Arbitrage Capital of Global Banks

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Background

- What is the role of unsecured short-term wholesale funding for banks post-crisis?
  - Short-term wholesale funding is fragile and subject to sudden dry-ups.
  - Past episodes of wholesale funding dry-ups led to fire sales of assets, contractions in credit supply, and financial distress.
- Policy response: Basel III introduced liquidity requirements, where the use of unsecured wholesale funding is heavily penalized.

Two Prominent Arbitrage Opportunities

- (1) Interest on excess reserves (IOER) arbitrage:
  - Obtain short-term unsecured dollar funding and park the proceeds at the Fed, earning the IOER rate.
- (2) Covered interest rate (CIP) arbitrage:
  - Obtain unsecured term dollar funding from the cash market, and lend out the dollars in the FX forward/swap markets.
- The ability of banks to engage in these two arbitrages crucially depends on the ability to fund dollars in the cash market at attractive terms.
- Banks cannot scale up their arbitrage activities to eliminate the arbitrages because of constraints on the size and composition of bank balance sheets.

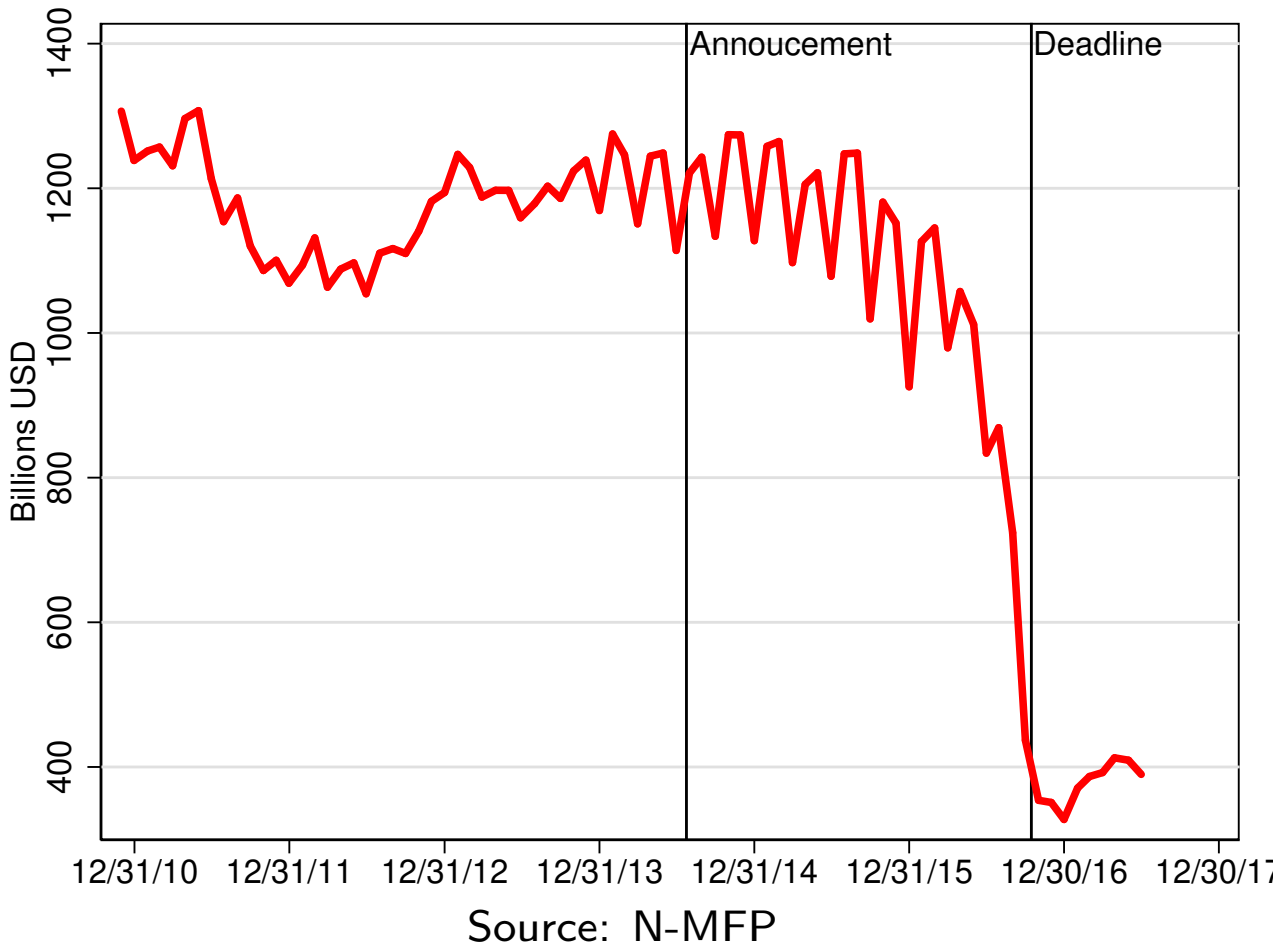
Overview of the Paper

- Unsecured short-term wholesale funding becomes the arbitrage capital for global banks.
  - Banks use wholesale funding to finance liquid arbitrage positions.
  - $1.5 trillion potential arbitrage capital for the IOER and CIP arbitrage.
- Examine the impact of a large negative wholesale funding shock on global banks: SEC MMF reform.
  - The primary response of global banks to the funding shock was a reduction in arbitrage positions, rather than a reduction in loan provision.
- Broad take-ways:
  - Global banks are more resilient to wholesale funding dry-ups.
  - Short-term wholesale funding less useful for maturity and liquidity transformation

SEC Money Market Mutual Fund Reform

- SEC's 2014 rules for MMF reform were implemented by October 14, 2016.
  - Institutional prime MMFs must use a floating NAV to value their assets
  - All prime MMFs can implement redemption gates and liquidity fees to limit redemptions.
  - Government funds can still use constant NAVs and are largely not subject to gates and fees.
- The reform made prime MMFs less "money-like": Prime funds lost $1 trillion AUM and government funds gained $1 trillion AUM

Prime Funds' Holding of Bank Securities



Source: N-MFP

- Redemption after the Lehman bankruptcy : ~$400 billions
- Peak of the European debt crisis; ~$200 billions
- MMF Reform: ~$900 billions (Foreign banks: $750 Bn; US banks: $130 Bn)

Main Datasets

1. N-MFP: month-end portfolio holdings of MMFs at the cusip level (publicly available).
2. Commercial Paper (CP): transaction-level CP issuance data from the DTCC
3. Fed funds (FF), eurodollar (ED), and certificate of deposits (CD): transaction-level FF, ED and CD issuance for U.S.-based banks (U.S. banks and branches and agencies of foreign banks) from FR 2420.
4. Tri-party repo transaction and position data available at the Fed
5. Daily excess reserves balances at the Fed.
6. Weekly US bank and FBO balance sheets from FR 2644 (micro data for H.8.)

Sample Banks

- 62 global banks that frequently trade with MMFs:
  - US (10 banks)
  - Euro-area (14 banks)
  - Other Europe (11 banks): UK, Switzerland, Scandinavia
  - Japan (6 banks)
  - Australia and Canada (10 banks)
  - Others (11 banks)
- Account for 90% of total prime MMFs holdings of bank securities.
- Main sample period: October 2015 - June 2017

Measuring IOER Arbitrage

- $Y_{i,t}^{IOER}$: total amount of unsecured wholesale funding outstanding borrowed at the rate below the IOER rate:

$$Y_{i,t}^{IOER} = \sum_{n,k} y_{i,n,k,t}[y_{i,n,k,t}|r_{i,n,k,t-n} < r_{t-n}^{IOER}],$$

  where $r_{i,n,k,t}$ denotes the borrowing rate for the k-th transaction outstanding at t, issued by bank i, with maturity n days, and $y_{i,n,k,t}$ denotes the outstanding volume of the transaction at time t.

- We proxy for the actual amount of IOER arbitrage as

$$Q_{i,t}^{IOER} = \min(ExcessReserve_{i,t}, Y_{i,t}^{IOER}).$$

Measuring CIP Arbitrage

- We swap JPY OIS rate into dollars

$$r_{n,t}^{¥\to\$} = r_{n,t}^{¥} - \rho_{n,t}^{¥\to\$},$$

where $\rho_{n,t}^{¥\to\$}$ is the forward premium to swap yen into dollars.

- Amount of unsecured funding outstanding borrowed at the rate below $r_{n,t}^{¥\to\$}$:

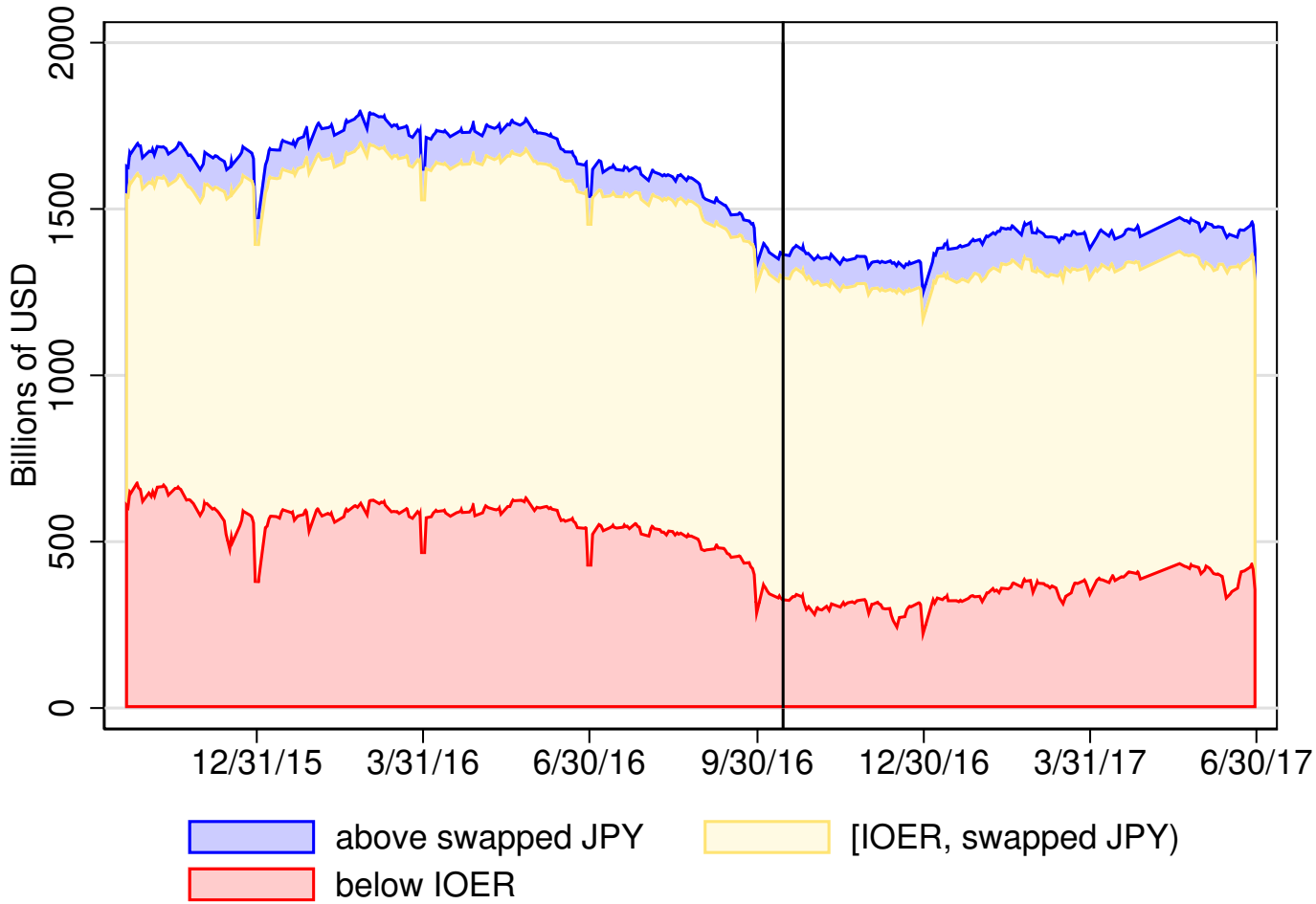
$$Y_{i,t}^{CIP} = \sum_{n,k} y_{i,n,k,t}[y_{i,n,k,t}|r_{i,n,k,t-n} < r_{n,t-n}^{¥\to\$}].$$

- We do not observe how much dollar funding is used for CIP arbitrage.
  - Interoffice transfers to foreign affiliates:

$$Q_{i,t}^{CIP} = -(NetDueTo_{i,t} - Y_{i,t}^{ED})$$

where $NetDueTo_{i,t}$ gives the net borrowing from foreign affiliates, and $Y_{i,t}^{ED}$ is the FR2420 ED outstanding for bank i at t.

Unsecured Borrowing by Rates

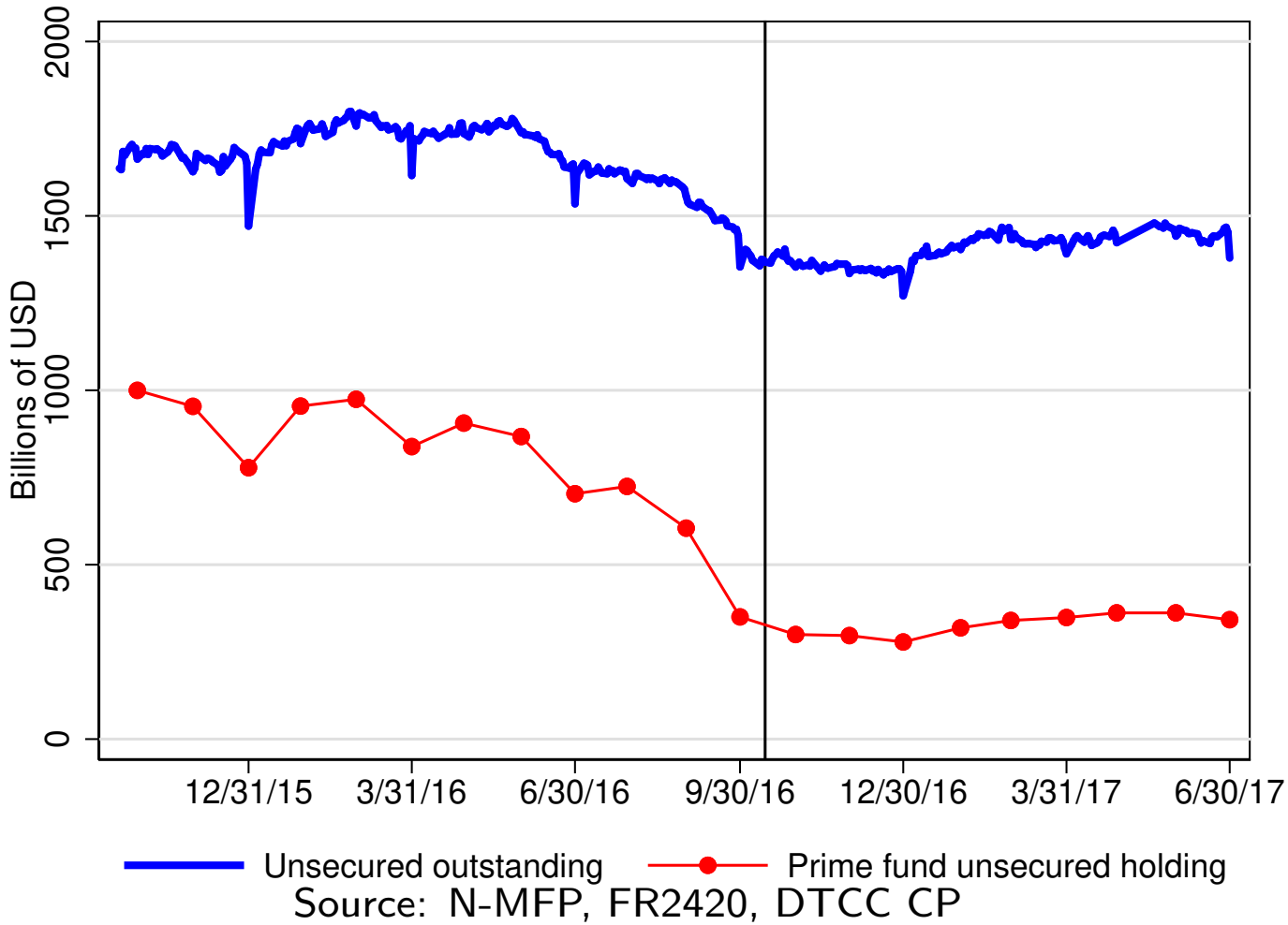


Source: FR2420, DTCC CP, Bloomberg and authors' calculations

- The bulk of all wholesale funding was issued at rates below the implied dollar rate from the dollar-yen swap.

Unsecured Wholesale Funding and MMF Holdings

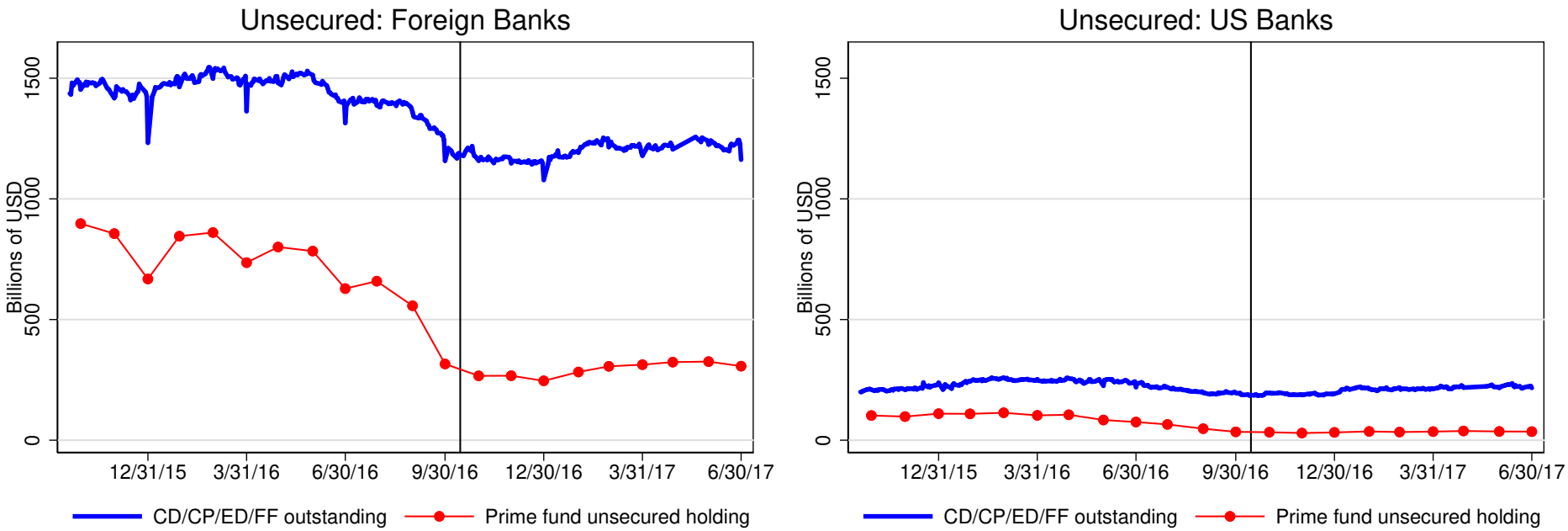
- Between Oct 2015 and Oct 2016, outstanding unsecured wholesale funding declined by $309 billion, less than the $700 billion decline in prime funds' unsecured holdings.



Source: N-MFP, FR2420, DTCC CP

Unsecured Funding: Foreign vs. U.S. Banks

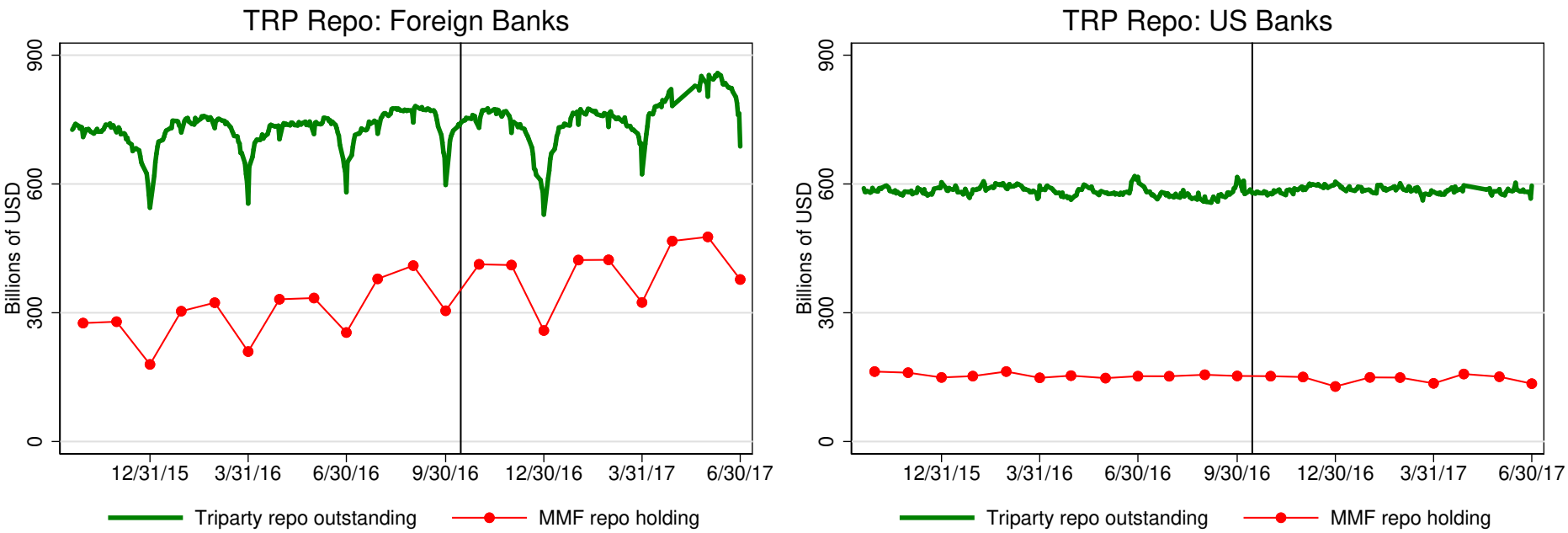
- Foreign banks accounted for the bulk of decline in unsecured wholesale funding outstanding and the decline in MMF unsecured holdings.



Source: N-MFP, FR2420, DTCC CP

Repo funding: Foreign vs. U.S. Banks

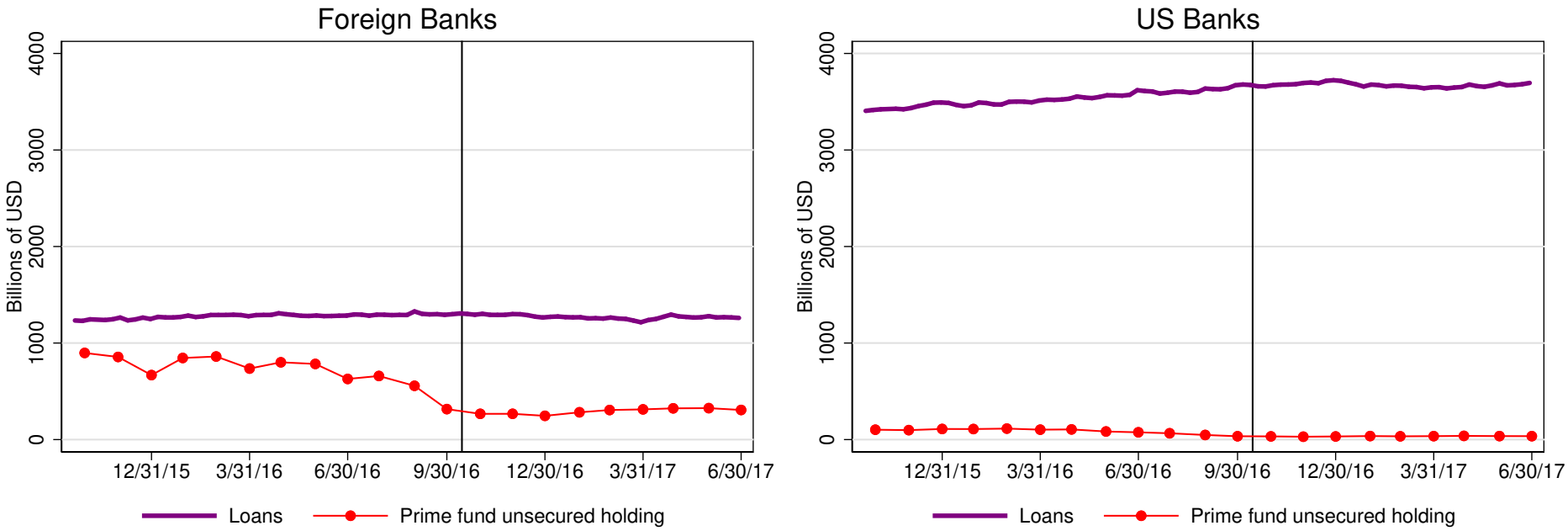
- Foreign banks did not increase their repo outstanding much.



Source: N-MFP, FRBNY TRP Repo data.

Loans: Foreign vs. US Banks

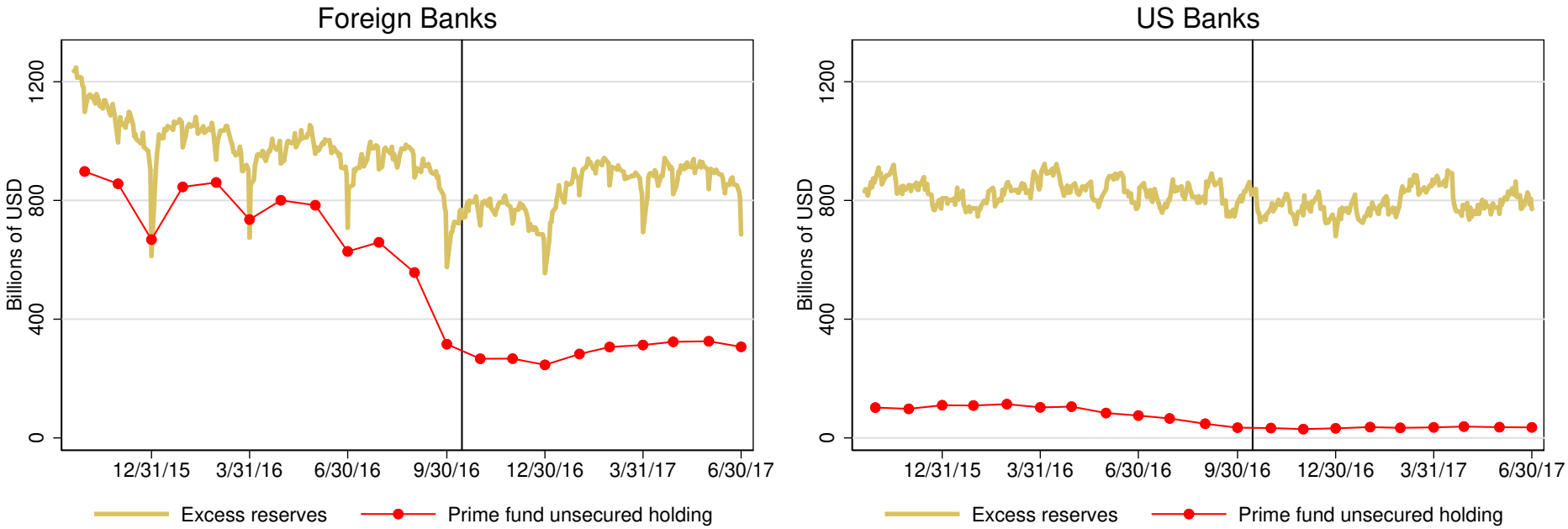
- No declines in loan positions in foreign or US banks (U.S. entities only).



Source: N-MFP, FR 2644.

Excess Reserves: Foreign vs. US Banks

- Excess reserves declined for foreign banks, but were little changed for US banks.



Source: N-MFP, FRB reserves data

Empirical Specifications

1. Baseline specification:

$$\Delta Y_{i,t} = \alpha + \beta \Delta hold_{i,t}^{Unsec} + \gamma X_{i,t} + \epsilon_{i,t}$$

   - Dependent variables: $\Delta Y_{i,t}^{IOER}$, $\Delta Q_{i,t}^{IOER}$, $\Delta Y_{i,t}^{CIP}$, $\Delta Q_{i,t}^{CIP}$

2. Instrument for $\Delta hold_{i,t}^{Unsec}$:

$$B_{i,t}^{c} = \sum_{j} s_{i,j,t_0} \Delta aum_{j,t}$$

   where $s_{i,j,0}$ denotes the lagged (pre-reform) share of bank i in complex j's prime fund portfolio, and $\Delta aum_{j,t}$ denotes the change in the AUM for complex j.

- Event window: October 2015 – October 2016 at quarterly frequency

Effects on Arbitrage Capital and Arbitrage Positions

Table 1: Changes in potential arbitrage capital vs. prime fund holdings (All banks)

	(1) $\Delta Y_{i,t}^{IOER}$	(2) $\Delta Y_{i,t}^{CIP}$	(3) $\Delta Q_{i,t}^{IOER}$	(4) $\Delta Q_{i,t}^{CIP}$
		OLS Estimates		
$\Delta hold_{i,t}^{Unsec}$	0.629***	0.845***	0.595***	0.449***
	(0.114)	(0.087)	(0.112)	(0.097)
		IV Estimates		
$\Delta hold_{i,t}^{Unsec}$	0.616***	0.665***	0.561***	0.359***
	(0.111)	(0.098)	(0.095)	(0.139)

IOER Arbitrageurs vs. Non-IOER Arbitrageurs

- IOER Arbitrageurs: above mean correlation between unsecured funding outstanding and excess reserve balances
- Non-IOER Arbitrageur: below mean correlation

Table 2: Changes in potential arbitrage capital vs. prime fund holdings (IV Results)

	(1) $\Delta Y^{IOER}_{i,t}$	(2) $\Delta Y^{CIP}_{i,t}$	(3) $\Delta Q^{IOER}_{i,t}$	(4) $\Delta Q^{CIP}_{i,t}$
	(A) All Banks			
$\Delta hold^{Unsec}_{i,t}$	0.616***	0.665***	0.561***	0.359***
	(0.111)	(0.098)	(0.095)	(0.139)
	(B) IOER Arbitrageur			
$\Delta hold^{Unsec}_{i,t}$	1.034***	0.879***	0.875***	0.315
	(0.265)	(0.268)	(0.227)	(0.338)
	(C) Non-IOER Arbitrageur			
$\Delta hold^{Unsec}_{i,t}$	0.477***	0.581***	0.460***	0.353**
	(0.087)	(0.066)	(0.073)	(0.139)

Effects on Bank Funding Costs

Table 3: Changes in banks' funding costs vs. prime fund holdings (IV Results)

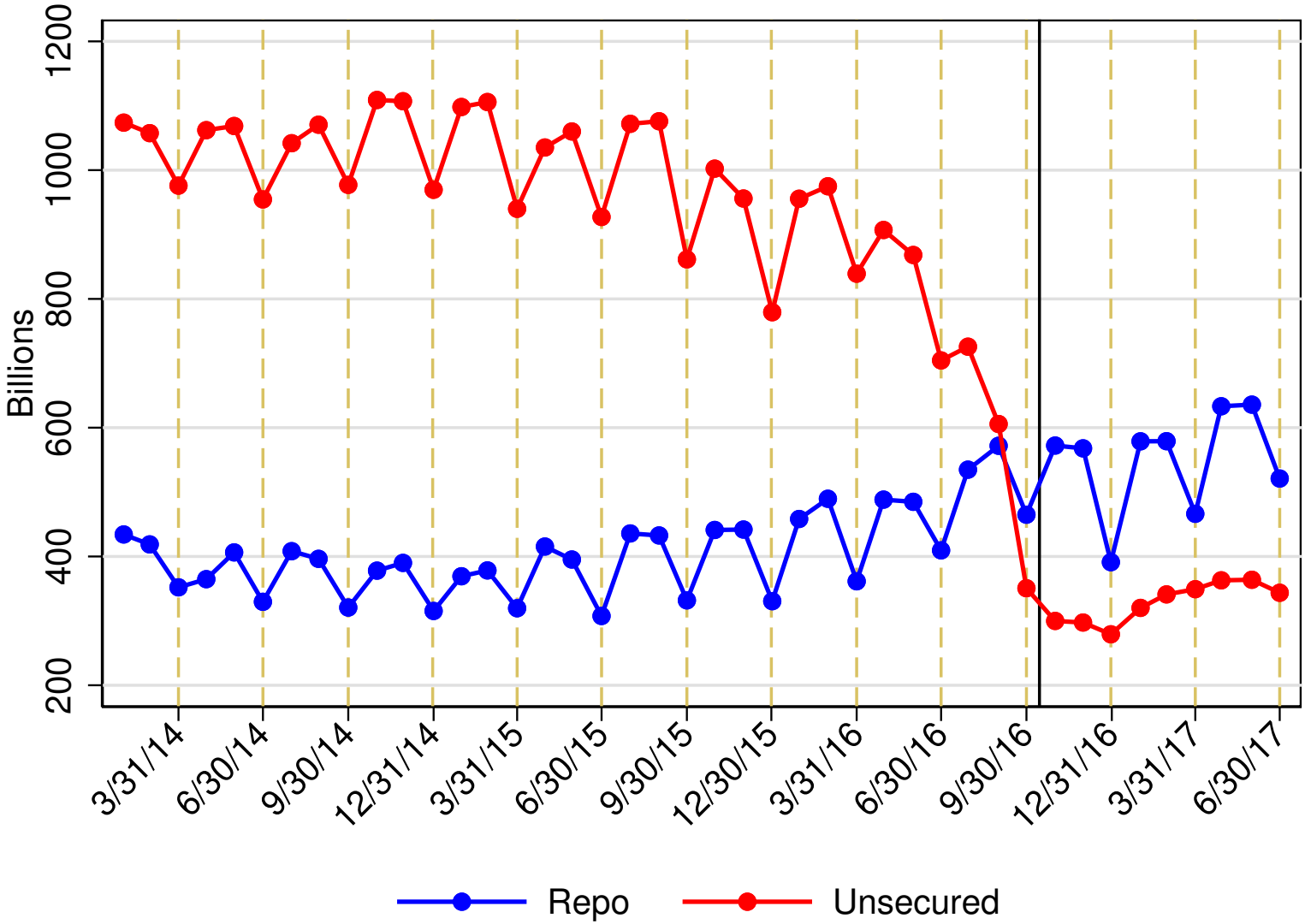
	(1) All banks	(2) IOER Arbs	(3) Non-IOER Arbs
$\Delta hold_{i,t}^{Unsec}$	-0.277*	-0.025	-0.402***
	(0.122)	(0.154)	(0.175)

Notes: Pooled regressions across benchmark tenors. SE clustered by banks.

- Consistent with a flatter demand curve for dollar funding among the IOER arbitrageurs, and a steeper demand curve for non-IOER arbitrageurs.

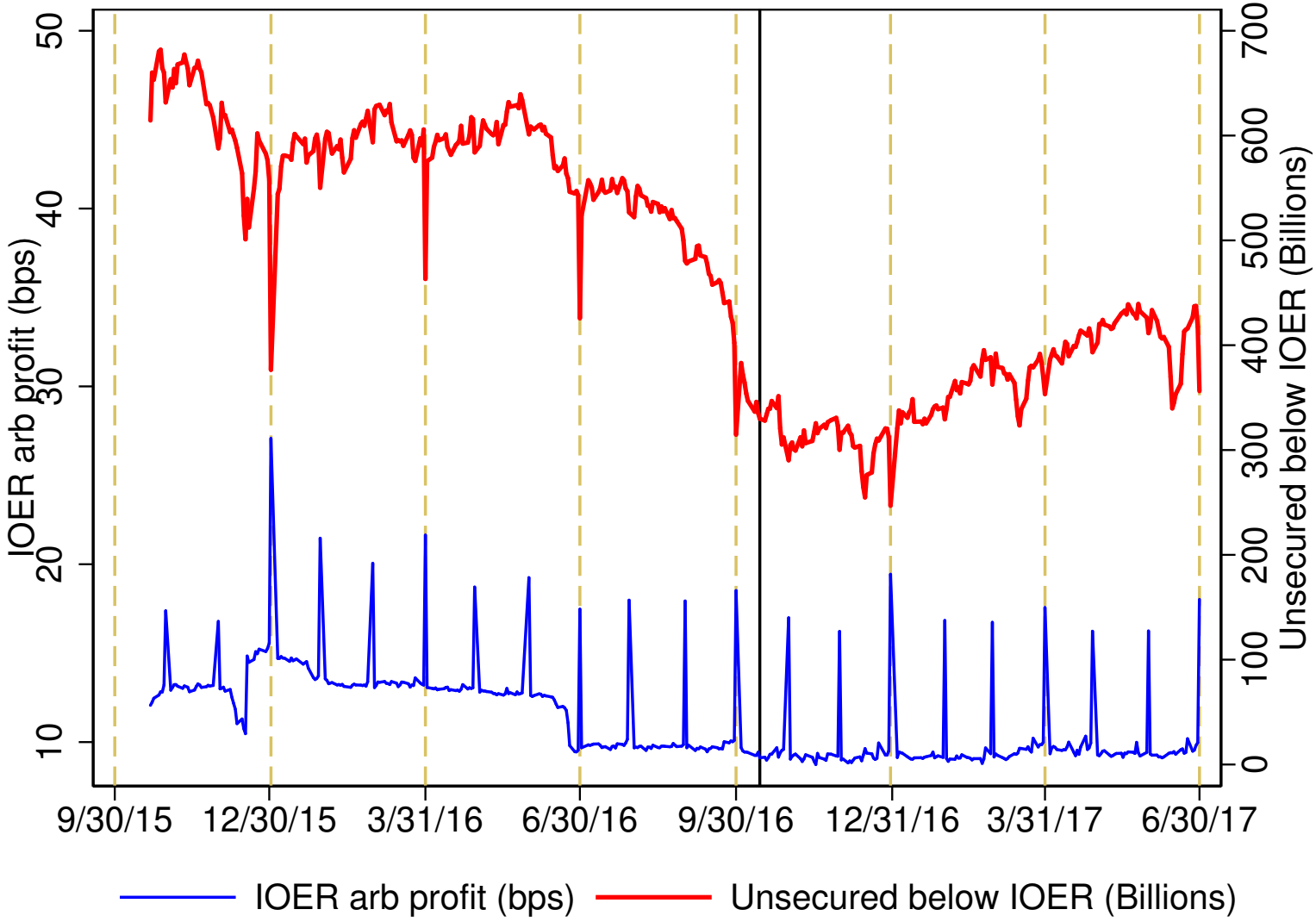
More Muted Q-end Effects from Unsecured Funding

- Intra-quarter unsecured arbitrage declined due to MMF reform, so we should observe smaller quarter-end quantity effects attributed to unsecured funding.



IOER Arbitrage Profits and Potential Arbitrage Capital

IOER arbitrage profits: $\pi_{i,t}^{IOER} = \sum_{n,k}(y_{i,n,k,t}/Y_{i,t})(r_t^{IOER} - r_{i,k,t})$.



Source: FR2420, DTCC CP and authors' calculations

Price elasticity for the IOER arbitrage

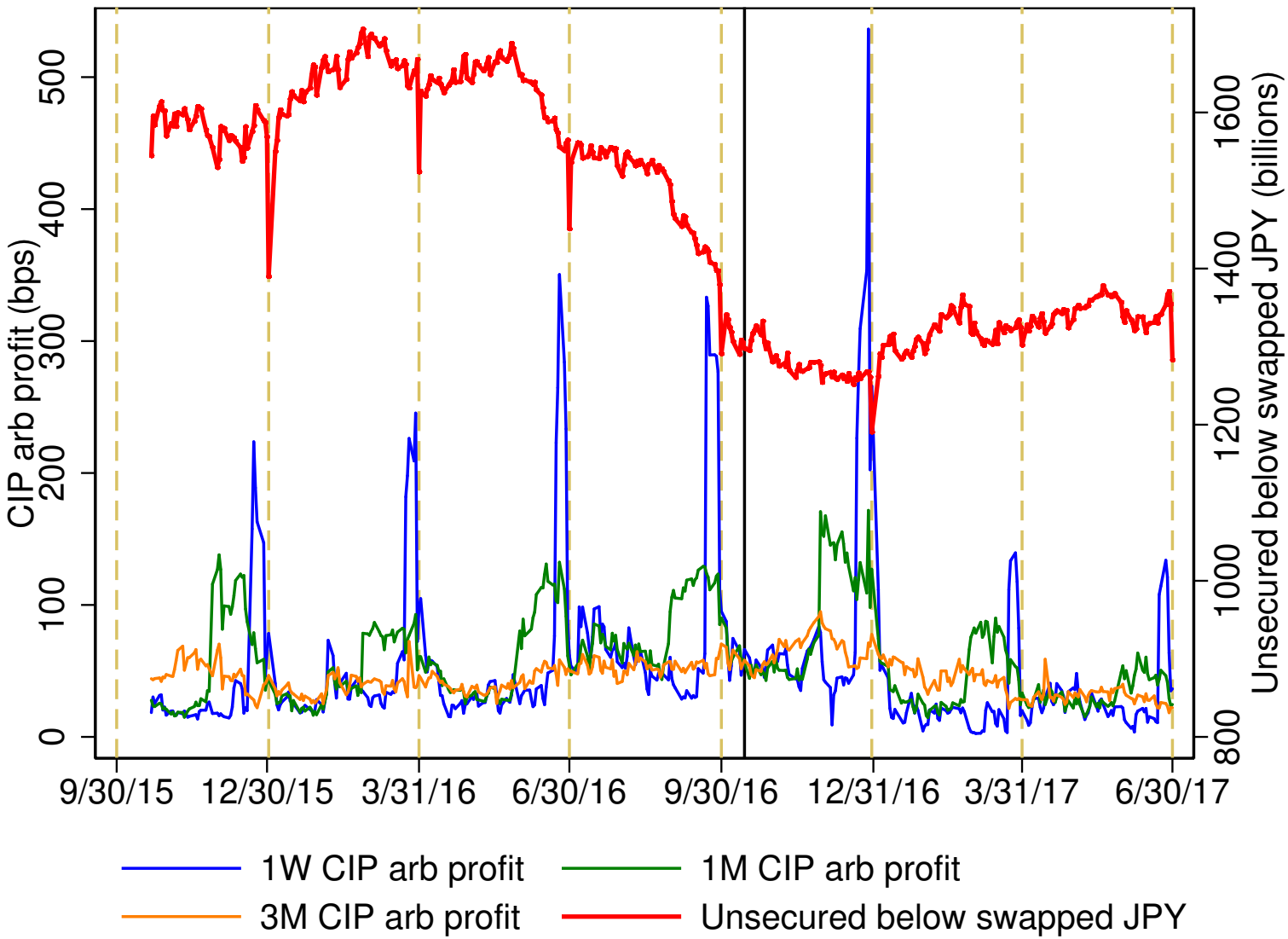
Table 4: IOER arbitrage profits vs. potential arbitrage capital

	(1) $\Delta\pi_t^{IOER}$ Non-ME	(2) $\Delta\pi_t^{IOER}$ ME	(3) $\Delta\pi_t^{IOER}$ QE	(4) $\Delta\pi_t^{IOER}$ Non-QE ME
ΔY_t^{IOER}	0.007	-0.083***	-0.073***	-0.219***
	(0.005)	(0.006)	(0.003)	(0.027)
$\Delta Y_t^{IOER} \times Post_t$	-0.014**	-0.116***	-0.081***	-0.220***
	(0.006)	(0.031)	(0.013)	(0.040)
$Post_t$	0.0223	0.469	1.201	0.0461
	(0.032)	(1.379)	(1.374)	(1.141)
N	371	40	13	27
R^2	0.063	0.702	0.946	0.799

- Sample Period: October 2015 – June 2017

CIP Arbitrage Profits and Potential Arbitrage Capital

- Volume weighted CIP arb profit: $\pi_{n,t}^{CIP} = \sum_{i,k}(y_{i,n,k,t}/Y_{i,t})(r_{n,t}^{¥\to\$} - r_{i,n,t})$.



Source: FR2420, DTCC CP and authors' calculations

Price elasticity for the CIP arbitrage

Table 5: CIP arbitrage profits vs. potential arbitrage capital

	(1) $\Delta\pi^{CIP}_{1W,t}$ Non-QE	(2) $\Delta\pi^{CIP}_{1W,t}$ QE	(3) $\Delta\pi^{CIP}_{1M,t}$ Non-QE	(4) $\Delta\pi^{CIP}_{1M,t}$ QE	(5) $\Delta\pi^{CIP}_{3M,t}$ Non-YE	(6) $\Delta\pi^{CIP}_{3M,t}$ YE
$\Delta Y^{CIP}_{n,t}$	-0.057	-0.701	-0.030*	-0.305**	-0.034***	-0.094***
	(0.047)	(1.023)	(0.016)	(0.127)	(0.011)	(0.034)
$\Delta Y^{CIP}_{n,t} \times Post_t$	-0.342	-2.181	-0.178	0.315	-0.050	0.066
	(0.334)	(2.754)	(0.129)	(0.203)	(0.042)	(0.093)
$Post_t$	-1.469	11.300	-0.545	0.187	-0.558	0.443
	(2.996)	(24.770)	(1.304)	(2.744)	(0.747)	(1.175)
N	375	36	259	152	305	106
R^2	0.022	0.033	0.049	0.031	0.030	0.057

- Sample Period: October 2015 – June 2017, daily changes

Conclusion

- Unsecured short-term wholesale funding has become arbitrage capital for global banks.
- The MMF reform reduced the availability of unsecured arbitrage capital. Banks cut down IOER and CIP arbitrage positions.
- Broader implications:
  - Global banks are more resilient to wholesale funding dry-ups.
  - Short-term wholesale funding less useful for maturity and liquidity transformation.
  - Supply of arbitrage capital matters for arbitrage profits, supporting intermediary asset pricing.