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.
Legacy of the crisis, they existed before, but not so large, and always around currency pegs supplementing international reserves
CB swap network

Chart 10 Network of bilateral swap lines

Chart 10a January 2007(a)

Chart 10b January 2009(b)

Chart 10c October 2015(c)

Sources: Central bank websites and Bank calculations

(a) Includes swap lines under the Chiang Mai Initiative
(b) Includes swap lines under the Chiang Mai Initiative Multilateralization as this network is no longer based on bilateral swap lines. The value of the links in the uncapped advanced economy network are illustrative.
(c) Does not include swap lines under the Chiang Mai Initiative

For central banks which drew from the Federal Reserve in 2008/09 we assume they can draw from each of the other central banks in the network the smaller of (i) their maximum drawing from the Fed and (ii) the lending central bank’s maximum drawing. For central banks which didn’t draw we assume that they can draw an amount equivalent to the average past drawings relative to the GDP of the borrower, multiplied by that country’s current GDP. The effective lines could be larger or smaller than these illustrative values. It is unlikely that a central bank would draw on all of these lines simultaneously.

• Unprecedented volume, extension of network
Assessments: policymakers

“The expanded use of the swap lines has helped to ease funding pressures on European and other foreign banks, lower tensions in U.S. money markets (in which foreign banks are major participants), alleviate pressures on foreign banks to reduce their lending in the United States, and boost confidence at a time of considerable strain in international financial markets. . . .

I would add that the swaps are very safe from the perspective of the Federal Reserve and the U.S. taxpayer. They present no exchange rate or interest rate risk; each drawing has a short maturity and must be approved by the Federal Reserve; they are collateralized by the foreign currencies for which dollars are swapped; and our counterparties are the foreign central banks, not the foreign commercial banks that receive the dollar loans”

• Ben Bernanke, Statement before the Committee on Oversight and Government Reform, U.S. House of Representatives, March 21, 2012
Assessments: policymakers

“From a Eurosystem perspective, they are therefore a monetary policy tool that enhances the smooth functioning of the transmission mechanism for both the issuing and the home central banks, by protecting the respective markets from external tensions, and thereby ultimately contributing to the fulfilment of the mandate of the central banks involved. …

The operations were successful in containing the spread between the US dollar London interbank offered rate (LIBOR) and the US dollar overnight indexed swap (OIS) rate while providing banks with time to restructure their balance sheets in an orderly fashion, limiting the need for fire sales of assets which would have had a negative impact on the economy.”

• ECB monthly Bulletin, August 2014

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.”

Assessments: commentators

The international financial architecture of today bears little resemblance to the one that existed 10 years ago. Before the financial crisis, the global safety net consisted mostly of a single, imposing — although somewhat dated — structure: the IMF. While alternative structures for official financial support existed, they were small by comparison. Like an emerging market cityscape, the international financial architecture has since then experienced a construction boom involving sprawling suburbs and towering high-rises, in the form of an increased number and greater size of RFAs, unlimited and standing bilateral swap lines, and contingent reserves arrangements.


What we need is an institutionalized global swap network. It is possible to establish a global swap network that has the capacity to meet the demonstrated need and at the same time meet the concerns of central bankers.

• Edwin Truman, “Enhancing the global financial safety net through central-bank cooperation” voxeu, September 2013
“This morning the Fed along with the central banks of Canada, England, Japan, Europe and Switzerland rang the dinner bell and basically said to banks around the world, "You need money? Come and get it!" […]

What does this mean? It means the Fed and other central banks around the world are really freaked out about Europe. They are worried that European banks can't get access to the money that they need and that could spell disaster for the global economy. The Fed is lending to the ECB on very favorable terms because they know Europe desperately needs dollars.”

- NPR Planet Money, November 30, 2011

- Academic assessments: …
This paper

1. Equivalence swap lines and discount lending
2. Proposition: swap line rate puts a ceiling on currency basis (CIP deviations)
3. Empirically: variation in swap-ceiling explains variation in basis.
4. Empirically: swap auction allocations peak with basis in line with discount auctions.
5. More evidence: swap lines and exchange rates, foreign reserves lending.
6. Model: central bank joint decision of discount window and swap line as liquidity backstops.
Literature review

• Central bank swap lines:

• Currency basis and CIP deviations

• Central banks and liquidity crisis
Central bank swap lines and discounting
Classic funding problem

- At beginning of period, bank chooses portfolio of:
  - euro-assets, $a$
  - euro reserves at central bank. $v$
- Fund this with net worth and:
  - euro-funding, $l$
- After (irreversible) investments, shock to funding:
  - $l' = l(1 - w)$
- Options and costs:
  (i) draw down reserves ($v \geq 0$), opp. cost $i^v$
  (ii) borrow from other banks ($b < 0$), rate $i$
  (iii) discount window, ($d < 0$) cost $i^d > i^v$
Classic funding solution

• If \( v \) is large enough relative to \( w \),
  \[ i^v = i \text{ and } b = d = 0 \]

• If \( V \) not too small relative to \( w \),
  \[ i^d > i > i^v \text{ and } b < 0 = d \]

• If \( w \) large enough,
  \[ i^d = i > i^v \text{ and } d < 0 \]

• Proposition: \( i \leq i^d \), so the discount rate puts a ceiling on the interbank rate.
With foreign investment/funding

• For concreteness: European bank, US dollars

• At beginning of period, bank chooses portfolio of:
  - euro-assets, \( a \)
  - euro reserves at central bank, \( v \)
  - dollar-assets, \( s a^* \)

• Fund this with net worth and:
  - euro-funding, \( f \)
  - dollar-funding, \( s f^* \)

• Shock to foreign funding, they refuse credit risk:
  \( l'^* = l^* (1 - w^*) \)

• To avoid fire sale, again need to borrow, but where?
First funding option: get euros

- Obtain euros domestically:
  - First draw down reserves, then borrow from domestic banks, then go to discount window.
  - But now, \( (a'' - l'')(a' - l' + v - b) \), the portfolio weights changed.
  - Currency mismatch of funding: banks no longer have the desired exchange-rate risk exposure

- Leads to lower foreign investment \( a^* \) ex ante:
  - Fear of ex post currency mismatch
  - Extreme case, Knightian w.r.t. funding risk.
Second funding option

- Covered transaction:
  - Borrow € domestically at $i$ Euro interest rate
  - Buy dollars in spot market at rate $s$,
  - Eliminate currency risk by buying a forward contract at rate $f$.
  - All in logs

- Effect of this replacement of funding on profits:
  - In dollars, : $(s - f) - i$
  - Take out risk by investing in reserves : $(s - f) - i + i^\nu$
Third option: CB swap line

1. Fed lends $ to ECB at $i^* + g^*$ predetermined terms, for one week, gets $ back.
2. ECB lends to banks at this rate, picks collateral, collects payment, sends to Fed, makes no profit
3. Banks get dollars, desired exchange-rate risk exposure.

Fisher, Kohn, Truman (1996) "...provide a mechanism whereby the Fed could provide dollar liquidity ... to foreign monetary authorities, who may in turn need to provide dollar liquidity to their banks in the event that dollar funding of their banks is suddenly (and expectantly) withdrawn."
Risks and stories

• Fed:
  • *no credit risk, no exchange-rate risk, no interest-rate risk.*
  • “the swaps are very safe from the perspective of the Fed”
  • “The Fed is lending to the ECB on very favorable terms.”

• ECB:
  • gets $, lends $, no exchange-rate risk or interest-rate risk
  • “The ECB is taking risk out of the banks’ balance sheets”.
  • keeps all credit risk as in discount lending.

• Exchange rates:
  • *pressure and arbitrage are on the basis, on forwards*
  • “Central bank swaps are used to keep the central role of the dollar and currencies pegged to it.”
From swaps to basis

- Currency basis: \( x = i^* - i - (s - f) \)
  - Covered Interest Parity: \( x = 0 \).
  - In the data \( x \leq 0 \)

- **Proposition:**
  \[-x \leq c = g^* + i - i^v\]
  The swap rate set by Fed + interbank rate in Eurozone - deposit rate at ECB, puts a ceiling on the basis

- Arbitrage trade between using the central bank or the covered trade market
Discount and swaps

• Discount borrowing and swap borrowing in both, bank gets emergency funding

• Discount lending and swap lending: in both, ECB gets same credit risk

• Discount rates and swap rates in both, ceiling on a market rate

• Conclusion: discount and swap are twins.
Empirical test of ceiling
Data

• $i$ and $i^*$: OIS rates, overnight indexed swaps, since limited counterparty risk, swaps on central bank rates, match 1-week duration of FX auctions.

• $f - s$: Forward and spot rates

• $g$: 100 bp when started in December of 2007, lowered to 50bp in November of 2011.

• $i - i^v$: difference between short-term repo policy rate and deposit facility rate.

• Sample: EUR, GBP, CAD, CHF, JPY, frequency weekly 2008/9/19-2015/12/21.
Euro (USD) basis, ECB ceiling
Basis and ceilings

1. Financial crisis: large $w^*$ shocks

2. Basis deviates from zero because of funding needs. We take these as given, see others’ work.

3. Swap line rate puts a ceiling (almost always) on the basis.

4. Average basis falls after change in $g$ in 2011 from 100bp to 50bp.
**Regression:**  
\[ x_{it} = \alpha_i + \beta c_{it} + \varepsilon_{it} \]

Panel over countries in swap network over weeks. Level and volatility as in discount window work.

<table>
<thead>
<tr>
<th></th>
<th>Baseline Basis ((x_{it}))</th>
<th>10(^{th}) percentile (x_{it})</th>
<th>Censored (x_{it})</th>
<th>Domestic variation (x_{it})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling ((c_{it}))</td>
<td>0.1372* (0.054)</td>
<td>0.2015*** (0.014)</td>
<td>1.9130** (0.652)</td>
<td>0.1122 (0.074)</td>
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<td>(N)</td>
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<td>291</td>
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Standard errors clustered at the currency level in parentheses  
* \(p < 0.1\), ** \(p < 0.05\), *** \(p < 0.01\)
Regression: $x_{it} = \alpha_i + \beta c_{it} + \varepsilon_{it}$

Quantile regression, as ceiling has more of an effect if basis is close to it

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More extreme, only when basis is within 10bp of ceiling

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Standard errors clustered at the currency level in parentheses

\(* p < 0.1, ** p < 0.05, ***p < 0.01\)
Regression: \[ x_{it} = \alpha_i + \gamma_t + \beta c_{it} + \varepsilon_{it} \]

Time fixed effects, only central bank variation \((i - i^v)\)

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* \(p < 0.1\), ** \(p < 0.05\), *** \(p < 0.01\)
Diff in diff strategy

• Panel regression, including also basis for a series of non-swap currencies (AUD, NZD, SEK, NOK, DKK).

• Change in Fed’s ceiling \( g \) on Dec 5, 2011, plausibly exogenous to basis.

• Window of 1 month before and after Dec 2011 (November and January), compare change in basis in countries or currencies covered by swap versus countries not covered by swap.
Effect of ceiling on basis

### Window=1 month before versus 1 month after

<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><strong>Mean</strong></td>
<td>-.248</td>
<td>-.153</td>
<td>-.136</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>-.261</td>
<td>-.117</td>
<td>-.120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>25th Percentile</strong></td>
<td>-.411</td>
<td>-.209</td>
<td>-.456</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>10th Percentile</strong></td>
<td>-.471</td>
<td>-.279</td>
<td>-.523</td>
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Similar $\beta$, in $(0.1, 0.2)$, effect doubles on percentile 10.
Swaps and discounts
Swap dollar funding

ECB USD Auctions

- ECB 1 Week USD Auction Allocations, (LHS) $bn
- 1 Week EUR/USD OIS Basis, RHS (%)
Discount window euro funding
Elasticity of allotment to gain

<table>
<thead>
<tr>
<th></th>
<th>ECB-EUR log($a_{it}$)</th>
<th>ECB-USD log($a_{it}$)</th>
<th>BoJ-USD log($a_{it}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x_{it}$</td>
<td>-1.6211***</td>
<td>-2.2353***</td>
<td>-2.4584***</td>
</tr>
<tr>
<td></td>
<td>(0.512)</td>
<td>(0.527)</td>
<td>(0.882)</td>
</tr>
<tr>
<td>$N$</td>
<td>427</td>
<td>217</td>
<td>88</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.14</td>
<td>0.08</td>
<td>0.15</td>
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Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Similar coefficients across countries and funding channel
More evidence: exchange rates and foreign reserves lending
Does basis predict future spot?

\[ s_{i,t+7} - s_{i,t} = \alpha_i + \beta_i x_{i,t} + \varepsilon_{i,t} \]

<table>
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<th>JPY app.</th>
<th>CHF app.</th>
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<tr>
<td>basis (x_{i,t})</td>
<td>-10.3528**</td>
<td>-19.2272***</td>
<td>3.3607</td>
<td>-21.8222***</td>
</tr>
<tr>
<td></td>
<td>(6.067)</td>
<td>(6.942)</td>
<td>(6.042)</td>
<td>(5.430)</td>
</tr>
<tr>
<td>(s_{t+7} - s_t)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N)</td>
<td>2546</td>
<td>2546</td>
<td>2284</td>
<td>2233</td>
</tr>
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Newey-West standard errors in parentheses

* \( p < 0.1 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

A 100bp increase in the euro basis reduces expected depreciation by 10% annualized over following week.
From CIP to UIP

\[ s_{i,t+7} - s_{i,t} = \alpha_i + \beta_i x_{i,t} + \gamma_i (f_{i,t} - s_{i,t}) + \varepsilon_{i,t} \]

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<tr>
<td>basis ( (x_{i,t}) )</td>
<td>-14.7969**</td>
<td>-19.4805***</td>
<td>-2.4115</td>
<td>-20.3309***</td>
</tr>
<tr>
<td>( s_{t+7} - s_t )</td>
<td>(6.038)</td>
<td>(6.933)</td>
<td>(9.779)</td>
<td>(6.931)</td>
</tr>
<tr>
<td>forward premium ( (f_t - s_t) )</td>
<td>5.7566</td>
<td>0.6367</td>
<td>4.8778</td>
<td>-1.1743</td>
</tr>
<tr>
<td>( s_{t+7} - s_t )</td>
<td>(4.114)</td>
<td>(1.476)</td>
<td>(8.514)</td>
<td>(2.659)</td>
</tr>
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\( N \) 2546 2546 2284 2233

Newey-West standard errors in parentheses

* \( p < 0.1 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

CIP deviations explains UIP deviations
Russian experience

Holds large USD reserves, lends them out through repo loans to Russian banks.
The joint choice of the swap and discount rate
Policy problem

• Choose \( V \) and \( i^v \). Focus on choice of \( g \) and \( i^d \).

• A large \( w^* \) shock is realized, close partial equilibrium model assume: upward sloping supply of forward contracts. Reduced-form assumption for models of deviations from CIP.

• Solve for endogenous interest rates, and ex ante choice of foreign investments. Policy evaluated in terms of size of \( a^*/a \).
The role of reserves

- **Proposition:** If $V$ is large enough so that the market for reserve is satiated after the shock, $i = i^V$, then a lower $g$ weakly raises $\alpha*/\alpha$.

- **Corollary 1:** $i^d$ is irrelevant for $\alpha*/\alpha$, independent of $g$.

- **Corollary 2:** $i^V$ does not affect $\alpha*/\alpha$.

- QE is a first line of defense in need for liquidity
Interdependence

- **Proposition:** If $V$ is small so $b < 0$, then a higher $i^d$ lowers $a^*/a$ for all $w^*$, while a higher $g$ only lowers $a^*/a$ for high enough $w^*$. An increase in $i^d$ and fall in $g$ such that $i^d - g$ is unchanged lowers $a^*/a$.

- **Corollary 1:** With a higher $g$, then $F/w^*$ is higher, and it is less likely that swap line is used.

- **Corollary 2:** With a higher $i^d$, then $F/w^*$ is higher, and it is less likely that swap line is used.

- Swap line complements the discount window.
Conclusion
Conclusion

• Central bank swap lines large and here to stay, need more academic work on the role that they play

• Showed swap lines similar to discount window, linked to currency basis and CIP deviations.

• Swap line rate puts ceiling on currency basis, affects it, moves future exchange rates

• A combination of QE and lower g address funding crises. Otherwise, vary iD and g together.