

Hunting for Dollars

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- Due to its role as reserve currency, it is critical for financial stability that global institutions have an easy and reliable access to **US dollar funding**.
- The breakdown of the **covered interest rate parity** (CIP) condition implies a scarcity premium for dollar funding.
- We ask ourselves: what constrains the free provision of dollar liquidity in **money markets**?

Paper in a nutshell

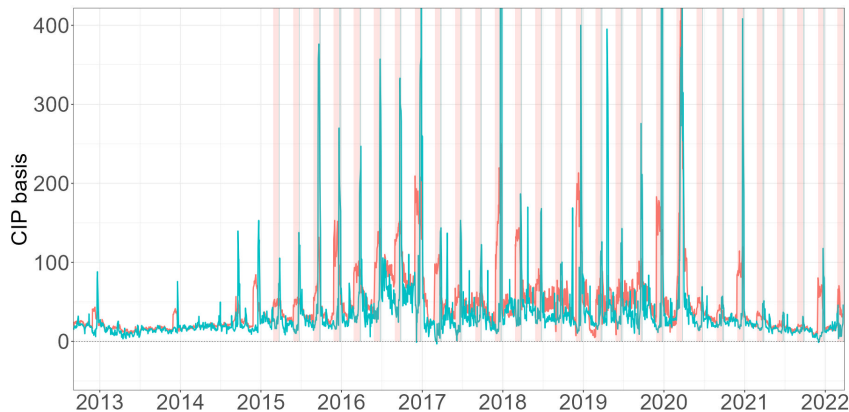
- CIP deviations have been linked to constraints on financial intermediaries caused by banking regulation.
- However, we make it clear that it is impossible for such banking regulation to affect CIP through FX swaps directly.

Paper in a nutshell

Our paper demonstrates that dislocations in **FX swap markets** stem from regulatory constraints on banks' ability to raise dollars from **US wholesale funding markets**.

- When constrained, non-US banks **substitute** regulation-costly USD repo borrowing with FX swap dollar funding.
- This substitution has pricing implications: regulation imposes **shadow costs** on wholesale funding, which is then reflected in the price of its substitute, FX swaps, through the cross-currency basis.
- Using data on synthetic flows and prices per nationality and institution type, we demonstrate that non-US institutions **inelastically demand** USD funding for which pay a premium at quarter-end.

Post-2015 quarterly CIP deviations (USDJPY, 1W/1M)



$$\chi_{t,t+n}^{x|y} = \left(\frac{F_{t,t+n}^{x|y}}{S_t^{x|y}} \right) \cdot (1 + i_{t,t+n}^x) - (1 + i_{t,t+n}^y)$$

Background

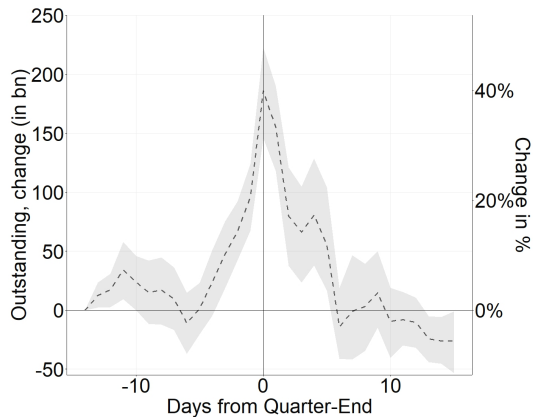
Literature has shown that Basel III regulation causes CIP deviations ([Du, Tepper, and Verdelhan \(2018\)](#); [Cenedese, Della Corte, and Wang \(2021\)](#)).

We build on this by demonstrating that the regulatory constraint stems from regulation's impact on **US repo** markets.

Our paper helps resolve some open questions:

- How could CIP be affected, when only **1%** of FX swaps' positions count towards the leverage ratio ([Borio et. al \(2018\)](#), [BCBS \(2014\)](#))?
- Why do FX swap volumes **surge** at the quarter-end?
- If *European* banks are constrained, why does the basis consistently spike in favor of a more expensive *US dollar*?

Quarter-end volume surge

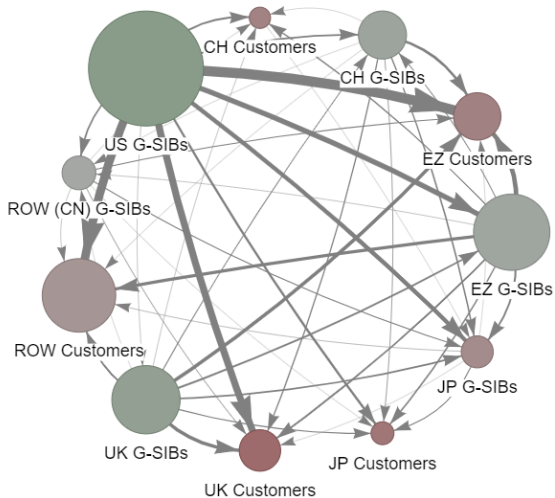


Outstanding swap volumes, SN to 1W tenor point, all currencies.

First step: construct data

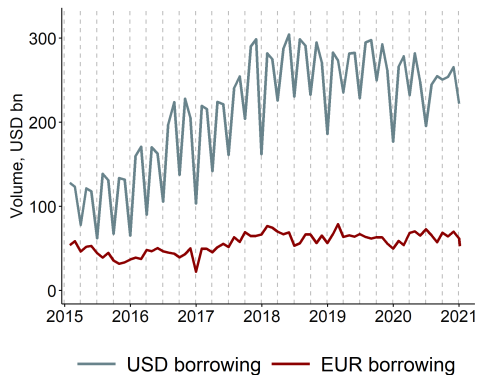
- Bespoke data on global FX settlement from CLS which shows FX swap trading flows and prices per category.
- We manually sort 4,169 banks, as well as their customers, into nationality buckets: US, Eurozone, UK, CH, Japan, and ROW. We further distinguish between G-SIBs, regular banks, and non-banks.
- Crucial: if a JP Morgan entity is trading in London, it is classified as an American G-SIB.
- Combine this with bank-level data on European and American wholesale money markets.

Synthetic dollar flows

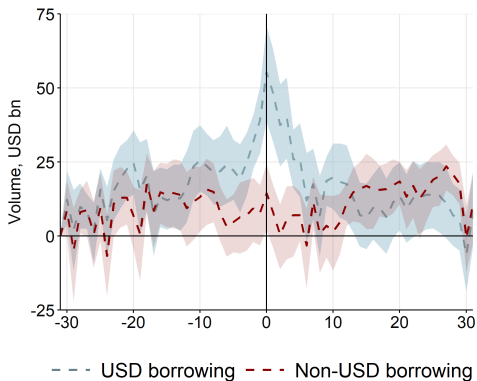


Repo-FX swap substitution

Eurozone banks in:



(a) Repo markets...



(b) ... and FX swaps.

Our hypothesis

Why would European banks substitute USD repo funding with synthetic dollars at quarter-end?

Two unintended consequences of regulation combine for this effect:

① Differential treatment of funding instruments:

- Repo expands balance sheet, penalizing the leverage ratio (LR).
- FX swaps are *off*-balance sheet, and thus only contribute 1% of their position to the LR. [▶ See more.](#)

② Heterogenous reporting requirements

- Majority of jurisdictions report results as a snapshot of their balance sheet at quarter-end - and thus can “window-dress.”
- UK and US two exceptions: report averages of quarter's daily values.

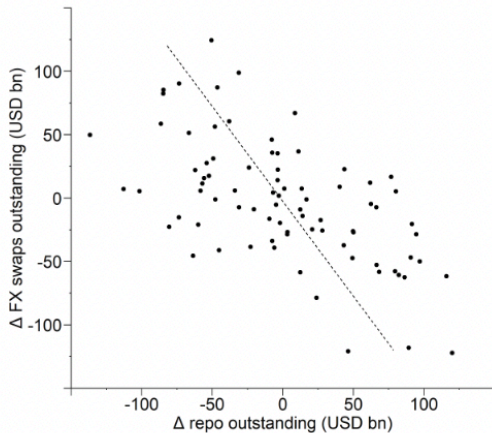
Repo-FX swap substitution: motivation

We hypothesize that regulatory concerns drive this substitution dynamic.

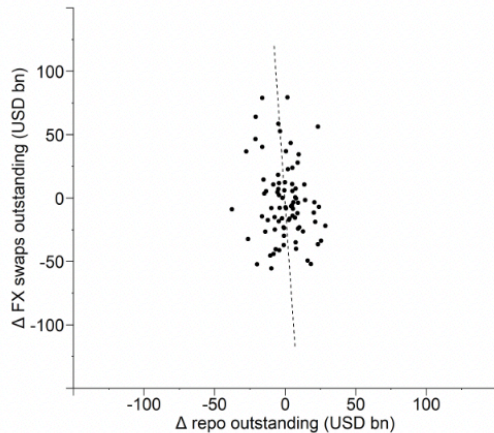
Thus, we run a differences-in-differences regression comparing banks with a quarter-end snapshot requirement (EZ, CH, JP) with those reporting daily averages (US, UK).

$$Y_{i,t} = \beta_1 \cdot Q_t^{end} + \beta_2 \cdot Snapshot_i + \beta_3 \cdot Q_t^{end} \cdot Snapshot_i + \beta_4 \cdot Y_t^{end} \\ + \beta_5 \cdot Q_t^{end} \cdot Y_t^{end} \cdot Snapshot_i + \alpha_i + u_{i,t}$$

Visual evidence...



(a) Eurozone G-SIB banks



(b) UK G-SIB banks

	Snapshot vs. daily average reporters		
	FX swap (logs)	Repo (logs)	Swap Share (%)
Q^{end}	-0.014 (0.055)	-0.093 (0.096)	1.644 (1.731)
<i>Snapshot</i>	-0.266*** (0.091)	-0.786*** (0.159)	9.864*** (2.862)
$Q^{end} : \textit{Snapshot}$	0.133** (0.066)	-0.355*** (0.121)	7.310*** (2.183)
<i>Controls</i>			
$Q^{end} : Y^{end}$	-0.515*** (0.096)	-0.025 (0.168)	-10.954*** (3.028)
$Q^{end} : Y^{end} : \textit{Snapshot}$	0.153 (0.114)	0.008 (0.209)	5.867 (3.756)
Observations	492	411	411
Adj. R^2	0.910	0.834	0.813

Further evidence for substitution:

- **Nationality:** Those nationalities decreasing repo the most, correspondingly increase synthetic usage the most. [» Nationality](#)
- **Currency:** substitution is specific to the USD. [» Currency](#)
- **Year-ends:** as FX swaps count towards the year-end G-SIB score, substitution reverts at year-end. [» Year-ends](#)

Repo vs. unsecured?

Repo is especially penalizing for two reasons:

- Both (i) cash borrowing and (ii) pledging collateral is penalized by the LR
- You need appropriate collateral to source cash!

What about *unsecured* borrowing then?

Secured v. unsecured funding: window-dressing occurs (virtually) only for repo, which requires collateral. Unsecured borrowing is relatively unaffected. [▶▶ Secured v. unsecured](#)

The 2016 US money market reform converted USD borrowing from unsecured to secured: unsecured now very small. [▶▶ US MMF Reform](#)

What are the implications for pricing?

- When an agent wishes to borrow dollars, he may do so through wholesale (direct) borrowing, or synthetically, by converting local currency with FX swaps.
- **CIP** tells us that these two methods must have an equal cost: law of one price!

$$\underbrace{(1 + i_{t,t+n}^{\$})}_{\text{Cost of raising USD}} = \underbrace{(1 + i_{t,t+n}^{\times})}_{\text{Cost of domestic funding}} \cdot \underbrace{\left(\frac{F_{t,t+n}^{\times|\$}}{S_t^{\times|\$}} \right)}_{\text{Cost of FX swap}}$$

- However, wholesale borrowing through repo is penalizing for the balance sheet **LR**.
- Direct borrowing also requires securing **collateral**, which may be difficult to source.
- These constraints imply **shadow costs** for wholesale borrowing in money markets.
- On the other hand, FX swaps count little for the LR, and do not require collateral.

$$\underbrace{(1 + i_{t,t+n}^{\$} + C_{t,t+n}^{\$})}_{\text{Cost of raising USD}} = \underbrace{(1 + i_{t,t+n}^{\times} + C_{t,t+n}^{\times})}_{\text{Cost of domestic funding}} \cdot \underbrace{\left(\frac{F_{t,t+n}^{\times|\$}}{S_t^{\times|\$}} \right)}_{\text{Cost of FX swap}}$$

Plugging in the basis shows that CIP deviations are driven by the *relative shadow cost of USD wholesale funding vs. raising domestic funds*:

$$\chi_{t,t+n}^{x|\$} = c_{t,t+n}^{\$} - c_{t,t+n}^x$$

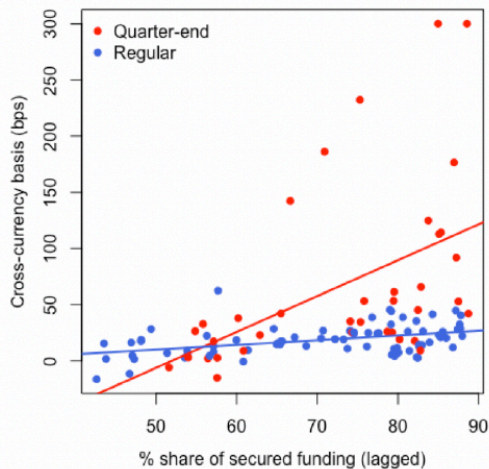
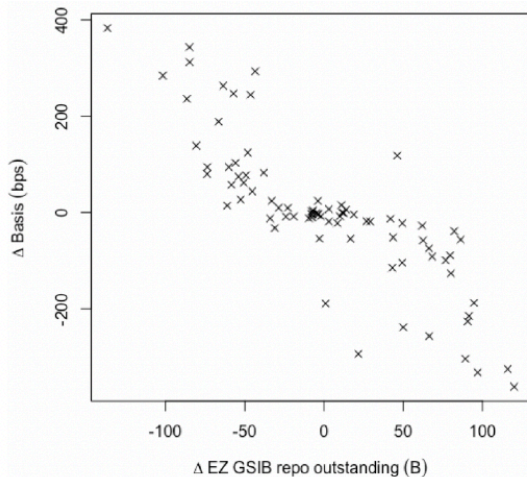
At the **quarter-end**, repo borrowing from US MMFs is penalized by regulation, and requires a collateral.

But non-US banks can raise **domestic** funds easily, especially in post-2015 era of loose monetary policy.

Synthetic dollar funding commands a **premium** because obtaining it through its substitute, wholesale funding, is expensive.

Pricing effects: CIP deviations correlate with:

- **L.h.s.:** Severity of Eurozone withdrawals from US MMF
- **R.h.s.:** Share of US MMF borrowing requiring collateral



Granular instrumental variable

The idiosyncratic shocks to major actors in FX swaps (i.e. dealer-banks) are a valid IV:

- **Relevance:** idiosyncratic shocks are big enough to impact the price.
- **Exclusion restriction:** can only impact price through flow because common shocks are removed, i.e. they are idiosyncratic.

We take the flows of non-US-G-SIB actors (17 total) and construct the GIV as the **size-minus-equal** weight of their dollar purchase shares. We form four different variants of the GIV.

Want to test whether:

- Non-US agents' flows impact the basis
- Non-US agents have inelastic demand for synthetic dollar funding

Panel A: First Stage - Prices on GIV

Dep. variable:	$\Delta\chi^{t,m,x}, \%$			
	$Z^{P/F}$	Z^F	Z^{preci}	Z^{equi}
Z^{GIV}	0.15* (0.08)	0.21** (0.08)	0.23** (0.08)	0.24** (0.09)
Controls	Yes	Yes	Yes	Yes
Fixed effects	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$
Clustering	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$
Obs.	48,740	48,740	48,740	48,740

→ Significant link between non-US-G-SIB agent buying pressure, and the cross-currency basis! This despite including non-US dealer-banks in the flows.

Panel B: Second Stage - Demand

Dep. variable:	Y_E^{preci}			
	$Z^{P/F}$	Z^F	Z^{preci}	Z^{equi}
$\Delta \chi_t^{x y,m}, \%$	-0.41*** (0.17)	-0.35*** (0.06)	-0.33*** (0.06)	-0.18*** (0.07)
Controls	Yes	Yes	Yes	Yes
Fixed effects	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$
Clustering	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$
Obs.	48,740	48,740	48,740	48,740

→ A 1% increase in the basis reduces dollar buying pressure by <1%: inelastic demand.

Thus when banks are constrained in US wholesale funding, they must replenish their source of dollars somewhere else.

Pricing and Cost Efficiency

Our CLS data also show **prices** paid by each nationality and institution type:

- Quarter-end cross-currency basis spikes cost non-US G-SIBs around **4.7 billion USD annually**.
- Eurozone G-SIBs' 50 billion USD of repo-FX swap substitution “**only**” costs 37 million USD suggesting an efficient regulatory optimization.
- Eurozone G-SIBs pay 1.6 billion USD for quarter-end dollar purchases but sell 1.7 billion USD. This indicates that dealers pass shadow costs on to their **customers** through their role as intermediaries; a regulatory/banking friction thus impacts “real economy” agents.

Pricing and Cost Efficiency

	Effective cost γ (bp)			CIP income (mn of USD)				
	excl. Q^{end} (1)	at. Q^{end} (2)	Δ bp (3)	Net (4)	Δ Buy (5)	Δ Sell (6)	Δ Net (7)	Δ Net _{RP-Swp} (8)
Non-US G-SIB banks	26	56	30	3,562	(4,674)	4,476	(197)	(74)
Eurozone	25	52	27	2,429	(1,604)	1,735	131	(37)
Swiss	24	55	31	692	(820)	699	(121)	(17)
Japan	37	78	41	(5,197)	(399)	277	(122)	(15)
UK	24	50	27	3,893	(1,557)	1,378	(179)	(11)
China	23	49	26	1,745	(294)	387	93	6
Other non-US banks	22	48	26	6,497	(1,672)	2,158	486	10
Non-Banks	22	46	24	(17,220)	(859)	744	(115)	(2)
US G-SIB banks	24	52	26	7,261	(3,911)	3,936	25	65

Conclusion

- Distortions in FX swap markets driven by regulation penalizing non-US banks' wholesale USD borrowing.
- Important frictions: USD demand is inelastic, and cost is passed on to the customer.
- Dealers are not homogenous: non-US banks are at disadvantage w.r.t. US dollar funding.
- Policy implications:
 - consequences of quarterly window reporting,
 - differential balance sheet treatment of instruments
 - structure of (US) wholesale funding markets.
- Highlights need to study interconnected markets as a whole, vs. a silo approach.

APPENDIX

- **Deviations from CIP:** Du et al. (2018), Borio, Iqbal, McCauley, McGuire, and Sushko (2018), Cenedese et al. (2021), Rime, Schrimpf, and Syrstad (2022), Wallen (2022), Becker, Schmeling, and Schrimpf (2023), Ben Zeev and Nathan (2024), Kubitza, Sigaux, and Vandeweyer (2024)
- **Global dollar funding:** Ivashina, Scharfstein, and Stein (2015), Aldasoro, Ehlers, and Eren (2022), Correa, Du, and Liao (2022), Bräuer and Hau (2022), Du and Huber (2024)
- **Intermediary balance sheet constraints:** Gabaix and Maggiori (2015), Duffie (2017), Andersen, Duffie, and Song (2019), Du, Hébert, and Li (2023)
- **Microstructure of FX forwards:** Syrstad and Viswanath-Natraj (2022), Krohn and Sushko (2022), Kloks, Mattille, and Rinaldo (2023)

Treatment of repo vs. FX swaps

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<i>Balance sheet</i>	Assets	Liabilities
	Bond 100 \$	Equity 200 €
	Cash 100 €	Debt 100 \$
	Cash 100 \$	
<i>Off-balance sheet</i>		

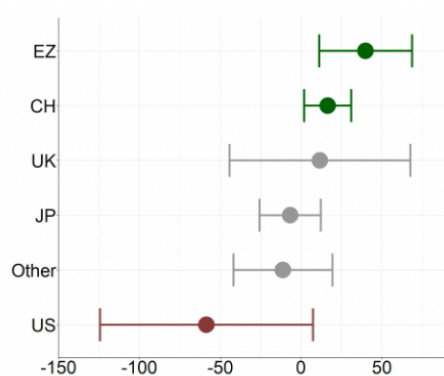
(a) After repo: $LR = 200/300 = 0.67$.

<i>Balance sheet</i>	Assets	Liabilities
	Bond 100 \$	Equity 200 €
	Cash 100 \$	
<i>Off-balance sheet</i>		
	FX receivables 100 €	FX payables 100 \$

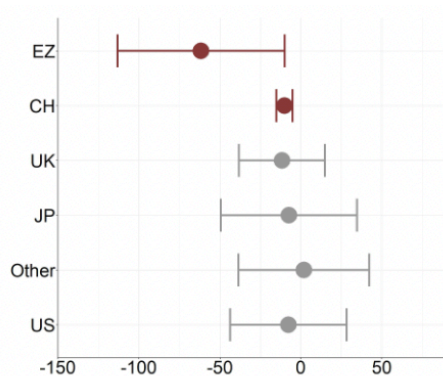
(b) After FX swap: $LR = 200/(200 + 0.01 \cdot 100) = 0.995$.

Nationalities

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(a) Net USD FX swap borrowing, Δ bn USD



(b) USD repo borrowing, Δ bn USD

Dollar uniqueness [» Back to slides.](#)

	Eurozone G-SIB repo borrowing					
	bn USD	log	bn USD	log	bn USD	log
USD	13.941*	0.552*	14.897*	0.587*	-62.978***	-0.285***
	(7.037)	(0.312)	(7.035)	(0.291)	(9.907)	(0.048)
QE	0.213	0.064	-0.078	-0.020	6.082	0.022
	(0.158)	(0.040)	(0.296)	(0.046)	(13.414)	(0.065)
QE:USD	-7.066***	-0.346***	-6.874**	-0.259**	-61.151***	-0.353***
	(2.460)	(0.106)	(2.524)	(0.092)	(18.971)	(0.092)
<i>Controls</i>						
QE:YE	-1.829***	-0.274***	-2.504**	-0.311*	-64.020***	-0.257***
	(0.493)	(0.075)	(0.859)	(0.158)	(22.880)	(0.111)
QE:YE:USD	-0.594	0.130	0.060	0.176	44.337	0.142
	(1.942)	(0.095)	(1.829)	(0.169)	(32.357)	(0.156)
Constant	No	No	No	No	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	No	No
Frequency	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Standard errors	Clustered	Clustered	Clustered	Clustered	Newey-West	Newey-West
Obs.	4,486	4,486	1,654	1,654	216	216
Adjusted R ²	0.609	0.667	0.448	0.509	0.369	0.393

	Swap Share (%)				
	EZ	CH	JP	UK	US
β_0	41.59*** (2.20)	84.28*** (2.04)	33.36*** (4.42)	68.94*** (2.81)	70.41*** (0.99)
Q^{end}	12.05*** (1.71)	9.01*** (1.53)	5.95*** (1.26)	4.59*** (1.03)	−0.46 (0.72)
$Q^{end} : Y^{end}$	−5.64 (3.48)	−3.94 (2.43)	−2.95 (2.65)	−8.99*** (2.90)	−11.52*** (2.09)
Obs.	82	82	82	82	82
Adj. R ²	0.23	0.22	0.01	0.06	0.32

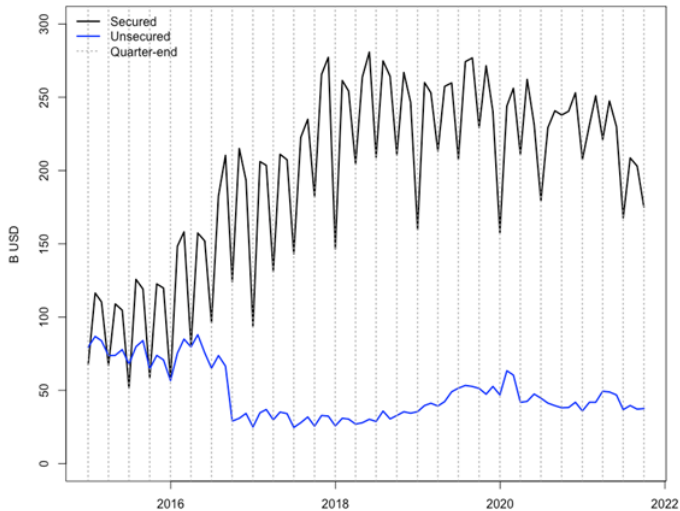
Secured v. unsecured borrowing

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	Wholesale USD borrowing					
	EZ/CH G-SIBs		UK GS-SIBs		US GS-SIBs	
	bn USD (1)	log (2)	bn USD (3)	log (4)	bn USD (5)	log (6)
<i>Secured</i>	16.18** (6.71)	0.72 (0.41)	8.42 (7.86)	-0.62 (1.32)	10.18* (4.33)	0.86 (0.88)
Q^{end}	-1.00 (0.71)	-0.04 (0.03)	-0.22 (0.48)	-0.14 (0.13)	-0.13 (0.32)	0.03 (0.10)
<i>Secured : Q^{end}</i>	-8.68*** (2.08)	-0.34** (0.11)	-1.46 (1.62)	0.01 (0.09)	-0.28 (0.41)	0.01 (0.09)
<i>Controls</i>						
$Q^{end} : Y^{end}$	-0.88 (0.64)	-0.08 (0.10)	0.25 (0.40)	0.08 (0.14)	0.85 (0.45)	0.13 (0.12)
<i>Secured : $Q^{end} : Y^{end}$</i>	-2.21 (2.80)	0.02 (0.08)	-5.21* (1.72)	-0.40** (0.06)	-1.11 (0.95)	-0.14 (0.15)
Fixed effects	G-SIB	G-SIB	G-SIB	G-SIB	G-SIB	G-SIB
Clustering	G-SIB	G-SIB	G-SIB	G-SIB	G-SIB	G-SIB
Observations	1,246	1,246	364	364	1,422	1,422
Adj. R^2	0.388	0.410	0.584	0.482	0.531	0.490

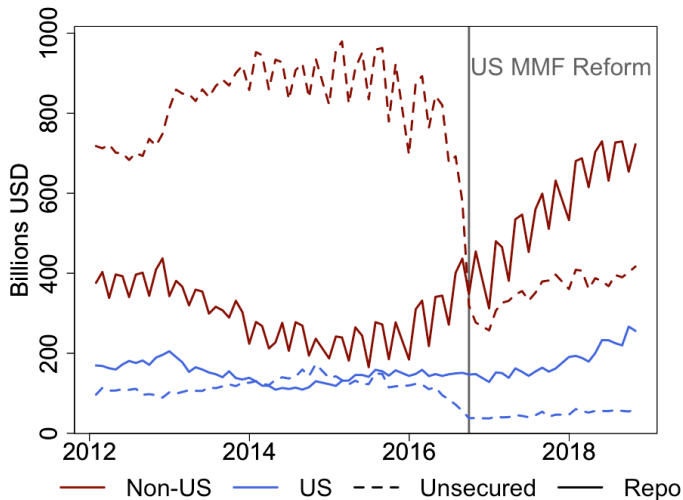
Secured v. unsecured borrowing

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US money market reform

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