Banking Limits on Foreign Holdings
Disentangling the Portfolio Balance Channel

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May 26, 2017
Research Objective

Analyze the effects of financial constraints on the exchange rate through the portfolio channel

- Construct a two-period model where constraints inhibit capital flows
  - Departures from UIP explain the effects of sterilized intervention

- Empirically test this channel by using a sharp policy discontinuity within Colombian regulatory banking limits
  - Effects of limits banking limits on foreign holdings

Findings: Effects on the exchange rate are short-lived, and significant only when: (a) constraints are binding and (b) in periods of Central Bank intervention
The “corner or bipolar hypothesis” began to lose popularity after the East Asia crises (1997-98) and the failure of Argentina’s currency board (2001) - Eichengreen (1994), Obstfeld and Rogoff (1995)

Since then, central banks have allegedly opted for monetary policy autonomy (but reluctant to relinquish control over currencies)

The impossible trinity (*trilemma*) indicates that a country cannot
- Allow for free capital flows
- Have autonomous monetary policy
- Adopt a fixed or managed exchange rate

*Policymakers can only regain control of the exchange rate if they abandon monetary policy or enact capital controls*

In the empirical literature, there is a lack of consensus regarding the effectiveness of Central Bank intervention
- Menkhoff (2013) and Villamizar and Perez (2015): 15/25 and 16/32 studies find significant FXI effects
Financial Rigidities: Limits on foreign exposure

- Colombian Banks have limits on foreign holdings
  - $PPC = \text{Assets minus Liabilities in USD relative to total capital (Jan 2004-Oct 2015)}$

- Colombian Banks are key players in COP-USD market

- When limits bind, banks are no longer indifferent between holding different currency denominated assets
Model

Two-period Small Open Economy (exogenous $r^*$)

- Representative household (Banks)
  - Receive exogenous endowment ($A_t$) and government transfer ($\tau_t$)
  - Choose whether to save in domestic or foreign assets
  - Face limits on the amount of foreign assets

- Government (Central Bank)
  - Issues domestic debt to buy foreign assets $B^*$ (Sterilized FXI)
Findings

Multiple equilibria

- Constraints do not bind - *UIP holds*
  - Agents are indifferent between foreign and domestic assets
  - Exchange rate does not depend on foreign assets

- Constraints bind - *UIP does not hold*
  - Household wants to save in asset with higher return until limit binds
  - Exchange rate depends on
    - FX intervention
    - Regulatory limits
  - Intervention helps overcome wedge caused by departure from UIP
Maximization Problem

Households

\[
\max_{c_0, c_1, B, B^*} U(c_0, c_1) = \ln c_0 + \beta \ln c_1
\]

s. t. \[c_0 + B + e_0 B^* = A_0 + \tau_0\]

\[c_1 = (1 + r)B + (1 + r^*)e_1 B^* + A_1 + \tau_1\]

\[
\frac{B}{1} \leq \frac{e_0 B^*}{I} \leq \frac{B}{1}
\]

where \[I \equiv A_0 + \tau_0 + \frac{A_1 + \tau_1}{1 + r}\]

Government

Budget is balanced through lump-sum transfers

\[
\tau_0 \equiv B_G - e_0 B^*_G
\]

\[
\tau_1 \equiv -(1 + r)B_G + (1 + r^*)e_1 B^*_G
\]

We can only pin down \[\frac{e_1}{e_0}\], so we assume \[e_0 = 1\]
Maximization Problem

- From Household’s maximization problem:

\[ 1 + r = e_1(1 + r^*) - \frac{\bar{\lambda} - \lambda}{\beta I} c_1 \]

- \( \bar{\lambda} (\lambda) \): Lagrange multiplier of upper (lower) bound on dollar exposure

- \( 1 + r < e_1(1 + r^*) \iff \bar{\lambda} > 0 \text{ and } \lambda = 0 \)

- \( 1 + r > e_1(1 + r^*) \iff \bar{\lambda} = 0 \text{ and } \lambda > 0 \)
A competitive equilibrium in this economy consists of

- Prices \( P = \{e_1, r\} \)
- Allocations \( X = \{c_0, c_1, B, B^*\} \)
- Government policies \( G = \{B_G, B_G^*\} \)

such that

1. Given \( P, X \) is a solution to the household’s problem
2. Markets clear
Proposition

- When constraints don’t bind, $e_1$ does not depend on $B_G^*$

$$
e_1 = \frac{1 + r}{1 + r^*} = \frac{A_1}{\beta A_0 (1 + r^*)}$$

- When constraints bind then FX intervention affects $e_1$

$$
e_1 = \frac{1 + r}{1 + r^*} \left( 1 - \frac{1}{\tilde{B}} - \frac{(1 + \beta) A_0}{B_G^*} \right) \quad \text{for } \tilde{B} \in \{B, \overline{B}\}$$
Empirical methodology

- Conduct a sharp RDD to study the effects of banking limits
  - Causal effects are identified in episodes of central bank intervention and non-intervention

- Findings
  - Banking limits have a short-lived effect on the exchange rate
  - Effects are greater in episodes when the central bank intervened
  - Effects on portfolio are significant (loans and foreign exposure)
Assignment of treatment:

\[ D_t = 1 \{ X_t \geq x_0 \} \]

Average Treatment Effect

\[
\text{ATE} = E (Y_{1t} - Y_{0t} \mid X_t = x_0) \\
= E (Y_{1t} \mid X_t = x_0) - E (Y_{0t} \mid X_t = x_0) \\
= \lim_{\epsilon \downarrow 0} E (Y_t \mid X_t = x_0 + \epsilon) - \lim_{\epsilon \uparrow 0} E (Y_t \mid X_t = x_0 + \epsilon)
\]

Last equality holds as long as conditional distribution of potential outcomes
\[ \Pr (Y_{it} \leq y \mid X_t = x) \] is continuous at \( X_t = x_0 \), for \( i \in \{0, 1\} \).
No manipulation at cutoff

**Figure:** McCrory’s (2008) Test
We estimate:

$$(\hat{a}, \hat{b}, \hat{\gamma}, \hat{\theta}) = \text{arg min}_{a, b, \gamma, \theta} \sum_{j=1}^{J} \sum_{t=2}^{T-J} (y_{t+j} - a_j - b_j (X_t - x_0) - \theta_j D_t - \gamma_j (X_t - x_0) D_t)^2 K \left( \frac{X_t - x_0}{h} \right)$$

- $\theta = (\theta_1, \ldots, \theta_J)'$ are the impulse-response coefficients (Jorda (2005), Kuersteiner et al. (2016))
- $K(\cdot)$ is a kernel function
- $h$ is the bandwidth
- $b_j, \gamma_j$ are polynomials
Caveats

- As horizon expands, control days ‘catch up’ over time

- Continuity of potential outcomes cannot be fully tested - there are however, testable implications

- Results can depend on kernel/bandwidth
  (Imbens and Kalyanaraman (2011), Calonico, Cattaneo, Titiunik (2014))
Data

**Figure:** Financial System’s Foreign Exposure as % of Equity

- **Effective lower (1%) bound** (Jan 23, 2004 - Oct 16, 2015)
- Total daily change in banks’ foreign exposure (in terms of equity) was 1% between 2004-2015
- **Running Variable:** \( \frac{1}{x_0} \frac{\text{Net Short Term Assets (USD)}}{\text{Capital}} < 1 \)
FX intervention

Figure: Official Foreign Exchange Intervention
IRF’s of Exchange rate ($\Delta e_t$)

**Figure:** IRFs - Exchange rate changes

(a) Whole Sample  
(b) Episodes of FXI  
(c) Episodes of no FXI
We consider effects of banking limits on portfolio balances of the five largest banks

\[ \frac{(A_t^* - L_t^*)e_t}{A_t} : \text{Assets minus Liabilities as share of domestic assets} \]

\[ \frac{L_t^*e_t}{L_t} : \text{Loans (USD) as share of loans (COP)} \]
Portfolio shifts

(d) \( \frac{(A_t^*-L_t^*)}{A_t} e_t \) Poly

(e) \( \frac{(A_t^*-L_t^*)}{A_t} e_t \) RDD

(f) \( \frac{L_t^*e_t}{L_t} \) Poly

(g) \( \frac{L_t^*e_t}{L_t} \) RDD
Concluding remarks

- 2-period tractable model: intervention has an effect on exchange rate when limits bind. Empirical exercise support this.
- We find shifts in portfolio balances as a response to limits on foreign holdings.

Ongoing Investigation

- N-period model: Role of current account
- Impact on capital flows, forward market