Central Bank Swap Lines

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The views expressed are those of the presenters and not necessarily those of the Bank of England, the MPC, the FPC or the PRC.
The governor of the Reserve Bank of India on Sunday called on major central banks to extend their network of currency swap lines deep into emerging markets, saying a type of “virtual apartheid” in the provision of foreign currencies hampers efforts to fight financial instability.” Wall Street Journal, October 15, 2017.
This paper

1. **How do swap lines work and what is their role in monetary policy?**
   - Source country CB lending to recipient country banks. Recipient CB bears credit risk/monitors.

2. **How does this monetary policy transmit through financial markets?**
   - Ceiling on CIP deviations => lower funding costs

3. **What economic consequences does this have?**
   1. Encourage investment from recipient-country banks into assets denominated in the source-country’s currency.
   2. Increases the expected profits of recipient-country banks that invest in source country.

**Empirics:** difference-in-differences strategy around the change in Fed Swap Line Rate in November 2011.

**Models:** Not going to go into details today.
1. Role in central banking: how the swap lines work
ECB borrowing USD from Fed

1. Fed sells dollars to ECB, ECB sells euros back at today’s spot exchange rate.
2. Agree in one week to resell, so euros are collateral.
3. Settlement happens at the same exchange rate.
4. Fed charges an interest rate in dollars set at start ($ OIS+spread).
5. ECB lends to EA bank, charges same rate, collect HQLA as collateral, determines who is eligible.
6. ECB in charge of collecting payment.

Liquidity assistance to foreign bank using foreign central bank to do the monitoring of collateral and bank.
Functions and alternatives

Properties
- US monetary policy on monetary base and rate, not EA monetary policy
- No exchange-rate or interest-rate risk, ECB has credit risk as in any lending facility

Basic function of central banks:
- Fed: provide liquidity when there is a funding crisis
- ECB: judge banks eligible for liquidity assistance
- Not exchange-rate pegs, not IMF loans, not US bailout of foreign banks

Alternatives (beyond FX reserves):
1. Fed lends directly to EZ banks through discount window/TAF? But (i) less efficient monitoring, Fed refuse, (ii) branches/subsidiaries did not have collateral; (iii) stigma.
2. EZ banks borrow euros from ECB buy dollars, swap out the currency risk? Spot and forward markets never closed, but cost…
2. Financial market effects of swap lines
Theory

- Trade involving only a bank and the central bank (all in logs)
  - EZ bank borrows dollars for one week from ECB swap line, pay \( j_s \)
  - Buys euros at spot rate \( s \), and sell forward at rate \( f \) in one week
  - Deposit euros at ECB at at rate \( j_v^* \)
  - Swap overnight for one-week rate at cost \( j^* - j_p^* \)

\[
i_s^t \geq s_t - f_t + (j_v^* + i_t^* - i_t^p)
\]

- Deviations from CIP:

\[
x_t = s_t - f_t + i_t^* - i_t
\]

**Proposition:** Deviations from covered interest parity have a ceiling given by the spread between the source swap and interbank rates plus the difference between the recipient central bank policy and deposit rates:

\[
x_t \leq (i_s^t - i_t) + (i_p^* - i_v^*)
\]
Further discussion: haircuts and regulation

**Proposition:** Bank-specific deviations from covered interest parity have a ceiling given by the spread between the source swap and interbank rates, plus the difference between the recipient central bank policy and deposit rates, plus the shadow value of collateral, plus the shadow cost of regulation on banks that is triggered by borrowing and lending from their central bank:

\[ x_{a,t} \leq (i^s_t - i_t) + (i^p_t - i^v_t) + (1 - \xi_c)(i^u_{a,t} - i^s_t) + \psi_{a,t}. \]

- Two independent sources of policy variation, domestic and foreign
- Safe bank or sovereign fund: minimum.
- Clear measure of CIP is the OIS one.
Euro (USD) basis, ECB ceiling
Difference-in-differences strategy

• On November 30, 2011, the Fed unexpectedly announced that from December 5th onwards it would lower swap rate spread from 1% to 0.5%. Motivation was to normalize the operations of the swap line.

• **Exclusion restriction** for identification with respect to CIP
  • The minutes of the meeting have no mention of recent 1-week CIP
  • Our measures were not particularly elevated the days or weeks before the change.
  • Timing: outcome of lengthy discussions with foreign central banks.
  • The change affected all swap-line central banks, event though closer event was crisis in Euro-area (treated) and Nordic countries (untreated)
  • Size of the change partly random: serious discussion of 0.75% versus 0.5%
  • Surprise to markets, little anticipation effect
Difference-in-differences visually
Effect on distribution of daily CIP deviations

[Graph showing the distribution of CIP deviations for swap line and non-swap line currencies before and after some event.]
Ceiling on quotes
Table 1: Di↵erence-in-di↵erences estimates of the e↵ect of the swap line rate change on CIP deviations

<table>
<thead>
<tr>
<th></th>
<th>Swap Line Currencies</th>
<th>Non-Swap-Line Currencies</th>
<th>D-in-D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
</tr>
<tr>
<td>Mean</td>
<td>.248</td>
<td>.153</td>
<td>.136</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>.261</td>
<td>.117</td>
<td>.120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25th Percentile</td>
<td>.411</td>
<td>.209</td>
<td>.456</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10th Percentile</td>
<td>.471</td>
<td>.279</td>
<td>.523</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Swap line currencies refers to the EUR, GBP, CAD, JPY, and CHF. Non-swap line currencies refers to the AUD, NZD, SEK, NOK, and DKK. The dependent variable is the 1-week CIP deviation vis-a-vis the USD. Before refers to the days in November 2011 and after to the days in January 2012. Standard errors, block-bootstrapped at the currency level, are in brackets. The quantile di↵erence-in-di↵erences estimators are estimated simultaneously with the cross equation covariance matrix is estimated using bootstrapping. *** denotes statistical significance at the 1% level; ** 5% level;* 10% level.
Domestic variation

\[ x_{j,t} = \alpha_j + \beta c_{j,t} + \varepsilon_{j,t} \]

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Censored</th>
<th>Time fixed effect</th>
<th>Shorter sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling ((c_{j,t}))</td>
<td>0.1996***</td>
<td>0.6578*</td>
<td>0.1675**</td>
<td>0.248***</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.249)</td>
<td>(0.057)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>(N)</td>
<td>9500</td>
<td>9500</td>
<td>950</td>
<td>8195</td>
</tr>
<tr>
<td>Adjusted (R^2)</td>
<td>0.08</td>
<td>0.16</td>
<td>0.67</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Notes: Estimates of equation (5). The dependent variable is the 1-week CIP deviation of the CAD, CHF, EUR, GBP, and JPY vis-a-vis the USD. The sample runs from 19th September 2008 (the date of the first multilateral Federal Reserve swap agreement) through to 31st December 2015. All regressions include currency fixed effects. Column (1): panel least squares estimator. Column (2): panel least squares estimator conditional on \(x_{j,t}\) being in the 90th percentile of the unconditional distribution. Column (3): panel least squares estimator including time fixed effects. Column (4): Removes 2015 observations so the sample ends on the 31st of December of 2014. Standard errors, clustered by currency and date, are in brackets. *** denotes statistical significance at the 1% level; ** 5% level; * 10% level.
Further discussion: Equilibrium in Financial Markets

• Model Sketch:
  • Representative intermediary sells FX swaps, matched with bank OTC:
  • Two frictions generating CIP deviation:
    • Funding value adjustment (Andersen, Duffie, Song (18)).
    • Regulatory capital constraints (Du, Tepper, Verdelhan (18))
  • Nash bargaining over price of swap -- outside option is the swap line.

**Proposition:** A decrease in the policy choice is leads to:

1. A lower **ceiling** in the distribution of bank-specific CIP quotes
2. A lower **mean** of the distribution of CIP deviations.
3. Macroeconomic effects of the swap lines: theory
Proposition: An exogenous decrease in the swap line rate:

1. Lowers the ceiling and expected realizations of CIP deviations;

2. Raises investment by recipient-country banks in source-currency capital;

3. Increases the expected profits of recipient-country banks that invest in source-currency capital.
Empirical strategy I: investments

- Banks in countries with access to USD via their central bank’s swap line should demand more USD-denominated assets relative to other banks and relative to non-USD bonds

- Triple difference-in-difference
  - (i) across time: swap rate change, days before and after
  - (ii) across banks: swap and non swap line across currencies
  - (iii) across investments: USD-denominated bonds versus bonds in other currencies
Data

• ZEN database:
  • All trades by EEA-regulated financial firms of either UK-issued corporate bonds or traded by UK-based firms (London financial center)
  • Individuals transactions, millions of observations. 26 (19) banks, 790 (69 bonds).
  • Aggregate to measure net daily flow from firm $a$, into corporate bond $b$, at trading date $t$, scaled by average flow: $n_{a,b,t}$.

• Later, also:
  • All USD-bonds in BAML indices, separate those that are actively traded by swap line banks, then match them to those with similar characteristics.
  • All bank stock prices in recipient countries, separating those with U.S. presence.
Diff USD-other bonds per bank
Considering bank and asset fixed effects

\[ n_{a,b,t} = \beta_t \times SwapLine_a \times USDBond_b + \alpha_{a,t} + \gamma_{b,t} + \varepsilon_{a,b,t} \]
\[ n_{a,b,t} = \beta \times Post_t \times SwapLine_a \times USDBond_b + \alpha_{.,t} + \varepsilon_{k,j,t} \]

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Post_t \times Swap_a \times USDBond_b )</td>
<td>0.0770* (0.042)</td>
<td>0.0770* (0.041)</td>
<td>0.0772* (0.041)</td>
<td>0.0788* (0.042)</td>
</tr>
<tr>
<td>( N )</td>
<td>205227</td>
<td>205227</td>
<td>205227</td>
<td>205227</td>
</tr>
<tr>
<td>bank × period f.e.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>bank × currency f.e.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>bank × issuer f.e.</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>bank × duration f.e.</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>bank × bond f.e.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>period × currency f.e.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>period × issuer f.e.</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>period × duration f.e.</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>period × bond f.e.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes: Estimates of equation (9). The dependent variable is \( n_{a,b,t} \), bond level daily flows by bank scaled by the total absolute flow by bank. \( Post_t \) is a dummy variable taking a value of 1 if \( t \) is after 30th of November 2011. \( Swap_a \) is a dummy variable taking a value of 1 if the bank \( a \) is headquartered in swap line country. \( USDBond_b \) is a dummy variable taking a value of 1 if bond \( b \) is dollar denominated. Column (1): triple difference estimator, including \( Swap_a \) × period, \( USDBond_b \) × period and \( Swap_a \) × \( USDBond_b \) fixed effects. Column (2): adds bank specific and bond-currency specific fixed effects. Column (3): additionally adds issuer and duration (3-year window) fixed effects. Column (4): saturated regression. Column (5): includes in the sample banks who trade infrequently. Column (6): limits the sample to bonds that are rated A- and above. Column (7): limits the sample to bonds that are rated BBB+ and below. Standard errors, clustered at the bank and bond level, are in brackets. *** denotes statistical significance at the 1% level; ** 5% level; * 10% level.
Effect on bond prices

- Nearest Neighbour estimator on similar USD bonds outside the sample of frequently traded bonds:
  - 8bp fall in average yields in five day window after announcement.
  - Not driven by Euro area issuers most likely to benefit.

<table>
<thead>
<tr>
<th></th>
<th>Nearest Neighbor</th>
<th>Exact Match on Euro Issuers</th>
<th>Dropping Euro-area Issuers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$foreign_{held_b}$</td>
<td>-0.0860**</td>
<td>-0.1221***</td>
<td>-0.1264***</td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td>(0.036)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>$N$</td>
<td>5474</td>
<td>5474</td>
<td>5257</td>
</tr>
</tbody>
</table>
Returns around swap rate line change
Conclusion

• Central bank swap lines: large and integral.

• Swap line is the twin of the discount window when foreign banks invest and borrow domestically.

• Swap line spread plus foreign difference between policy and deposit central bank rates put ceiling on CIP deviations, empirically there from both variations.

• Swap line encourages investment in dollar assets ex ante, prevents fire sales ex post. Empirically see portfolio tilt towards bonds, increase in price of USD bonds traded by foreigners, increase in share price of foreign banks.

• Overall: eased funding pressure in cost of hedging foreign funding, choice of investments to fund, asset prices of those investments, stock price of investors.
Appendix Material
Features and how large

• Further features:
  • Triple difference allows us to control for bond specific factors, like shocks to the issuer's credit worthiness, and to identify shifts in preferences among banks for bonds of different denominations.
  • Stronger effect on lower credit ratings, stronger effect for infrequent traders

• How large was effect of 0.5% fall in swap line rate?
  • Within sample, increase in gross flows of $230 million, 4.8% of their absolute flow.
  • Extrapolating out of sample to all bonds issued by U.S. non-financial excluding the government in the flow of funds: $8.31 billion shift in capital flows.
Swap dollar funding allocation
### Elasticity of allotment to gain

\[
\log(q_{j,t}) = \alpha_j + \beta_j x_{j,t-1} + \varepsilon_{j,t}
\]

<table>
<thead>
<tr>
<th></th>
<th>ECB: USD Auctions</th>
<th>BoJ: USD Auctions</th>
<th>ECB: EUR Auctions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x_{j,t-1}: \text{CIP Deviation})</td>
<td>2.2353*** (0.527)</td>
<td>2.4262*** (0.9891)</td>
<td></td>
</tr>
<tr>
<td>(x_{j,t-1}: \text{1-week Libor-OIS})</td>
<td></td>
<td></td>
<td>1.5804*** (0.587)</td>
</tr>
<tr>
<td>(N)</td>
<td>217</td>
<td>90</td>
<td>388</td>
</tr>
<tr>
<td>Adjusted (R^2)</td>
<td>0.08</td>
<td>0.14</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**Notes:** Estimates of equation (6). CIP deviation is the 1-week EUR or JPY vis-a-vis the USD on the day prior to the auctions. We consider auctions where a positive amount is allotted between the 19th September 2008 (the date of the first multilateral Federal Reserve swap agreement) through to 31st December 2015. Robust standard errors are in brackets. *** denotes statistical significance at the 1% level; ** 5% level; * 10% level.