

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.

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 \Rightarrow 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.

I. 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 i^s
 - Buys euros at spot rate s , and sell forward at rate f in one week
 - Deposit euros at ECB at rate i^{v*}
 - Swap overnight for one-week rate at cost $i^* - i^{p*}$

$$i_t^s \geq s_t - f_t + (i_t^{v*} + i_t^* - i_t^{p*})$$

- 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:*

$$x_t \leq (i_t^s - i_t) + (i_t^{p*} - i_t^{v*})$$

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:*

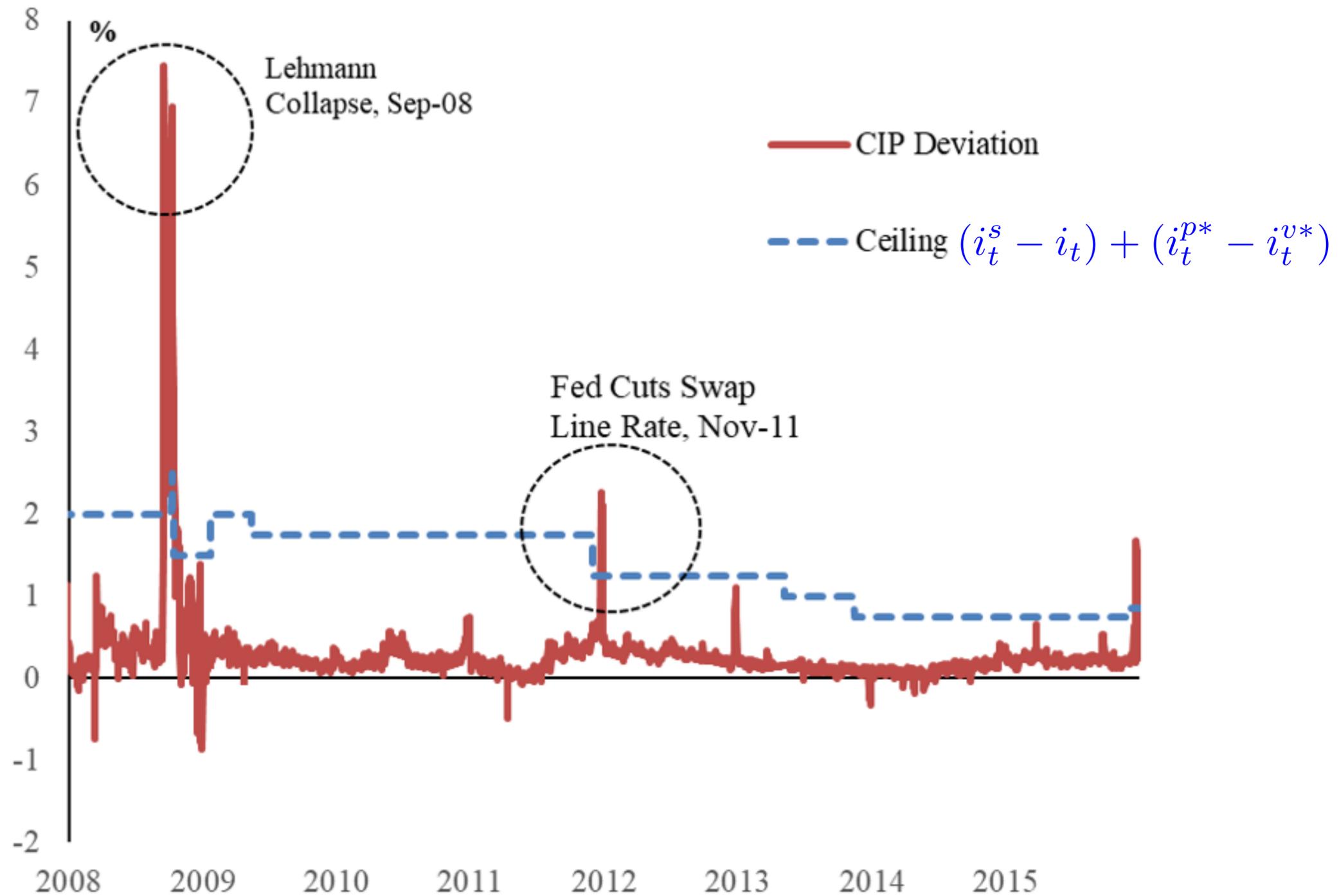
$$x_{a,t} \leq (i_t^s - i_t) + (i_t^{p*} - i_t^{v*}) + (1 - \xi^c)(i_{a,t}^u - i_t^s) + \psi_{a,t}.$$

Shadow value of
collateral

Shadow value of
reg. constraint

- Two independent sources of policy variation, domestic and foreign
- Safe bank or sovereign fund: minimum.
- Clear measure of CIP is the OIS one.

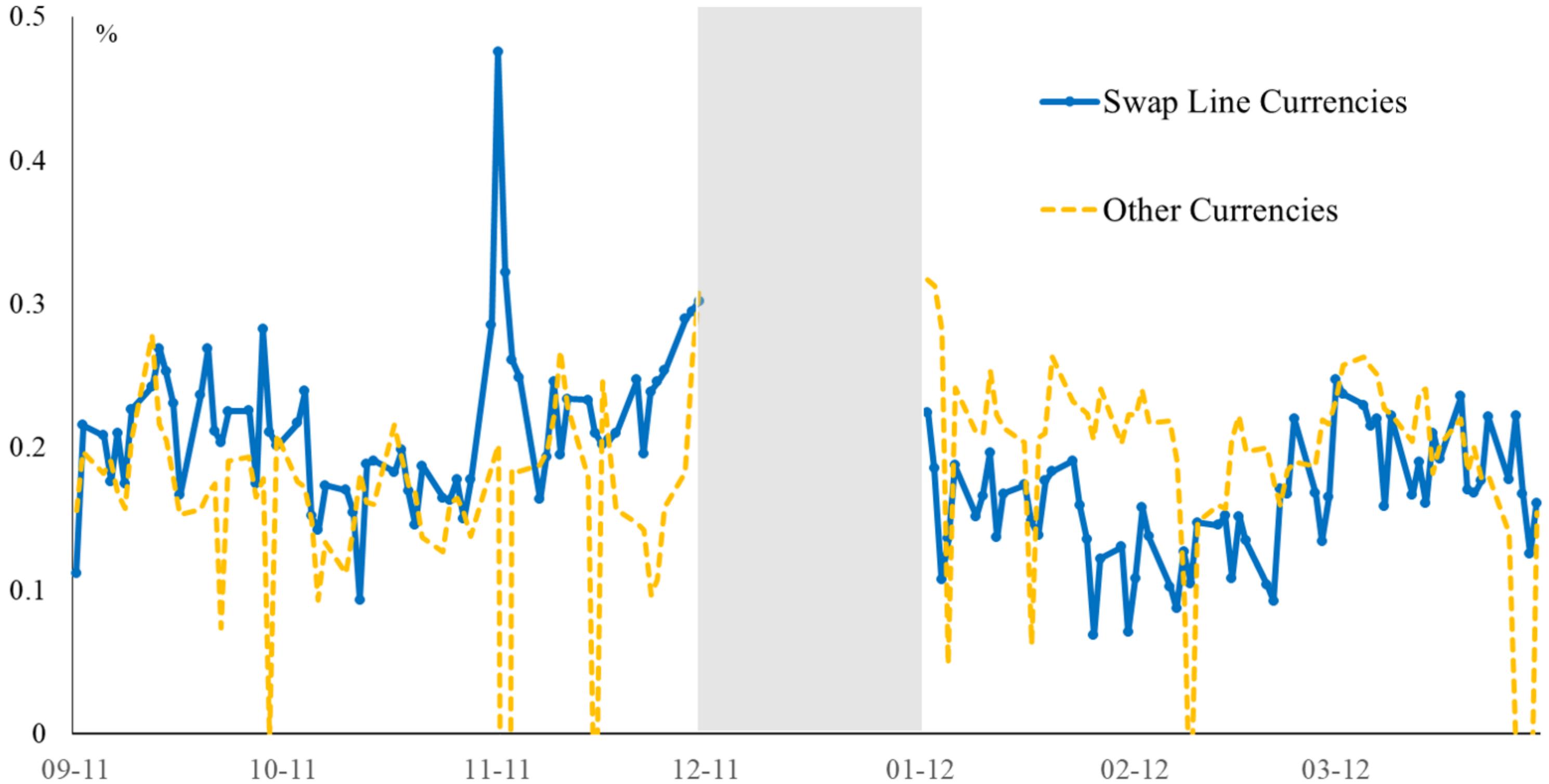
Euro (USD) basis, ECB ceiling



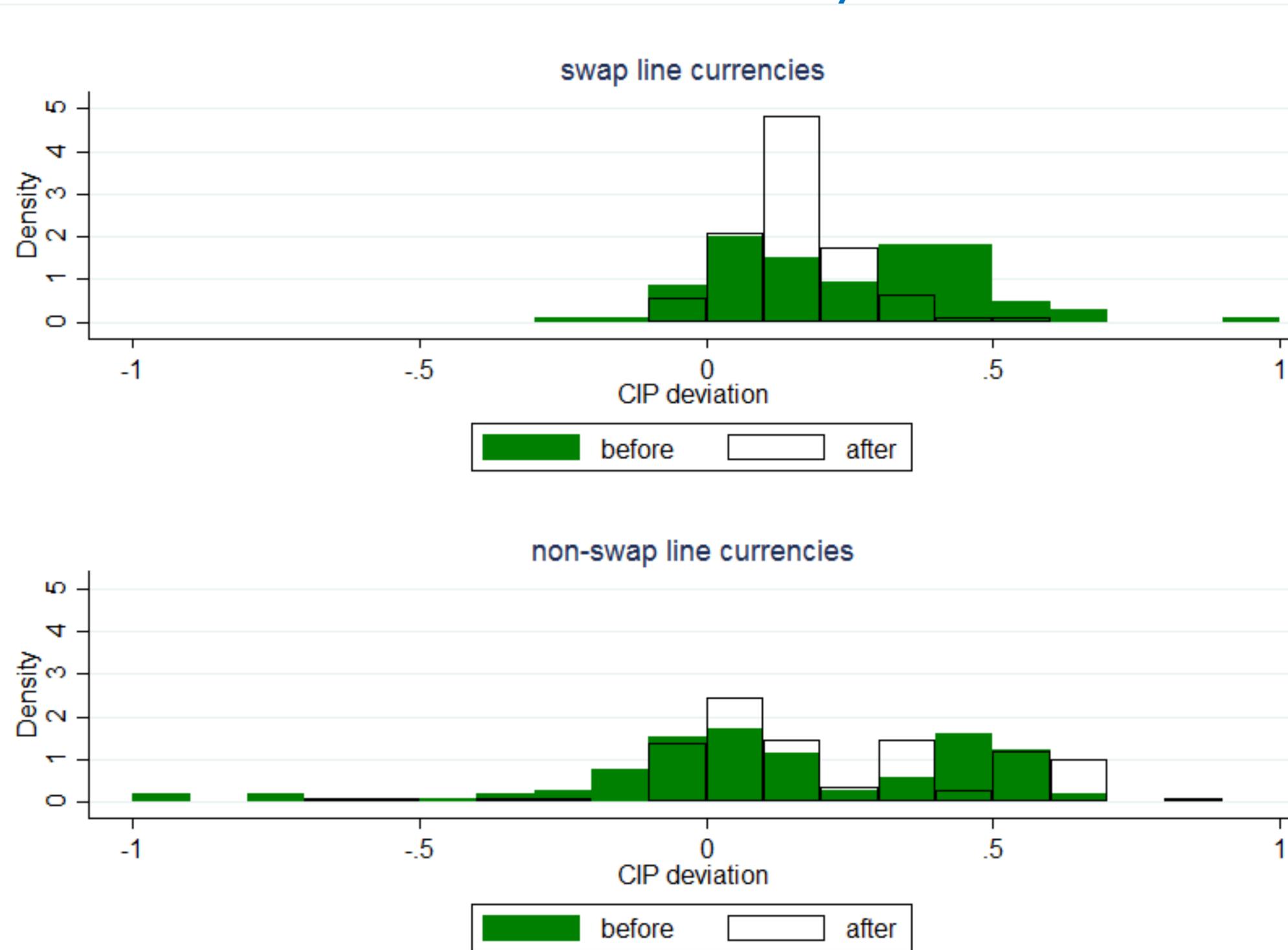
Difference-in-differences strategy

- 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

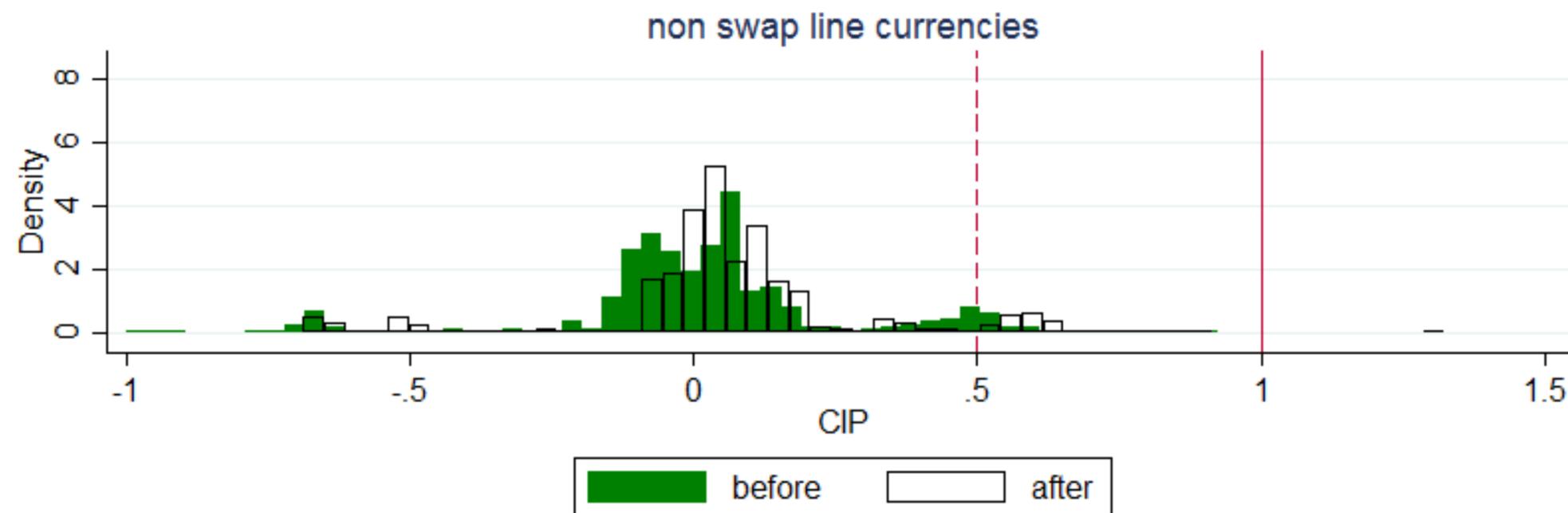
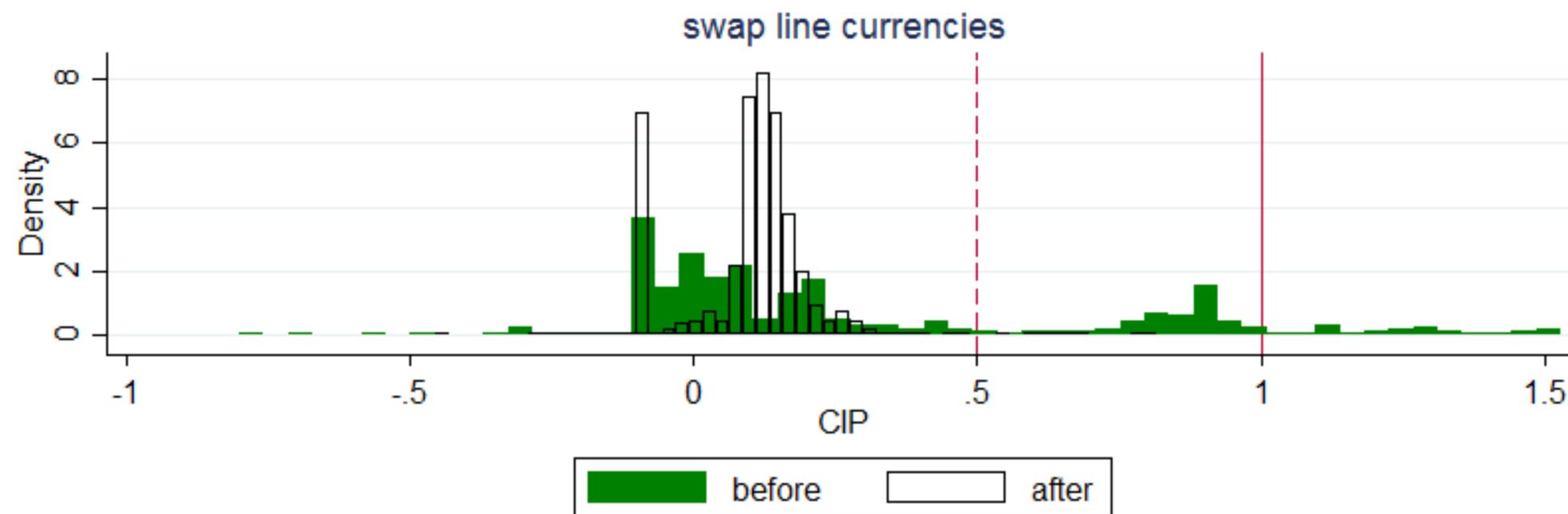
Difference-in-differences visually



Effect on distribution of daily CIP deviations



Ceiling on quotes



Standard errors

$x_{j,t}$					
	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)

*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 difference-in-differences 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

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

	Baseline	Censored	Time fixed effect	Shorter sample
	x_{jt}	x_{jt}	x_{jt}	x_{jt}
Ceiling ($c_{j,t}$)	0.1996*** (0.037)	0.6578* (0.249)	0.1675** (0.057)	0.248*** (0.039)
N	9500	9500	950	8195
Adjusted R^2	0.08	0.16	0.67	0.08

*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 i^s 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

Investment: Theoretical predictions

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.*

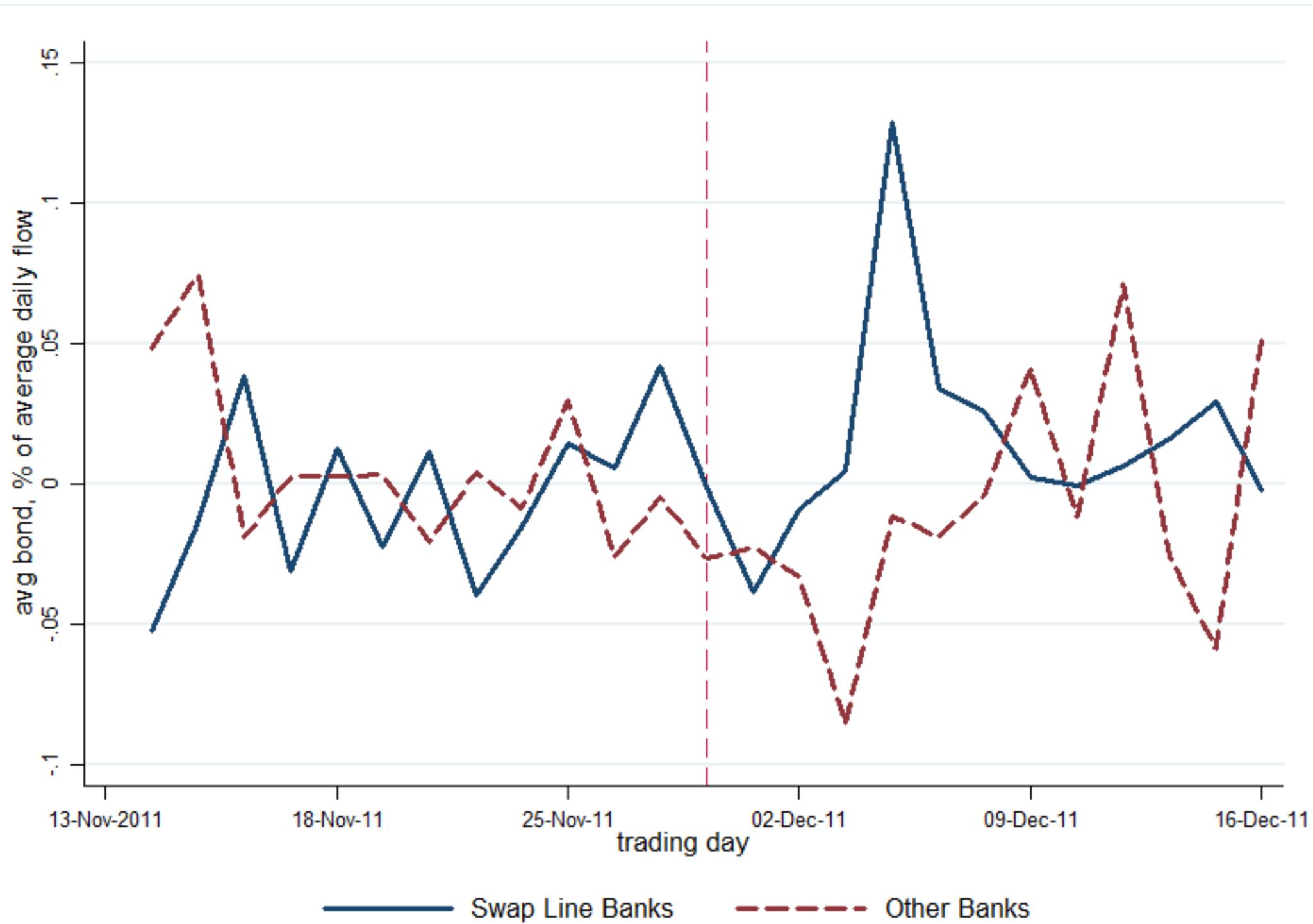
Empirical strategy I: investments

- 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

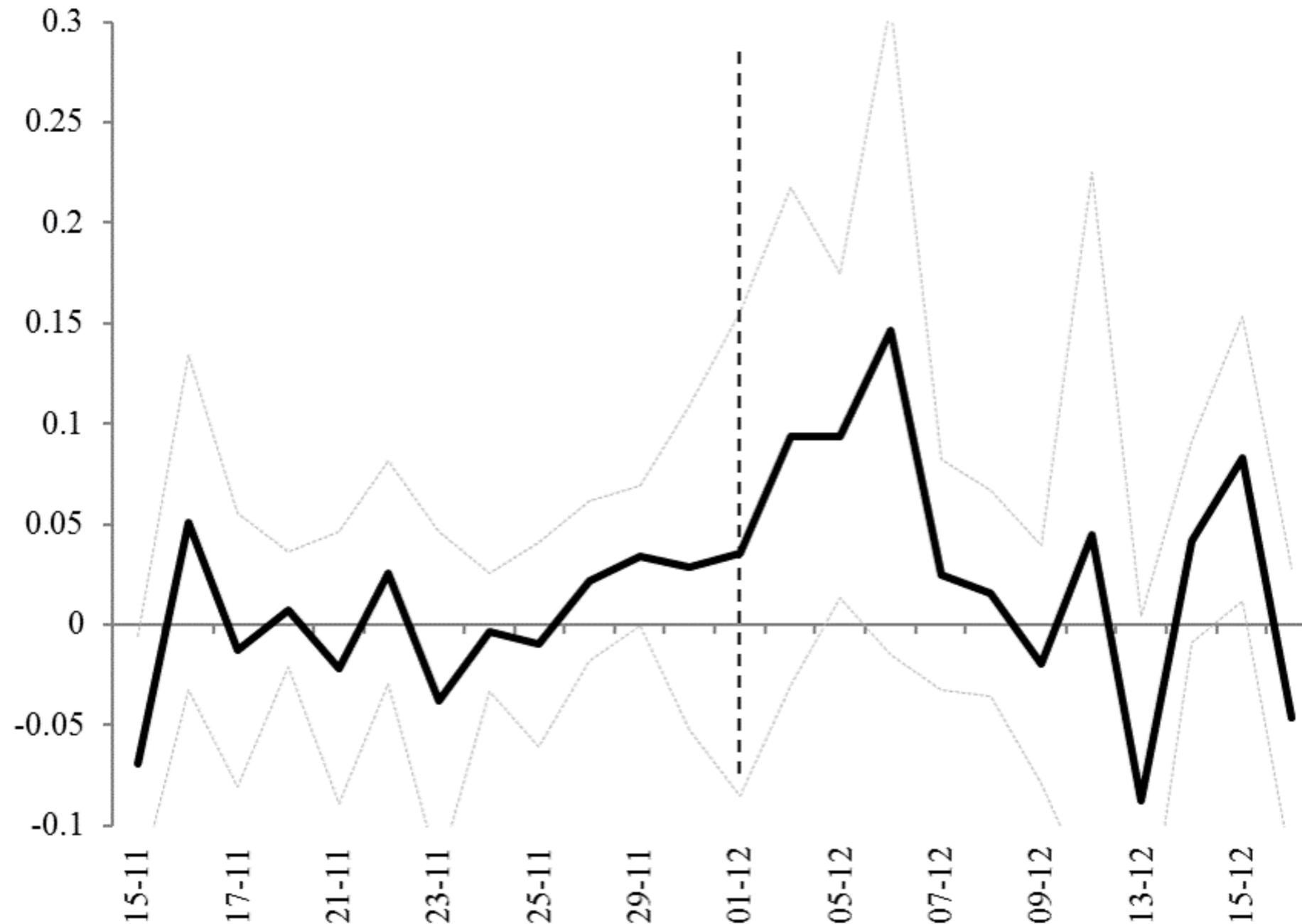
- ZEN database:
 - All trades by EEA-regulated financial firms of either UK-issued corporate bonds or traded by UK-based firms (London financial center)
 - Individuals transactions, millions of observations. 26 (19) banks, 790 (69 bonds).
 - Aggregate to measure net daily flow from firm a , into corporate 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

$$n_{a,b,t} = \beta_t \times \text{SwapLine}_a \times \text{USDBond}_b + \alpha_{a,t} + \gamma_{b,t} + \varepsilon_{a,b,t}$$



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

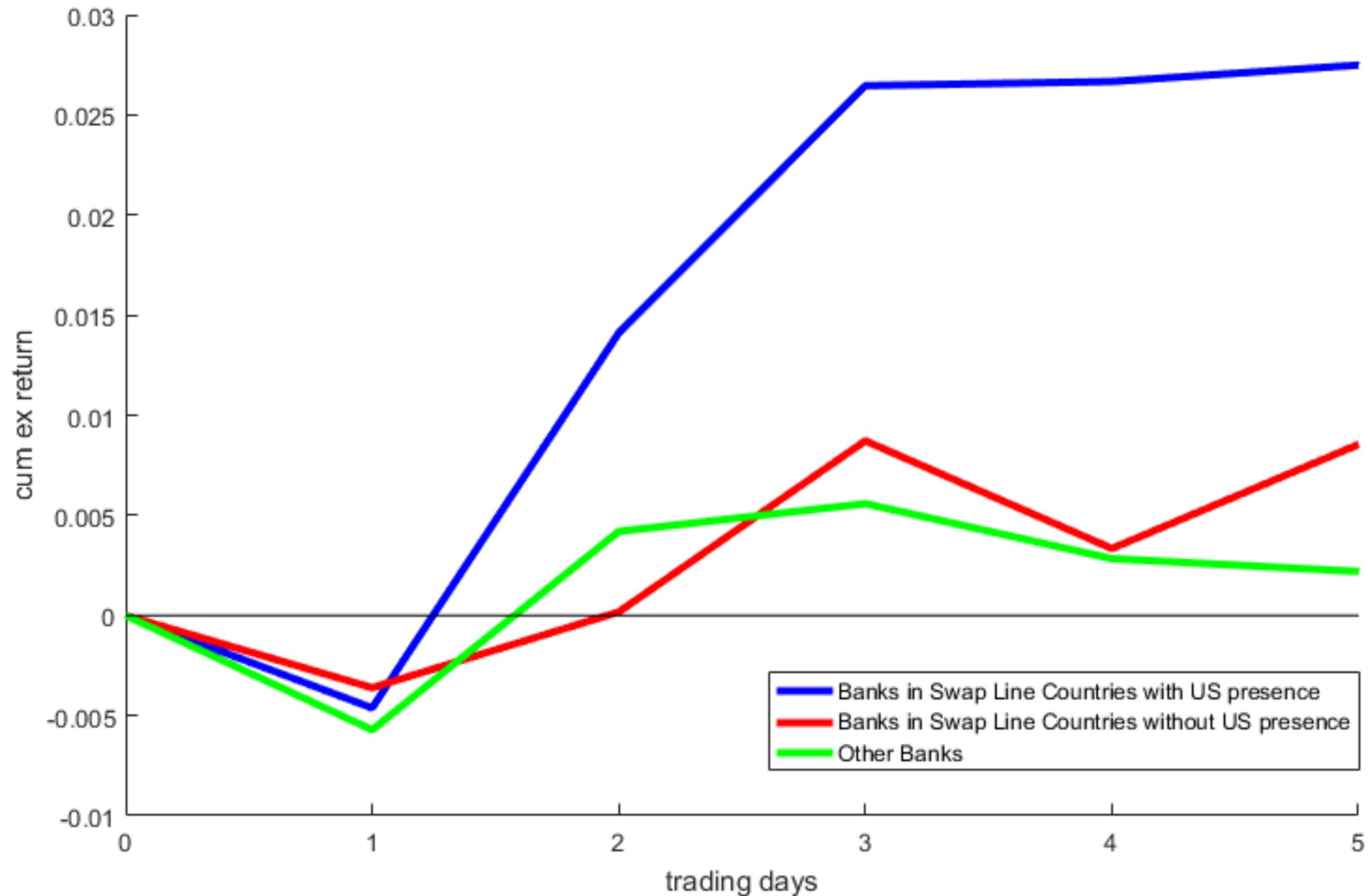
	(1)	(2)	(3)	(4)
	<i>Fixed Effects</i>			
	<i>baseline</i>	<i>currency, bank</i>	<i>currency, bank, bond char.</i>	<i>saturated</i>
$Post_t \times Swap_a$ $\times USDBond_b$	0.0770* (0.042)	0.0770* (0.041)	0.0772* (0.041)	0.0788* (0.042)
N	205227	205227	205227	205227
<i>bank</i> \times <i>period</i> f.e.	No	Yes	Yes	Yes
<i>bank</i> \times <i>currency</i> f.e.	No	Yes	Yes	No
<i>bank</i> \times <i>issuer</i> f.e.	No	No	Yes	No
<i>bank</i> \times <i>duration</i> f.e.	No	No	Yes	No
<i>bank</i> \times <i>bond</i> f.e.	No	No	No	Yes
<i>period</i> \times <i>currency</i> f.e.	No	Yes	Yes	No
<i>period</i> \times <i>issuer</i> f.e.	No	No	Yes	No
<i>period</i> \times <i>duration</i> f.e.	No	No	Yes	No
<i>period</i> \times <i>bond</i> f.e.	No	No	No	Yes

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.

	Nearest Neighbor	Exact Match on Euro Issuers	Dropping Euro-area Issuers
<i>foreignheld_b</i>	-0.0860** (0.036)	-0.1221*** (0.036)	-0.1264*** (0.038)
<i>N</i>	5474	5474	5257

Returns around swap rate line change



Conclusion

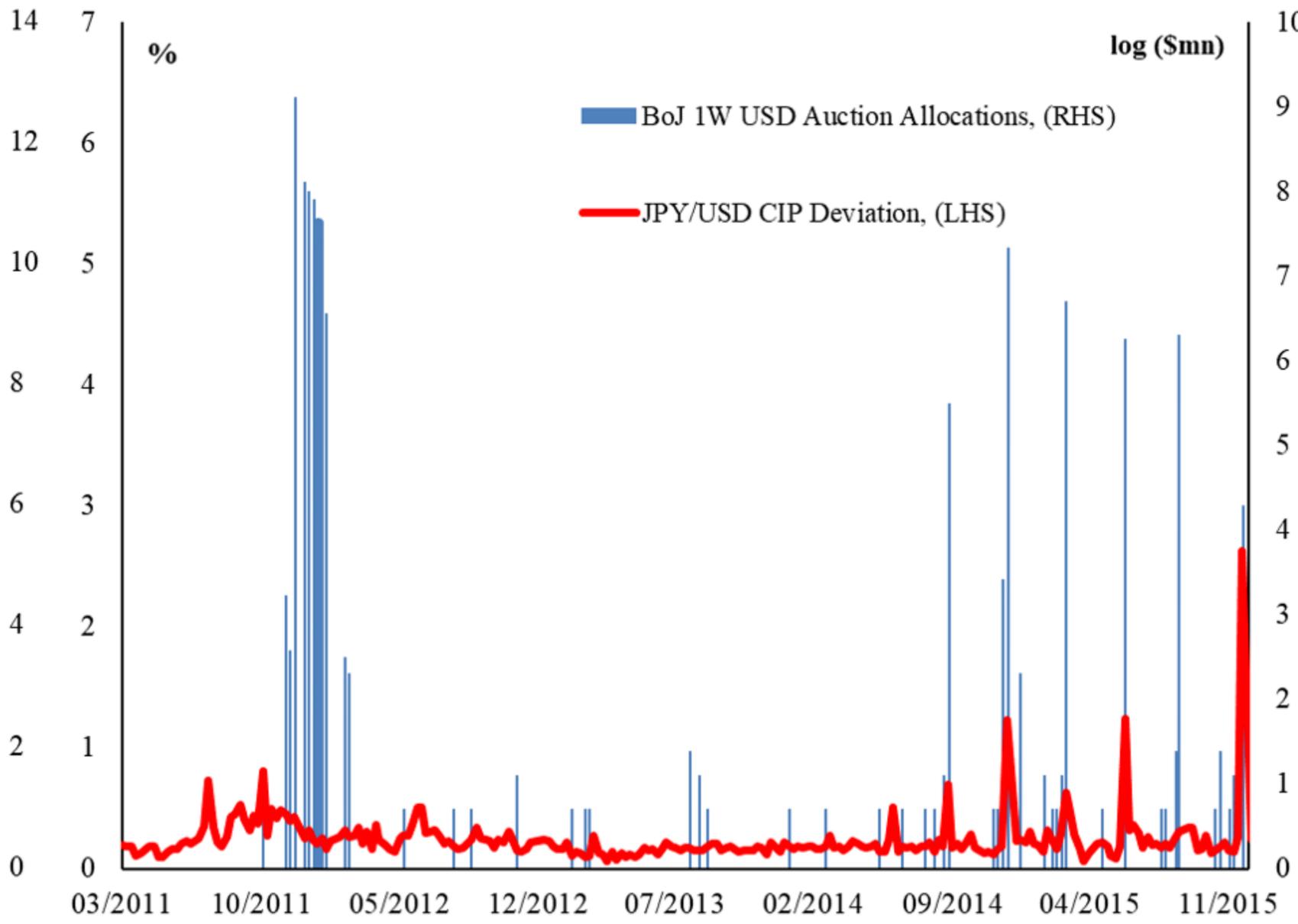
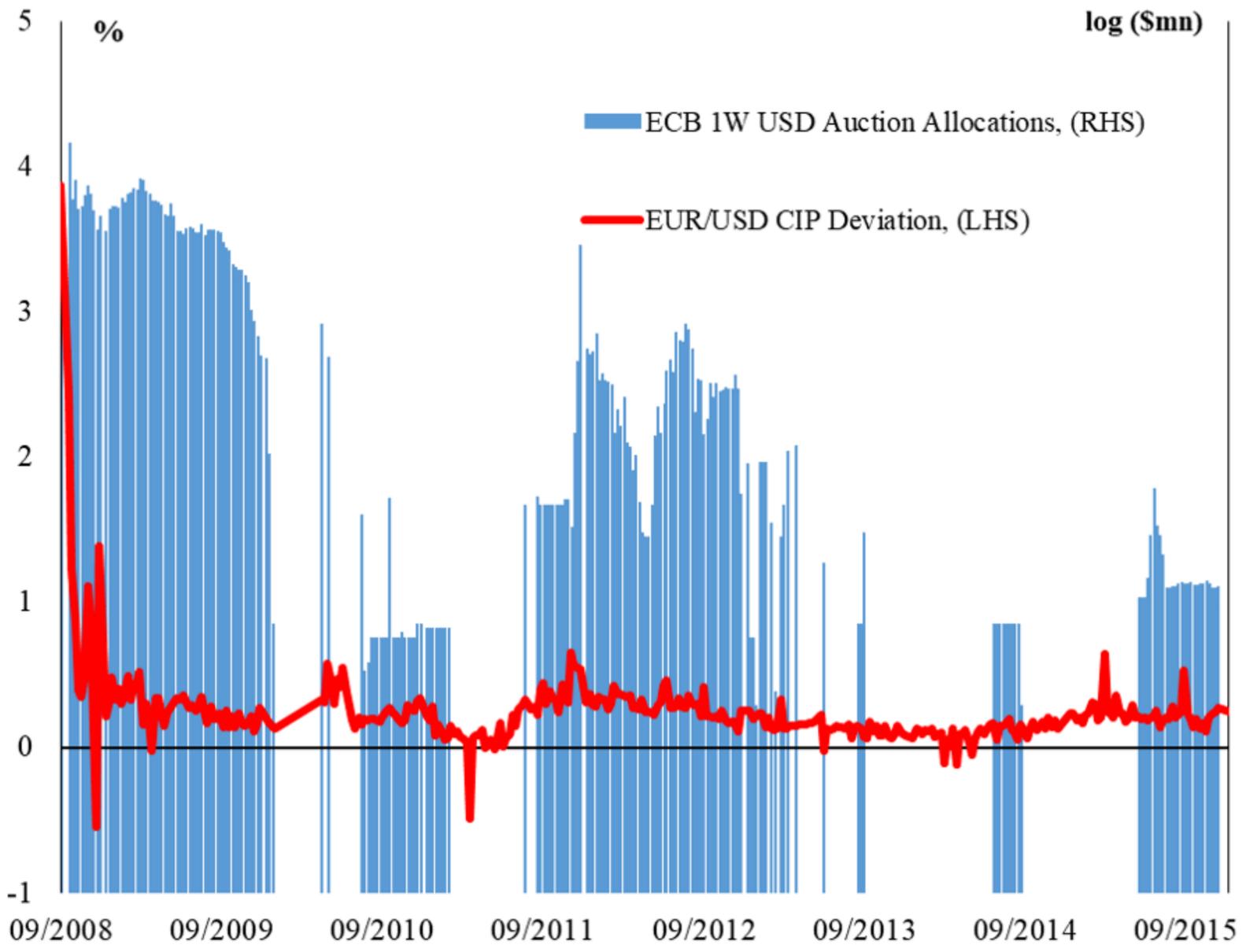
- Central bank swap lines: *large and integral*.
- Swap line is the *twin of the discount window* when foreign banks invest and borrow domestically
- Swap line spread plus foreign difference between policy and deposit central bank rates put *ceiling on CIP deviations*, empirically there from both variations.
- 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

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

	ECB: USD Auctions $\log(q_{j,t})$	BoJ: USD Auctions $\log(q_{j,t})$	ECB: EUR Auctions $\log(q_{j,t})$
$x_{j,t-1}$: CIP Deviation	2.2353*** (0.527)	2.4262*** (0.9891)	
$x_{j,t-1}$: 1-week Libor-OIS			1.5804*** (0.587)
N	217	90	388
Adjusted R^2	0.08	0.14	0.14

*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.*