Synthetic Dollar Funding

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November 2025

U.S. dollar liquidity is vital for the international financial system

- Firms worldwide demand U.S. dollars for trade credit, working capital, long-term debt
  - 75% of cross-border trade, 67% of foreign currency debt is dollar denominated

- Global **banks** play a central role in dollar intermediation

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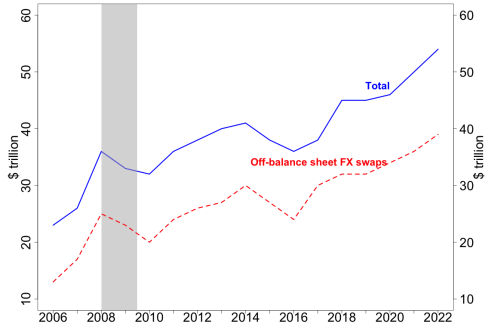
  1. Wholesale market *(e.g., repo, commercial paper)*:
     - Major investors are money market institutions

  2. **Synthetic market** *(off-balance sheet foreign exchange swaps)*
     - How it works: temporarily exchange foreign currency deposits for dollars using swaps

Banks are increasingly reliant on *synthetic dollar funding*



U.S. dollar debt of non-U.S. banks (*Missing Dollar Debt*, BIS, 2022)

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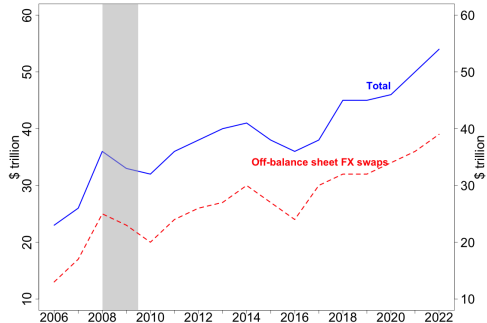
- Renewed focus on funding constraints:
  - Limits on wholesale investors' exposure to risky banks (e.g., Kacperczyk & Schnabl, 2013)
  - Potential lever for evolving tariff policy**

⇒ **What role do swaps play in banks' dollar funding portfolio?**



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***"European banks exposed to risk of U.S. dollar shortfall"*, Financial Times (April 2025)

***"EU firms fear dollar liquidity becoming tariff bargaining chip"*, Risk.net (April 2025)

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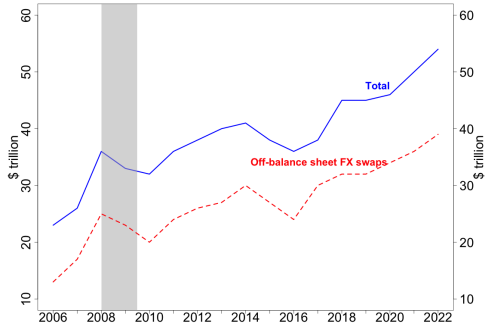
- Swap prices are misaligned from fundamentals

  ⇒ **Does banks' demand affect swap prices?**



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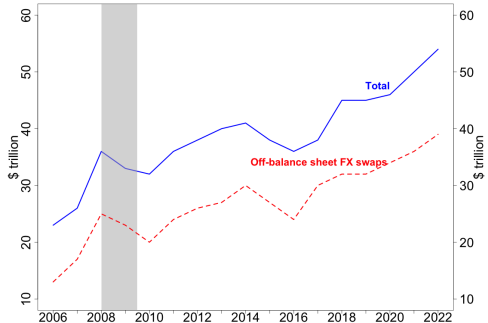

U.S. dollar debt of non-U.S. banks (*Missing Dollar Debt*, BIS, 2022)

- These questions collectively determine the transmission of funding frictions to bank lending

This paper jointly analyzes short-term dollar funding markets

1. Banks increase synthetic dollar borrowing when wholesale funding declines
   - Utilize novel swap transactions data combined with banks' wholesale funding
   - Banks face occasionally binding constraints in wholesale markets $\rightarrow$ increase swap usage

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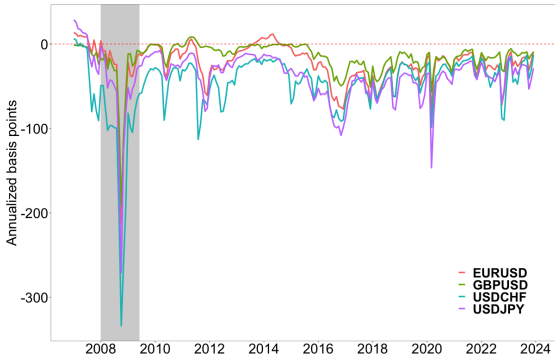
     $\Rightarrow$ Banks sharply $\uparrow$ synthetic dollar borrowing when the availability of wholesale funding $\downarrow$

   - Implications:
     - Evidence of demand shift due to *quantitative* constraints; distinct from cost optimization
     - Reliance on swaps obscures the true size of banks' dollar debt

This paper jointly analyzes short-term dollar funding markets

2. Synthetic dollar demand affects asset prices: *covered interest parity* (CIP) deviations

- CIP deviations are extensively discussed in asset pricing literature
  (e.g., Du, Tepper, Verdelhan (2018))



Cross-currency basis :=

$$x_{t,t+n} = \underbrace{y^{\$}_{t,t+n}}_{\text{direct \$ rate}} - \underbrace{(y_{t,t+n}}_{\text{direct foreign ccy rate}} - \underbrace{\rho_{t,t+n})}_{\textbf{swap price}}$$

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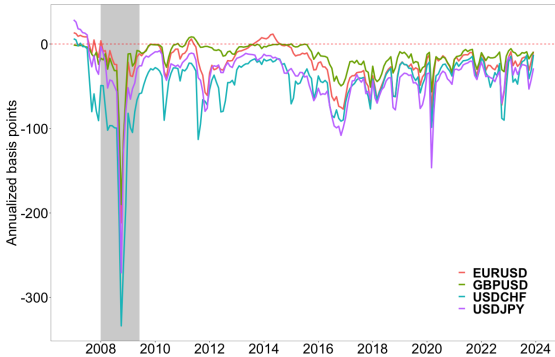
- CIP deviations are extensively discussed in asset pricing literature (e.g., Du, Tepper, Verdelhan (2018))
- Shift in banks' swap *demand* causes the basis to turn more negative
- Instrument for banks' swap demand using wholesale funding constraints
- Implications:
  - Major *demand-side channel* complementing costly supply
  - Raises effective intermediation *costs*



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3. Quantify the impact of funding frictions on dollar credit when accounting for swap positions
   - Calibrate bank funding model (Ivashina et al, 2015) to run policy-relevant counterfactuals
   - How tight can wholesale market constraints get before disrupting dollar credit?

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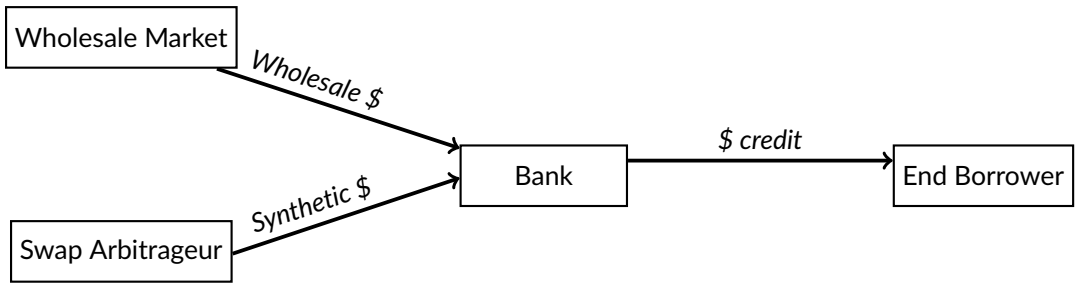

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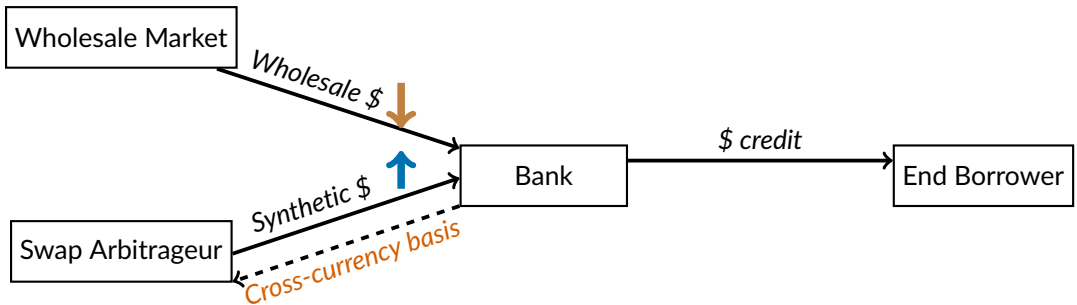

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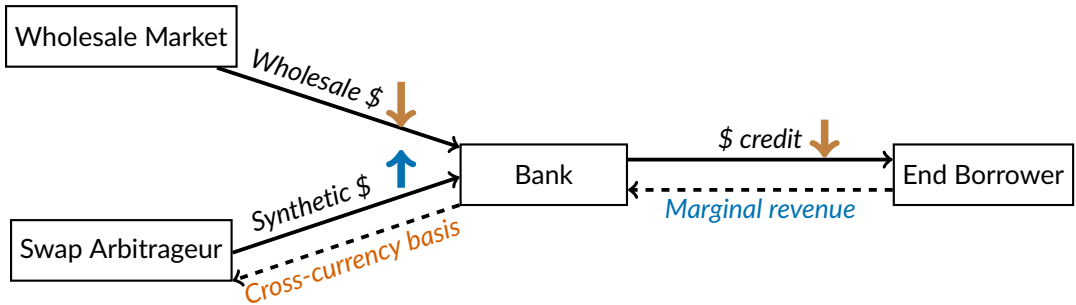

$\Rightarrow$ When $\underbrace{\text{marginal cost}}_{\text{cross-currency basis}} > \underbrace{\text{marginal revenue}}_{\text{on dollar assets}} \longrightarrow$ bank lending declines

Contribution to three strands of literature

- **Funding market frictions**
  - Ivashina, Scharfstein & Stein (2015); Barajas et al (2020); Correa, Du & Liao (2020); Aldasoro et al (2022); Aldasoro & Doerr (2023); Kloks, Mattille & Ranaldo (2024)...
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- **Spillover of domestic regulations on cross-border lending**
  - Becker, Li, Schmeling & Schrimpf (2024); Keller (2024); Eguren-Martin et al (2024)...
  - This paper: quantifies the (non-linear) relationship between funding frictions and lending

Demand for Synthetic Dollar Funding

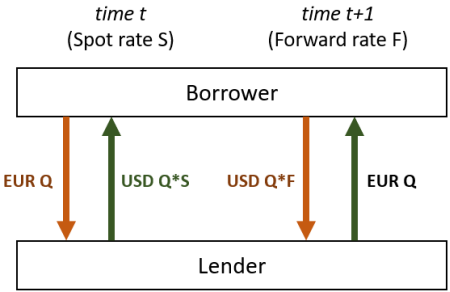
Institutional background and data: wholesale funding market

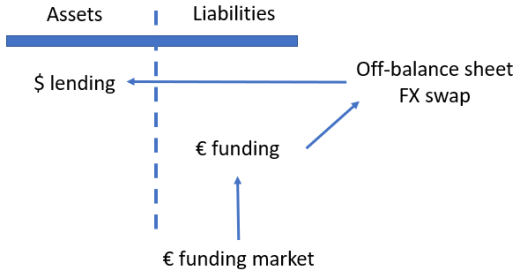
- Focus on **money market funds** - large but constrained wholesale investors
  - Invested $>$\$1.2 trillion in short-term debt of non-U.S. banks in 2023 Summary statistics
  - Data: N-MFP filings; granular security level holdings (e.g., Vanguard's in Deutsche Bank)
- Primary objective is capital preservation; constrained lending to banks arising from:
  1. Investor outflows and segmentation among borrower types
  2. Regulatory concentration limits on unsecured lending[1]
  3. Sensitivity to changes in borrowers' credit rating

[1] Does not apply to secured lending (e.g., repo) where borrowers incur leverage ratio penalty (Kloks et al, 2024)

Institutional background and data: synthetic funding market

- Swaps resemble collateralized revolving credit; quantities difficult to observe





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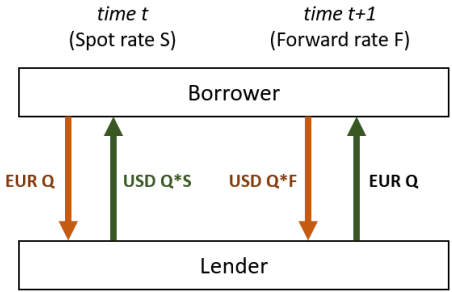
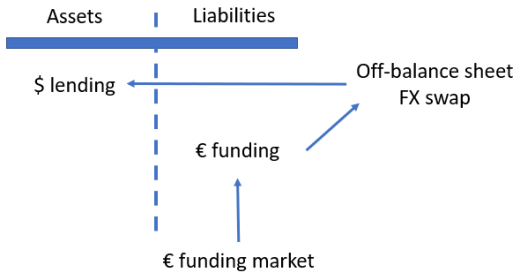
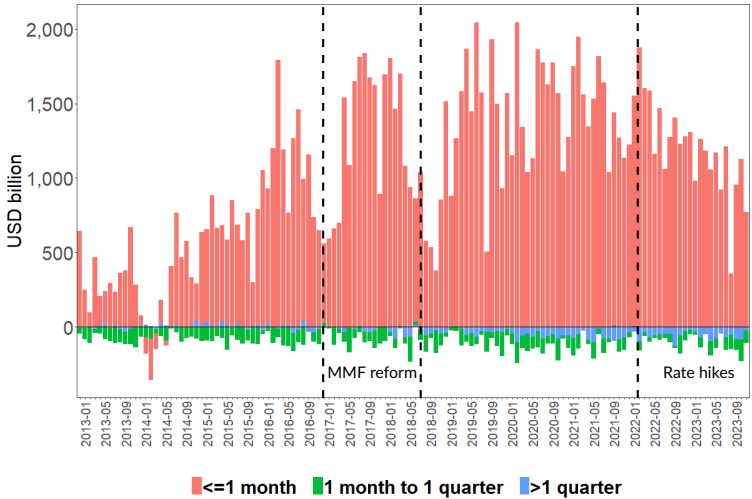




- Data: Daily *signed* sector-currency-tenor transactions from Continued Linked Settlement (CLS)
  (Sample period: 2013-23, Market coverage:>25% Breakdown Representativeness)
- Limitation: do not observe individual entities; *bank-level* heterogeneity difficult to capture

  ⇒ use wholesale data granularity for identification

Global banks consistently borrow short-term dollars via FX swaps



Summary statistics

Sector breakdown

Banks use swaps to offset wholesale funding declines

$$\Delta\text{Synthetic Dollars}_{c,t} = \beta\, \Delta \underbrace{\text{MMF Holdings}}_{\text{Wholesale dollars}}{}_{c,t} + \text{Controls} + \alpha_c + \alpha_q + \varepsilon_{c,t}$$

	Δ Synthetic Dollars			
	(1)	(2)	(3)	(4)
Δ MMF holdings	-0.232**	-0.228***	-0.228***	-0.228***
	(0.073)	(0.058)	(0.058)	(0.061)
N	1,048	1,040	1,040	1,040
Controls	N	Y	Y	Y
Currency FE	N	N	Y	Y
Time FE	N	N	N	Y

Economic magnitude: one-std-dev ($\sim$\$100 bn) $\downarrow$ in MMF holdings, synthetic borrowing $\uparrow$ 23%

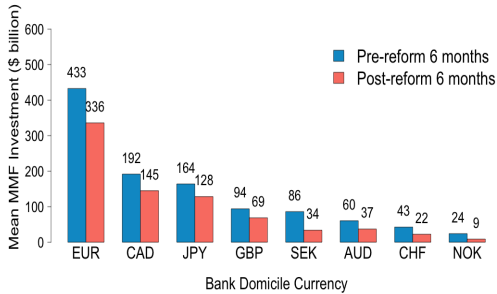
Other on-balance sheet funding sources Robustness

A natural experiment: the 2016 money market fund regulatory reform

- The SEC implemented reforms to improve resilience of MMFs to liquidity shocks
- Key provisions - floating net asset values and redemption gates - impacted prime MMFs

  $\rightarrow$ mass redemptions from MMF investors

  $\rightarrow$ global banks lost $>$\$250 billion



Decline in MMF funding to banks

Banks sharply increased synthetic dollar borrowing after the reform

$$\text{Synthetic Dollars}_{s,c,t} = \sum_{\substack{\tau \in -5,6, \\ \tau \neq -1}} \beta_\tau \times \textit{Reltime}_\tau + \alpha_{s \times c} + \alpha_{c \times t} + \varepsilon_{s,c,t}$$

- Treated: banks (impacted by the reform)
- Control: corporations, funds, NBFI
  (use swaps, but *not impacted by the reform*)

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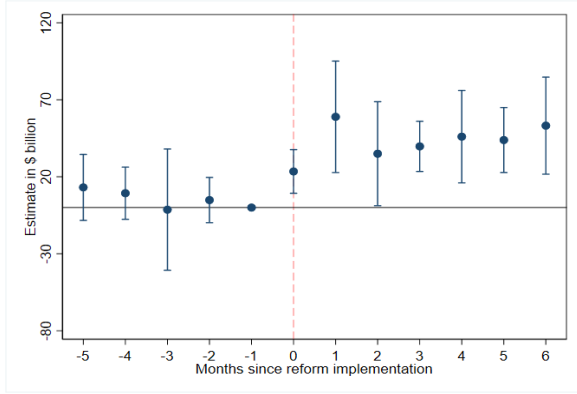
- Treated: banks (impacted by the reform)
- Control: corporations, funds, NBFI (use swaps, but *not impacted by the reform*)
- Anderson et al (2025) show arbitrageurs also faced increased costs; higher net quantities suggest demand was impacted more

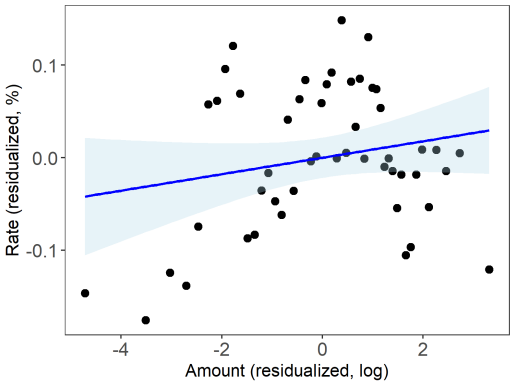
Pre/post table

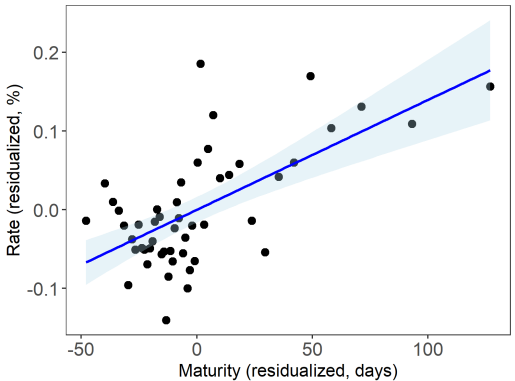


Event study

Why can’t banks pay more to secure additional wholesale funding?

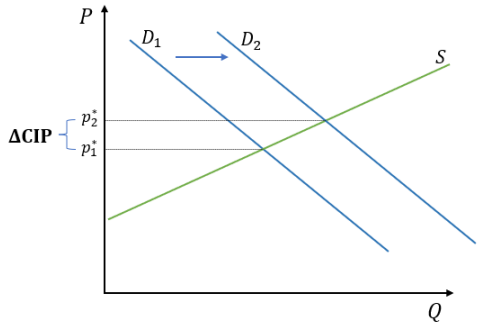
- Money market funds focus on capital preservation over higher returns through risky lending
- Higher interest rates do not incentivize more investment, indicating inelastic supply





Asset Pricing Implications

We want to understand the price impact of banks' swap demand



- Post-GFC, arbitrageurs face increased regulatory costs $\rightarrow$ supply curve slopes upwards

  For example, leverage ratio requirement on on/off balance sheet assets (Du et al, 2018); market power (Wallen, 2020)

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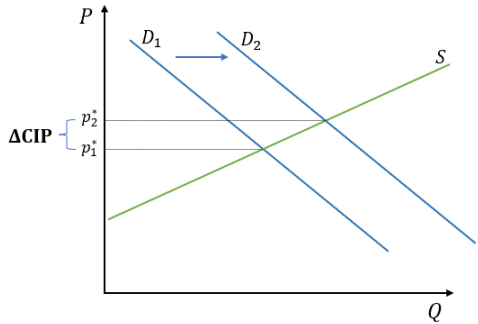

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- **Identification challenge**: simultaneous determination of quantities and prices

  $\Rightarrow$ Need an instrument for aggregate swap demand that is otherwise orthogonal to price

Identifying swap price impact using shocks to wholesale funding

Bank i's swap demand $Q_{i,t} = \underbrace{\phi^d p_t}_{\text{price effect}} + \underbrace{\lambda_i \eta_t}_{\text{common shock effect}} + \underbrace{u_{i,t}}_{\text{idiosyncratic residual}}$

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- Idiosyncratic (bank-specific) demand for swaps arises due to:
  1. Cross-sectional variation in *ex ante* exposure to money market fund flows — Details
  2. Differential proximity to the (exogenous) 5% concentration limit — Details
  3. Bank-specific credit downgrades (e.g., Deutsche Bank downgrade in 2014) — Details

- Extract and aggregate using granular instrumental variables $\Rightarrow$ "excess wholesale funding" (Gabaix and Koijen, 2024)

Diagnostics | Validation

Instrument relevance and exclusion

- **Relevance**: ↑ in excess wholesale funding, ↓ synthetic funding demand

	Δ Synthetic Dollars		
	(1)	(2)	(3)
Excess wholesale funding ($z_{c,t}$)	-0.800***	-0.794***	-0.912***
	(0.113)	(0.112)	(0.233)
N	778	778	706
Instrument F-statistic	46.23	48.50	13.57
Controls	Y	Y	Y
Currency FE	N	Y	Y
Time FE	N	N	Y

- **Exclusion**: instrument affects price only through banks' swap demand
  1. Uncorrelated with *swap arbitrageurs'* balance sheet costs
  2. Not driven by macro-economic conditions or "common shocks"
  3. Does not affect non-bank investors' (inelastic) swap demand

Correlations table

Non-bank elasticities

Confirm causality between ↑ swap demand and ↓ cross-currency basis

	Δ Cross-currency basis$_{c,t}$				
Tenors:	First principal component (1W, 1M, 3M)			1 week	1 month
	(1)	(2)	(3)	(4)	(5)
Δ $\widehat{\text{Synthetic Dollars}}_{c,t}$	-8.419***	-8.759***	-6.399***	-5.530***	-7.164***
	(0.778)	(0.917)	(1.197)	(0.624)	(0.753)
N	776	776	704	778	780
Controls	Y	Y	Y	Y	Y
Currency FE	N	Y	Y	Y	Y
Time FE	N	N	Y	N	N

- Economic magnitude: A \$10% ↑ in net demand → 7 bps ↓ in 1-month basis (mean: -26 bps)
- Generalizability: price impact also visible outside of quarter-end dates Table

Linking funding frictions to banks' dollar lending

Goal: quantitatively determine the limits of synthetic market to meet dollar credit demand

1. Two-country model where banks use swaps to offset wholesale funding shortfall
   - Build on Ivashina, Scharfstein, and Stein (2015)
   - Add swap arbitrageur $\rightarrow$ CIP deviations an equilibrium object (Iida et al., 2018)

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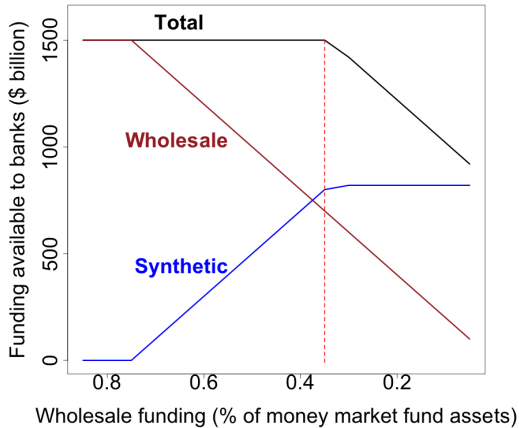
2. Calibrate using empirical estimates and data on banks' revenue on dollar assets
   - Locate the threshold beyond which banks reduce dollar lending

Counterfactual decline in bank lending: marginal cost > revenue

- The bank initially offsets decline in wholesale funding using swaps
- But synthetic borrowing is capped when cross-currency bases exceed marginal asset returns



Risk vs. price trade-off | If swap arbitrageurs are also affected

Main takeaways

- The synthetic dollar market has become a significant part of banks' funding portfolios

- This paper jointly analyzes wholesale and synthetic markets to make three key contributions:

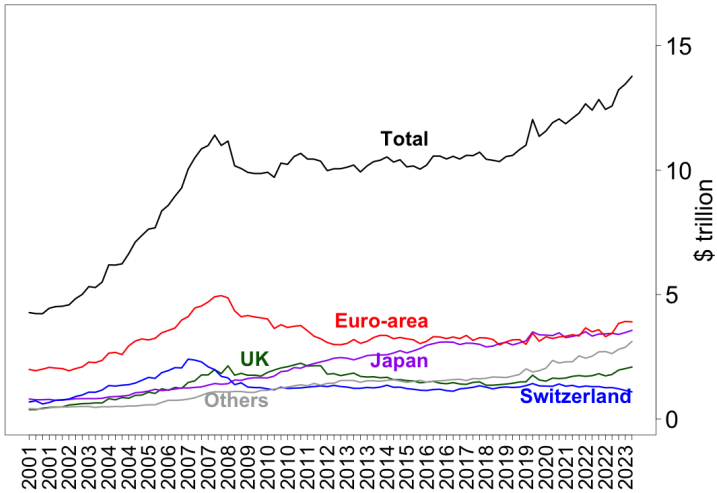
  1. Banks increase the use of synthetic dollars when wholesale funding declines

  2. This demand turns cross-currency basis more negative: synthetic dollars become costlier

  3. Sharp decline in wholesale funding contracts bank lending when the marginal cost (basis) exceeds banks' asset returns

Appendix

U.S. dollar assets of non-U.S. banks



Back

MMF summary statistics

Panel A: MMF holdings ($ billion)	Mean	SD	p25	p50	p75	N
All non-U.S. banks	963.9	155.7	867.4	979.8	1051.8	132
– of which, uncollateralized	495.8	181.7	351.7	422.6	679.3	132
Δ All non-U.S. banks	-0.4	133.3	-85.6	2.5	76.7	131
EUR banks	346.0	80.1	290.1	340.8	408.7	132
Δ EUR banks	0.1	86.3	-52.5	4.0	48.4	132
JPY banks	163.7	30.3	139.8	154.1	187.4	132
Δ JPY banks	0.6	14.0	-7.0	-0.1	8.3	132

Panel B: Share of portfolio	Non-U.S. Banks	U.S. Banks	Govt. & Others
All MMFs mean holding	23.2%	15.5%	60.5%
– Change, conditional on outflow	-0.3%	0.0%	0.3%
Non-exclusive MMFs mean holding	29.1%	19.4%	50.7%
– Change, conditional on outflow	-0.2%	0.0%	0.1%
Vanguard mean holding	20.4%	14.8%	62.6%
– Change, conditional on outflow	-0.5%	0.0%	0.4%
Blackrock mean holding	26.4%	10.8%	62.4%
– Change, conditional on outflow	-0.5%	-0.1%	0.6%

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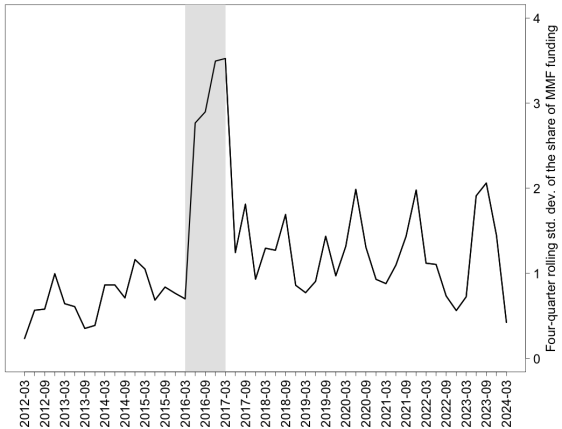
The evolution of non-U.S. banks' dollar liabilities



- Money market funds remain significant investors but with increasingly volatile flows; contribute 10-20% of total USD funding and 40-50% of short-term funding
- USD deposits and FHLBs are small; eurodollars and interbank borrowing curtailed post GFC

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CLS data representativeness compared to BIS survey

Panel A: Share of volume by tenor	BIS (%)	CLS (%)
$\leq$ 7 days	71	61
$>$ 7 days & $\leq$ 1 month	11	22
$>$ 1 month & $\leq$ 3 months	11	11
$>$ 3 months	7	5
Panel B: Share of volume involving currency	**BIS (%)**	**CLS (%)**
EUR	33	33
JPY	15	21
GBP	15	16
AUD	6	9
CAD	7	7
CHF	6	7

Notes: Benchmarked using Bank for International Settlements April 2022 OTC Turnover Survey.

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CLS data coverage

Trading between dealers and	BIS ($ billion)	CLS Share (%)
Non-reporting entities (Buy-side)	1,768	23
Financial institutions (Buy-side - Corporate)	1,620	25
Non-reporting banks (Buy-side - Fund - NBFI - Corporate)	909	31
Institutional investors (Fund + NBFI)	650	18
Non-financial institutions (Corporate)	148	2

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Daily net synthetic dollar borrowing by currency

	Mean	SD	p25	p50	p75	N
AUDUSD	-0.90	6.20	-4.80	-0.60	3.00	2,853
EURUSD	25.80	20.30	11.40	25.00	39.10	2,853
GBPUSD	1.80	11.10	-4.80	1.50	8.70	2,853
NZDUSD	-0.30	2.30	-1.80	-0.30	1.20	2,853
USDCAD	0.50	4.50	-2.20	0.20	2.90	2,853
USDCHF	3.20	8.40	-2.20	2.30	8.10	2,853
USDJPY	12.20	14.20	2.10	11.60	21.40	2,853
USDNOK	-0.50	2.80	-2.30	-0.30	1.30	2,853
USDSEK	1.50	3.40	-0.70	1.30	3.80	2,853

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Daily net synthetic dollar borrowing by sector

	Mean	SD	p25	p50	p75	N
All non-dealers (combined)	43.28	35.08	17.24	41.43	67.67	2,853
Non-bank financials (NBFI)	-0.52	2.20	-1.52	-0.42	0.42	2,853
Investment funds	-14.00	21.62	-24.92	-11.48	-0.38	2,853
Corporate	-0.45	1.00	-0.78	-0.29	0.00	2,853
Non-dealer banks	58.25	40.89	26.54	56.63	88.46	2,853

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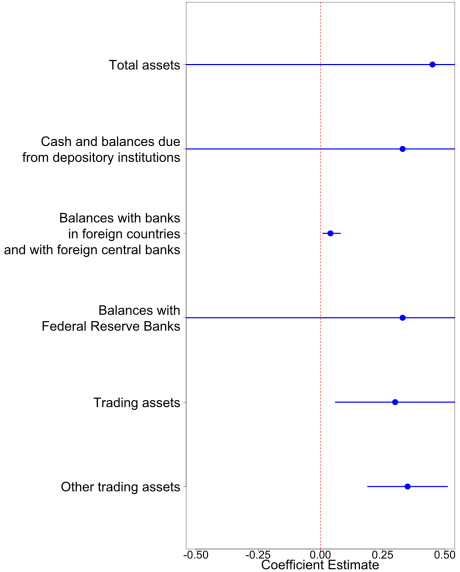
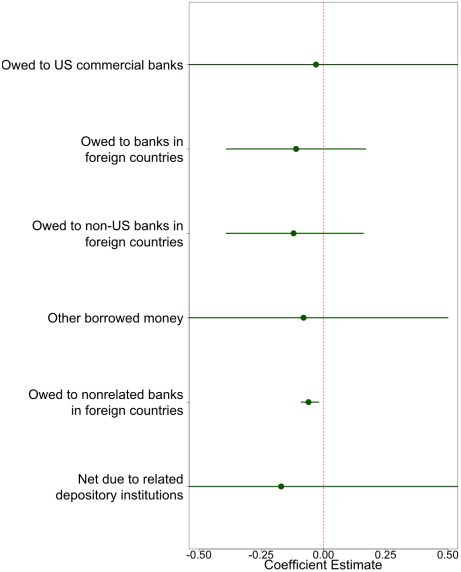
Impact of MMF holdings decline on banks' on-balance sheet items





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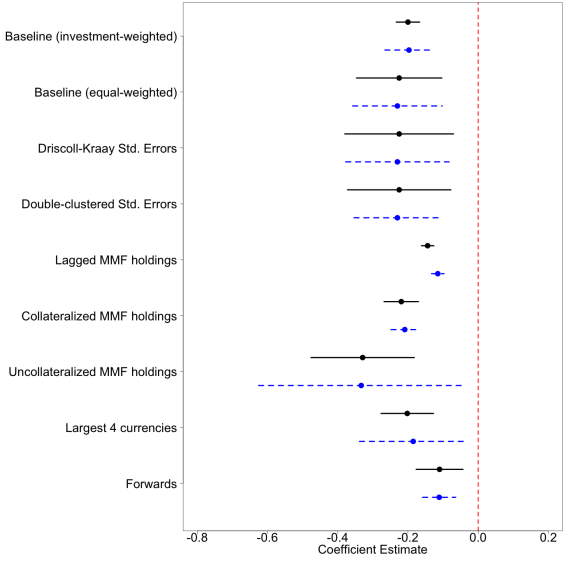
Robustness and specification curve



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2016 regulatory reform: pre/post analysis

	Net Synthetic Dollars ($ billion)			
	(1)	(2)	(3)	(4)
Treated × Post	26.857**	24.700**	26.857**	24.700**
	(12.939)	(12.106)	(12.227)	(11.239)
N	384	384	384	384
Controls	Y	Y	Y	Y
Fixed Effects	Sector, Currency, Month	Sector × Currency, Month	Sector, Currency × Month	Sector × Currency, Currency × Month

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Swap demand and CIP deviations: OLS

	Δ Cross-currency basis ($\Delta x_{t,t+n}$)			
	PC1 (1W, 1M, 3M)		1W	1M
	(1)	(2)	(3)	(4)
Δ Synthetic Dollars	-3.831***	-3.930***	-2.953***	-2.446***
	(0.929)	(0.620)	(0.433)	(0.458)
N	1,036	1,036	1,038	1,040
Controls	Y	Y	Y	Y
Adj. R^2	0.41	0.60	0.61	0.62
Currency FE	N	Y	Y	Y
Time FE	N	Y	Y	Y

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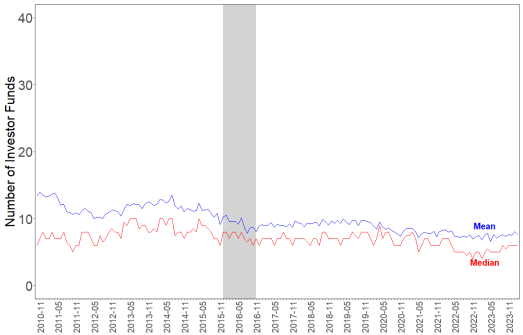
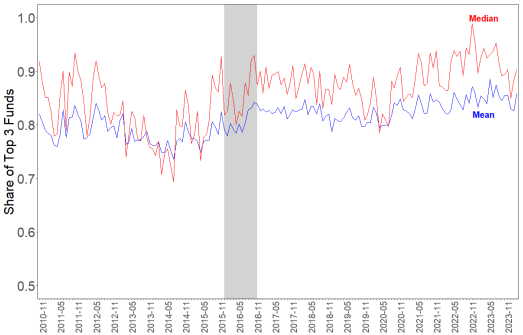
Concentration in Money Market Fund Flows



(c) Number of MMFs investing in a non-U.S. bank



(d) Share of Top 3 MMFs

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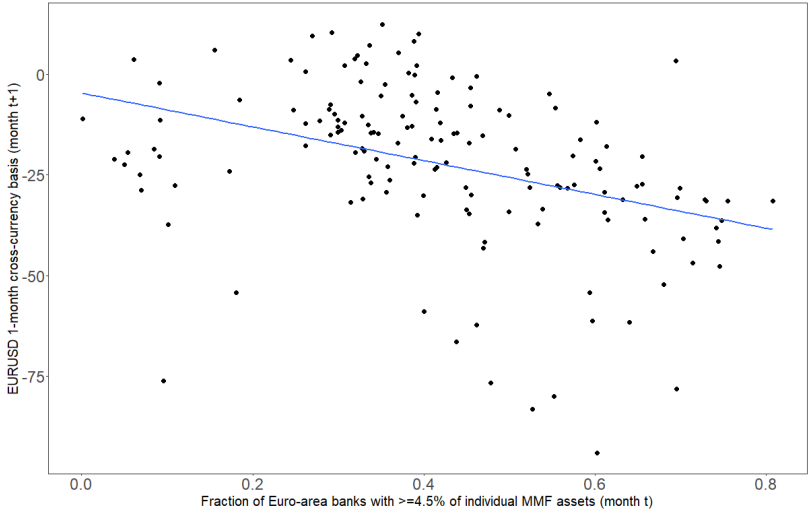
Banks' proximity to MMF concentration limit and cross-currency basis



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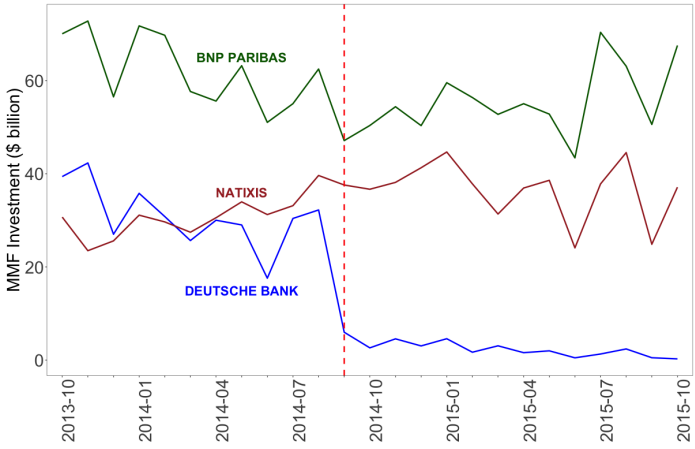
Bank-specific credit downgrade and MMF decline



Bank-specific credit downgrade and MMF investments

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GIV diagnostics – excess Herfindahl

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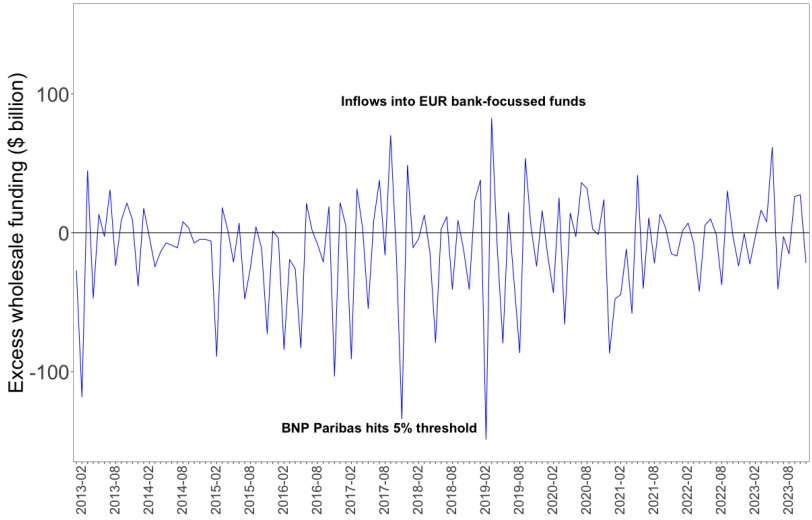
Instrument validity: shocks are economically interpretable



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Instrument orthogonality with covariates

	All currencies	EURUSD
Δ Money Market Fund holdings (aggregate)	-0.001	-0.009
Δ Money Market Fund holdings (U.S. banks)	0.031	0.007
Δ Intermediary leverage ratio (squared)	0.072	0.096
Quarter-end indicator (1/0)	0.031	0.027
Δ U.S. 1-month OIS	0.005	0.008
Δ Repo market borrowing (non-MMF)	-0.019	-0.030
Serial correlation	0.039	0.046
Bank size (average borrowing from MMFs)	-0.062	-0.063

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Elasticity of non-bank investors' swap demand to cross-currency basis

Panel A: First stage	ΔCross-currency basis		
	PC1 (1W, 1M, 3M)	1W	1M
Excess wholesale funding ($z_{c,t}$)	7.292***	4.486***	6.293***
	(1.010)	(0.462)	(0.709)
Instrument F-statistic	51.19	94.20	78.75
Panel B: Second stage	Hedging Demand^S		
	Fund	Corporate	NBFI
$\Delta\widehat{\text{Cross-currency basis}}_{c,t}$	0.006	0.005	0.005
	(0.010)	(0.050)	(0.042)
N	782	784	786
Controls	Y	Y	Y
Currency, Time FE	Y	Y	Y

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Swap demand and cross-currency basis: non-quarter-end months

	Δ Cross-currency basis$_{c,t}$				
Tenors:	First principal component (1W, 1M, 3M)			1 week	1 month
	(1)	(2)	(3)	(4)	(5)
$\Delta \widehat{\text{Synthetic Dollars}}_{c,t}$	-8.419***	-8.759***	-6.399***	-5.530***	-7.164***
	(0.778)	(0.917)	(1.197)	(0.624)	(0.753)
N	776	776	704	778	780
Controls	Y	Y	Y	Y	Y
Currency FE	N	Y	Y	Y	Y
Time FE	N	N	Y	N	N

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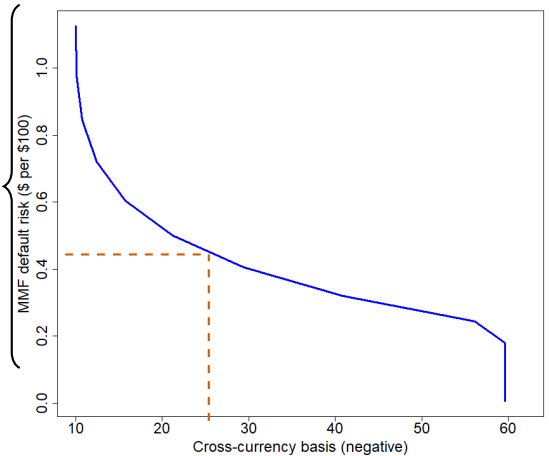
Inverse relationship between MMF default risk and CIP deviations

MMF default risk ↓
as α ↓ (tighter constraint)



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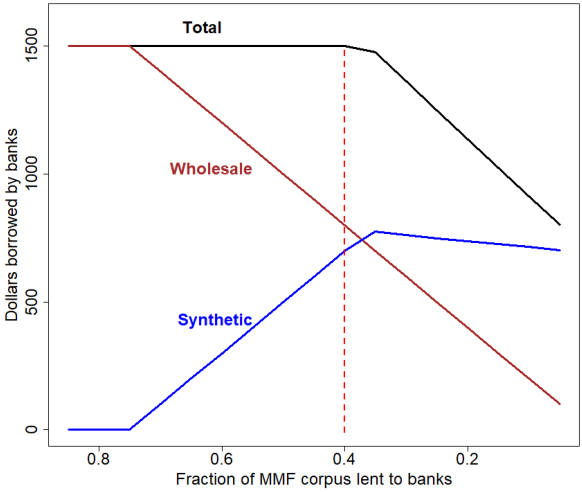
Counterfactual decline in bank lending:: $\rho(\lambda, \alpha) \neq 0$



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