

# Central Bank Swap Lines

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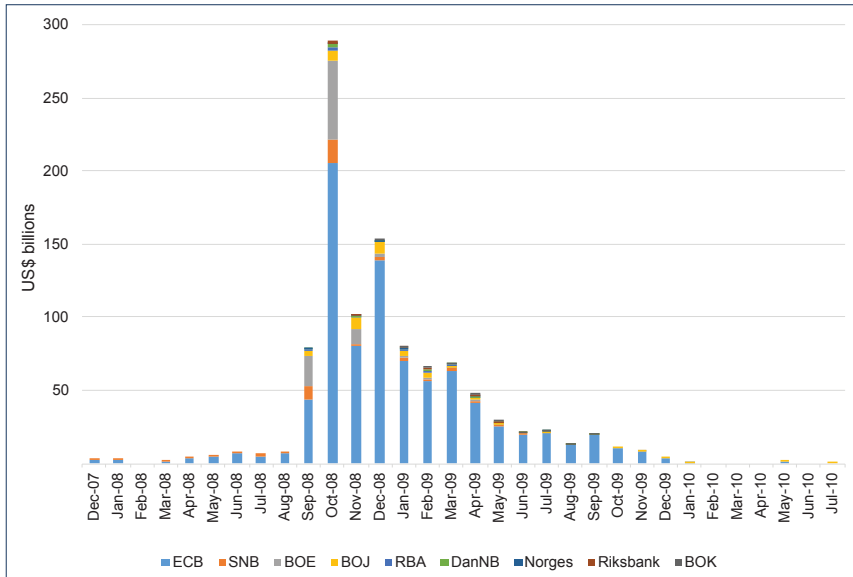
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*The views expressed are those of the presenters and not necessarily those of the Bank of England, the MPC, the FPC or the PRC.*

# CB swap lines after 2008

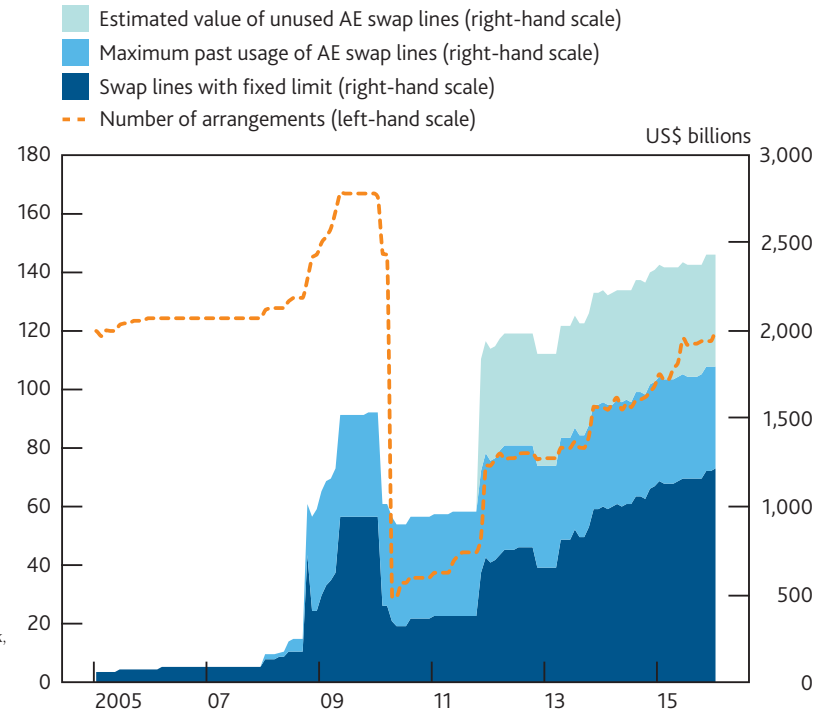
**Figure 2: US Dollar Swap Amounts Extended by the US Federal Reserve, by Recipient Central Bank, 2007–2010**



Data source: US Federal Reserve.  
 Note: Abbreviations left to right refer to the European Central Bank and the central banks of Switzerland, the United Kingdom, Japan, Australia, Denmark, Norway, Sweden and Korea.

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

**Chart 11 Estimated value of central bank swap lines<sup>(a)(b)</sup>**



Sources: Central bank websites and Bank calculations.

- The value of the swap lines is equal to the sum of all bilateral swap line arrangements. The value of reciprocal (two-way) arrangements is counted twice (once for each currency provided). Maximum past drawings are calculated for swap lines in the AE central bank swap network; those which haven't been drawn have been estimated based on the average past drawings of those lines which have relative to their GDP.
- The sharp fall in the number of swap lines is due to the multilateralisation of the Chiang Mai Initiative.

# CB swap network

Chart 10 Network of bilateral swap lines

Chart 10a January 2007<sup>(a)</sup>

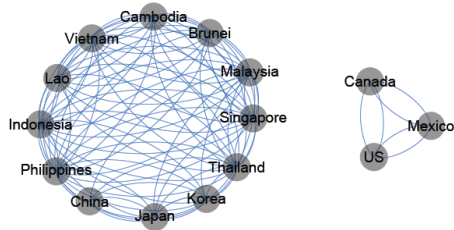


Chart 10b January 2009<sup>(b)</sup>

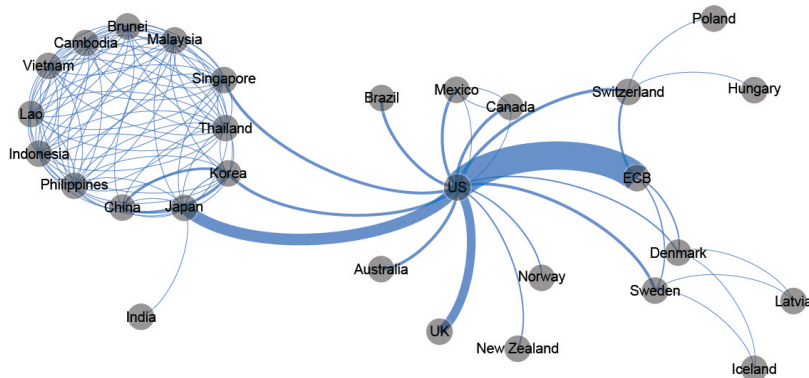
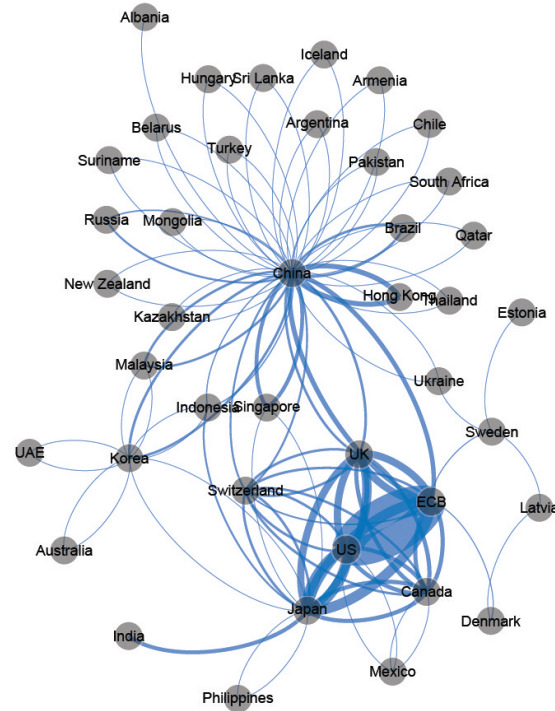


Chart 10c October 2015<sup>(c)</sup>



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.

(c) Does not include 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. 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.”*

- Wall Street Journal, October 15, 2017.

# 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.*

- Zettelmeyer and Di Mauro, "The New Global Financial Safety Net", Essays on International Finance, 2017,

*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

# Assessments: public

*“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:

*Obstfeld, Shaumburg, Taylor (2009) Prasad (2014), Goldberg, Kennedy, Miu (2011), Domanski, Moessner, Nelson (2014)*

- Currency basis and CIP deviations

*Du, Tepper, Verdelhan (2017), Borio et al (2016), Ajdiev et al (2017), Baba and Packer (2009).*

- Central banks and liquidity crisis

*Poole (1968), Ennis and Keister (2008), Bianchi and Bigio (2017).*

# 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*,  $sa^*$
- Fund this with net worth and:
  - euro-funding,  $f$
  - *dollar-funding*,  $sf^*$
- 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 :  $(s - f) - i + i^v$

# 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

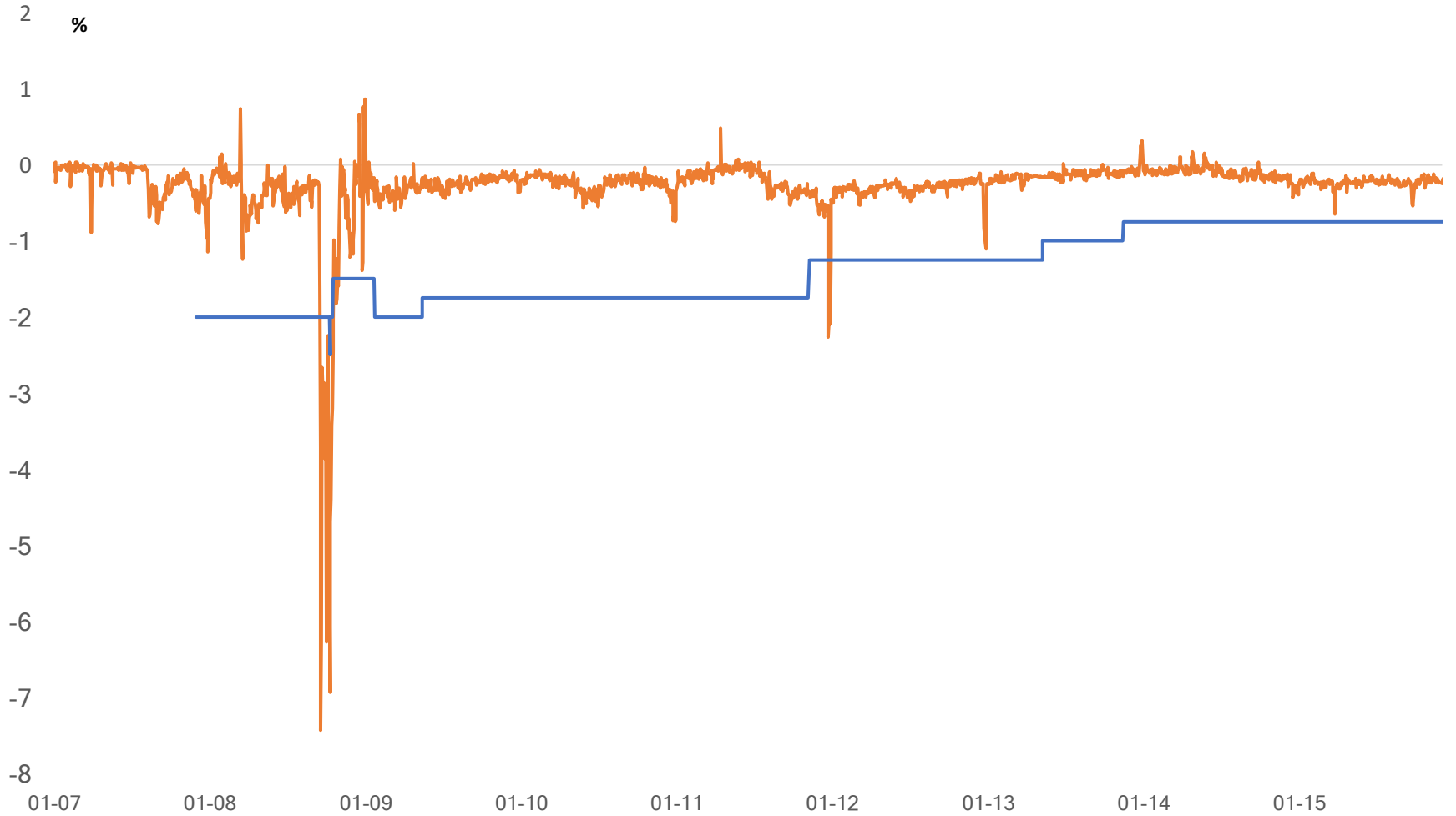
- Discount borrowing and swap borrowing  
in both, *bank gets emergency funding*
- Discount lending and swap lending:  
in both, *ECB gets same credit risk*
- Discount rates and swap rates  
in both, *ceiling on a market rate*
- Conclusion: **discount and swap are twins.**

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.

	Baseline Basis ( $x_{it}$ )	10 <sup>th</sup> percentile $x_{it}$	Censored $x_{it}$	Domestic variation $x_{it}$
Ceiling ( $c_{it}$ )	0.1372* (0.054)	0.2015*** (0.014)	1.9130** (0.652)	0.1122 (0.074)
$N$	9481	9481	291	9481
Adjusted $R^2$	0.02		0.22	0.65

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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# Regression: $x_{it} = \alpha_i + \gamma_t + \beta c_{it} + \varepsilon_{it}$

Time fixed effects, only central bank variation ( $i - i^V$ )

	Baseline Basis ( $x_{it}$ )	10 <sup>th</sup> percentile $x_{it}$	Censored $x_{it}$	Domestic variation $x_{it}$
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# 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

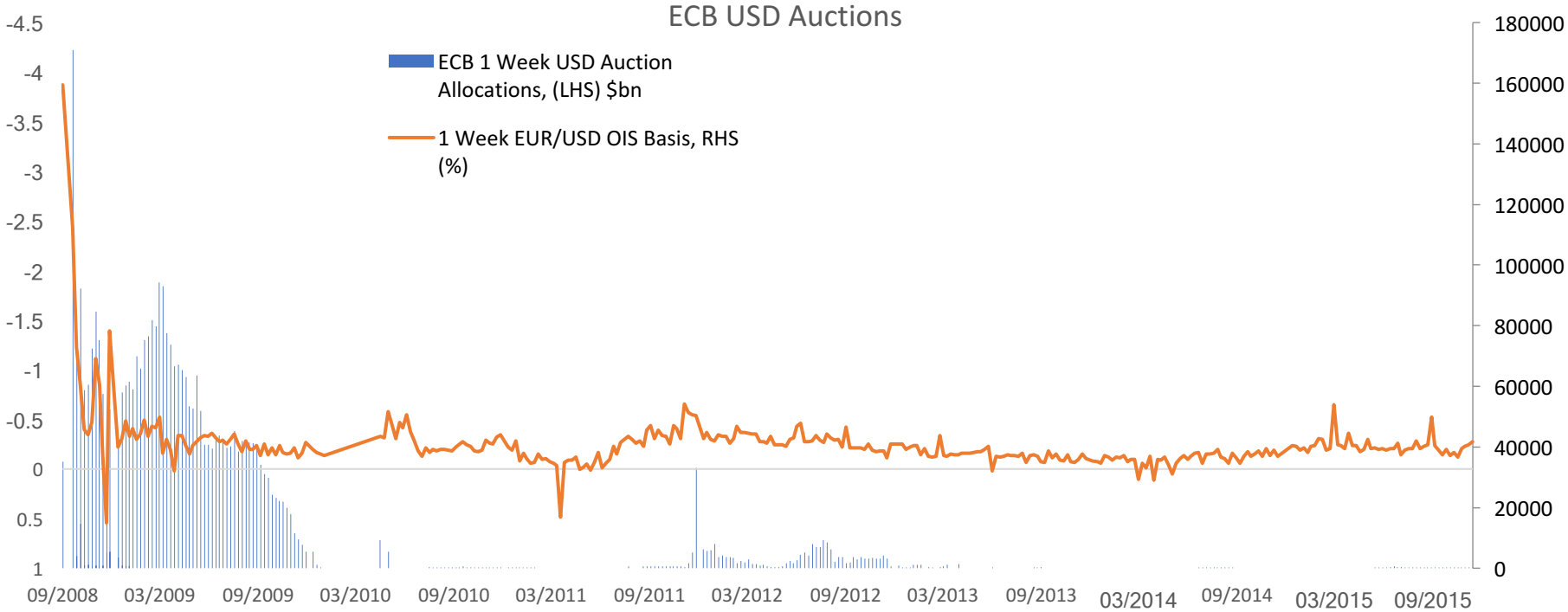
Window=1 month before versus 1 month after

	Swap Line Currencies		Non-Swap Line Currencies		D-in-D
	before	after	before	after	
Mean	-.248	-.153	-.136	-.219	.178* (.092)
Median	-.261	-.117	-.120	-.144	.134 (.147)
25th Percentile	-.411	-.209	-.456	-.407	.154 (.108)
10th Percentile	-.471	-.279	-.523	-.613	.269** (.012)

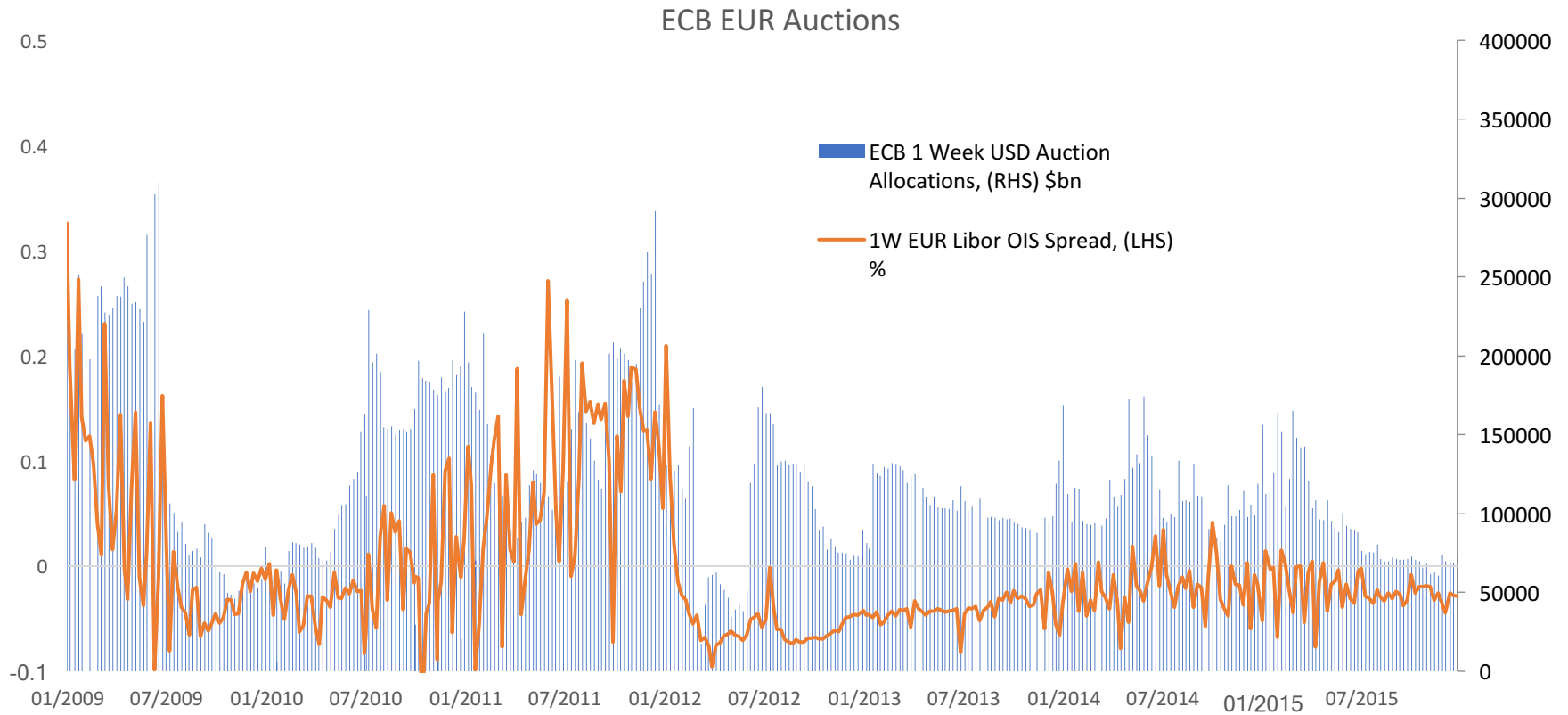
Similar  $\beta$ , in  $(0.1, 0.2)$ , effect doubles on percentile 10.

# Swaps and discounts

# Swap dollar funding



# Discount window euro funding





# Elasticity of allotment to gain

	ECB-EUR	ECB-USD	BoJ-USD
	$\log(a_{it})$	$\log(a_{it})$	$\log(a_{it})$
$x_{it}$	-1.6211*** (0.512)	-2.2353*** (0.527)	-2.4584*** (0.882)
$N$	427	217	88
Adjusted $R^2$	0.14	0.08	0.15

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?

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

	EUR app. $s_{t+7} - s_t$	GBP app. $s_{t+7} - s_t$	JPY app. $s_{t+7} - s_t$	CHF app. $s_{t+7} - s_t$
basis ( $x_{i,t}$ )	-10.3528** (6.067)	-19.2272*** (6.942)	3.3607 (6.042)	-21.8222*** (5.430)
$N$	2546	2546	2284	2233

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

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

	EUR app. $s_{t+7} - s_t$	GBP app. $s_{t+7} - s_t$	JPY app. $s_{t+7} - s_t$	CHF app. $s_{t+7} - s_t$
basis ( $x_{i,t}$ )	-14.7969** (6.038)	-19.4805*** (6.933)	-2.4115 (9.779)	-20.3309*** (6.931)
forward premium ( $f_t - s_t$ )	5.7566 (4.114)	0.6367 (1.476)	4.8778 (8.514)	-1.1743 (2.659)
$N$	2546	2546	2284	2233

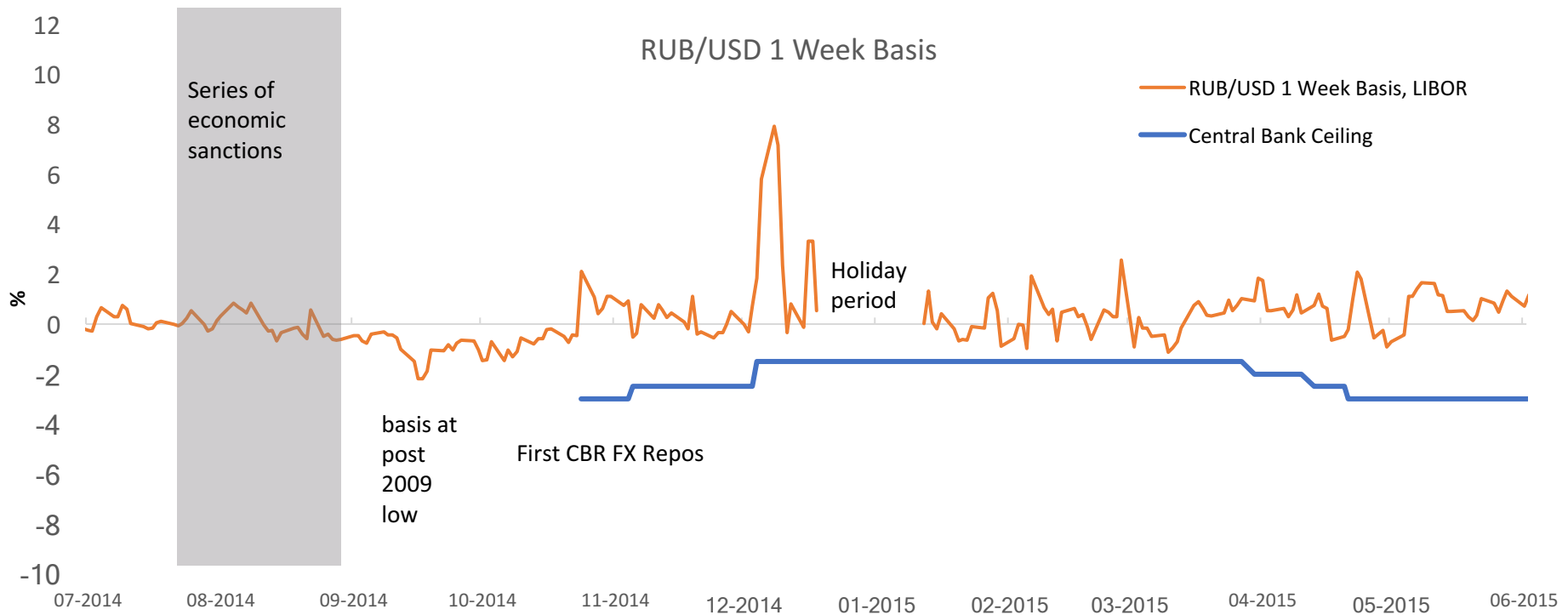
Newey-West standard errors in parentheses

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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  $a^*/a$ .*
- **Corollary 1:**  *$i^d$  is irrelevant for  $a^*/a$ , independent of  $g$ .*
- **Corollary 2:**  *$i^V$  does not affect  $a^*/a$ .*
- 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.