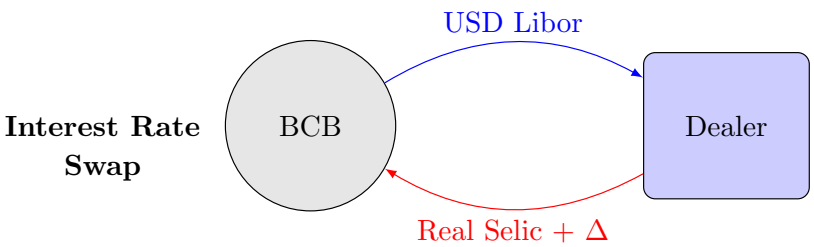
FXI Data: Types of Interventions

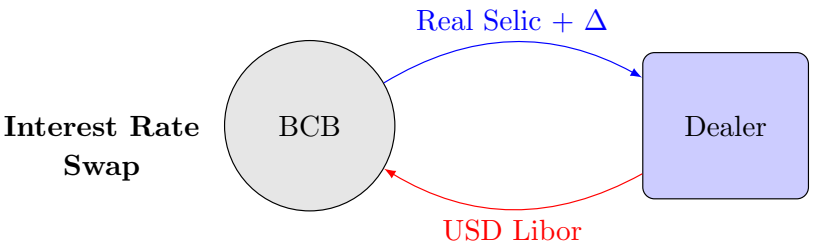
- Use a comprehensive public database by the BCB on all FXI instruments, including amount, type, announcement and oeprational date, from 1999 to 2023.
- **Spot Purchase and Spot Sales**: Operations where the BCB sells (purchase) of USD in the FX market.
- **Traditional and reverse Swap**: Traditional (reverse) swap is the sale (purchase) of USD at the spot leg. At maturity, BRL (USD) is re-exchanged for USD (BRL).
- **Announcement date**: Date BCB informs the public about interventions. High frequency timestamp (HH:MM:SS).
- **Operational date**: Date in which auctions take place. Daily timestamp.
- **Unexpected Interventions**: Operational date is on the same day as the announcement.
- **Expected Interventions**: Operational date is day/s after the announcement.

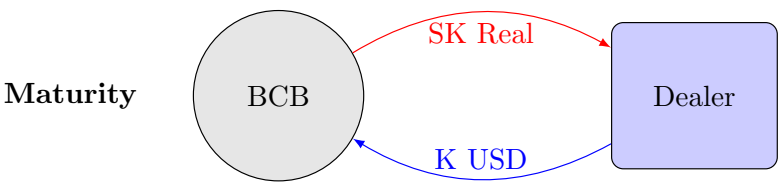
Currency Swaps

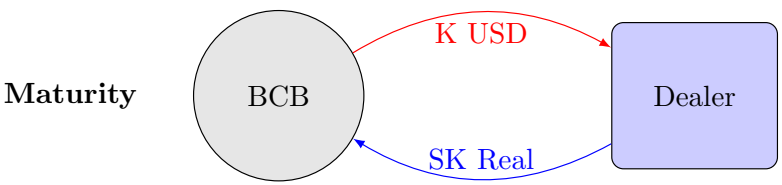










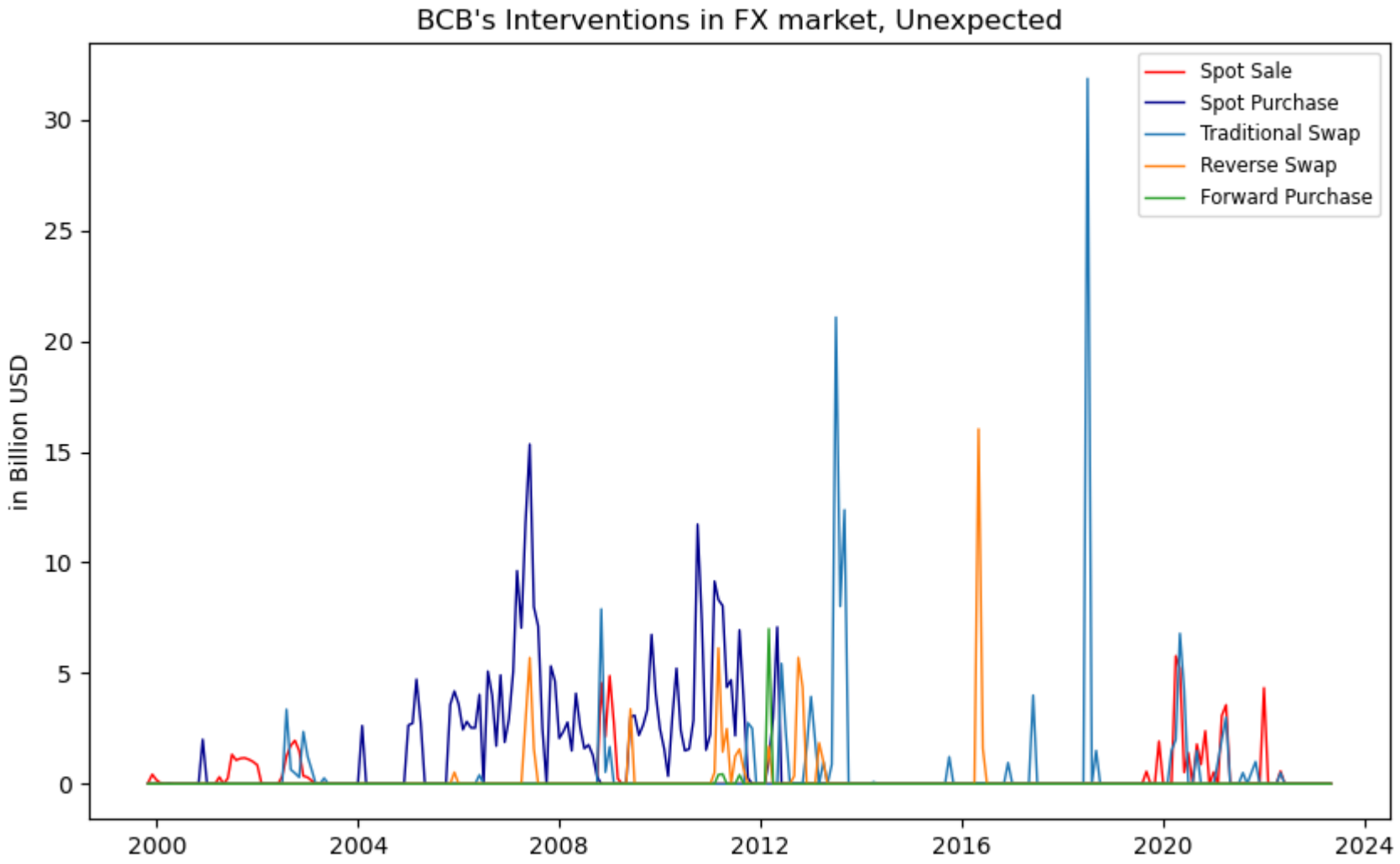


FXI: Summary Statistics

	Spot Sale		Spot Purchase	
	Unexpected	Expected	Unexpected	Expected
Mean	0.17	0.48	0.19	NaN
S.D	0.22	0.39	0.24	NaN
Max	1.10	3.00	4.64	NaN
Count	385	87	1483	NaN

	Traditional Swap		Reverse Swap		Forward Purchase	
	Unexpected	Expected	Unexpected	Expected	Unexpected	Expected
Mean	0.43	0.25	0.35	0.20	0.39	0.16
S.D	0.41	0.24	0.45	0.28	1.05	0.17
Max	1.85	3.50	3.38	4.00	4.00	0.45
Count	345	5094	174	846	21	6

FXI instruments



Additional Data

Spot and Forward Prices

- High-frequency data from Thomson Reuters Tick History.
- 5-minute interval quotes for BRL/USD Spot Rate and Currency Basis.

Interest Rates

- Daily interest rates from IPEA Brazil Government dataset.
- 1-month maturity constructed from National Treasury Bill (LTN) yield curve.

Intermediary Constraints

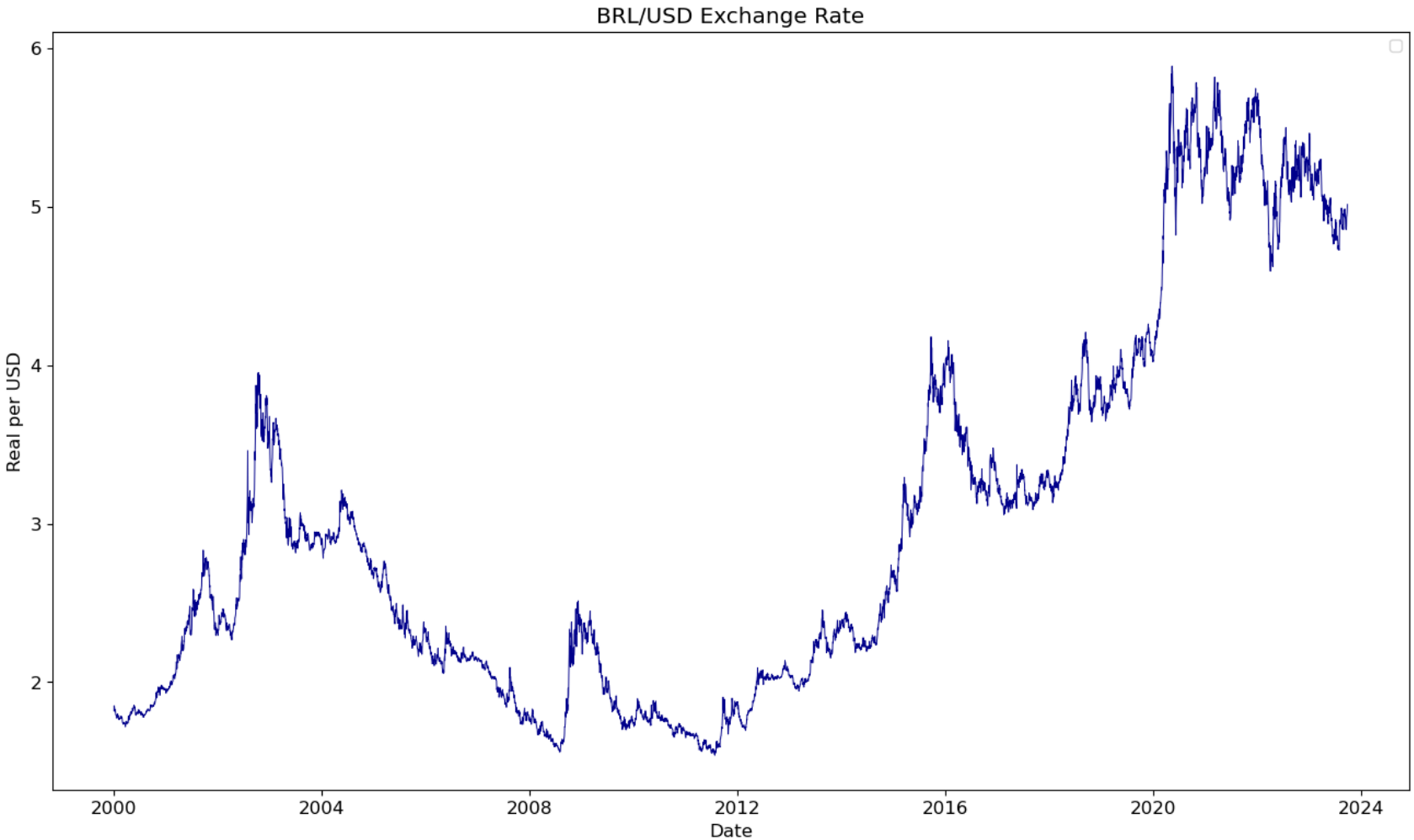
- Balance sheet constraints of financial intermediaries.
- Utilize intermediary capital risk factor from He, Kelly and Manela (2017).

Credit Risk

- Address credit risk in measuring CIP deviations for emerging markets.
- Use EMBI+ from IPEA dataset to control for credit risk.

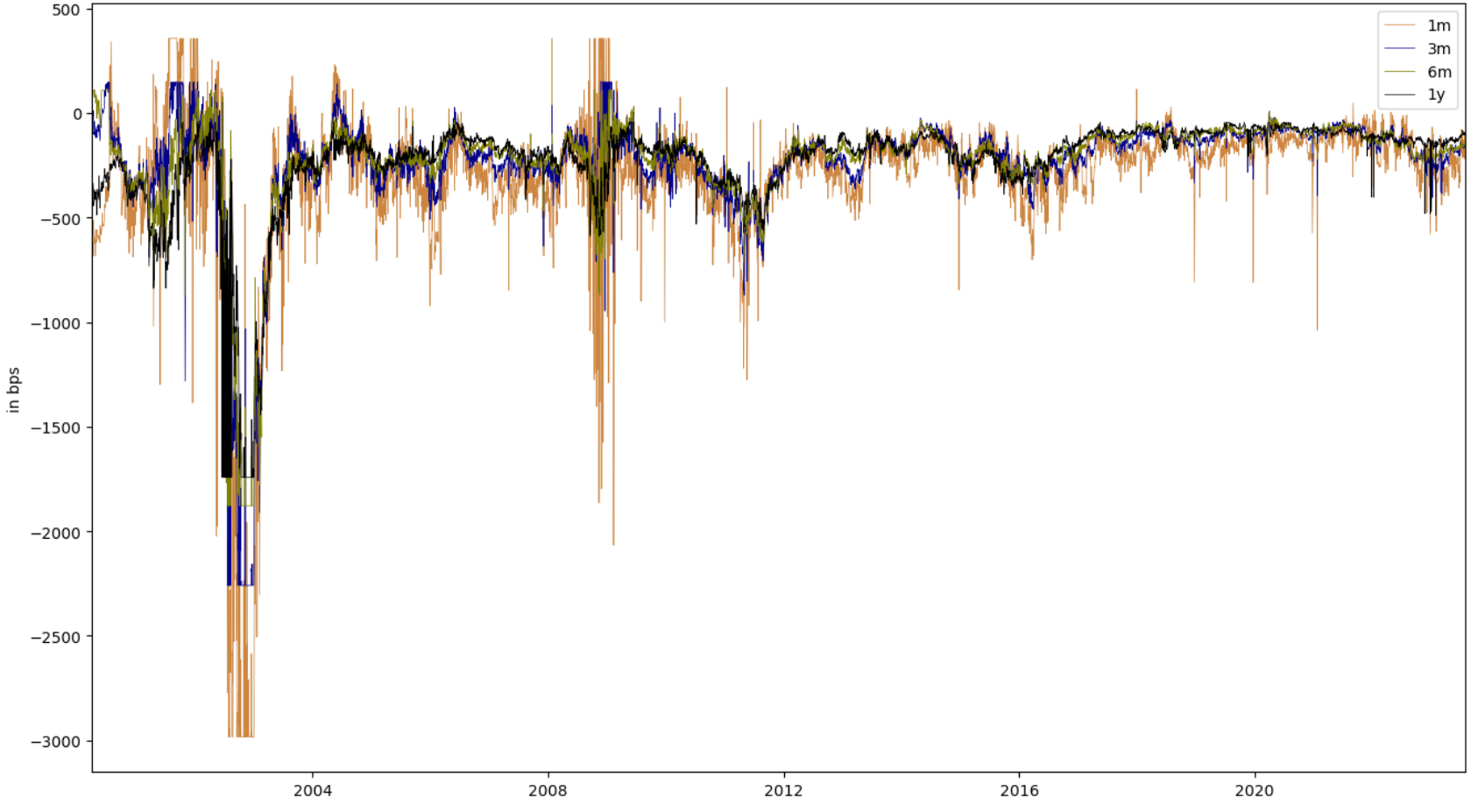
BRL/USD Exchange Rate

Expressed as units of BRL per USD. $\uparrow \implies$ BRL Depreciation



BRL/USD CIP Deviation

$$x_{t,t+n} = \underbrace{r_{t,t+n}}_{\text{direct}} - \underbrace{r^*_{t,t+n} + \frac{1}{n}(f^{bid}_{t,t+n} - s^{ask}_t)}_{\text{synthetic}} < 0$$

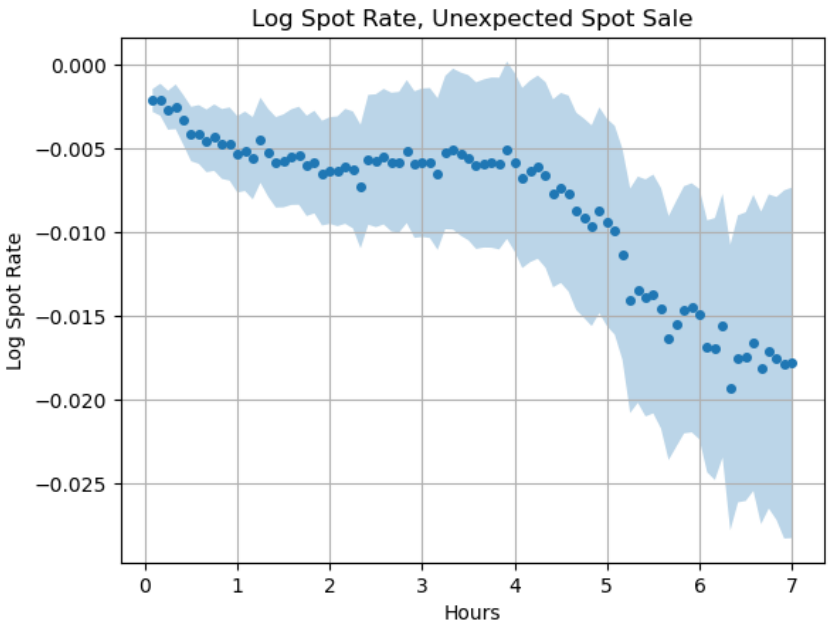


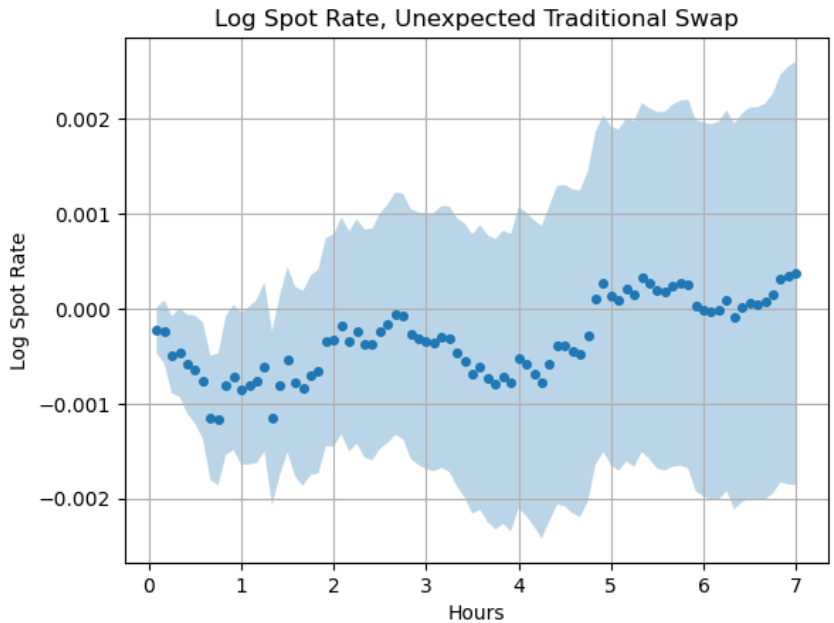
FXI Baseline Specification

$$y_{t+h} - y_{t-1} = \beta_h^z INT_t^z \times SAD_{t+h} + \gamma_h^z INT_t^z \times (1 - SAD_{t+h}) + SAD_{t+h} + \text{controls}_t + u_{t+h}$$

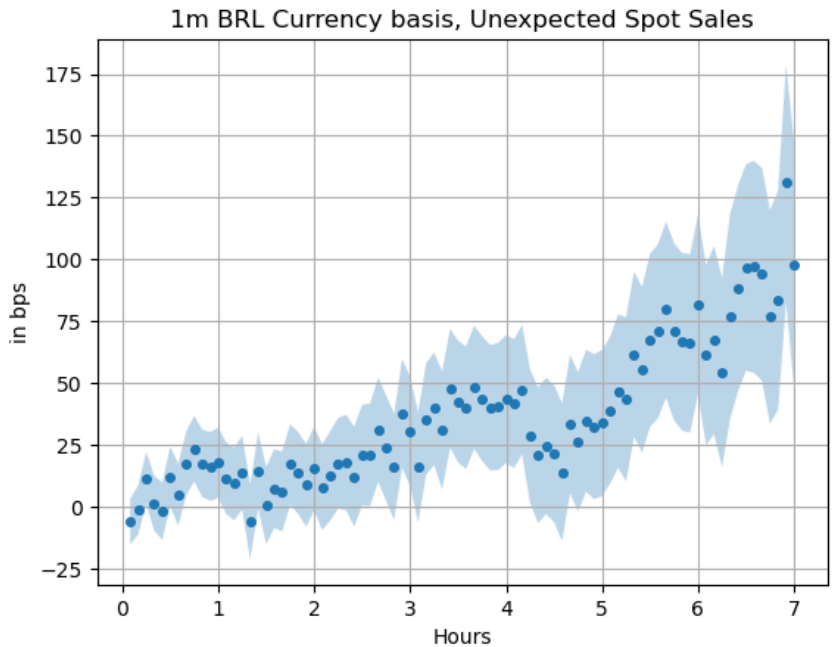
- INT_t^z: BCB's intervention amount at time t in USD for intervention type z.
- SAD_{t+h}: Indicator for whether y_{t+h} is on the same day as y_t when the intervention was announced.
- Controls include (daily) various financial indicators measuring credit risk, VIX, intermediary constraints.
- High frequency controls include lags of the outcome variable and bid-ask spreads (10 lags).

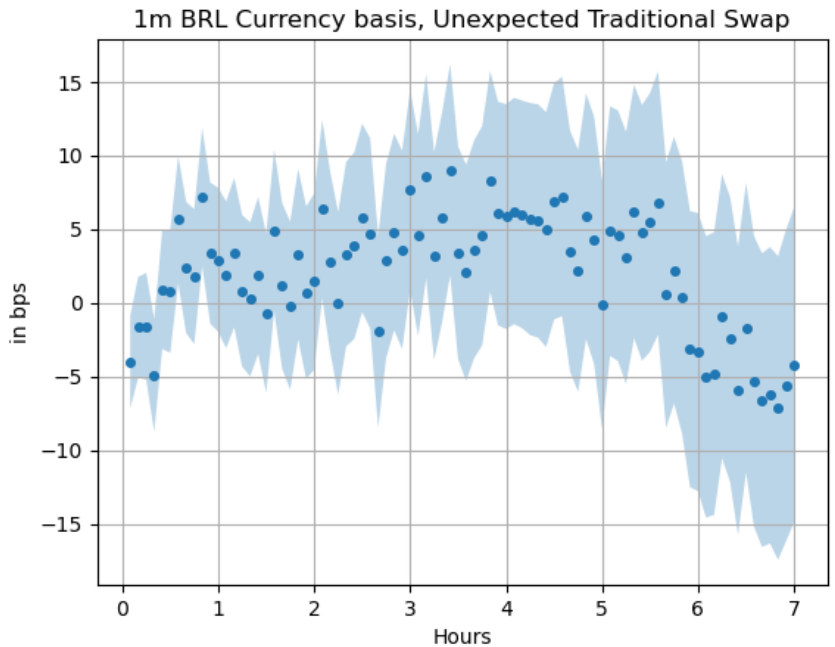
FXI on (log) Spot Rate





FXI on CIP


1m BRL Currency basis, Unexpected Spot Sales
in bps
Hours
175
150
125
100
75
50
25
0
−25
0
1
2
3
4
5
6
7


1m BRL Currency basis, Unexpected Traditional Swap
in bps
Hours
15
10
5
0
−5
−10
−15
0
1
2
3
4
5
6
7

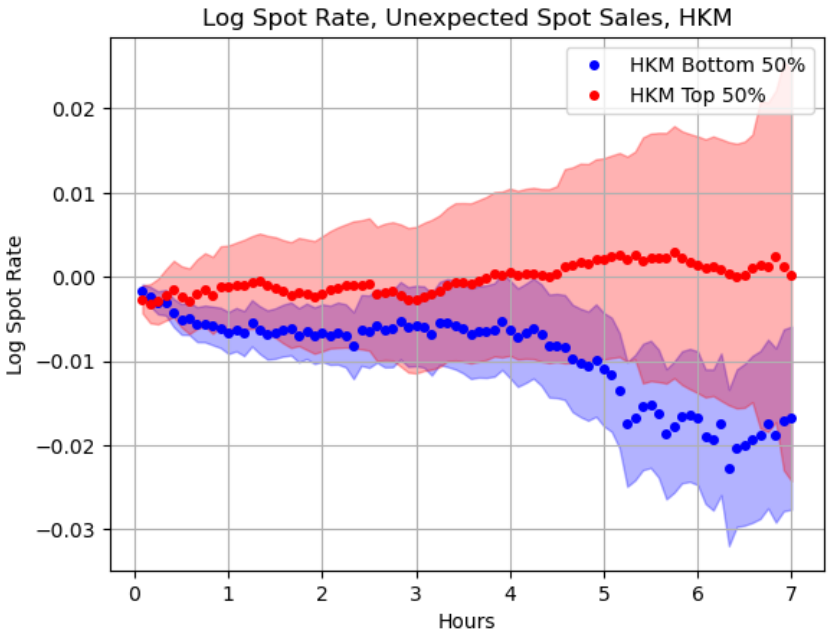
FXI Heterogeneity Test

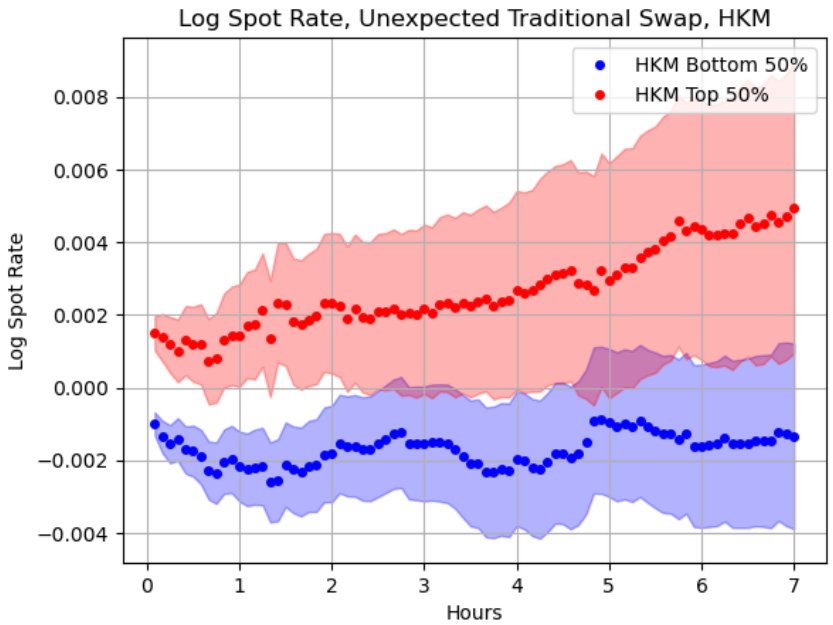
- **Prediction**: The impact of FXI is heightened during periods of intermediary constraints.
- Central bank conducts operations to supply dollars in spot or forward/swap markets to alleviate the demand for dollar liquidity during constrained periods.

$$
\begin{aligned}
y_{t+h} - y_{t-1} = & \beta_h^z INT_t^z \times SAD_t \times D_{HKM,t} \\
& + \gamma_h^z INT_t^z \times (1 - SAD_{t+h}) \times D_{HKM,t} \\
& + SAD_{t+h} + D_{HKM,t} + \text{Daily frequency controls}_t \\
& + \text{High frequency controls}_t + u_{t+h}
\end{aligned}
$$

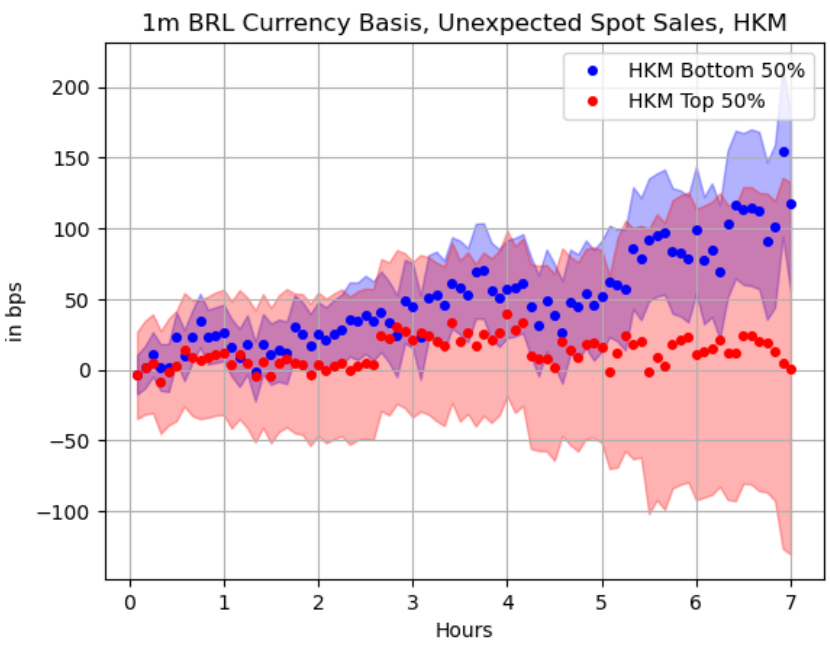
- **Measure of intermediary constraints**: HKM measures dealer capital ratio of global systemically important dealers (He, Kelly and Manela, 2017).
- A dummy variable $D_{HKM,t}$ takes a value of 1 for periods when HKM is above or below the 50th percentile, and is interacted with FXI.

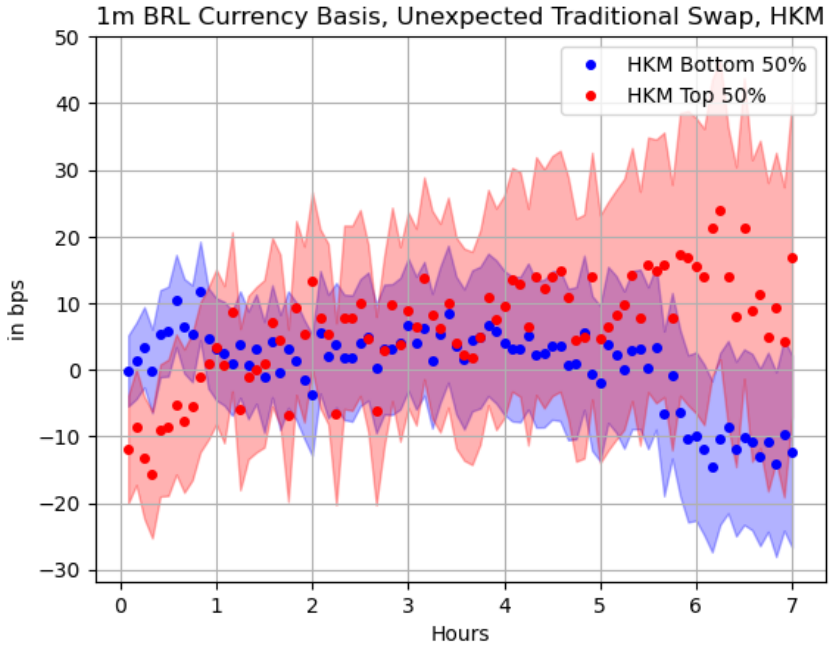
FXI and Intermediary Constraints: (log) Spot Rate





FXI and Intermediary Constraints: CIP





Robustness tests

1. **Expected interventions**: when announcement date is day/s before operational date, we find no/weak systematic effects of FXI on spot rates and CIP.
2. **Spot purchases and reverse swaps**: FXI that involve purchase of USD do not have impact on spot rate and CIP deviations. Suggests the intermediary constraints are reflective of a *dollar intermediation* channel.
3. **Alternative measures of intermediary constraints**: consistent results when using VIX or the absolute level of CIP violations.

Signaling vs Portfolio Balance: Work in Progress

- Long debate on the importance of signaling vs. portfolio balance channel in FXI transmission.
- **Signaling**: FXI provides information on future interest rates. Spot sales of USD reserves signal a desire to strengthen domestic currency, implying higher future domestic interest rates.
- Preliminary findings:
  1. High frequency: no interest rate response
  2. Low frequency (daily forecasts): no evidence unconditionally, but interest rate paths conditional on whether FXI is during periods of intermediary constraints.

Conclusion

- Analyzed high-frequency effects of the BCB FXI on spot rates and CIP.
- Key findings:
  1. Unanticipated USD sales appreciated BRL, narrowed CIP deviations, enhancing market efficiency.
  2. Results strongest for spot sales of USD reserves, less significant for USD purchase and swap FXI.
  3. Dollar intermediation channel is quantitatively important: larger effects on spot rate and CIP when intermediaries are constrained.
- Preliminary evidence suggests signaling of monetary policy is weak and insignificant based on intra-day evidence.
- Findings have policy implications on the use of FXI as a tool to provide USD liquidity during periods of tight constraints.
- Thank you!