Hunting for Dollars

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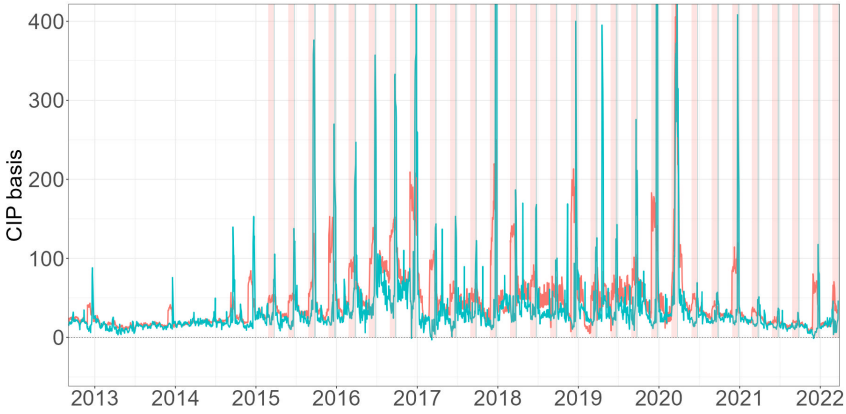
- Due to its role as reserve currency, it is critical for financial stability that global institutions have an easy and reliable access to **US dollar funding**.

- Recent violations of **covered interest rate parity** (CIP) highlight inefficiencies in both FX pricing and dollar funding markets

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



$$\chi^{x|y}_{t,t+n} = \left(\frac{F^{x|y}_{t,t+n}}{S^{x|y}_{t}} \right) \cdot (1 + i^{x}_{t,t+n}) - (1 + i^{y}_{t,t+n})$$

Our research questions:

- How do non-US institutions, such as Eurozone banks, obtain their dollar funding, given they have foreign-denominated deposit bases?
- How does banking regulation impact non-US banks' ability to obtain USD funding? Are there unintended consequences?
- Do such regulatory frictions contribute to (mis)pricing in FX markets?

Contributions

Our analysis shows that the **regulatory framework** penalizes USD funding in **US wholesale markets** and promotes it through **FX swaps**, driving **substitution** between these two main sources of dollars.

Here is the mechanism ...

- Constrained non-US banks **hunt for dollars** by substituting USD repo borrowing with FX swaps.
- This repo-swap substitution, driven by higher regulatory costs on wholesale funding, impacts both **volumes** and **prices**.
- We quantify these **volume shifts** and show that non-US institutions have an **inelastic demand** for USD funding, for which they incur a **premium** at **quarter-end**. This premium materializes in the **cross-currency basis**.

Background

Literature has shown that Basel III regulation imposes a **supply** constraint on banks (Du, Tepper, and Verdelhan (2018); Cenedese, Della Corte, and Wang (2021)).

We demonstrate that regulation affects banks by constraining wholesale borrowing, thus driving up the **demand** for dollars through FX swaps.

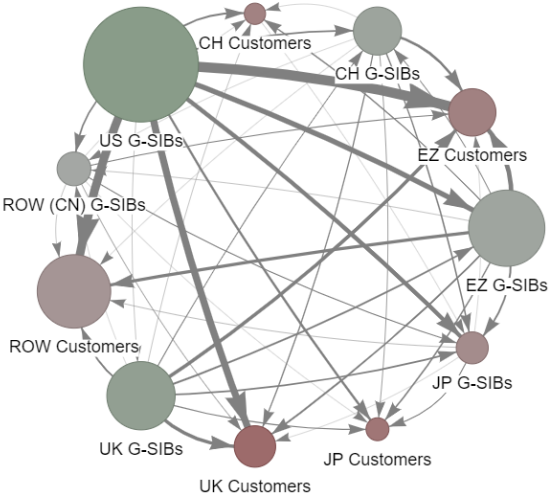
Our paper helps resolve some open questions:

- 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? (Kloks, Mattille, and Ranaldo, 2023) ⏩ See plot.
- If *European* banks are constrained, why does the basis consistently spike in favor of a more expensive *US dollar*?

First step: construct data

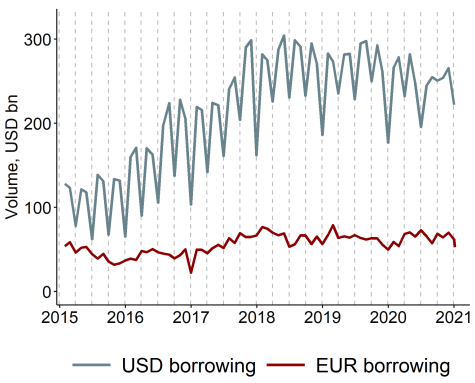
- Bespoke data on global FX settlement from CLS which shows FX swap trading flows and prices per category.
- We manually sort 4,169 banks, as well as their customers, into nationality buckets: US, Eurozone, UK, CH, Japan, and ROW. We further distinguish between G-SIBs, regular banks, and non-banks.
- 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

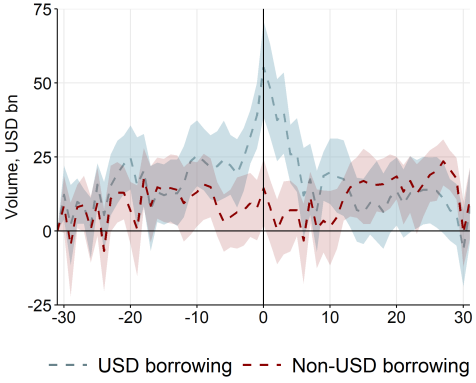


Repo-FX swap substitution

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.

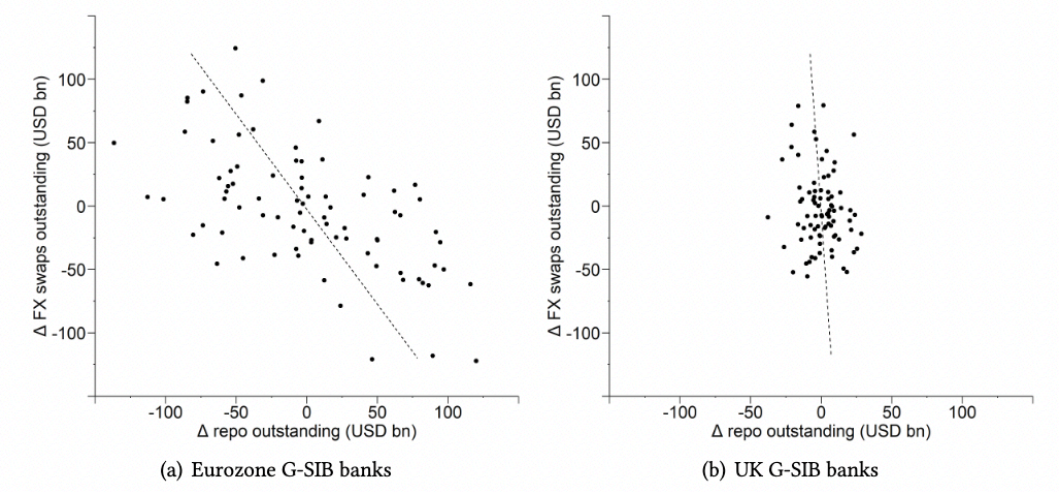
Repo-FX swap substitution: motivation

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	−0.093	1.644
	(0.055)	(0.096)	(1.731)
Snapshot	−0.266***	−0.786***	9.864***
	(0.091)	(0.159)	(2.862)
Q^{end} : *Snapshot*	0.133**	−0.355***	7.310***
	(0.066)	(0.121)	(2.183)
Controls			
Q^{end} : Y^{end}	−0.515***	−0.025	−10.954***
	(0.096)	(0.168)	(3.028)
Q^{end} : Y^{end} : *Snapshot*	0.153	0.008	5.867
	(0.114)	(0.209)	(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
- **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**, which converted USD borrowing from unsecured to secured. ⏩ 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!

$$\underbrace{(1 + i^{\$}_{t,t+n})}_{\text{Cost of raising USD}} = \underbrace{(1 + i^{x}_{t,t+n})}_{\text{Cost of domestic funding}} \cdot \underbrace{\left(\frac{F^{x|\$}_{t,t+n}}{S^{x|\$}_{t}} \right)}_{\text{Cost of FX swap}}$$

- 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.

$$\underbrace{(1 + i^{\$}_{t,t+n} + C^{\$}_{t,t+n})}_{\text{Cost of raising USD}} = \underbrace{(1 + i^{x}_{t,t+n} + C^{x}_{t,t+n})}_{\text{Cost of domestic funding}} \cdot \underbrace{\left(\frac{F^{x|\$}_{t,t+n}}{S^{x|\$}_{t}} \right)}_{\text{Cost of FX swap}}$$

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

$$\chi^{x|\$}_{t,t+n} = c^{\$}_{t,t+n} - c^{x}_{t,t+n}$$

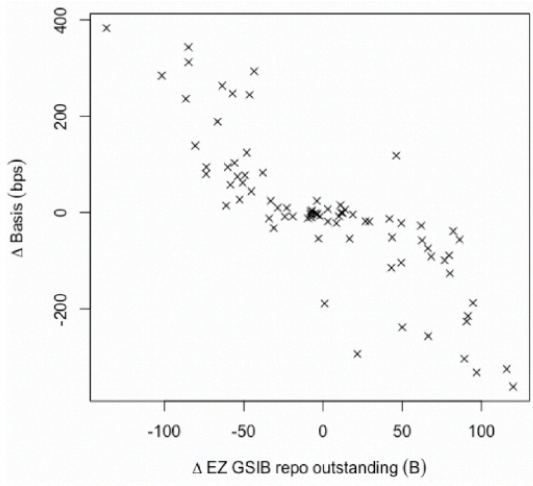
At the **quarter-end**, repo borrowing from US MMFs is penalized by regulation, and requires a collateral.

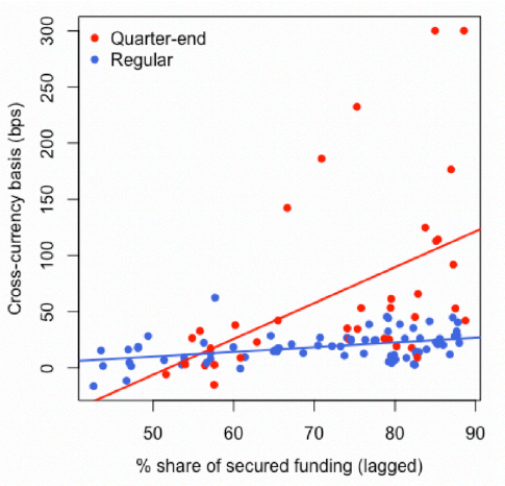
But non-US banks can raise **domestic** funds easily, especially in post-2015 era of loose monetary policy.

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

Do non-US agents have **inelastic demand** for the US dollar? Does their buying pressure move the **cross-currency basis**?

We use the granular instrumental variable (**GIV**) approach of Gabaix and Koijen (2024), which extracts idiosyncratic demand shocks from latent macro factors.

Using non-US agents' holding of synthetic dollars, we use GIV to show that:

- Non-US agents have inelastic demand for synthetic USD funding: a 1% increase in the basis results in a <1% decrease in USD holdings (-0.41%).
- Non-US agents' buying pressure puts pressure on the basis: a 1% surge increases price by 0.54%.

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*	0.21**	0.23**	0.24**
	(0.08)	(0.08)	(0.08)	(0.09)
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***	−0.35***	−0.33***	−0.18***
Controls	Yes	Yes	Yes	Yes
FE/clustering	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$	$\alpha + \tau$
Obs.	48,740	48,740	48,740	48,740

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 $Net_{Rp\text{-}Swp}$ (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.
- Policy implications: consequences of quarterly window reporting, differential balance sheet treatment of instruments, and structure of (US) wholesale funding markets.

APPENDIX

Literature

- **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 et al. (2023)

Quarter-end volume surge

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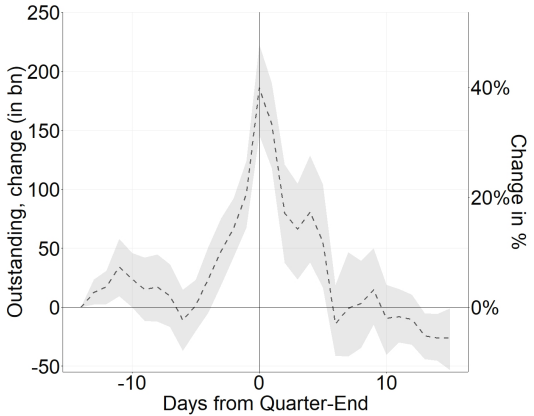

Outstanding swap volumes, SN to 1W tenor point, all currencies.

Treatment of repo vs. FX swaps

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Balance sheet	Assets		Liabilities		
	Bond	100 $	Equity	200 €	
	Cash	100 €	Debt	100 $	
	Cash	100 $			
Off-balance sheet					

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

Balance sheet	Assets		Liabilities		
	Bond	100 $	Equity	200 €	
	Cash	100 $			
Off-balance sheet					
	FX receivables	100 €	FX payables	100 $	

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

Nationalities

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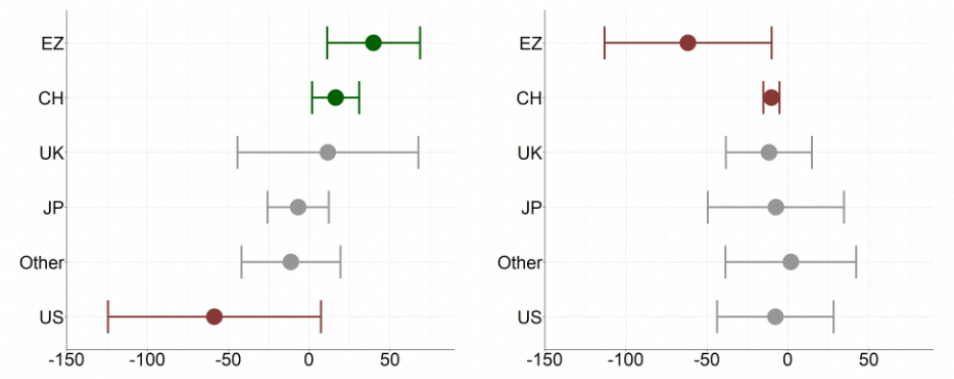

(a) Net USD FX swap borrowing, Δ bn USD

(b) USD repo borrowing, Δ bn USD

Dollar uniqueness

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	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)
Controls						
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

Year-ends

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	Swap Share (%)				
	EZ	CH	JP	UK	US
β_0	41.59***	84.28***	33.36***	68.94***	70.41***
	(2.20)	(2.04)	(4.42)	(2.81)	(0.99)
Q^{end}	12.05***	9.01***	5.95***	4.59***	−0.46
	(1.71)	(1.53)	(1.26)	(1.03)	(0.72)
$Q^{end} : Y^{end}$	−5.64	−3.94	−2.95	−8.99***	−11.52***
	(3.48)	(2.43)	(2.65)	(2.90)	(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	log	bn USD	log	bn USD	log
	(1)	(2)	(3)	(4)	(5)	(6)
Secured	16.18**	0.72	8.42	−0.62	10.18*	0.86
	(6.71)	(0.41)	(7.86)	(1.32)	(4.33)	(0.88)
Q^{end}	−1.00	−0.04	−0.22	−0.14	−0.13	0.03
	(0.71)	(0.03)	(0.48)	(0.13)	(0.32)	(0.10)
Secured : Q^{end}	−8.68***	−0.34**	−1.46	0.01	−0.28	0.01
	(2.08)	(0.11)	(1.62)	(0.09)	(0.41)	(0.09)
Controls						
Q^{end} : Y^{end}	−0.88	−0.08	0.25	0.08	0.85	0.13
	(0.64)	(0.10)	(0.40)	(0.14)	(0.45)	(0.12)
Secured : Q^{end} : Y^{end}	−2.21	0.02	−5.21*	−0.40**	−1.11	−0.14
	(2.80)	(0.08)	(1.72)	(0.06)	(0.95)	(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

US money market reform

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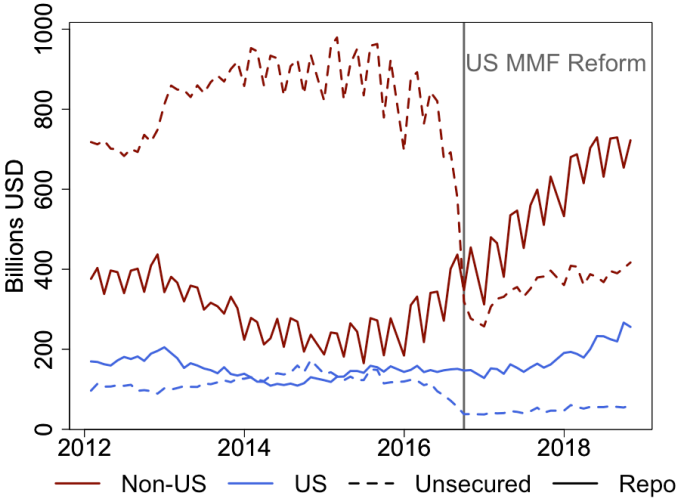

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