Draining the Well: Quantitative Tightening and Bank Lending

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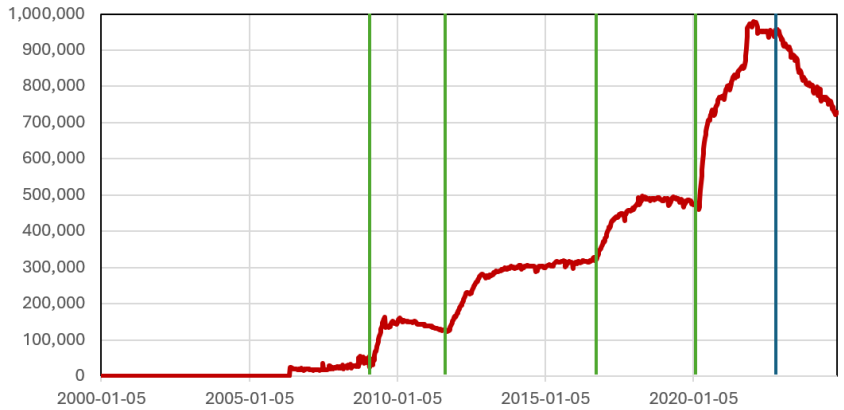
In a nutshell



Motivation:

1. Since 2022: QT $\rightarrow$ withdrawal of liquidity (reserves) from banks.
2. 2023 Banking turmoil $\rightarrow$ shone light banks' liquidity and interest rate risk.

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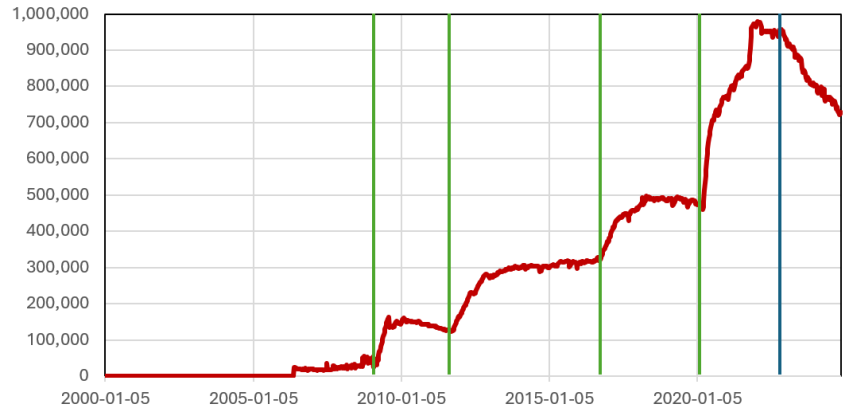

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Question: **How does QT affect bank lending, and what's the role of banks' liquidity and interest rate risk management**

In a nutshell

Answer: QT reduces the quantity of lending, but increases its maturity

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Mechanism: QT shrinks self-insurance (reserves) available to banks, leading to:

1. Banks $\downarrow$ their exposure to illiquid assets (loans)
2. Broader rebalancing towards liquid assets and stickier funding
3. Lowers liquidity risk but tends to compress return on assets and maturity transformation $\rightarrow$ rebalancing towards assets with same liquidity but longer maturities

Why do we care?

Impact of QT theoretically ambiguous

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Our implications:

1. Novel bank-lending channel driven by interaction of liquidity and interest rate risk management, rather than reserve requirements (Bernanke and Blinder (1988)), deposit markets (Drechsler et al. (2017)), or interbank market (Bianchi and Bigio (2022))

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2. QE/QT affects allocation of duration between banks and borrowers, not only its quantity in private sector (Vayanos and Vila(2021)).
3. Banks neutralise effect on liquidity risk $\rightarrow$ QE does not need to lead to risk ratcheting up (Acharya et al.(2023)). But this neutralisation might entail higher interest rate risk.

Empirical laboratory: Post Covid UK (2020-2024)

- 2020-2021: QE
- 2022-2024: QT

QT Motivation

- Not tighten monetary policy (preference for using Bank Rate).
- But avoid ratcheting up in balance sheet over time.

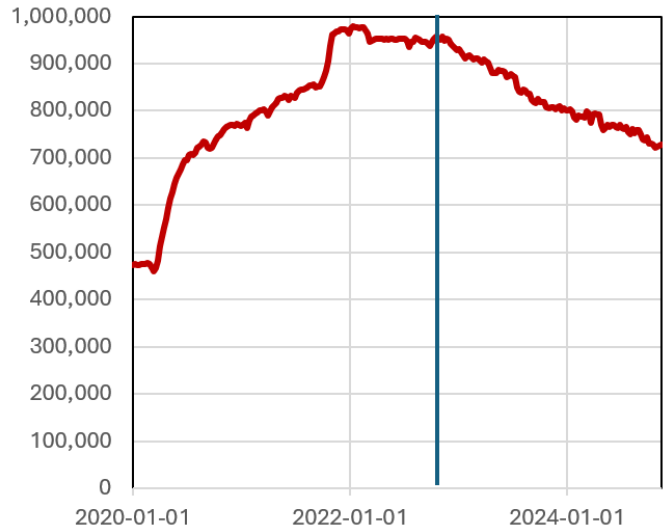

Figure: Total UK central bank reserves

Benefits of UK context

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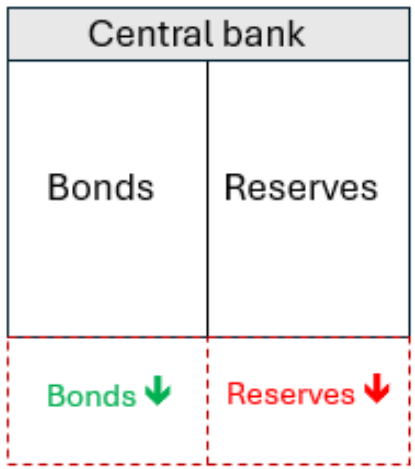
- Loan-level data (mortgages) $\rightarrow$ control for demand
- Monthly data on composition and maturity split of assets and liabilities $\rightarrow$ understand mechanism
- No leverage requirement on reserves $\rightarrow$ focus on liquidity effects and not capital (Diamond et al. 2024 JFE)
- All banks subject to Liquidity Coverage Ratio, unlike pre-Covid US (Acharya et al. 2023)

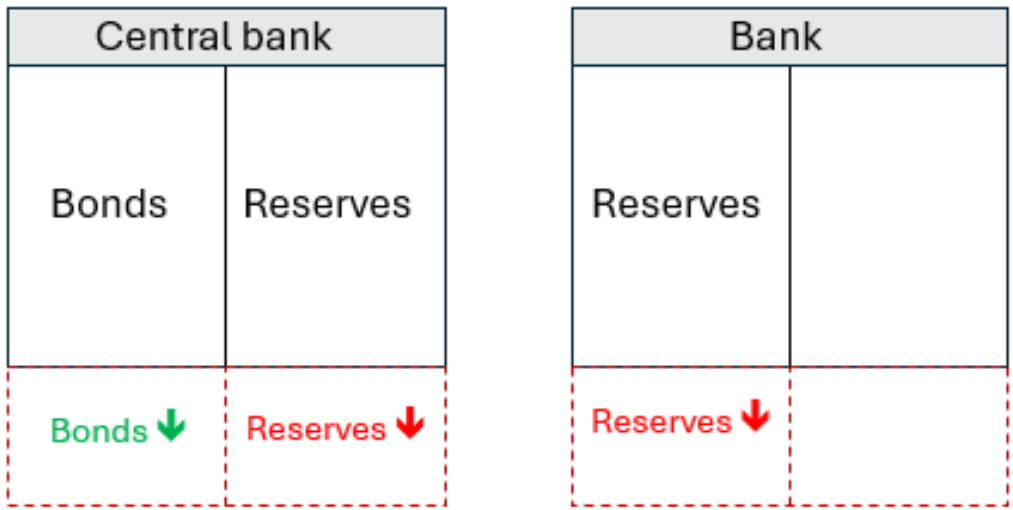
Theoretical framework

Mechanical effect of QT



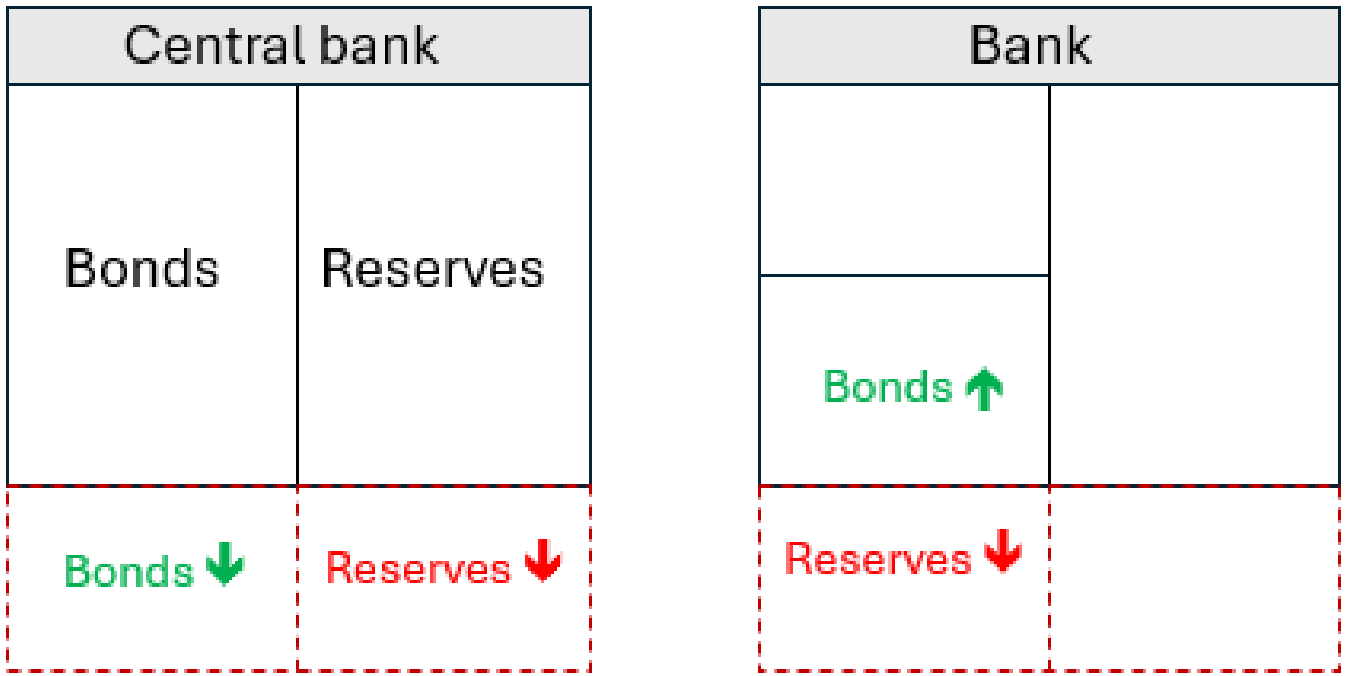
- Central bank sells bonds against reserves. Reserves are destroyed.

Mechanical effect



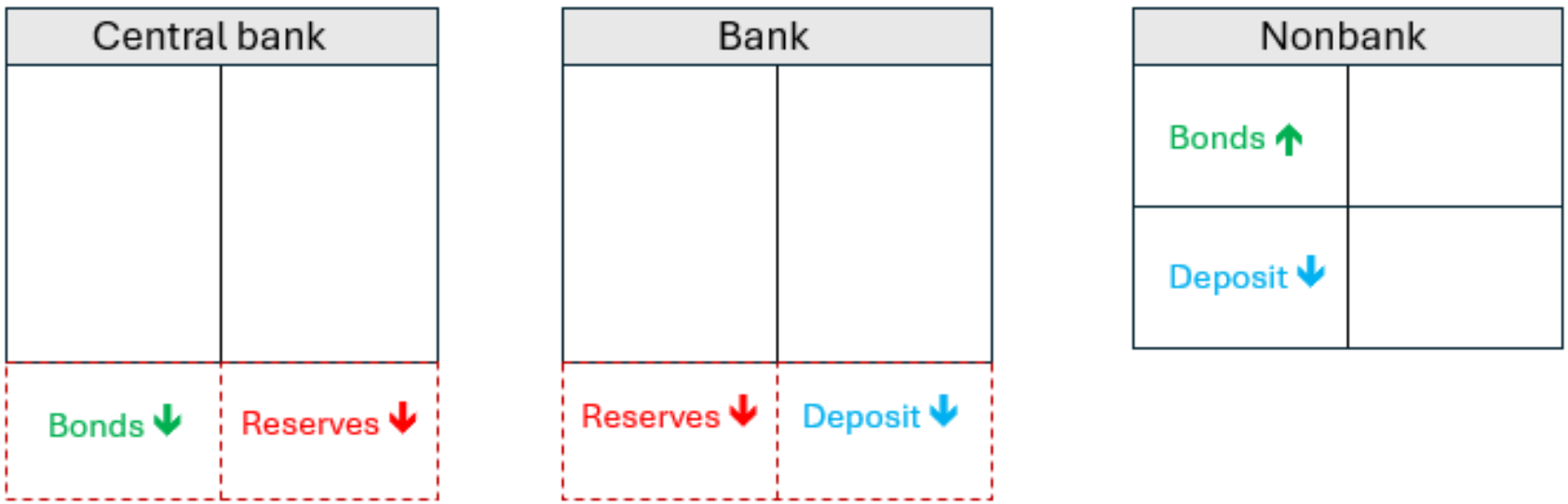
- Banks' reserves holdings shrink one-for-one (Only banks can hold reserves)
- Net effect for banks depends on who buys bonds.

Scenario I: bank buys bonds



Not the dominant scenario (e.g. Kaminska and Kontoghiorghes, 2025): QE/QT auctions dominated by NBFIs, not banks.

Mechanical effect (II): nonbank buys bonds



Hypothesis: Liquidity risk management mechanism

How should reserve losses due to QT impact lending?

- H1: $\downarrow$ **Reserves** $=$ $\downarrow$ **lending**
  - Reserves = most liquid asset (direct monetization)
  - $\downarrow$ reserves=$\uparrow$ higher liquidity risk.
  - $\downarrow$ exposure to illiquid assets e.g. lending.

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How should reserve losses due to QT impact lending?

- H1: ↓ **Reserves = ↓ lending**
  - Reserves = most liquid asset (direct monetization)
  - ↓ reserves=↑ higher liquidity risk.
  - ↓ exposure to illiquid assets e.g. lending.

- H2: ↓ **Reserves = lending unchanged**.
  1. Parallel loss in deposits = ↓ liquidity risk; this could offsets loss in liquidity insurance
  2. Banks above preferred liquidity holdings going into QT

Empirical Approach

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Run variants of:

$$\text{Lending}_{i,t} = \beta \cdot \Delta(\textit{Reserves})_{i,t} + \varepsilon_{i,j,t}$$

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$$\text{Lending}_{i,t} = \beta \cdot \Delta(\textit{Reserves})_{i,t} + \varepsilon_{i,j,t}$$

Challenge: isolate variation in $\Delta(\textit{Reserves})_{i,t}$ driven by plausibly exogenous factors due to QT rather than by factors endogenous to banks' lending decisions

$\rightarrow$Three-pillar empirical approach.

Pillar 1: Loan demand model with fixed effects

Issue: QT could coincide with changes in credit demand

$$Spread_{i,l,t} = \beta \cdot \Delta(Reserves)_{i,t} + \varepsilon_{i,l,t}$$

Include:

- Postcode-month fixed effects;
- Borrower type-month fixed effects (first-time buyer; refinance; house mover);
- Mortgage type-month fixed effects (combination of LTV and maturity bucket)

Pillar 2: Instrumental variable

- Instrument $\Delta(\textit{Reserves})$ to only exploit variation driven by QT.
- Shift-share IV building on Acharya et al. (2023).
- Captures interaction of two exogenous dimensions of QT

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- Change in BoE reserves supply over last year $\rightarrow$ should be exogenous to any individual bank.
- Share of reserves held by bank i over last year $\rightarrow$ captures the extent to which a bank is exposed to QT for pre-determined reasons (eg exposure to NBFI clients).

Pillar 3: Controlling for confounding supply-side mechanisms

Add interacted controls to address correlations between either aspect of the shift-share instrument and some supply-side confounding factors.

- Interact Bank Exposure$_{i,t}$ with correlates of Δ(Agg. Reserves$_t$) (e.g. high-frequency monetary policy shocks)
- Interact Agg. Reserves$_t$ with correlates of Bank Exposure$_{i,t}$ (e.g. government bond holdings).

Headline Results

QT and Bank Lending: Loan-Level Panel

	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:	OLS	IV (Stage 1)			IV (Stage 2)	
Dependent variable:	$Spread_{i,l,t}$	$\Delta(Reserves)_{i,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$
$\Delta(Reserves)_{i,t}$	-0.110*		-0.274**	-0.244*	-0.411**	-0.442***
	(0.0621)		(0.132)	(0.125)	(0.154)	(0.132)
$Predicted(\Delta(Reserves)_{i,t})$		7.182***				
		(0.671)				
$\Delta(Reserves)_{i,t} \times Mat_{i,j,t}$						
Observations	2078542	1985418	1985418	1985418	1984445	1944640
R-squared	0.608	0.766	0.00973	0.149	0.0457	0.0132
F-stat KP			114.7	114.8	30.40	37.73
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	No	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Product x Time	No	No	No	No	Yes	Yes
Product x Bank FE	No	No	No	No	Yes	Yes
Location x Time FE	No	No	No	No	No	Yes
Borrower type x Time FE	No	No	No	No	No	Yes

QT and Bank Lending: Robustness

- ✓ Alternative dataset: monthly loan volumes
- ✓ Change measurement of $\Delta Reserves$
- ✓ Modifications of IV: lagging *Bank Exposure* by 1+ year, etc.
- ✓ Extra interactions w/ *Bank Exposure* (conventional monetary policy shocks using high-frequency identification)
- ✓ Extra interactions w/ $\Delta Agg.Reserves$ (size, gilt holdings)

II. Balance-Sheet Rebalancing

Evidence from Balance-Sheet Rebalancing

If main results reflect liquidity self-insurance mechanism, balance sheets could rebalance more broadly to offset liquidity risk from QT

- Switch to *bank-level model*
- Looser identification, but richer picture of balance sheet changes.

Three main consistent results

1. Pivot towards more liquid assets and stable funding

$$\%(Y)_{i,t} = \beta \cdot \Delta(Reserves)_{i,t} + B \cdot Controls + \epsilon_{i,t}, \qquad (1)$$

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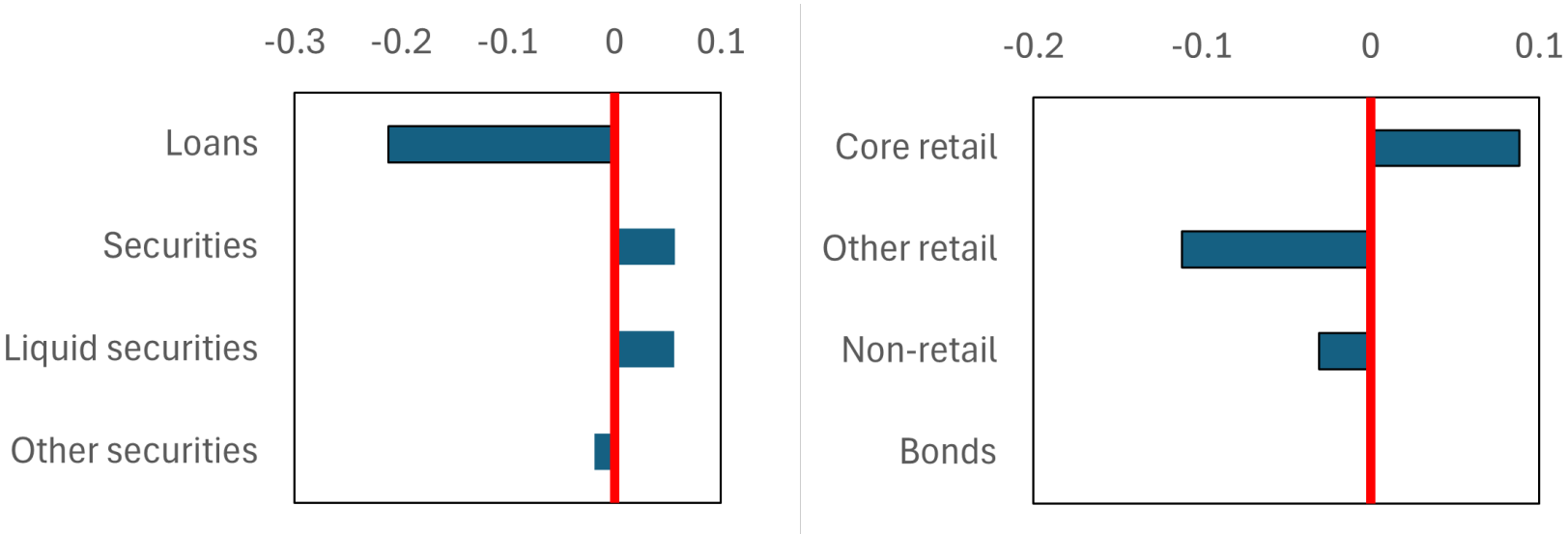
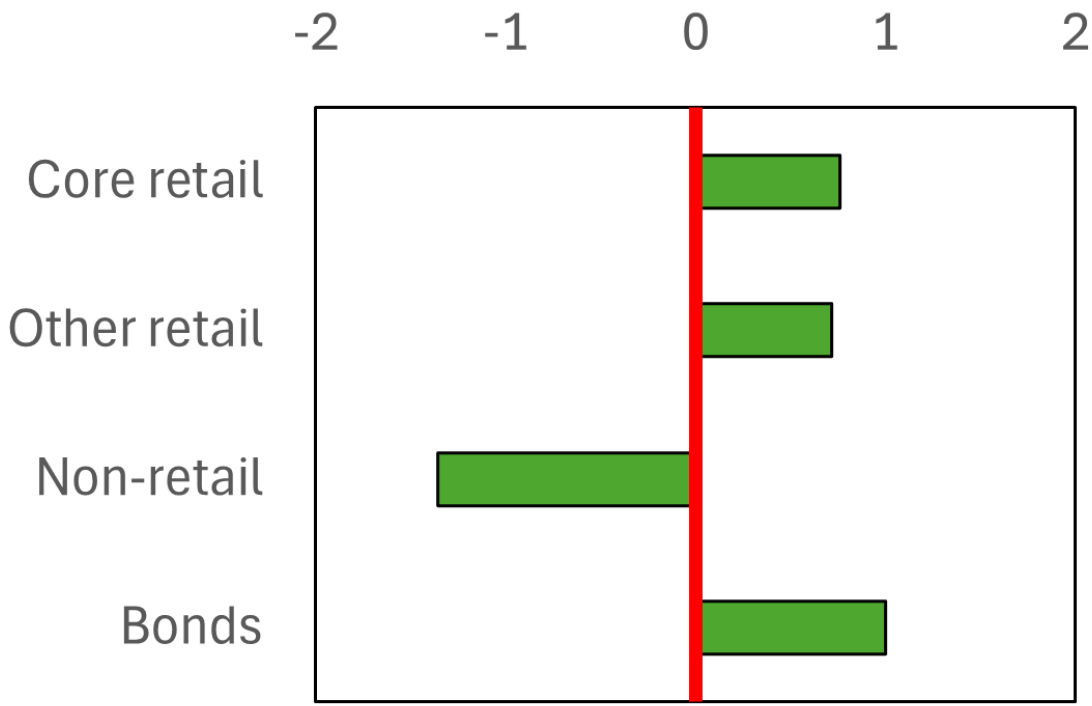


Figure: IV parameter estimate for -β (if significant)

2. Pivot towards longer-maturity funding

$$\Delta(Maturity)_{i,y,t} = \beta \cdot \Delta(Reserves)_{i,t} + B \cdot Controls + \epsilon_{i,t}, \quad (2)$$



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3. Lending effect stronger when initial liquidity risk higher

$$\Delta(Loan)_{i,t} = \gamma \cdot \Delta(Reserves)_{i,t} \times Liquidity\ Risk_{i,t=0} + B \cdot Controls + \epsilon_{i,t}, \quad (3)$$

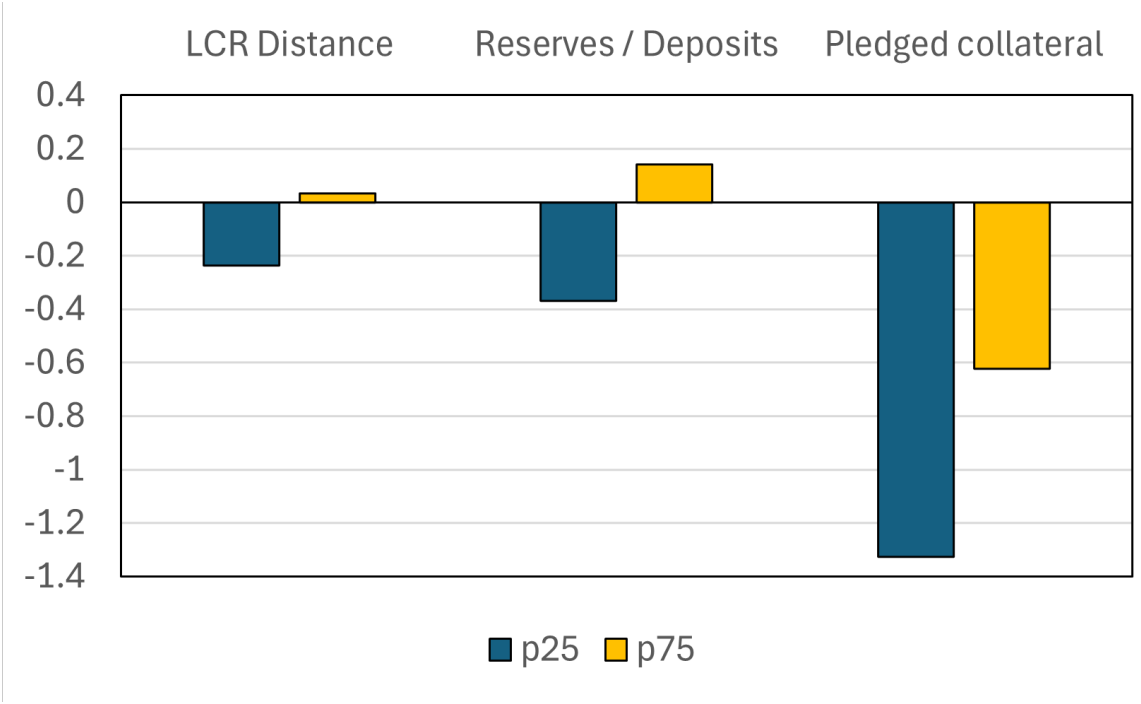

Figure: IV parameter estimate for -γ for 25th and 75th percentile bank

Effect insignificant for banks with starting LCR above sample mean.

III. Interaction between liquidity and interest rate risk

Interaction between liquidity and interest rate risk

- Banks neutralise impact of QT on liquidity risk
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- Banks neutralise impact of QT on liquidity risk
- This entails pivoting towards (i) lower-yielding assets and (ii) costlier funding
- Banks offset that by pivoting towards assets with longer duration and therefore interest risk exposure, but have the same liquidity profile

- Three key consistent results

1. Increase in spreads weaker for longer-term mortgages

$$Spread_{i,l,t} = \beta \cdot \Delta(Reserves)_{i,t} \times Maturity_{i,l,t} + \varepsilon_{i,l,t}$$

Estimator:	(1) OLS	(2) IV (Stage 1)	(3)	(4)	(5) IV (Stage 2)	(6)	(7)
Dependent variable:	$Spread_{i,l,t}$	$\Delta(Reserves)_{i,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$	$Spread_{i,l,t}$
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Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan Controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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Product x Bank FE	No	No	No	No	Yes	Yes	Yes
Location x Time FE	No	No	No	No	No	Yes	Yes
Borrower type x Time FE	No	No	No	No	No	Yes	Yes

2. Pivot towards longer-maturity loans and securities

$$\Delta(Maturity)_{i,y,t} = \beta \cdot \Delta(Reserves)_{i,t} + B \cdot Controls + \epsilon_{i,t}, \quad (4)$$

Figure: IV parameter estimate for -β (if significant)

3. LCR effect is neutralised, but duration gap increases

$$\Delta(Risk)_{i,y,t} = \beta \cdot \Delta(Reserves)_{i,t} + B \cdot Controls + \epsilon_{i,t}, \qquad (5)$$

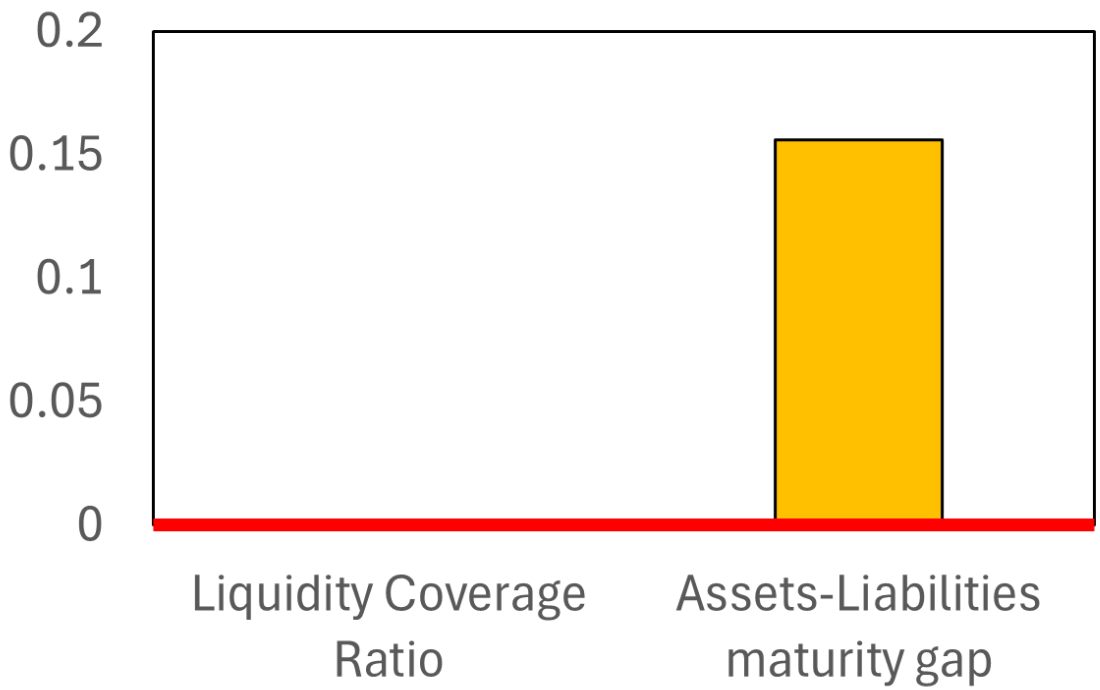

Figure: IV parameter estimate for -$\Delta(Reserves)$ (if significant); Dependent variable is monthly change in given indicator.

Conclusion

Banking frictions affect the transmission of balance sheet policies; opposite effects on quantity and maturity of lending.

- Novel bank-lending channel driven by interaction of liquidity and interest rate risk management, rather than by reserve requirements, deposit market competition, or interbank markets
- QE/QT affects the allocation of duration between banks and borrowers, not only the quantity of duration in private sector.
- QE does not need to lead to risk ratcheting up – subject to liquidity being regulated.
- But lowering liquidity risk might entail higher interest rate risk

Appendix

Related literature

- **BLC of conventional policy:** Bernanke and Blinder (1988); Drechsler et al., (2017)' Bianchi and Bigio (2022)

- **Impact of QE on lending via:**
  - **Impact on reserves:** Diamond et al. (2022); Kandrac and Schulsche (2021), Kandrac et al. (2021); Miller and Wanengkiryto (2020); Butt et al. (2014)
  - **Asset substitution:** Darmouni and Rodnyansky (2017); Giansante et al., (2022)

- **Impact of QT on:**
  - **Liquidity creation:** Acharya et al (2023)
  - **Interest rate control:** Lopez-Salido and Vissing-Jorgensen (2023)
  - **Operational frameworks**: Altavilla et al. (2023)

Data

- **Bank balance sheets**: PRA 110
  - Covers all UK banks regulated by the PRA
  - Info on
  - Contains info on banks other assets and liabilities
  - Starts in 2020. Weekly for big banks, monthly for small banks.
  - Cross-checked against Bank Panel Dataset.
- **Mortgages**: Product Sales Database (PSD)
  - Confidential dataset collected by the FCA
  - All UK residential mortgages on a loan-by-loan basis
- **Controls:** FinRep and CoRep
  - Quarterly data on bank profitability (ROA) and capitalization (Tier 1 capital ratio)

Merged dataset: Approximately 2 million loans originated by 64 different banks over 2020 - 2024 period (QE5 + QT).

Bank Lending Robustness

Table: QT and bank lending: robustness checks (monthly bank panel)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6) $\Delta(Loans)_{i,t}$	(7)	(8)	(9)	(10)	(11)
$\Delta(Reserves)_{i,t}$	0.424***			1.008**	0.340***	0.242***	0.481***	0.441***	0.408***	1.001***	0.416***
	(0.0580)			(0.441)	(0.0322)	(0.0325)	(0.0535)	(0.0677)	(0.0572)	(0.105)	(0.0374)
$\Delta^{3m}(Reserves)_{i,t}$		0.315***									
		(0.0383)									
$\Delta(Reserves)_{i,t-1}$			0.399***								
			(0.0582)								
$\Delta(Reserves)_{i,t} \times Size_{i,t-1}$					0.0270						
					(0.0182)						
$\Delta(Reserves)_{i,t} \times ROA_{i,t-3}$					0.0470***						
					(0.0136)						
$\Delta(Reserves)_{i,t} \times Capital_{i,t-3}$					0.0278						
					(0.0295)						
$\Delta(Reserves)_{i,t} \times \%(Size)_{i,t-1}$						1.241***					
						(0.417)					
$Path_{i,t-12} \times BankExposure_{i,t}$											2.432***
											(0.834)
$Target_{i,t-12} \times BankExposure_{i,t}$											0.407
											(0.663)
Observations	2740	3415	2742	2740	2740	2740	2464	2776	2407	1524	2740
R-squared	-0.140	-0.391	-0.176	-4.121	0.0884	0.237	-0.329	-0.205	-0.0770	-3.858	-0.112
F-stat KP	43.99	43.20	43.83	5.550	140.2	20.39	17.14	24.16	64.43	10.57	65.82
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Big-6 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Big-6 x Time FE	No	No	No	Yes	No	No	No	No	No	No	No
IV variant							APF	13M	13-18M	%(ICPF)	

Back

Mortgage spreads Robustness

Table: QT and bank lending: robustness checks (loan-level regressions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta(Reserves)_{i,t}$	-0.442***			-0.379***	-0.389***	-0.384***	-0.542**	-0.222***	-0.210***	-0.138	-0.344***
	(0.132)			(0.0750)	(0.125)	(0.0862)	(0.208)	(0.0708)	(0.0727)	(0.0954)	(0.109)
$\Delta^{3m}(Reserves)_{i,t}$		-0.551**									
		(0.248)									
$\Delta(Reserves)_{i,t-1}$			-0.475***								
			(0.161)								
$\Delta(Reserves)_{i,t} \times Size_{i,t-1}$					-0.106						
					(0.0733)						
$\Delta(Reserves)_{i,t} \times ROA_{i,t-3}$					0.0425						
					(0.0999)						
$\Delta(Reserves)_{i,t} \times Capital_{i,t-3}$					-0.0476						
					(0.0401)						
$\Delta(Reserves)_{i,t} \times \%(Size)_{i,t-1}$						-0.530					
						(1.043)					
$\Delta(Reserves)_{i,t} \times Exposure_{i,t}$											0.197
											(1.423)
$Target_{i,t-12} \times Exposure_{i,t}$											-3.135***
											(0.939)
Observations	1944640	2497511	1881599	1944640	1944640	1944640	1866105	2039567	1668678	1814093	1944640
R-squared	0.0132	0.00560	0.0112	0.0150	0.0166	0.0163	0.00612	0.0210	0.0198	0.0230	0.0197
F-stat KP	37.73	31.93	25.68	37.56	16.88	28.85	13.88	38.38	44.84	6.943	35.73
Bank and loan Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product x Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location x Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower type x Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Big-6 x Time FE	No	No	No	Yes	No	No	No	No	No	Yes	No
IV variant							APF	13M	13-18M	%(ICPF)	

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QT and Bank Lending: mechanism (Asset Volumes)

Table: QT and Bank Lending: mechanism (Asset Volumes)

Dependent variable:	(1) $\Delta(Loans)_{i,t}$	(2) $\Delta(Securities)_{i,t}$	(3) Δ(Liquid Sec)$_{i,t}$	(4) Δ(Less liquid Sec)$_{i,t}$
Panel A				
$\Delta(Reserves)_{i,t}$	0.424***	-1.065***	-0.961*	0.153
	(0.0580)	(0.223)	(0.505)	(0.359)
Observations	2740	1937	1797	1200
F-stat KP	43.99	34.85	28.52	55.14
Panel B				
$\Delta(Reserves)_{i,t} \times QE$	0.489***	-1.152***	-0.296**	-1.176***
	(0.0751)	(0.0932)	(0.115)	(0.108)
$\Delta(Reserves)_{i,t} \times QT$	0.430***	-1.117***	-1.061**	0.837
	(0.0745)	(0.269)	(0.423)	(0.792)
Observations	2740	1937	1797	1200
Time FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

QT and Bank Lending: mechanism (Liabilities Volumes)

Table: QT and Bank Lending: mechanism (Liabilities Volumes)

Dependent variable:	(1) $\Delta(\text{Core Retail})_{i,t}$	(2) $\Delta(\text{Non-core Ret})_{i,t}$	(3) $\Delta(\text{Non-Retail})_{i,t}$	(4) $\Delta(\textit{Bonds})_{i,t}$	(5) $\Delta(\text{Sight})_{i,t}$	(6) $\Delta(\text{Time})_{i,t}$
Panel A						
$\Delta(\textit{Reserves})_{i,t}$	0.172***	0.869***	0.222	-1.178**	-0.0550	-1.618***
	(0.0310)	(0.0959)	(0.172)	(0.508)	(0.174)	(0.294)
Observations	2547	2713	2511	1305	2656	2656
Panel B						
$\Delta(\textit{Reserves})_{i,t} \times QE$	0.0141	1.338***	0.853***	-1.030	0.397*	-3.023***
	(0.211)	(0.130)	(0.166)	(0.612)	(0.207)	(0.213)
$\Delta(\textit{Reserves})_{i,t} \times QT$	0.0971**	1.020***	-0.166	-2.194***	0.406	-1.223***
	(0.0391)	(0.142)	(0.129)	(0.424)	(0.352)	(0.223)
Observations	2547	2713	2511	1305	2656	2656
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

The impact of QT on the LCR

$$LCR = \frac{HQLA}{Liabilities^{Outflow}_{\text{over 30 days}} - Assets^{Inflow}_{\text{over 30 days}}}$$

- QT usually expected to worsen banks' liquidity position (e.g. Bank of Canada (2024), EBA (2024), Riksbank (2024).
- We show that this formally depends on (i) assumed outflow rate of NBFI deposits and (ii) starting LCR.

$$\Delta(LCR) = \frac{\Delta[k \times HQLA - (N \times k + R \times m)]}{(N \times k + R \times m - \Delta \times k)(N \times k + R \times m)}$$

This simplifies to:

$$k < \frac{1}{LCR_0}.$$

Back

The impact of QT on the LCR

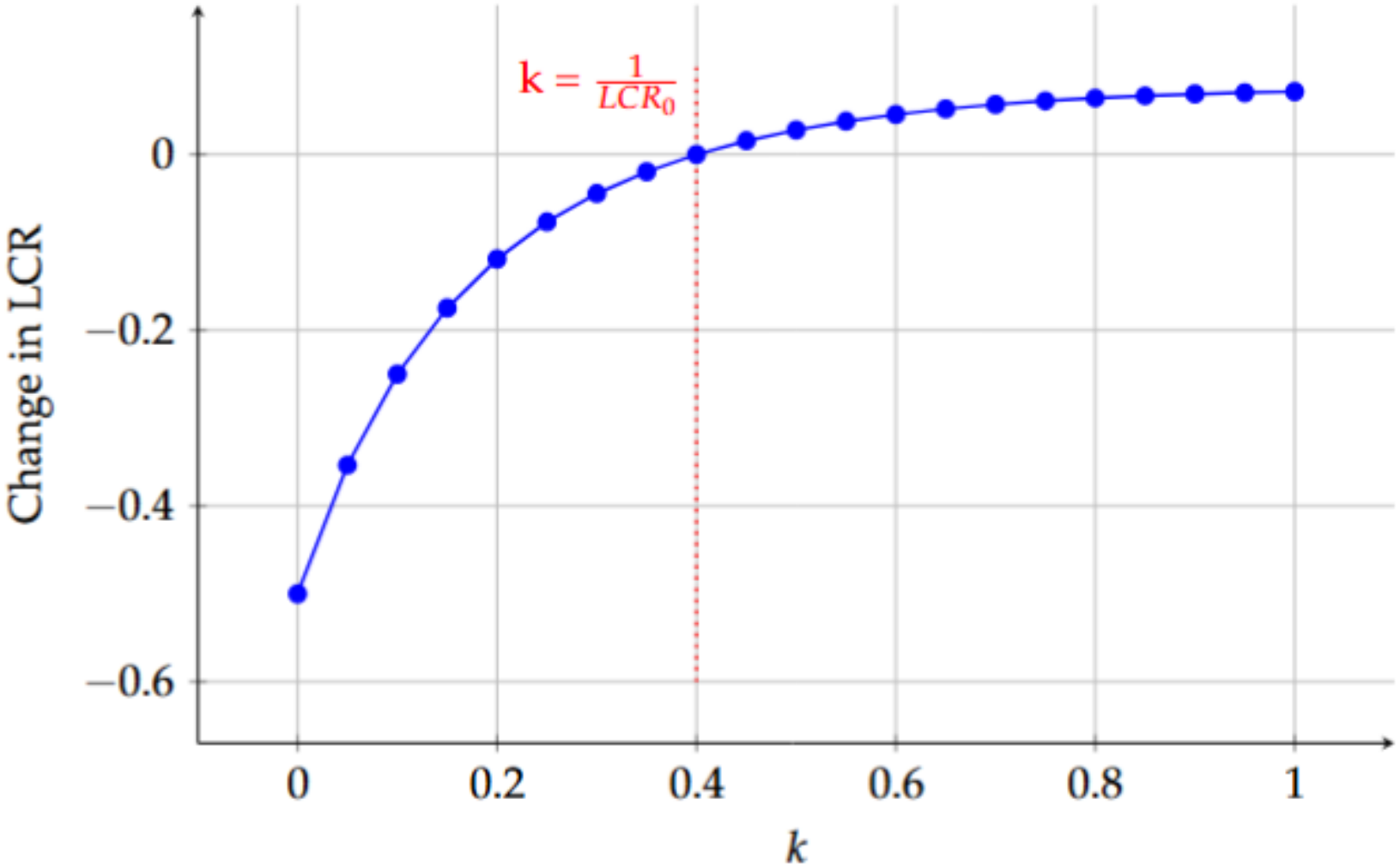


Figure: Impact for a bank with median LCR level.

The impact of QT on the LCR

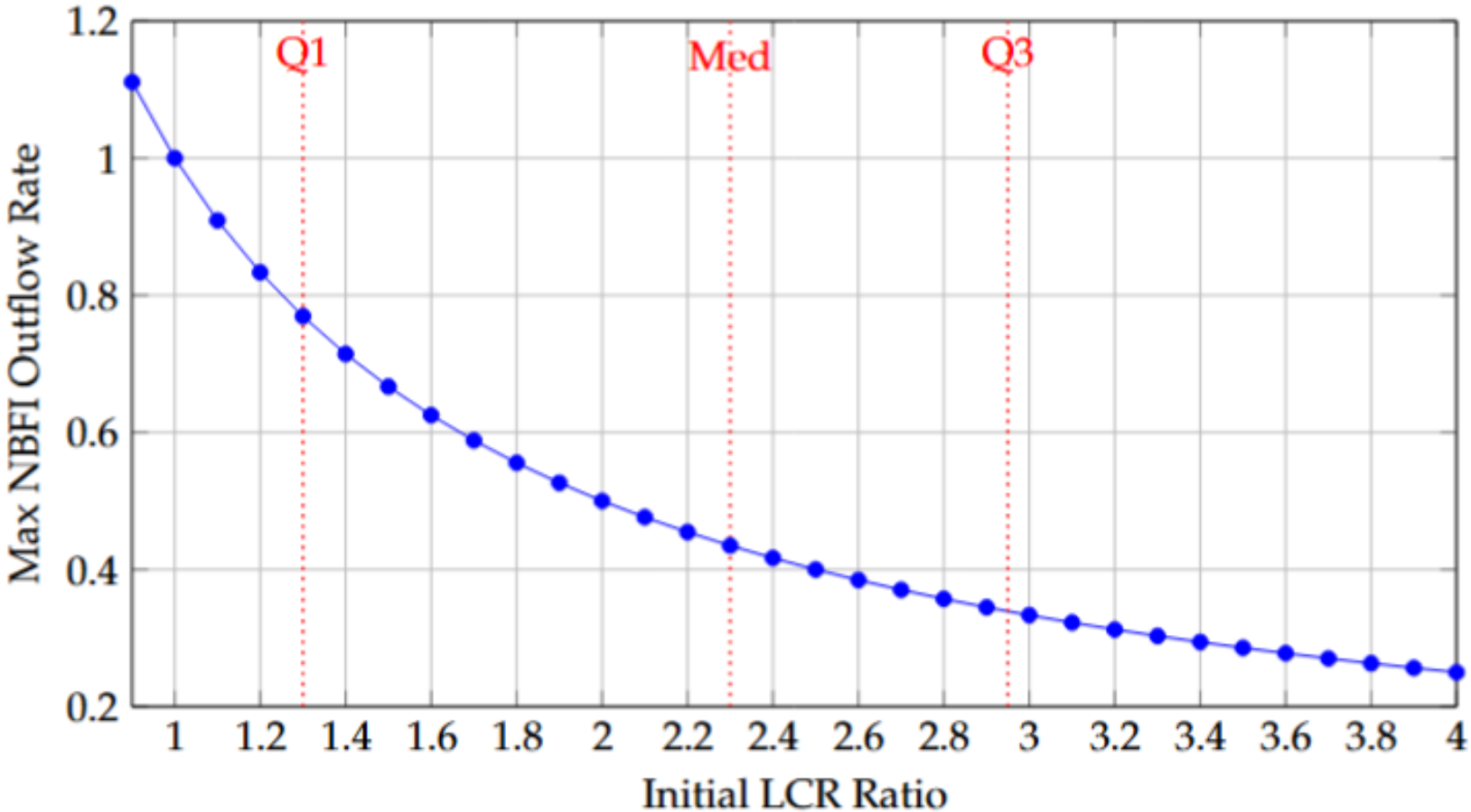


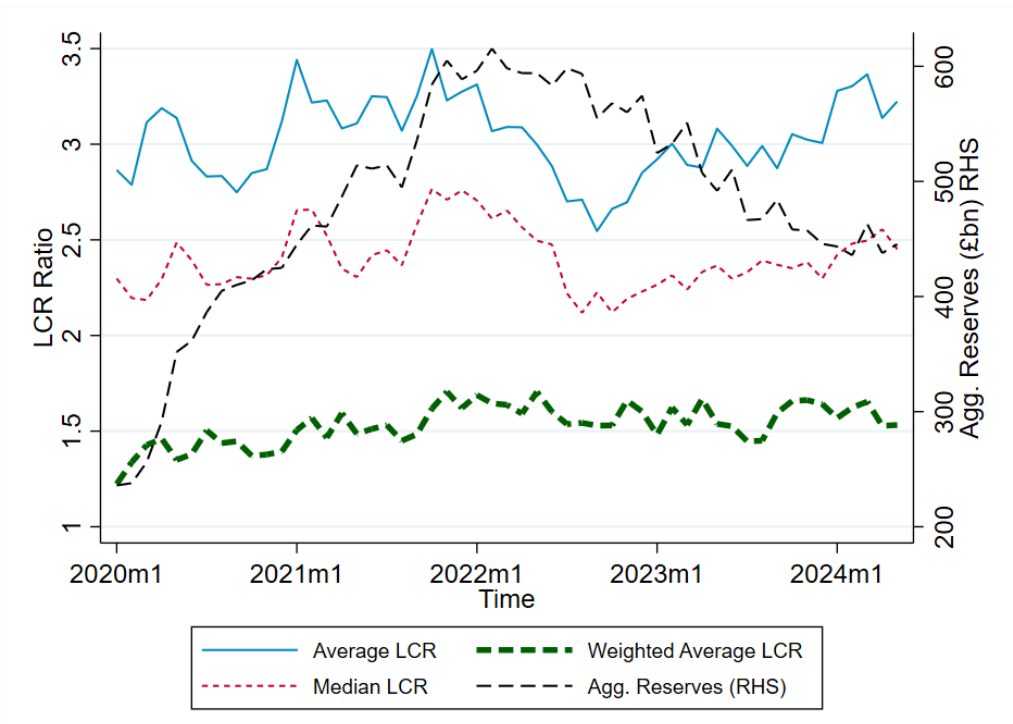
Figure: "Q1" and "Q3" refer to the 25th and 75th percentile of the LCR distribution

The impact of QT on the LCR

- Key question: what is the outflow rate of deposits drained due to the QT?
- Basel rulebook for NBFI deposits: $k = 25\%$ or $k = 100\%$, depending on whether classified as "operational" or not.
- May qualify as operational if arises from clearing, custody, or cash management activities.
- Might depend on individual banks, accounts, and supervisors.
- During QE, strong incentive to classify as operational. High costs to reversing during QT (Riksbank, 2024)
- Our results only hold for LCR<average (critical k ca. 0.4).

Why can LCR bind even if relatively high?

- Banks appear to have a preference for stable LCR. Consistently, we find that LCR are not responsive to QE/QT.
- Consistent with regulatory views on lack of buffer usability during Covid (Basel Committee 2021; Saporta, 202x).
- "*BCBS report .. shows evidence of banks taking ... action to bolster liquidity... includ[ing by] cutting some lending... Certain actions ... could lessen market intermediation and credit provision through a reduction in certain types of lending and asset holding*".



Why can LCR bind even if relatively high?

	(1) $\Delta(\text{Tot Assets})_{WAM}$	(2) $\Delta(\text{Tot Liabilities})_{WAM}$	(3) $\Delta(\text{Assets - Liabilities})_{WAM}$	(4) $\Delta(LCR)$
$\Delta(Reserves)_{it}$	-0.171**	-0.135	-0.156*	0.469
	(0.0728)	(0.201)	(0.0864)	(0.686)
Observations	2734	1305	1271	2587
R-squared	0.270	0.0341	0.126	0.0431
F-stat KP	139.6	42.97	72.34	40.81
Time FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Figure: QT, asset and liabilities maturity, and LCR