Liquidity Dependence
and the Waxing and Waning of Central Bank Balance Sheets

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(Earlier version "Liquidity Dependence: Why Shrinking Central Bank Balance Sheets is an Uphill Task", presented at Jackson Hole Economic Symposium 2022)

Conundrum: Where did all the liquidity go?

- Unprecedented expansion of central bank balance sheets since the GFC

- Surprisingly fragile financial conditions
  - Repo rate spike in September 2019, Dash for cash in March 2020, Turmoil in UK gilts in Sep-Oct 2022, Silicon Valley, Signature and First Republic Bank failures in March 2023

- Are central bank balance sheet expansion and financial fragility related?

This paper

- Focus on banking sector liability-side (see Acharya-Rajan 2021)
  - In contrast to the more common asset-side and asset-pricing approach to QE

- Key insights: Reserves financed with demand deposits
  - QE is not just an expansion of central bank balance sheet
  - QE is typically also an expansion of commercial bank balance sheets

  - QE -> QT transition is not benign and fraught with financial fragility
  - Ratcheting up of central bank b/s size as it injects more reserves with each stress
  - QT can be an uphill task and QE may be less effective than envisaged

QE : (i) Purchase from banks

Initial Balance Sheet Conditions

The Fed Purchases Assets from Banks
Balance Sheet Effects

FEDERAL RESERVE	
Assets	**Liabilities**
Treasury securities	Reserves held by banks Cash

FEDERAL RESERVE	
Assets	**Liabilities**
Treasury securities +$1	Reserves held by banks +$1 Cash

BANKING SECTOR	
Assets	**Liabilities**
Treasury securities	Deposits
Reserves at the Fed	Capital

BANKING SECTOR	
Assets	**Liabilities**
Treasury securities -$1	Deposits
Reserves at the Fed +$1	Capital

Asset swap with banks

Source: "How the Fed Changes the Size of its Balance Sheet" (Leonard, Martin and Potter, *Liberty Street Economics,* 2017)

QE: (ii) Purchase from public/non-banks

Initial Balance Sheet Conditions

The Fed Purchases Assets from the Public
Balance Sheet Effects

FEDERAL RESERVE	
Assets	Liabilities
Treasury securities	Reserves held by banks
	Cash held by the Treasury

FEDERAL RESERVE	
Assets	Liabilities
Treasury securities +$1	Reserves held by banks +$1
	Cash held by the Treasury

Bank balance sheets expand, financed with deposits (typically wholesale or uninsured)

BANKING SECTOR	
Assets	Liabilities
Treasury securities	Deposits
Reserves at the Fed	Capital

PUBLIC	
Assets	Liabilities
Deposits	Net worth
Treasury securities	

BANKING SECTOR	
Assets	Liabilities
Treasury securities	Deposits +$1
Reserves at the Fed +$1	Capital

PUBLIC	
Assets	Liabilities
Deposits +$1	Net worth
Treasury securities -$1	

Source: "How the Fed Changes the Size of its Balance Sheet" (Leonard, Martin and Potter, *Liberty Street Economics,* 2017)

Given different ways of Fed b/s expansion...

We seek to answer the following important questions:

- How does Fed balance-sheet (QE) expansion affect the size, deposits, and "demandability" of deposits of the banking sector?

- Do other demandable liabilities issued by banks, such as credit lines to corporations, also grow with reserves?

- Do these claims shrink when the Fed shrinks its balance-sheet (QT)?

- Where do the claims to liquidity lie in the cross-section of banks? And why?

- What are its consequences for financial stability?

QT is not simply a reversal of QE!

- QE => growth of on- and off-balance-sheet demandable bank liabilities
  - Reserves expand
  - (Uninsured) Demand deposits expand
  - Plus shrinkage of deposit maturity; additional writing of credit lines

- Asymmetry between QE and QT:
  - Risk 1. Time-series: Hysteresis – Uninsured demand deposits don't come off when reserves do, raising the aggregate price of liquidity during QT
  - Risk 2. Cross-section: Reserves do not remain where the uninsured demand deposits are, increasing liquidity risk during QT
    - Less-capitalized banks seek illiquidity to boost ROE but become fragile in the process

- "Liquidity dependence" in the banking system in case of (even small) shocks
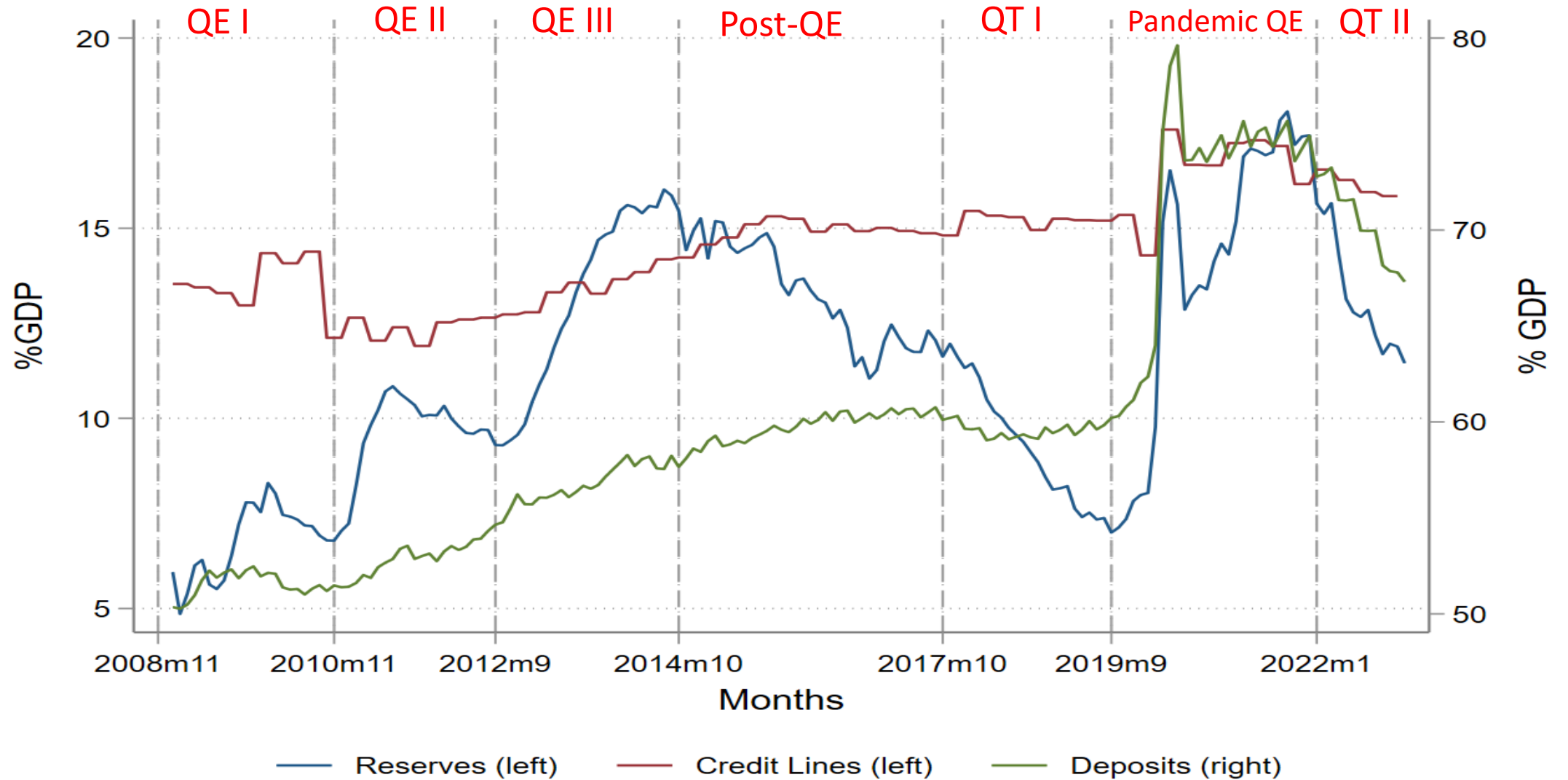
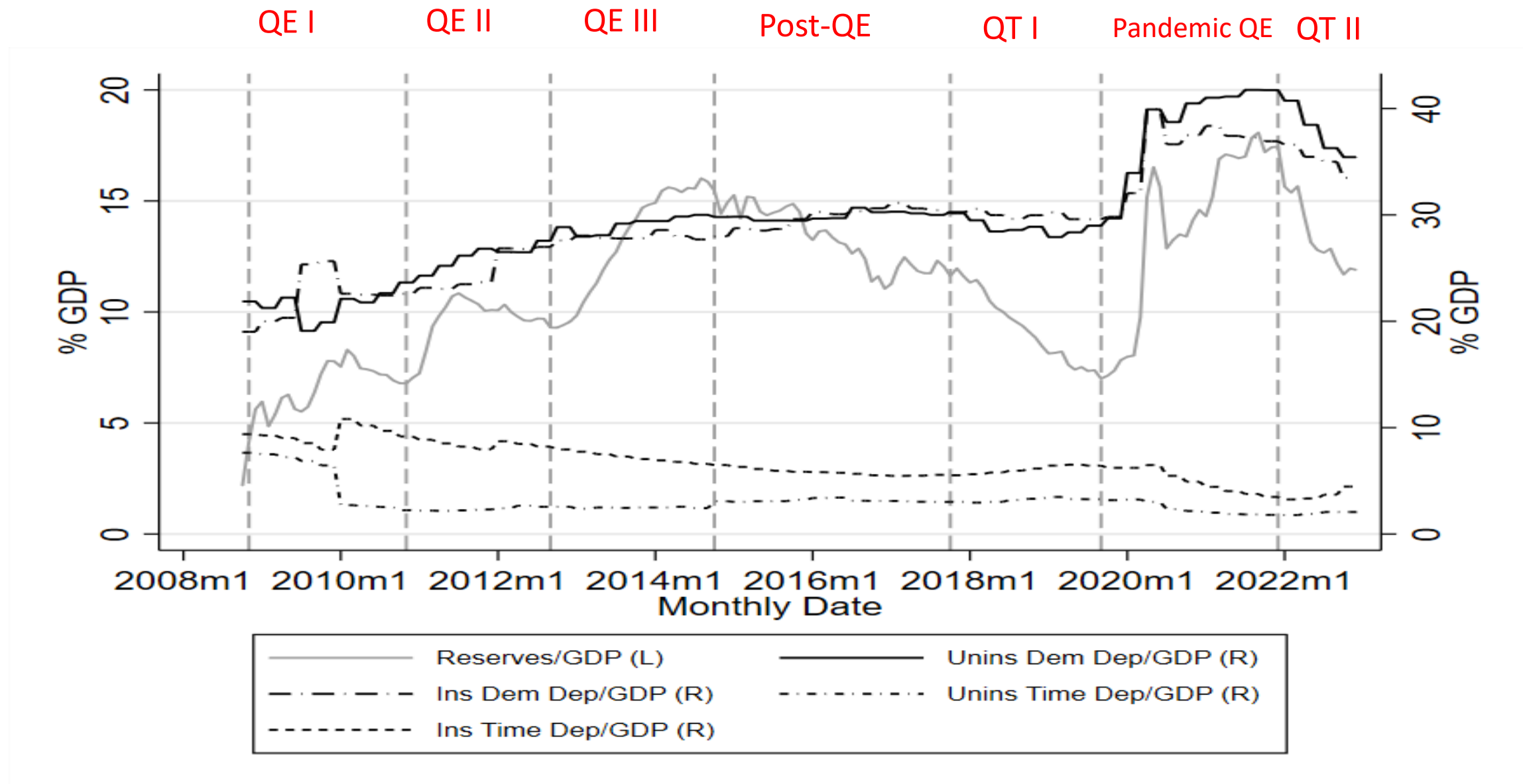# Reserves and Claims (% of GDP)
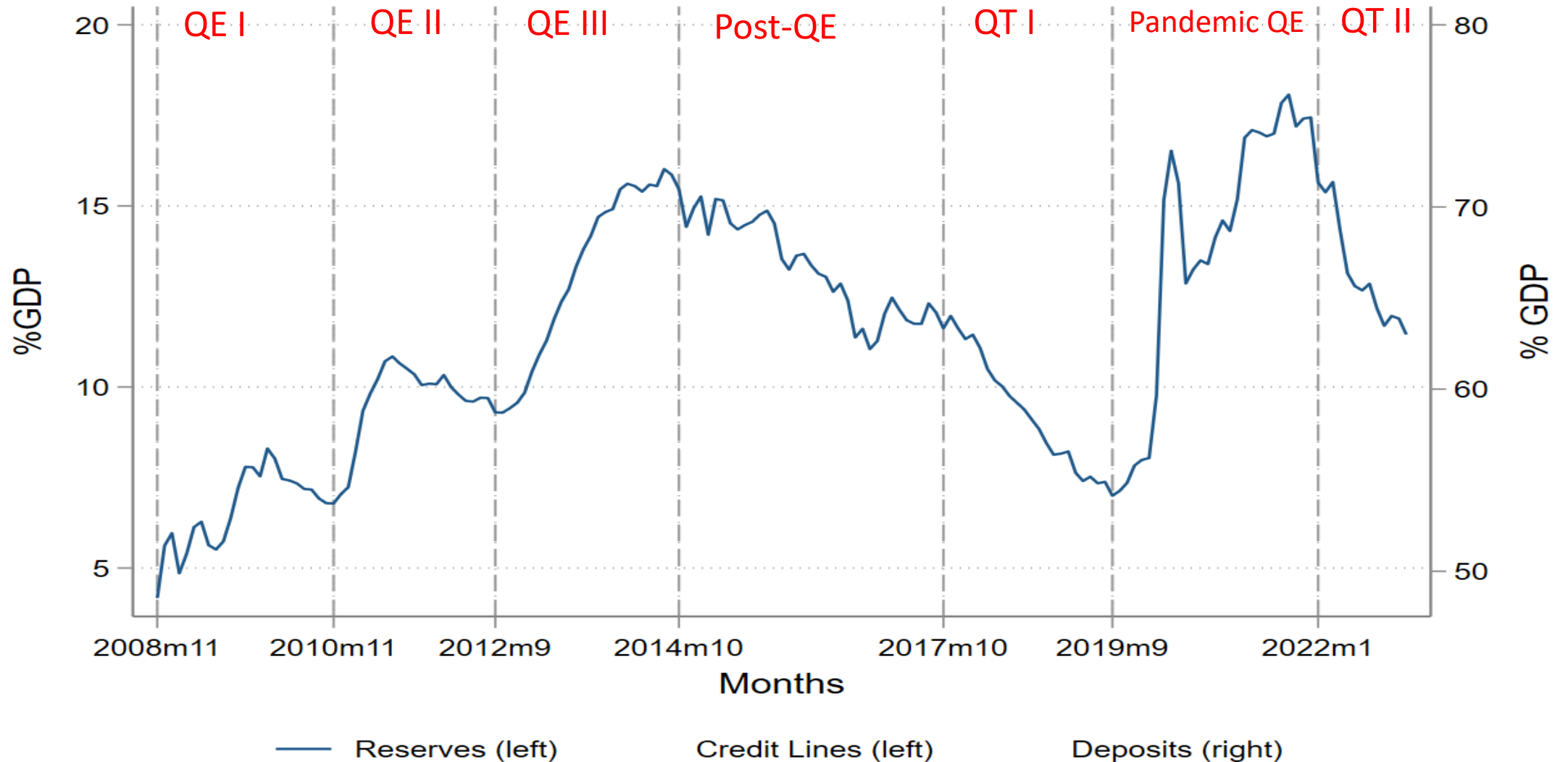
Reserves and Claims (% of GDP)
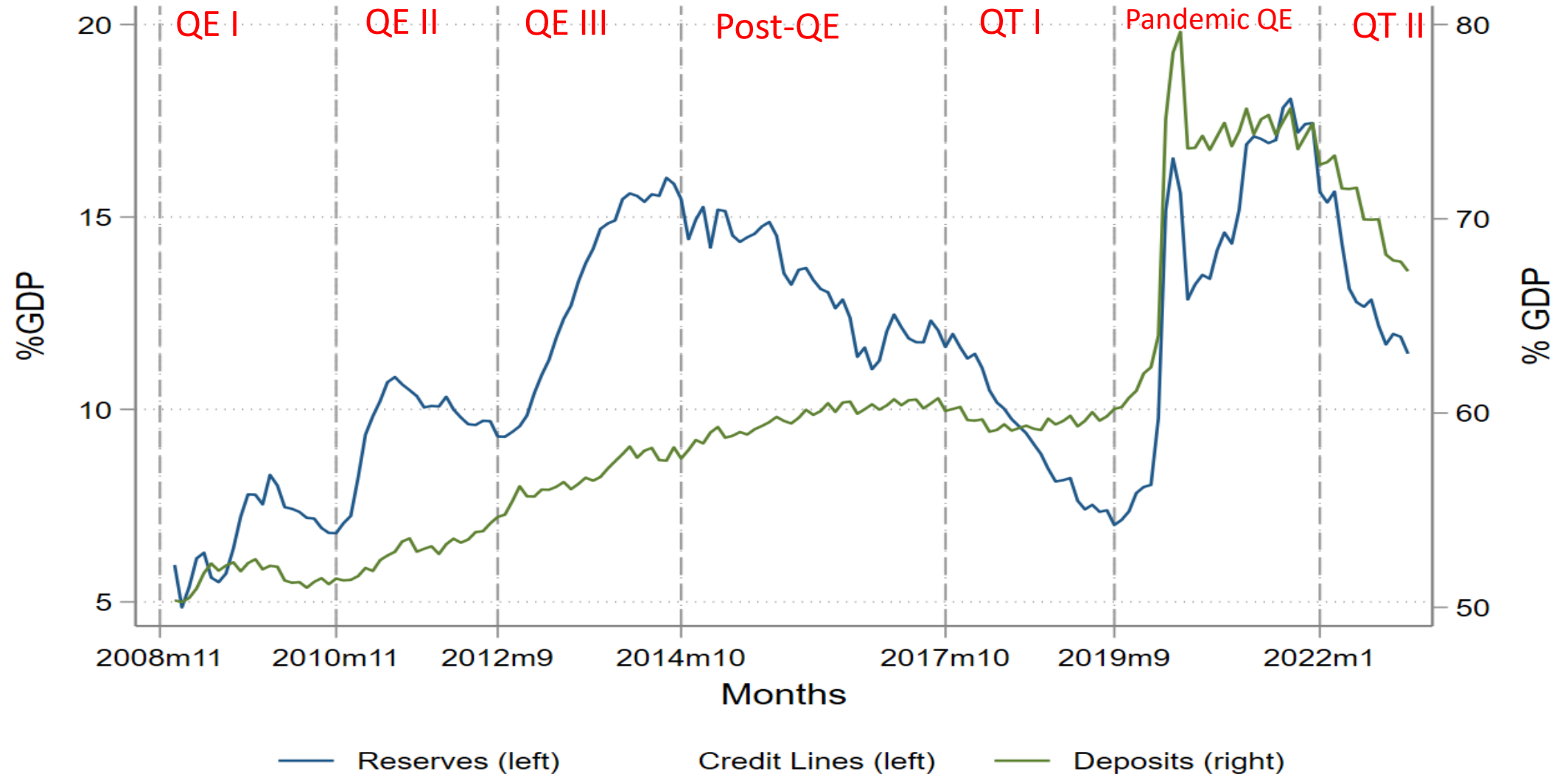
Reserves and Claims (% of GDP)

Uninsured/Insured Demandable/Time Deposits (% of GDP)

Empirical Tests

- Aggregate, time-series evidence
  - Reserves -> Quantities of demandable claims
  - Reserves -> Price of demandable claims

- Panel tests across banks
  - Reserves -> Quantities: Instrument for bank-level reserves
  - Reserves -> Price of liquidity: Term Spread in deposit rates (also IV for deposits)

- Financial fragility: March 2020, March 2023

  - Ratcheting of liquidity risk over time: (UDD + CL)/(Reserves + Eligible Assets)
  - Distribution of liquidity risk and aggregate price of liquidity: Δ from QE to QT?
  - Relate bank stock returns and demandable claim drawdowns to liquidity risk

Aggregate, Time-series Evidence

Time-series analysis: Reserves -> Claims

$$\Delta Y_t = \alpha \Delta X_t + \beta X_{t-12} + \varepsilon_t$$

$\Delta Y_t = Y_t - Y_{t-12}$ is either the Δ Ln(Deposits) or Ln(Credit Lines) or Δ Deposits or Credit Lines

$\Delta X_t = X_t - X_{t-12}$ is respectively either the Δ Ln(Reserves) or Δ Reserves.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ Ln(Deposits)	Δ Ln(Demand Deposits)	Δ Ln(Time Deposits)	Δ Ln(Credit Lines)	Δ Deposits	Δ Demand Deposits	Δ Time Deposits	Δ Credit Lines
Δ Ln(Reserves)	0.137***	0.180***	-0.242**	0.0802***				
	(0.0368)	(0.0541)	(0.114)	(0.0282)				
Ln(Reserves)$_{t-12}$	0.0503***	0.0136	-0.0251	0.0882***				
	(0.0140)	(0.0227)	(0.0702)	(0.0323)				
Δ Reserves					0.999***	1.358***	-0.224**	0.147***
					(0.242)	(0.314)	(0.0932)	(0.0392)
Reserves$_{t-12}$					0.329***	0.343***	0.0726	0.146***
					(0.0691)	(0.0838)	(0.0684)	(0.0399)
Constant	-0.327***	-0.0265	0.163	-0.616**	-88.97	-15.98	-220.0	-162.4*
	(0.106)	(0.172)	(0.533)	(0.249)	(169.3)	(164.0)	(150.2)	(91.28)
Obs	147	147	147	147	147	147	147	147
R-sq	0.592	0.589	0.296	0.232	0.663	0.673	0.334	0.416
S.E.(# Lags)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)

Reserves → Demandable deposits and CLs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ Ln(Uninsured Deposits)	Δ Ln(Insured Deposits)	ΔLn(Uninsured Demandable Deposits)	Δ Ln(Insured Demandable Deposits)	Δ Ln(Uninsured Deposits)	Δ Ln(Insured Deposits)	Δ Ln(Uninsured Demandable Deposits)	Δ Ln(Insured Demandable Deposits)
Δ Ln(Reserves)	0.217**	0.0818	0.181**	0.140**				
	(0.101)	(0.0734)	(0.0701)	(0.0631)				
Ln(Reserves)$_{t-4}$	0.0945	0.0211	0.0147	-0.00274				
	(0.0900)	(0.0293)	(0.0572)	(0.0445)				
Δ Reserves					0.687***	0.324	0.797***	0.479***
					(0.0891)	(0.219)	(0.174)	(0.160)
Reserves$_{t-4}$					0.212	0.116	0.125	0.0809
					(0.151)	(0.111)	(0.101)	(0.0859)
Constant	-0.609	-0.129	-0.0418	0.0870	-78.02	-12.75	83.39	174.9
	(0.693)	(0.224)	(0.437)	(0.346)	(372.7)	(293.6)	(226.6)	(207.4)
N	49	49	49	49	49	49	49	49
r2	0.0526	0.0536	0.303	0.274	0.366	0.101	0.586	0.423
S.E.(# Lags)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)

Reserves → (Especially) Uninsured demand deposits

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Time-series analysis: Reserves -> Price of liquidity

Lopez-Salido and Vissing-Jorgensen (2022):

$$EFFR - IOR_t$$
$$= \alpha \, Ln(Reserves)_t + \beta \, Ln(Deposits)_t + \gamma Ln(Credit \; Line)_t + \varepsilon_t$$

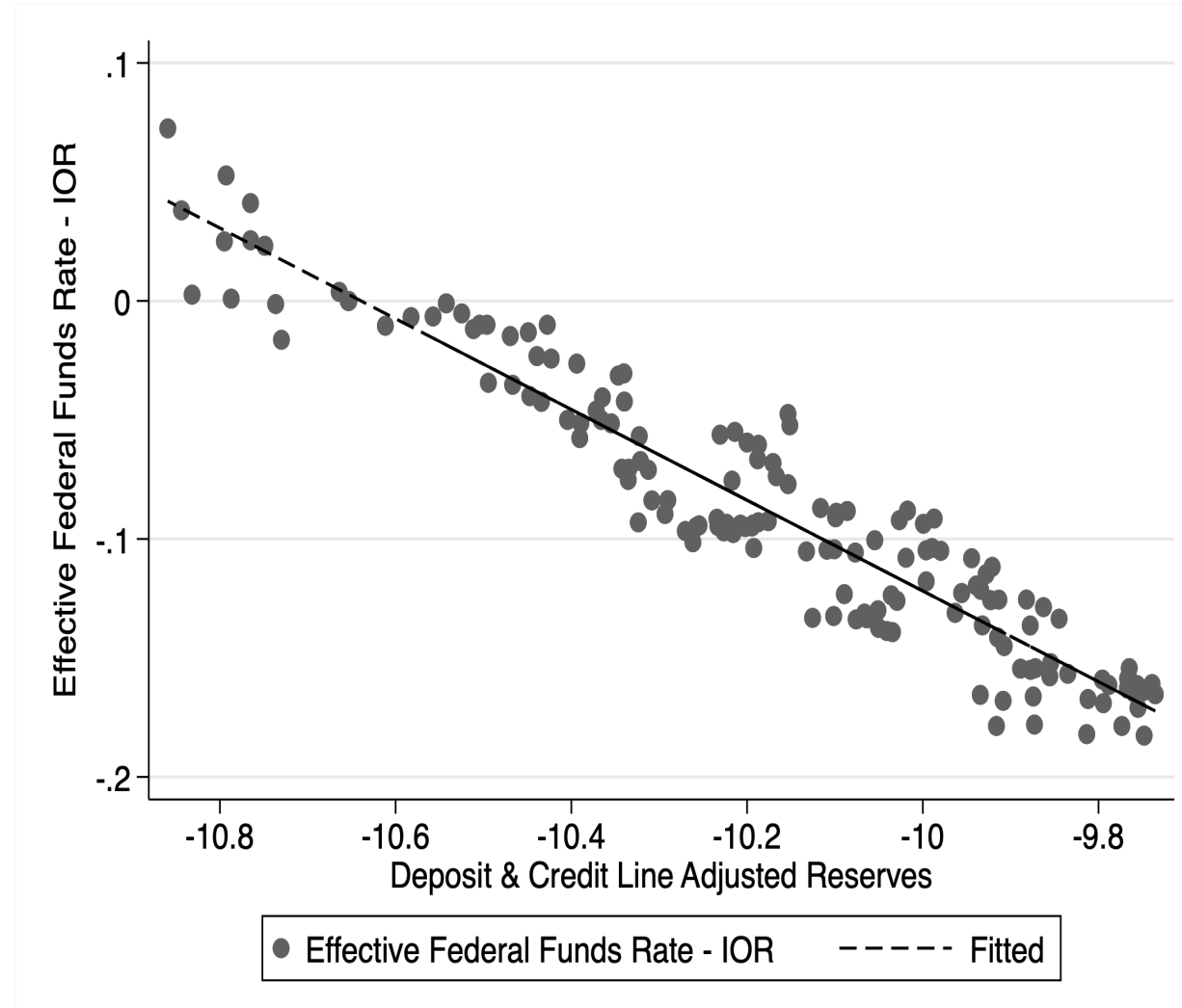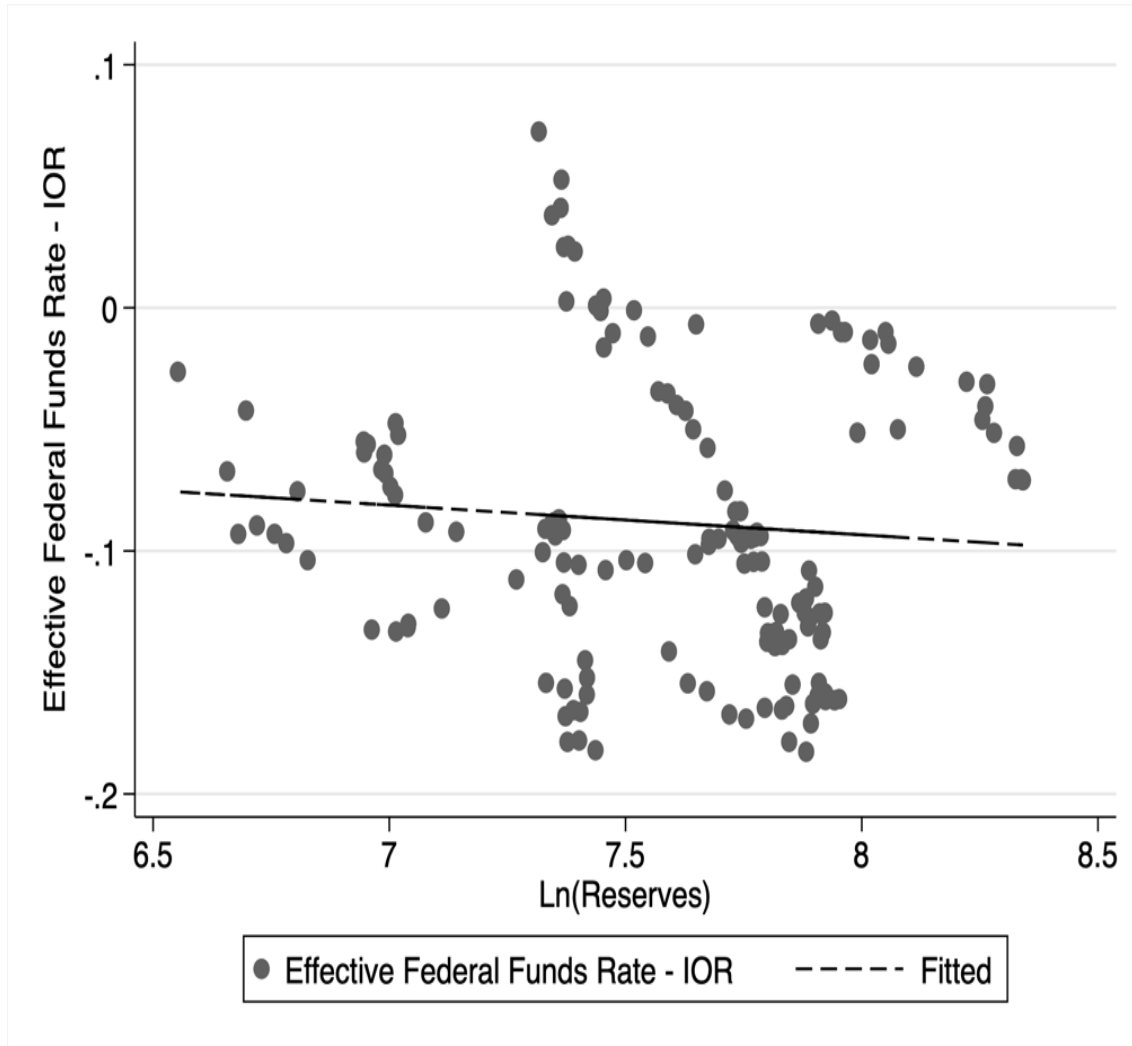OR (to address issues of non-stationarity and co- integration)

$$\Delta(EFFR - IOR)_t$$
$$= \alpha \, \Delta Ln(Reserves)_t + \beta \, \Delta Ln(Deposits)_t + \gamma \Delta Ln(Credit \; Line)_t + \varepsilon_t$$

$\Delta X_t = X_t - X_{t-4}$ for regressions with quarterly variables and
$\Delta X_t = X_t - X_{t-12}$ for regressions with monthly variables
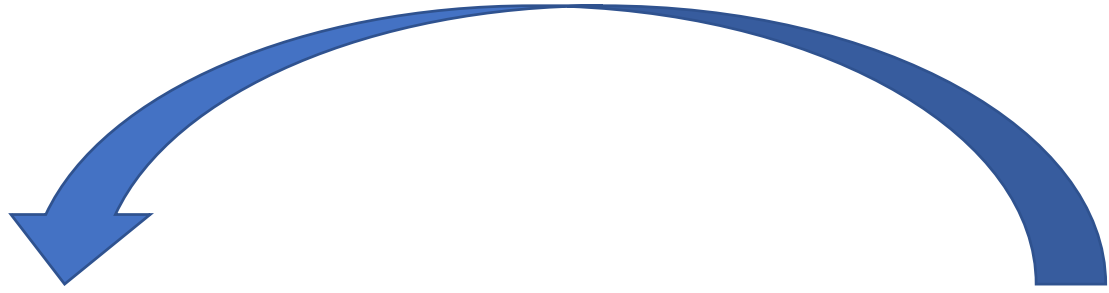
Reserves, Claims, and the Price of Liquidity

Note: inspired by Lopez-Salido and Vissing-Jorgensen (2022)

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Aggregate price of liquidity $(EFFR - IOR)_t$

	(1)	(2)	(3)	(5) EFFR-IOR	(6)	(7)	(8)
Ln(Reserves)	-0.0105 (0.0273)	-0.190*** (0.0133)	-0.189*** (0.0157)	-0.146*** (0.0109)	-0.182*** (0.0143)	-0.191*** (0.0170)	-0.209*** (0.0151)
Ln(Deposits)		0.365*** (0.0164)			0.275*** (0.0582)		
Ln(Demandable Deposits)			0.316*** (0.0142)			0.248*** (0.0449)	
Ln(Time Deposits)			0.107*** (0.0354)			0.0705 (0.0478)	
Ln(Uninsured Demandable Deposits)							0.186*** (0.0299)
Ln(Credit Lines)				0.295*** (0.0199)	0.0830 (0.0537)	0.0915* (0.0488)	0.182*** (0.0271)
Ln(Gross Drawdowns)				0.0196** (0.00784)	0.00304 (0.00766)	-0.00653 (0.00647)	-0.00435 (0.00857)
Constant	-0.00839 (0.203)	-2.035*** (0.111)	-2.370*** (0.411)	-1.709*** (0.188)	-1.972*** (0.128)	-2.039*** (0.505)	-1.438*** (0.137)
Obs	52	52	52	52	52	52	52
R-sq	0.005	0.911	0.913	0.870	0.916	0.921	0.929
Reg-Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS
SE (# Lags)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)	Newey-West (4)

Traditional view: Exogenous demand for liquidity

Price of Liquidity   =

Supply of Reserves
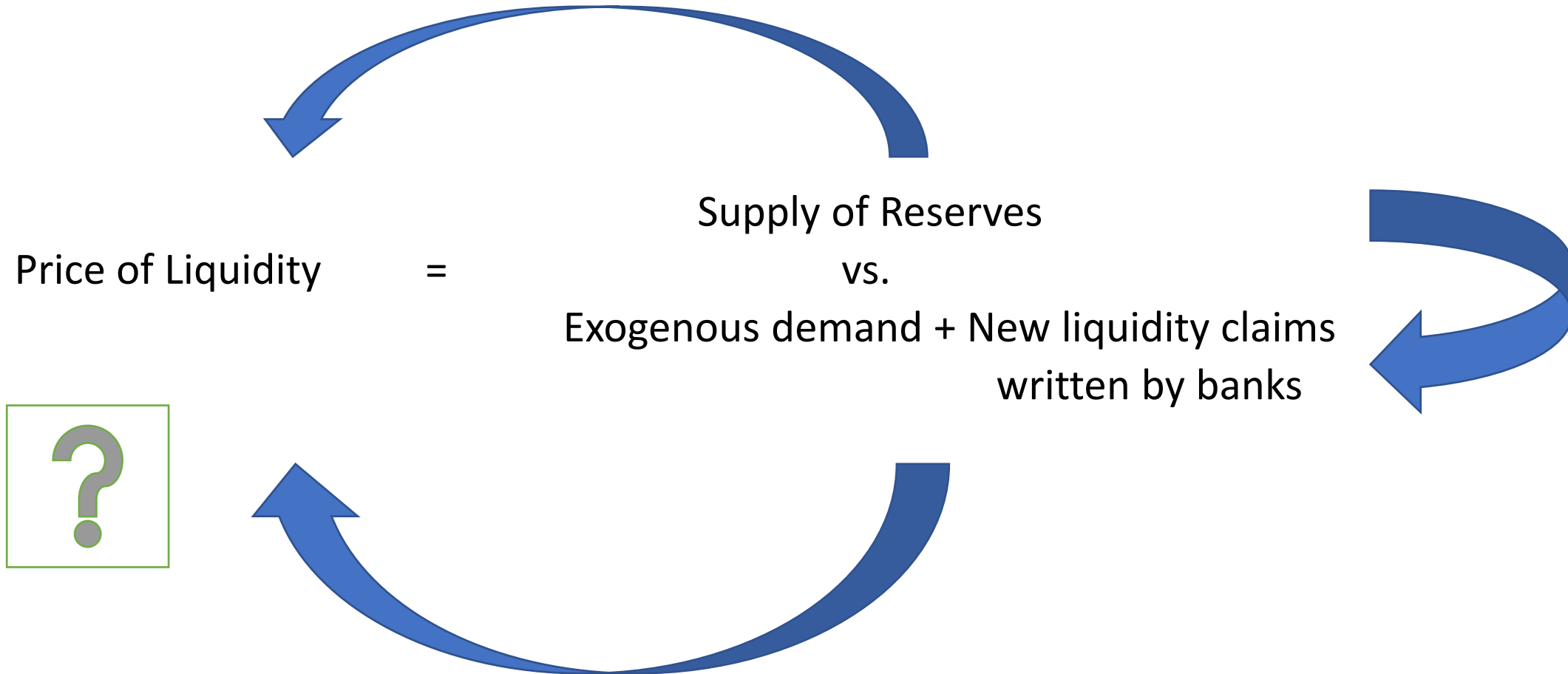
vs.

Exogenous demand for liquidity

- As demand is exogenous, increasing supply of reserves is stabilizing

Dependence view: Liquidity demand affected by reserves

Price of Liquidity   =
Supply of Reserves
vs.
Exogenous demand + New liquidity claims
written by banks

?

- Supply of reserves creates its own additional demand, new claims written by banks.
- Liquidity conditions and the effect of quantitative tightening depend on how these claims evolve.

Qtrly Rolling Coefficient of EFFR-IOR on Reserves + UDD
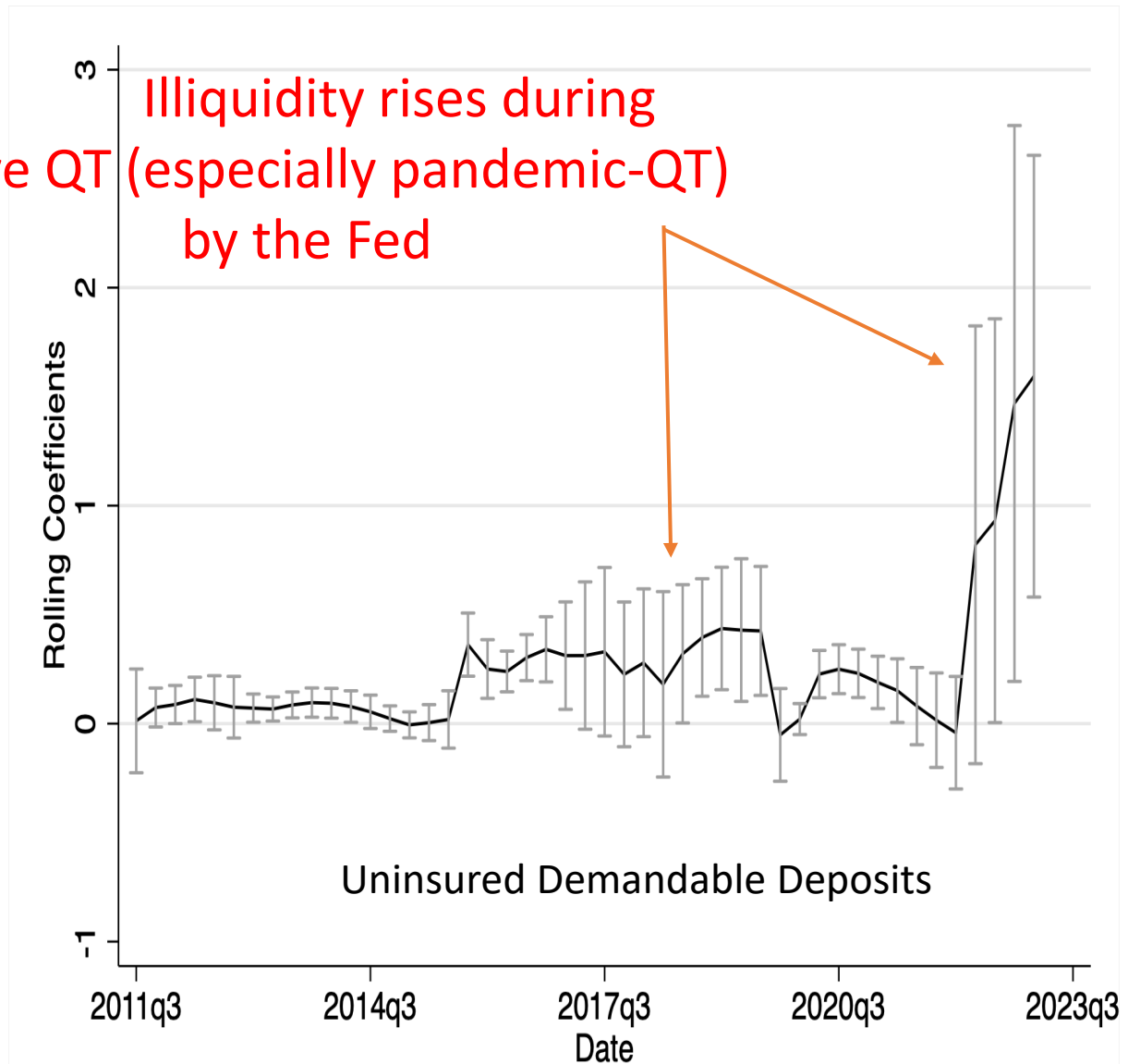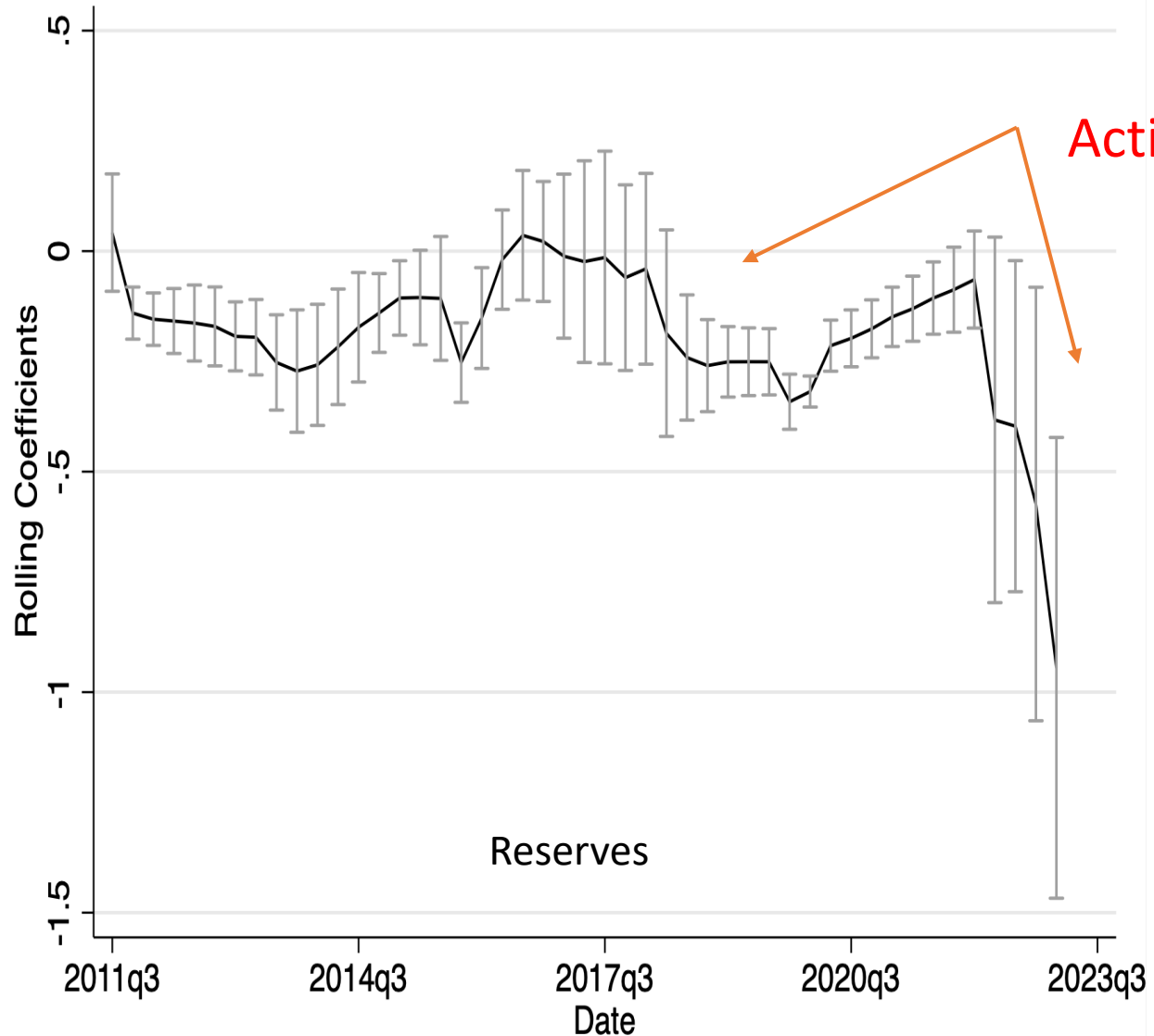
Panel Tests (across banks)

From time-series to panel tests

- Time-series evidence suggests

  - Reserves affect claims on liquidity held by the banking system
    - ➢ Demandable deposits and credit lines rise
    - ➢ Time deposits shrink

  - Claims on liquidity have to be accounted for to price liquidity

- Time-series tests lack power to isolate well the QE/QT periods
  - Can't rule out confounding effects due to interest rates, economic activity

- Hence, panel tests… but newer challenges!

Challenges in panel tests

- Reserves are <u>exogenous for the banking system as a whole, but endogenous for each individual bank</u>

(1) Reserves may rise at a bank due to asset sales or equity issuance

(2) Reserves may correlate with *higher* time-deposits and *lower* demand deposits or credit-lines due to bank's risk-aversion or regulations (LCR)

- We instrument bank-level reserves to get at a "reserves beta"
  - Non-transient bank-level variation: Bank's share of aggregate (commercial bank) reserves over the past year
  - Two instruments to measure *exogenous* variation in reserves:
    - ➤ Growth in <u>Fed's balance-sheet size</u> is the most exogenous shock
    - ➤ However, a bank's "reserves beta" likely a multiplier on Growth in <u>Aggregate bank reserves</u>
    - ➤ Fed b/s size to Aggregate commercial bank reserves: (Endogenous) Demand for cash, ONRRP

Instruments for Reserves

$$z_{it}^{R1} = \ln\left(\frac{Aggregate\ Reserves_t}{Aggregate\ Reserves_{t-1}}\right) \times \frac{1}{4}\sum_{k=1}^{4} Bank\ i's\ share\ of\ aggregate\ reserves_{t-k}$$

$$z_{it}^{R2} = \ln\left(\frac{Fed\ Assets_t}{Fed\ Assets_{t-1}}\right) \times \frac{1}{4}\sum_{k=1}^{4} Bank\ i's\ share\ of\ aggregate\ reserves_{t-k}$$

Bank i's share of aggregate reserves in quarter t is calculated by dividing the bank-level reserves by aggregate central bank reserves. [<u>Note</u>: Results qualitatively robust with just the first instrument.]

Rationale:

- Average of lagged share reflects "location" of the bank with regard to picking up exogenous reserves
    - being a money-center bank,
    - having relationships with non-banks tendering assets to the Fed
- Assumption: Endogenous responses caused by shocks uncorrelated to "location"

Uninsured Demand Deposits– IV 2nd Stage

	(1)	(2)	(3)	(4)
		ΔLn(Uninsured Demandable Deposits)		
ΔLn(Reserves)	0.104***	0.110***	0.109***	-0.253
	(0.0281)	(0.0295)	(0.0300)	(0.202)
Obs	96284	42439	34825	29807
Time-FE	Y	Y	Y	Y
Two-way Clustering	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Reg Type	IV	IV	IV	IV
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

NOTE: Results driven by banks with below-median equity capitalization (Appx); Search for yield (we will revisit later...)

Active maturity-shortening:
Reserves -> Lower deposit term spreads

	(1) 3 month CD Rate - Savings Rate	(2) 12 month CD Rate - Savings Rate	(3) 18 month CD Rate - Savings Rate	(4) 24 month CD Rate - Savings Rate
Ln(Reserves)	-0.154***	-0.0690	-0.220***	-0.104***
	(0.0320)	(0.0654)	(0.0582)	(0.0146)
Ln(Total Deposits)	0.775	0.654	1.448**	0.737
	(0.479)	(0.545)	(0.564)	(0.456)
Obs	78827	84196	70531	82941
Bank & Time-FE	Y	Y	Y	Y
Two-way Clustering	Y	Y	Y	Y
Reg Type	IV	IV	IV	IV
Controls	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	Overall: 2001Q1 - 2021Q4	Overall: 2001Q1 - 2021Q4	Overall: 2001Q1 - 2021Q4

Bank preference to shorten the maturity of deposits in QE ; No reversal of this preference post-QE / QT

NOTE: Robust to instrumenting Total Deposits for exogenous variation; Results driven by high-deposit HHI banks (Appx)

Active selling of demandable claims (CLs)

- Do reserves-intensive banks also sell more credit lines?
  - Consistent with time-series tests, results hold for sub-IG credit line originations

| Non-Investment Grade	(1)	(2)	(3)	(4)
		ΔLn(Credit Lines)		
ΔLn(Reserves)	0.354*	0.337*	0.295**	0.0921
	(0.184)	(0.190)	(0.131)	(0.236)
Obs	1768	719	550	484
Time-FE	Y	Y	Y	Y
Time Clustered SEs	Y	Y	Y	Y
Reg-Type	IV	IV	IV	IV
Period	Overall	QE I-III + Pandemic QE	QE I-III	Post-QE III + QT

QE → QT and Financial Fragility

Financial Fragility Build-up: From QE to QT

- Overall ratcheting-up of claims to liquidity

- <u>Who</u> does not shrink liquidity claims when reserves fall?

  - Banks substitute into eligible assets (Treasuries, MBS, Agency debt)
  - Measure of liquidity risk: Claims to Potential Liquidity
  = [Credit Lines + (Uninsured) Demandable Deposits] / [Reserves + Eligible Assets]

- <u>What</u> are the consequences?
  - Skews liquidity risk distribution and increases duration mismatch
  - Financial fragility: COVID shock, Mid-size/regional banking failures/stress

- <u>Why</u> do banks take on liquidity risk in spite of the associated fragility?

  - Evidence of illiquidity-seeking by (smaller) banks not subject to LCR
  - Illiquidity-seeking results in higher ROE… especially for below-median-capitalization banks

Ratcheting-up of Uninsured Demand Deposits

| Date	>$250 billion	$50-250 billion	< $50 billion
2008Q3	35.8	20.9	10.4
2014Q3	46.1	30.1	18.3
2019Q3	**44.1**	**27.7**	**21.9**
2019Q4	**45.1**	**28.7**	**22.5**
2021Q4	50.4	37.6	33.5
2022Q4	**49.8**	**34.8**	**30.3**
2023Q1	**46.2**	**30.2**	**23.9**
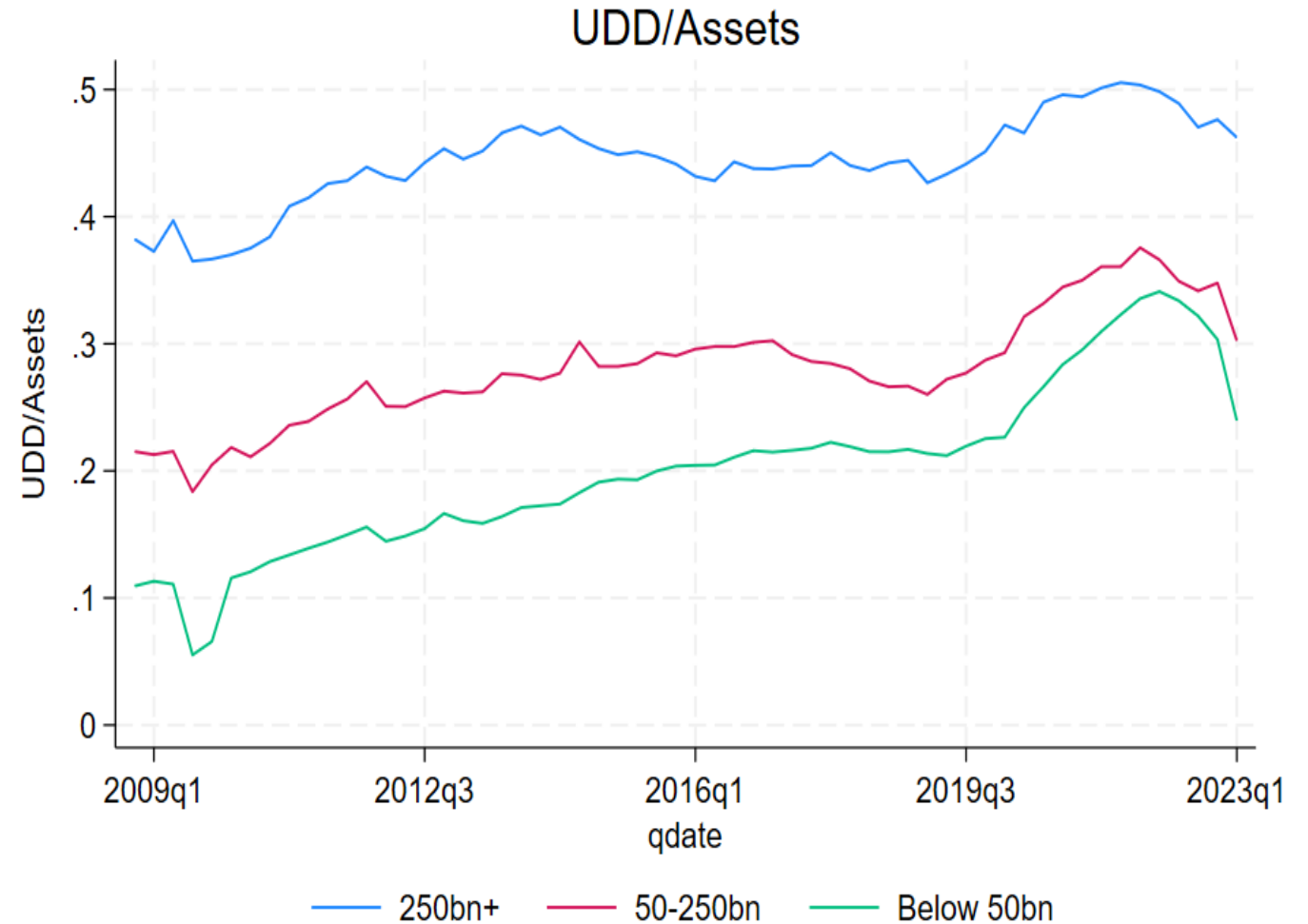
Ratcheting-up of Claims (multiple of reserves)
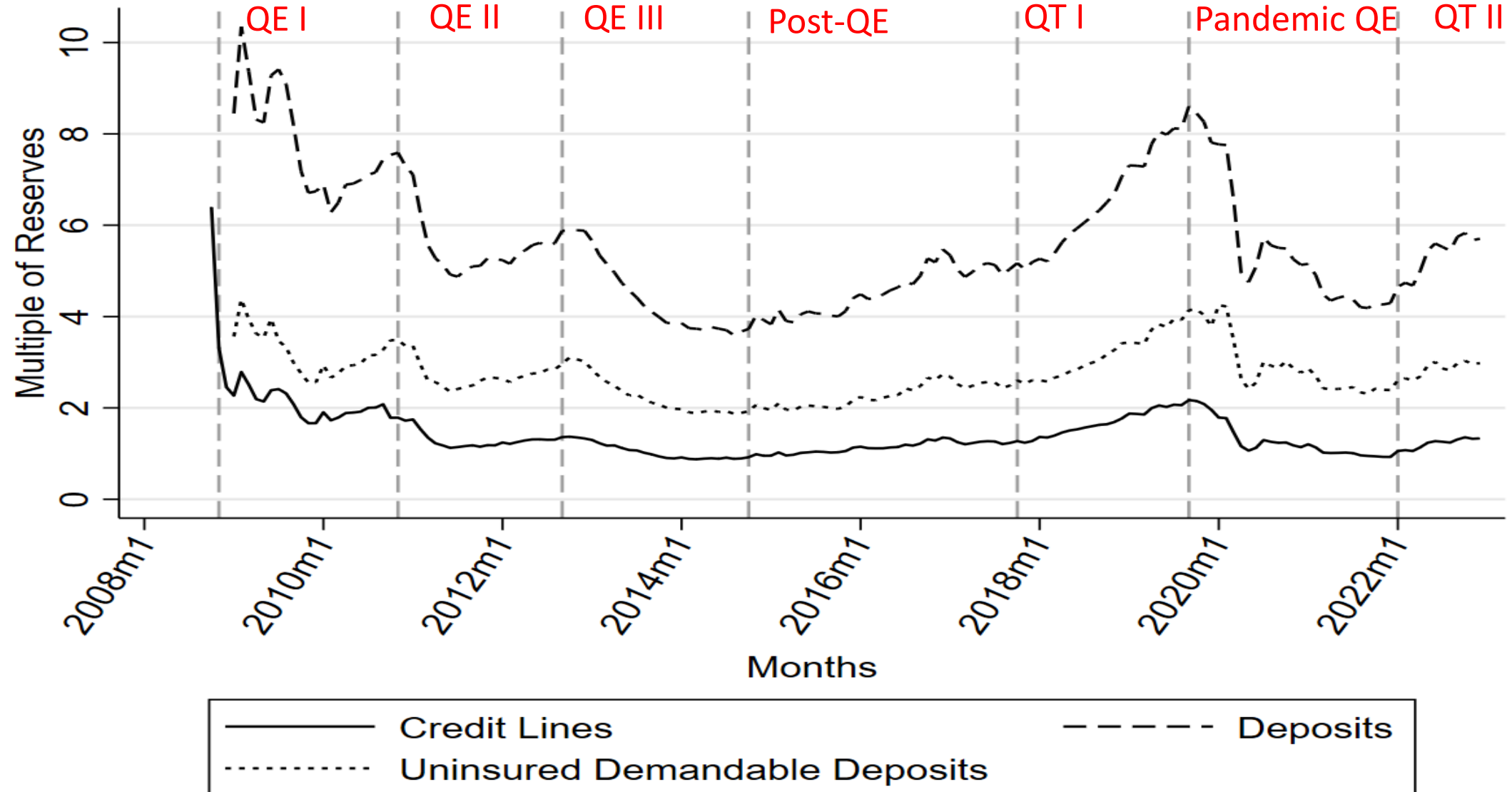
Ratcheting-up of Liquidity Risk

Claims to Liquidity (Uninsured Demandable Deposits) /
Potential Liquidity (Reserves + Eligible Assets)

Date	>$250 billion	$50-250 billion	< $50 billion
2008Q3	3.77	2.5	0.76
2014Q3	1.93	1.35	0.95
2019Q3	**1.97**	**1.11**	**1.47**
2019Q4	**1.97**	**1.15**	**1.51**
2021Q4	1.48	1.02	1.47
2022Q4	**1.76**	**1.15**	**1.71**
2023Q1	**1.66**	**1.02**	**1.34**

Unins. Dem Dep/(Reserves+Eligible Assets)
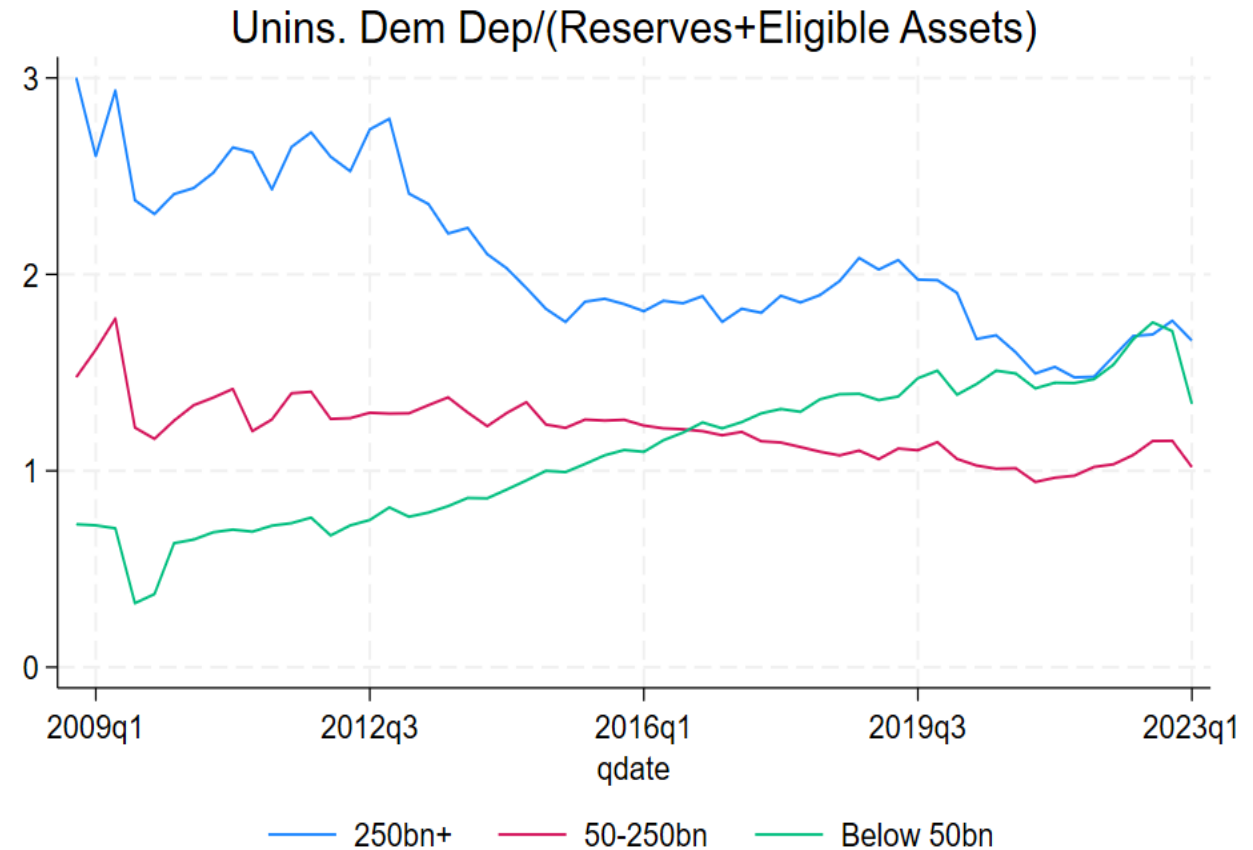
Largest banks becoming safer, smallest banks increasingly at risk of illiquidity

[Credit Lines + Uninsured Demandable Deposits] / [Reserves and Eligible Assets] : Histogram by Period

Note: Ratios above 6 are binned as 6
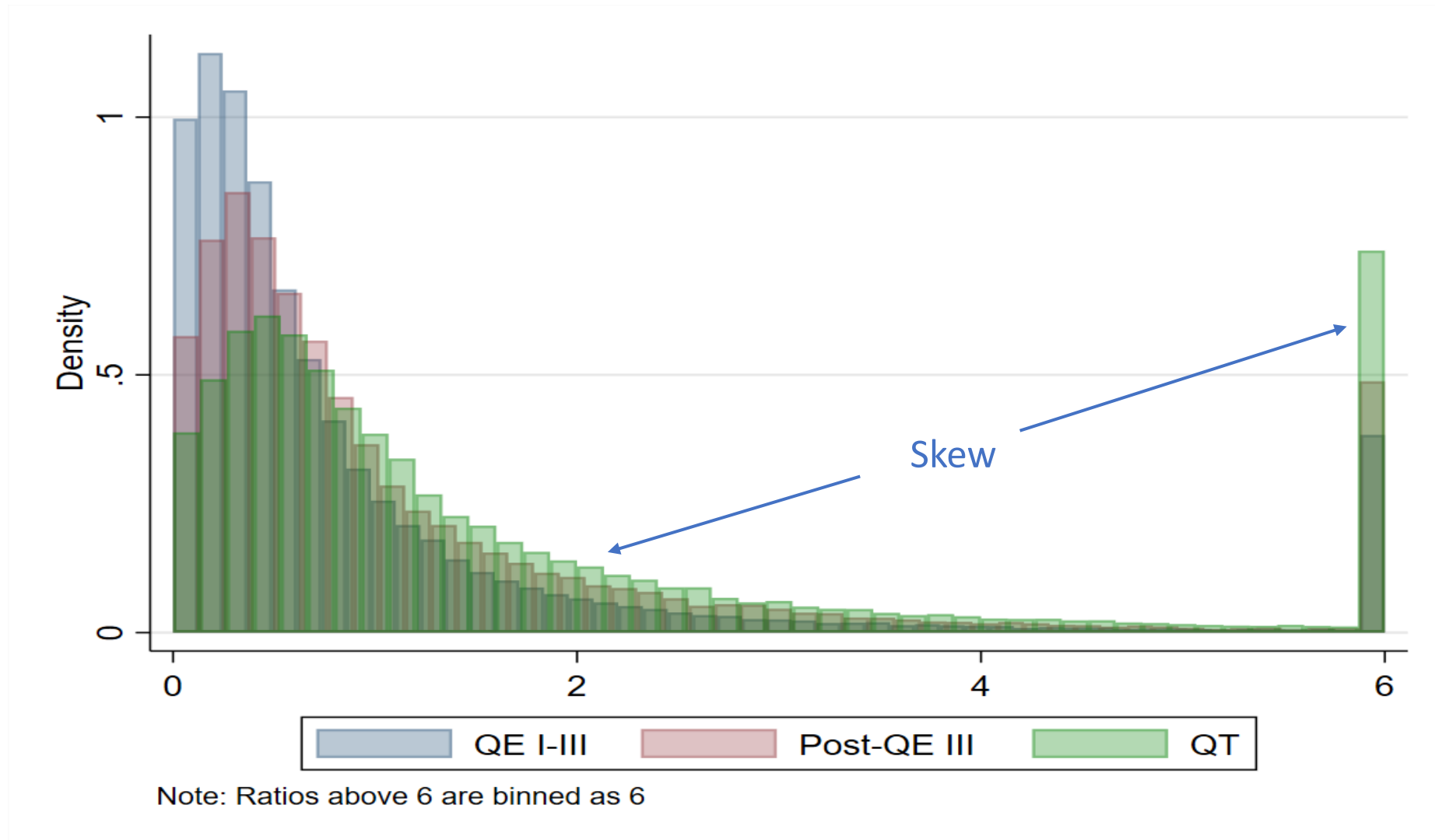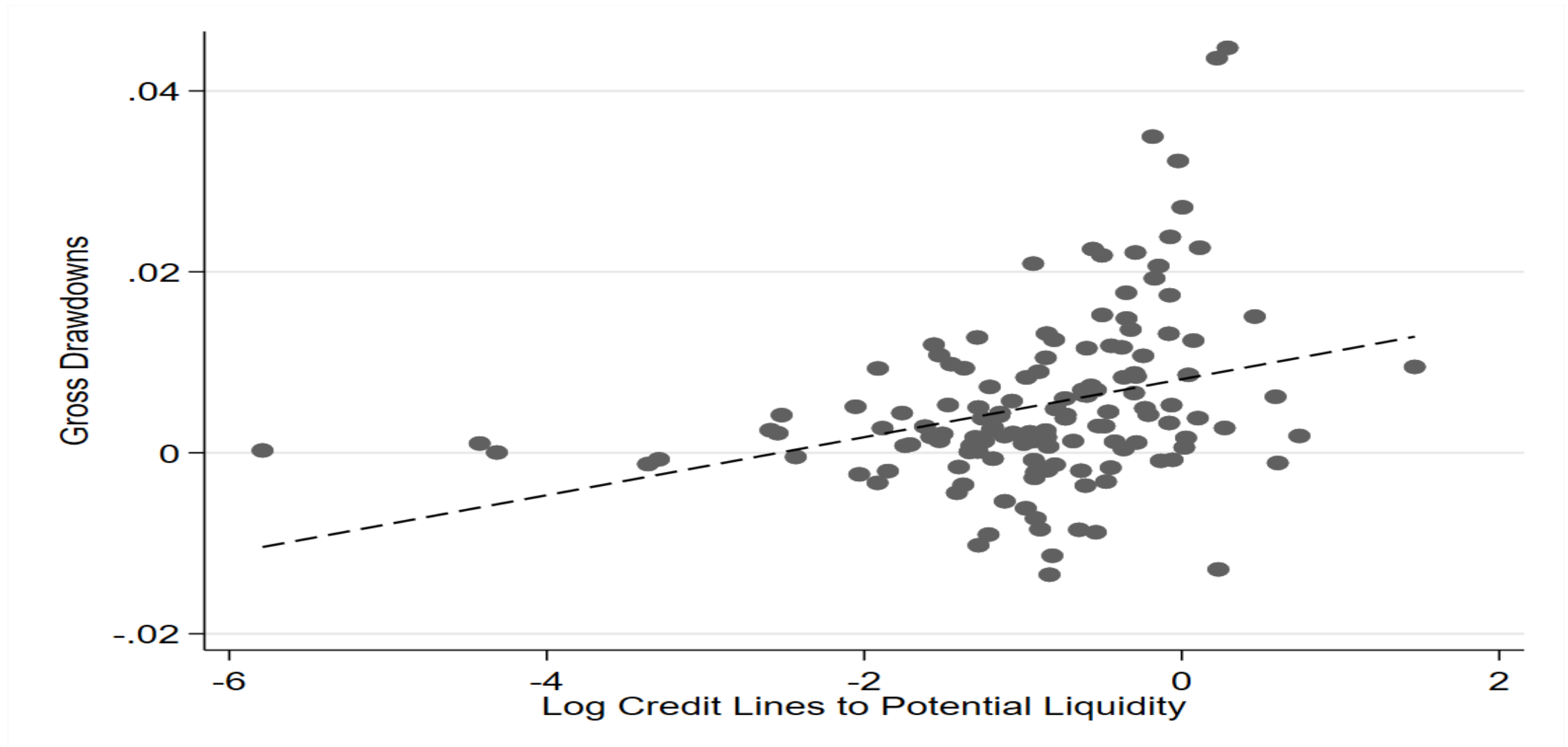
Financial Fragility I: COVID case study

- How did liquidity risk fare post-QT I, i.e., at the pandemic outbreak?

  - 2020: COVID shock - Dash for cash on bank credit lines by corporate clients

CL + Uninsured Demandable Deposits and Fragility: Covid Shock
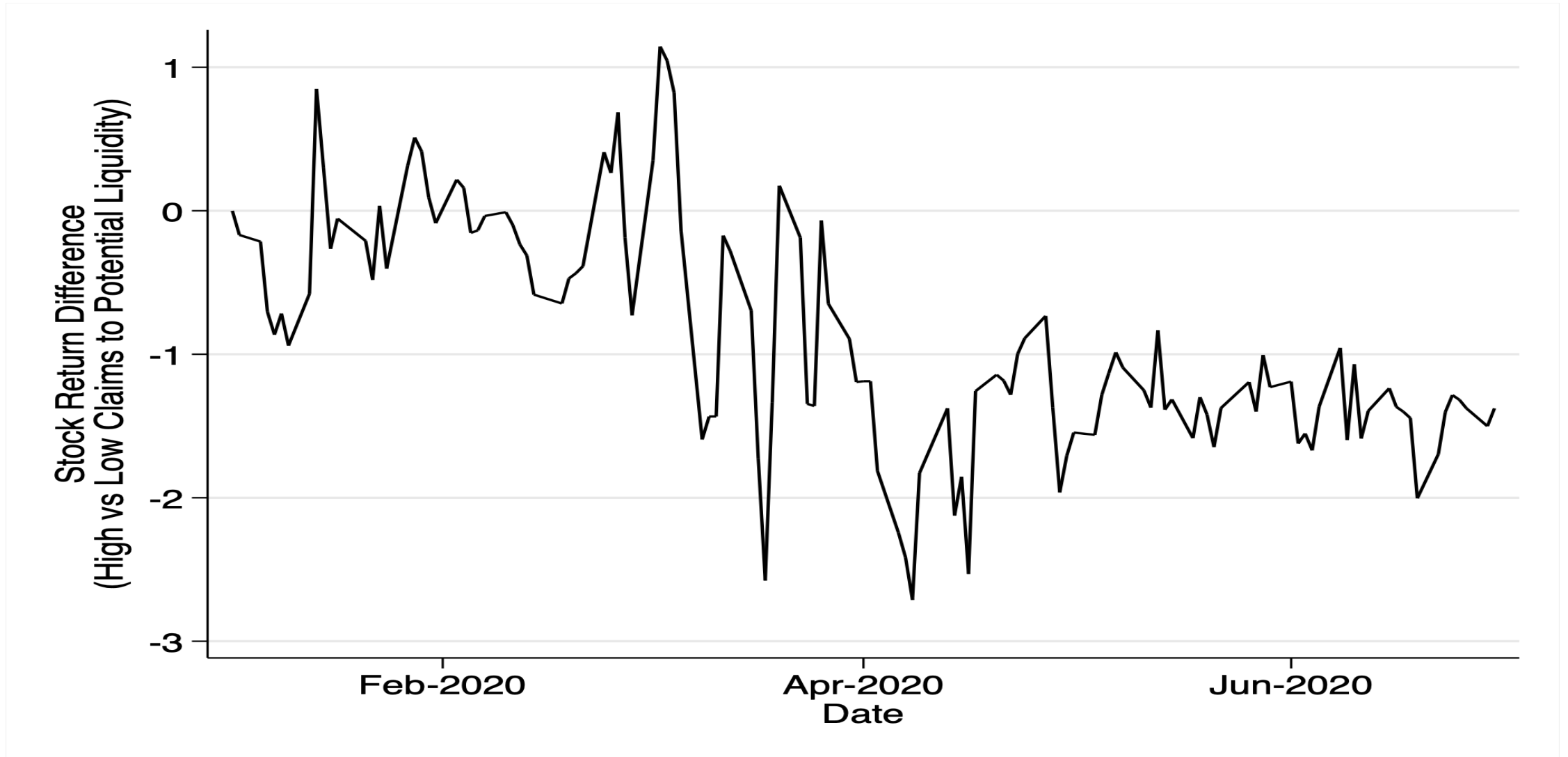
Panel A. Implications for bank stock returns (1 March – 23 March 2020)

Credit Lines and Drawdown Fragility: Covid Shock

Panel B. Implications for gross credit line drawdowns of credit lines (Q1 2020)

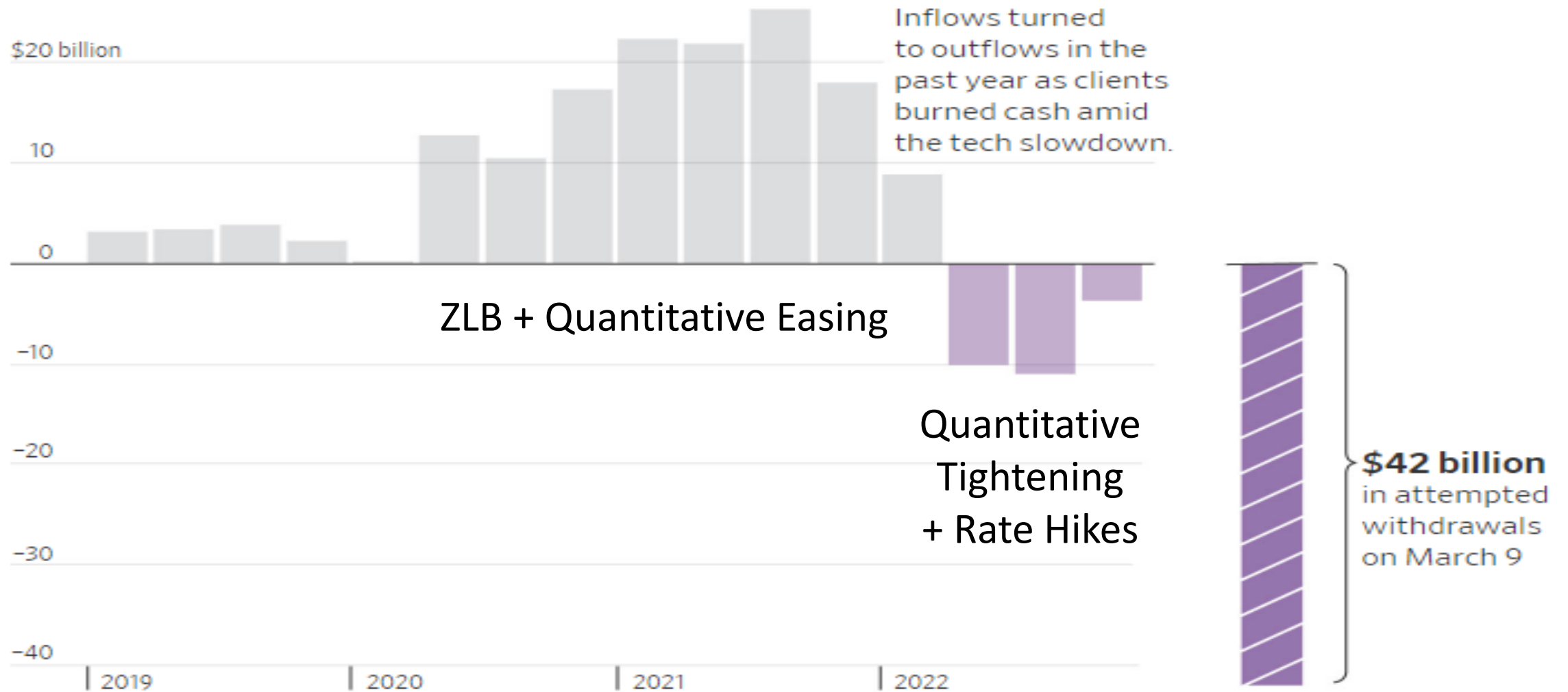# Uninsured Demandable Claims (Credit Lines) and Fragility
Bank Stock Returns, Gross Credit Line Drawdowns and CDS Spread Changes

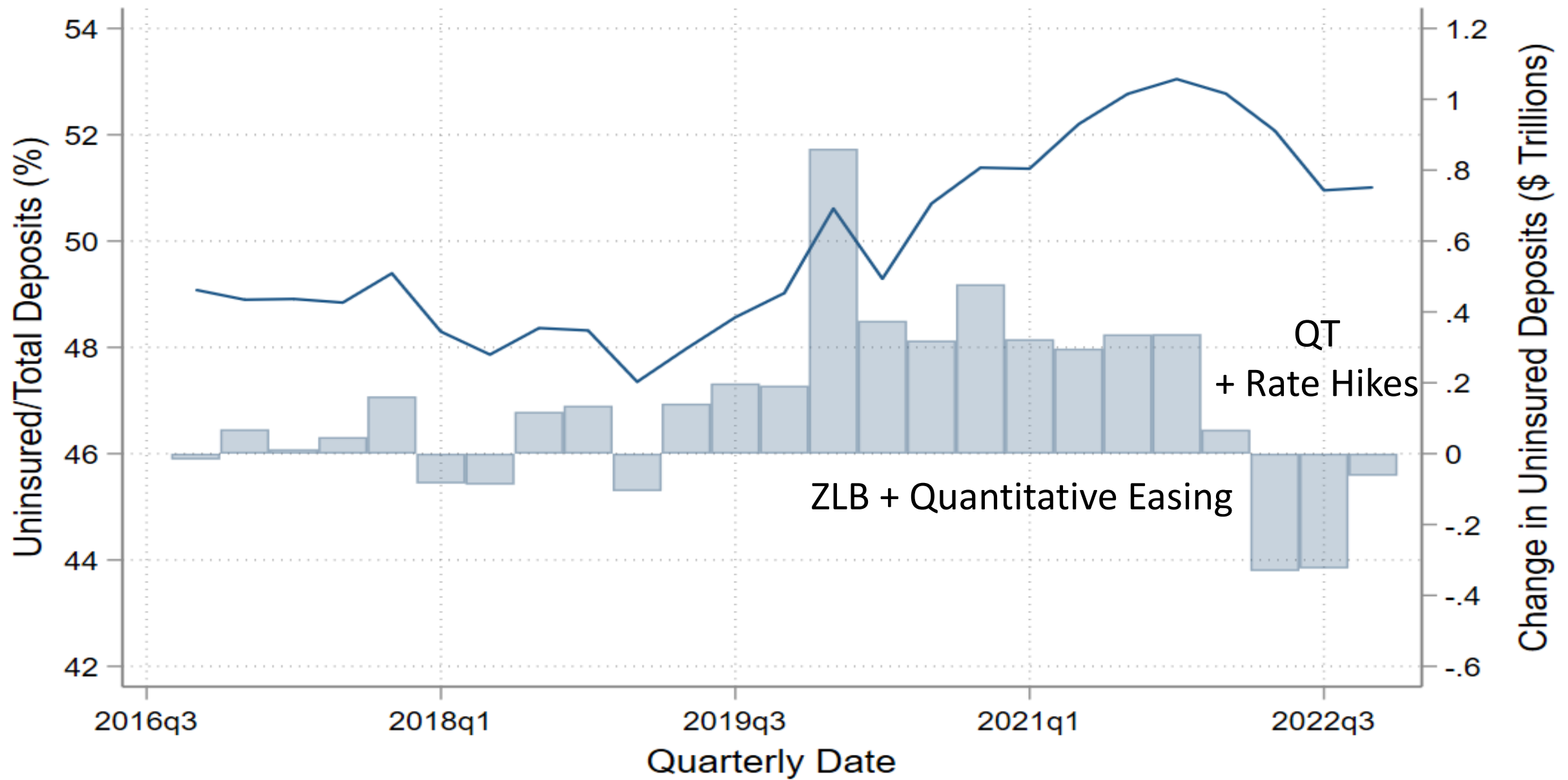|	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Excess Returns				Gross Drawdowns			ΔLog(CDS)	
	Jan 1st – Feb 28th 2020	March 1st – 23rd 2020			2020Q1			March 1st – 23rd 2020	
Claims to Potential Liquidity	0.00661	-0.070**						0.0512**	
	(0.810)	(0.015)						(0.025)	
Credit Lines to Potential Liquidity			-0.046***		0.003***			0.0518*	
			(0.000)		(0.000)			(0.069)	
Uninsured Demandable Deposits to Potential Liquidity				-0.035*		0.003***			0.0317
				(0.064)		(0.000)			(0.157)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-Sq	0.0302	0.0991	0.120	0.0832	0.349	0.329	0.524	0.565	0.519
N	145	145	145	145	145	145	252	222	252

Financial Fragility II:
COVID QE, recent QT and banking stress

- Solvency was not an issue at the time of COVID outbreak because of massive stimulus and low rates

- This time, QT is accompanied by sharp rate increases
  - Slow deposit outflows during 2022
  - (Solvency-based?) Runs in Q1 of 2022 on SVB, Signature, First Republic Bank

- An important feature of failed banks: large share of uninsured deposits

- Why did uninsured deposits grow at unprecedented pace until 2021?
  - The role of QE (fiscal stimulus -> insured deposits)

- Did QE, by raising uninsured deposits, set the stage for banking stress?

SIVB deposits, quarterly net change

$20 billion

Inflows turned to outflows in the past year as clients burned cash amid the tech slowdown.

10

0

ZLB + Quantitative Easing

-10

Quantitative Tightening + Rate Hikes

-20

$42 billion in attempted withdrawals on March 9

-30

-40

2019   2020   2021   2022

Sources: company filings (quarterly); California regulators (March 9)

Chart showing "Uninsured/Total Deposits (%)" (left axis, 42–54) and "Change in Uninsured Deposits ($ Trillions)" (right axis, -.6 to 1.2) against "Quarterly Date" from 2016q3 to 2022q3. Annotations: "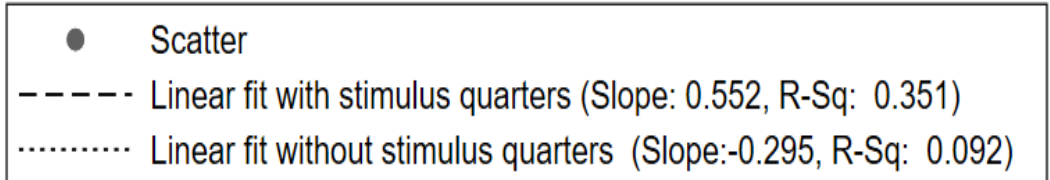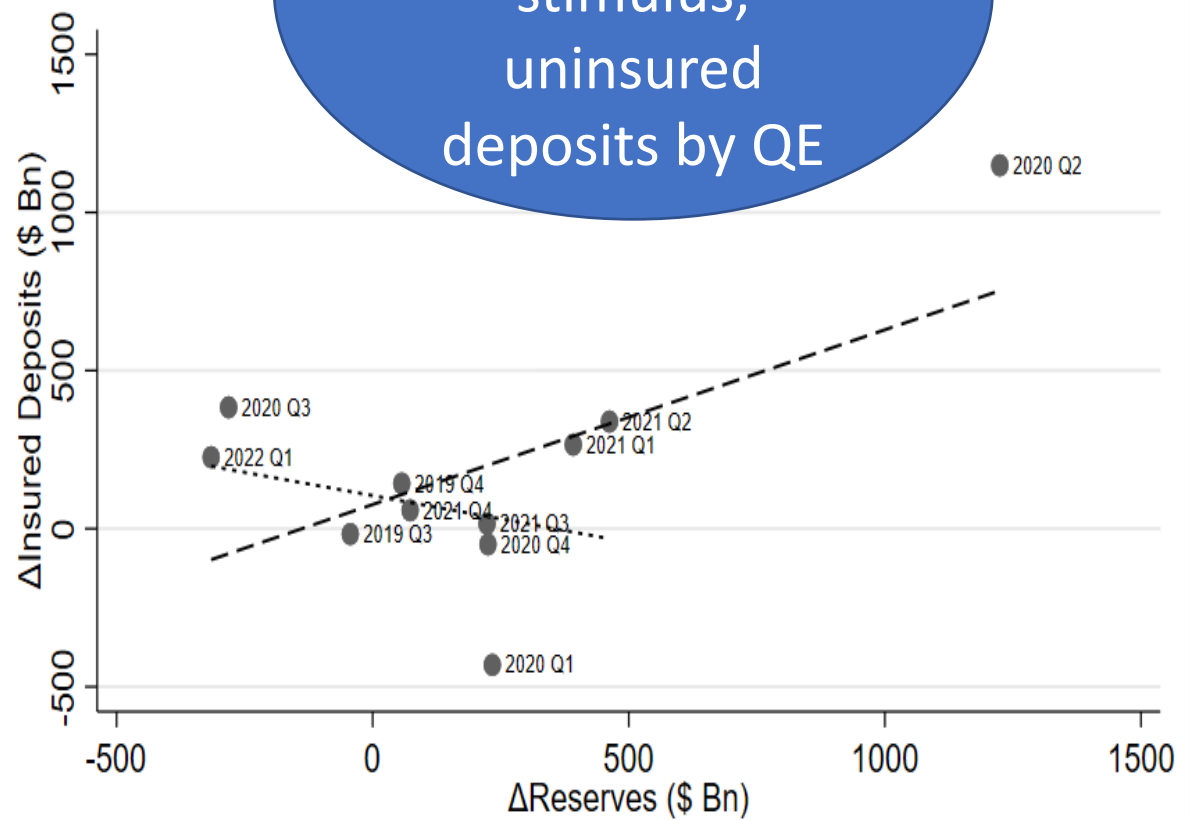QT + Rate Hikes" and "ZLB + Quantitative Easing". Legend: "Uninsured/Total Deposits (%) (Left)" and "Change in Uninsured Deposits ($ Tn.) (Right)".

Uninsured vs Insured Deposits during Pandemic: QE or Fiscal stimulus?
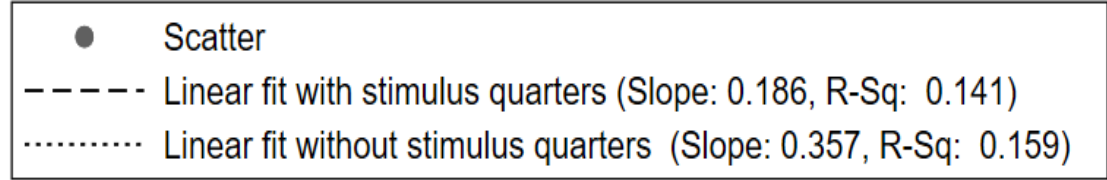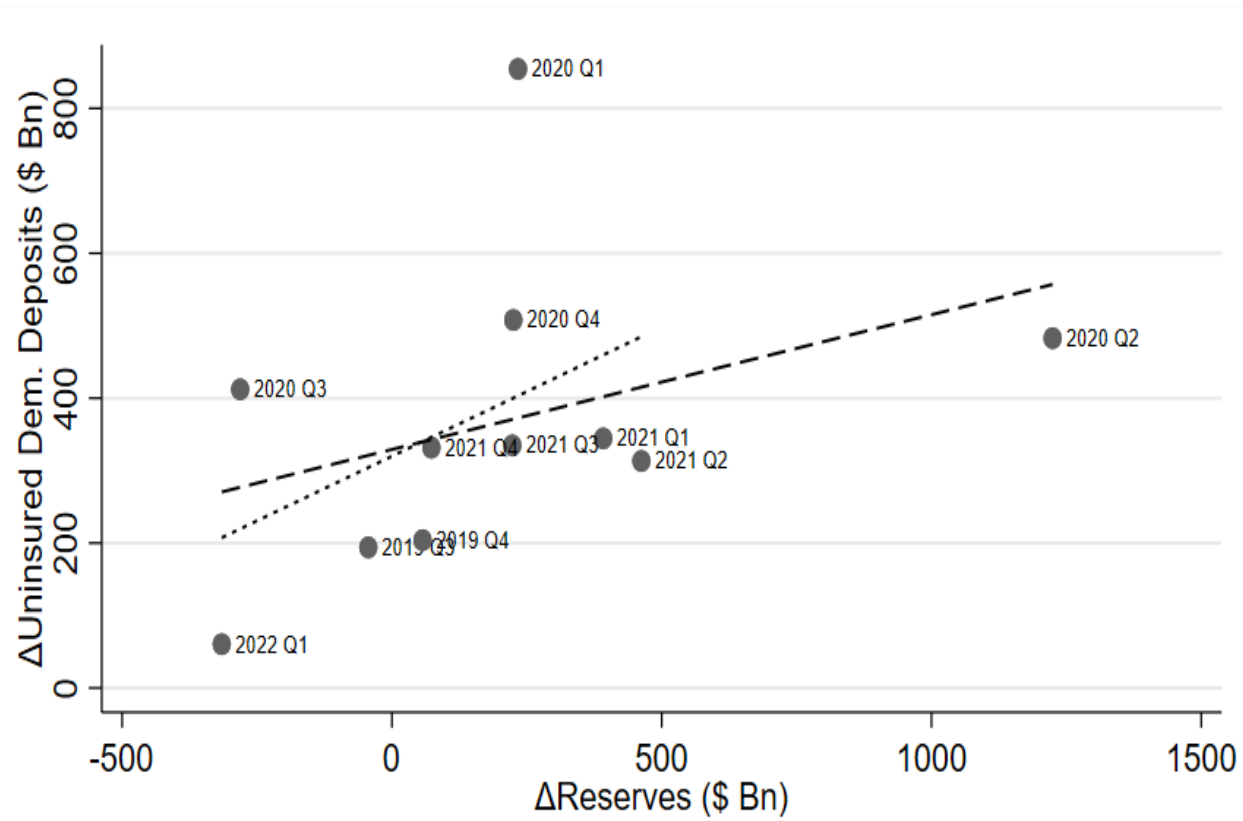
Insured deposits driven by fiscal stimulus, uninsured deposits by QE

Uninsured Demandable Deposits vs. Reserves

Insured Deposits vs. Reserves

Uninsured Demandable Claims (Deposits) and Fragility
Bank Stock Returns (1-13 Mar 2023) and UDD Drawdowns (Q1 23)

	(1)	(2)	(3)	(4)	(5)	(6)
	Excess Return			ΔLn(Uninsured Demandable Deposits)		
Claims to Potential Liquidity	-0.0266*			-0.0324***		
	(0.0150)			(0.0101)		
Credit Lines to Potential Liquidity		-0.00997			-0.0159***	
		(0.00765)			(0.00478)	
Uninsured Dem Deposits to Potential Liquidity			-0.0280*			-0.0351***
			(0.0157)			(0.0111)
N	305	299	304	4094	3800	4094
r2	0.0944	0.0797	0.0959	0.0113	0.0101	0.0132

NOTE: Results driven by banks with below $250bln size in assets as of Q4 2022 (see Appx)

Bank stock returns during SVB stress:
1-13 March 2023
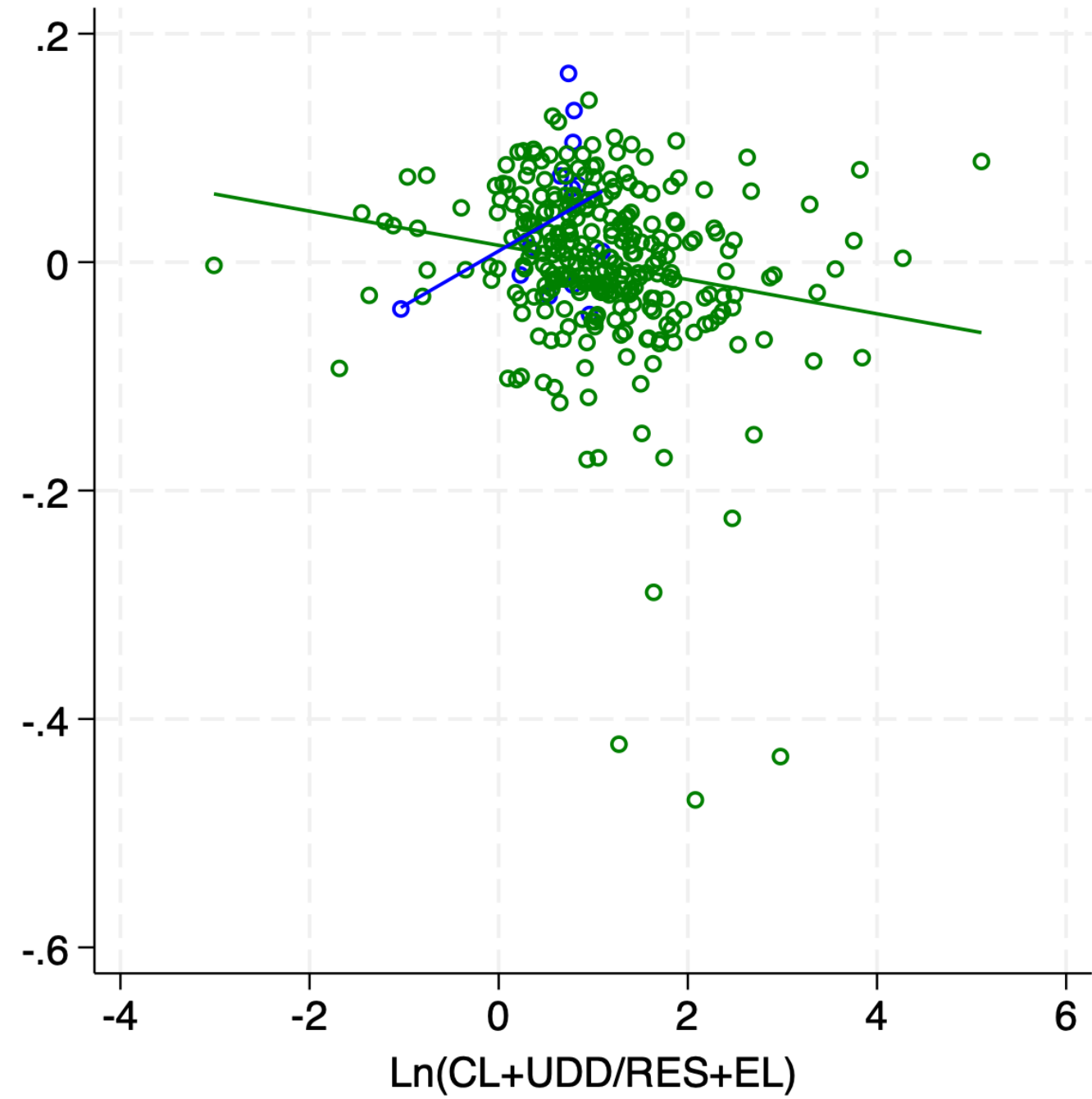
○ Returns Large Bank (>$250bn)

○ Returns Small Banks
(<$250bn)

— Fit Small Banks
(<$250bn)

— Fit Large Banks
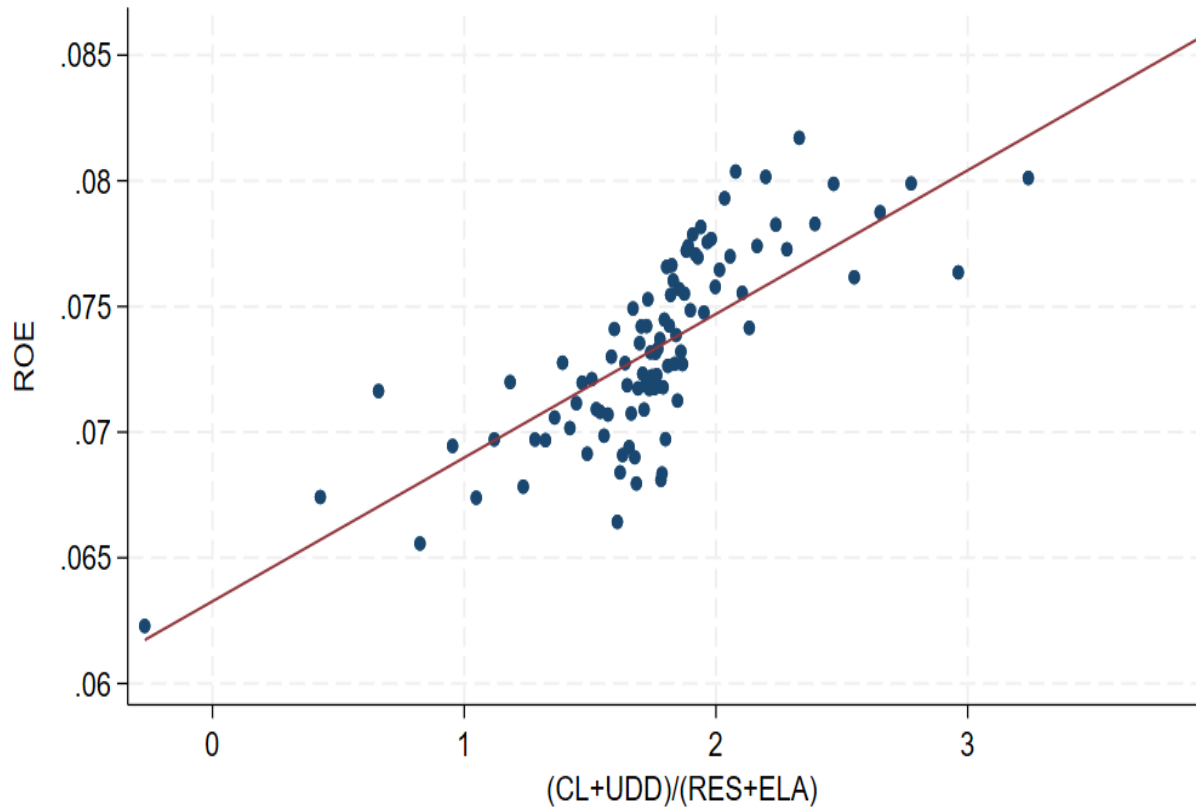(>$250bn)

Small bank line: slope is -0.015 (t-stat: -3.26)

Large bank line: slope is 0.048 (t-stat: 1.32)

Seen also in Uninsured Demand Deposit Losses

Ln(CL+UDD/RES+EL)

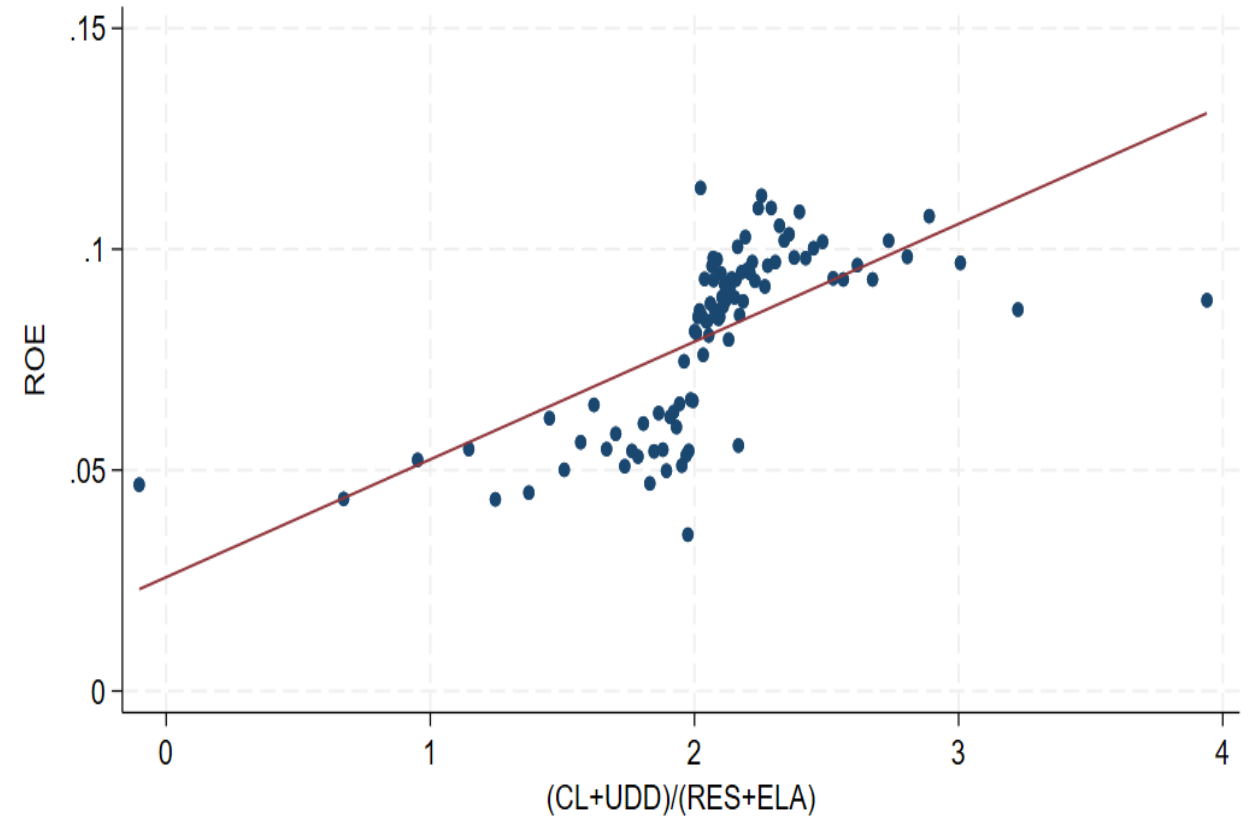# Why do banks take on liquidity risk?
Gains from Claims to ROE?

Binscatter for 2014Q4-2019Q3

Binscatter for 2022Q1-2023Q1

Controls include Bank and Time Fixed Effects, Both Variables winsorized at 5th and 95th percentile

1. Results hold during QE also, but ROE less steeply related to liquidity risk than during QT
2. Results hold with lagged or beginning-of-period liquidity risk

Liquidity risk boosts ROE (%) more for below-median capital banks

	(1)	(2)	(3)	(4)	(5)
			ROE		
(CL+UDD)/(RES+ELA)$_{t-1}$	0.0482*	-0.0584	0.0614**	-0.0322	-0.0758
	(0.0269)	(0.0340)	(0.0240)	(0.0643)	(0.0727)
Below Median (1/0) Equity/Assets$_{t-1}$	0.0997	-0.276*	0.519***	-0.310	-0.719
	(0.165)	(0.151)	(0.143)	(0.282)	(0.529)
Below Median (1/0) Equity/Assets$_{t-1}$ ×(CL+UDD)/(RES+ELA)$_{t-1}$	0.134***	0.156***	0.0507*	0.0886	0.172
	(0.0301)	(0.0429)	(0.0254)	(0.0496)	(0.0795)
N	89495	40123	37216	8459	3565
R^2	0.639	0.654	0.775	0.806	0.837
Period	2010Q1-2023Q1 Overall	2010Q1-2014Q3 QE I-III	2014Q3-2019Q3 Post-QE III + QT I	2019Q4-2021Q4 Pandemic QE	2022Q1-2023Q1 QT II

Policy Implications

Is there a cost to repeated Fed liquidity provision?

- Tightening post-QE associated with financial fragility

- Liquidity dependence? Can liquidity support be pursued indefinitely?

- Market underprices liquidity, enhancing need to intervene.

  - Easy for Fed to get in, hard to get out
  - Distortion in financial activity, risk taking.
  - Distortion in real activity?

- Accidents/places Fed cannot reach
- Permanent fiscal financing
- Interferes with monetary function

Financial stability at conflict with monetary policy?

- QE magnifies banking sector's size, especially its demandable liabilities

- Accidents waiting to happen? Not just banks, but also in shadow banks?
  - BOE in 2022
- Severe conflict also in case of depositor runs/outflows at present
  - Fed in 2023
- Engage in QT while "feeling the stones" for financial fragility

- Revisit desirable scale, scope, duration of QE: "pushing on a string"?

Appendix

Aggregate price of liquidity $\Delta(EFFR - IOR)_t$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔLn(Reserves)	-0.149***	-0.198***	-0.206***	-0.174***	-0.207***	-0.219***	-0.183***
	(0.0335)	(0.0291)	(0.0204)	(0.0312)	(0.0190)	(0.0213)	(0.0293)
ΔLn(Deposits)		0.464**			0.343*		
		(0.222)			(0.194)		
ΔLn(Demandable Dep)			0.430***			0.360***	
			(0.106)			(0.0951)	
ΔLn(Time Dep)			0.0586			0.0423	
			(0.0542)			(0.0603)	
ΔLn(Unins Dem Dep)							0.0776**
							(0.0338)
ΔLn(Credit Lines)				0.182***	0.160***	0.170***	0.188***
				(0.0496)	(0.0511)	(0.0487)	(0.0508)
ΔLn(Gross Draws)				-0.0154***	-0.0138*	-0.0120*	-0.0142***
				(0.00512)	(0.00693)	(0.00657)	(0.00437)
Constant	0.00474**	-0.00182	-0.00333	0.00321	-0.00146	-0.00359*	0.00164
	(0.00195)	(0.00427)	(0.00296)	(0.00199)	(0.00379)	(0.00210)	(0.00240)
Obs	51	51	51	51	51	51	51
R-sq	0.468	0.518	0.530	0.562	0.588	0.605	0.575
Reg-Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Price of liquidity
→ - Reserves,
+ Demandable,
+ Uninsured DD

Reserves Instrument: 1st Stage

	(1) ΔLn(Reserves)	(2) ΔLn(Reserves)	(3) ΔLn(Reserves)	(4) ΔLn(Reserves)
z^{R1}	28.79***	30.15***	27.33**	-22.18
	(8.127)	(7.162)	(11.78)	(13.86)
z^{R2}	-44.35	-50.30*	-42.21	243.8***
	(27.02)	(25.17)	(39.17)	(58.14)
N	112098	50835	43041	30696
R-sq	0.128	0.162	0.162	0.0290
F-stat	284213.1	82579.8	319247.0	27.86
Controls	Ln(Assets), Equity/Assets, Net Income/Assets, Primary Dealer, HHI			
Period	Overall: 2001Q1-2021Q4	QE I-III+Pandemic QE: 20008Q4-2014Q3 + 2019Q4-2021Q4	QE I-III: 20008Q4-2014Q3	Post-QE III+QT: 2014Q4-2019Q3

Mechanisms at work...

Additional Test I: Active maturity-shortening

- Is the shortening of maturities bank-driven?
  - Ability to affect deposit quantity by adjusting rates requires market power
  - Effects driven by banks with above-median HHI banks, limited effect for others
    - Banks with above median value of deposits-weighted county-level-deposit-HHI (full-sample)

Term spread and bank deposit HHI

|	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A.1				3 month CD Rate - Money Market AC Rate				
		Above Median HHI				Below Median HHI		
Ln(Reserves)	-0.170***	-0.203***	-0.216***	0.209*	0.0259	0.0579	0.00854	0.260
	(0.0525)	(0.0612)	(0.0541)	(0.117)	(0.0356)	(0.0533)	(0.0544)	(0.375)
Ln(Total Deposits)	0.753	0.825	1.016	-0.528	-0.363	-1.154	-0.234	0.127
	(0.637)	(0.681)	(0.615)	(1.068)	(0.747)	(0.735)	(0.340)	(1.651)
N	40573	19429	17026	10856	41143	19918	17552	10570
Bank and Time-FE	Y	Y	Y	Y	Y	Y	Y	Y
Bank and Time Clustered SE	Y	Y	Y	Y	Y	Y	Y	Y
Period	Overall	QE I-III+Pandemic QE	QE I-III	Post-QE III+QT	Overall	QE I-III+Pandemic QE	QE I-III	Post-QE III+QT

II: Maturity-shortening by less-capitalized banks

- Which banks raise uninsured deposits and shrink maturity?
  - Results driven by below median (one-quarter-lagged) equity-to-assets banks
  - QE x Bank under-capitalization –> Uninsured deposits, maturity shortening

Bank capital and demand deposits

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			ΔLn(Uninsured Demand + Savings Deposits)					
	Above Median Equity/Assets				Below Median Equity/Assets			
ΔLn(Reserves)	0.110	0.167	0.186	-0.108	0.113***	0.116***	0.127***	-0.317
	(0.110)	(0.115)	(0.125)	(0.244)	(0.0224)	(0.0201)	(0.0239)	(0.420)
N	41001	19111	15794	13468	55283	23328	19031	16339
Time-FE	Y	Y	Y	Y	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Bank	Y	Y	Y	Y
Period	Overall	QE I-III + Pandemic QE	QE I-III	Post-QE III + QT	Overall	QE I-III + Pandemic QE	QE I-III	Post-QE III + QT

(Credit Lines + Uninsured Demandable Deposits) / (Reserves + Eligible Assets)
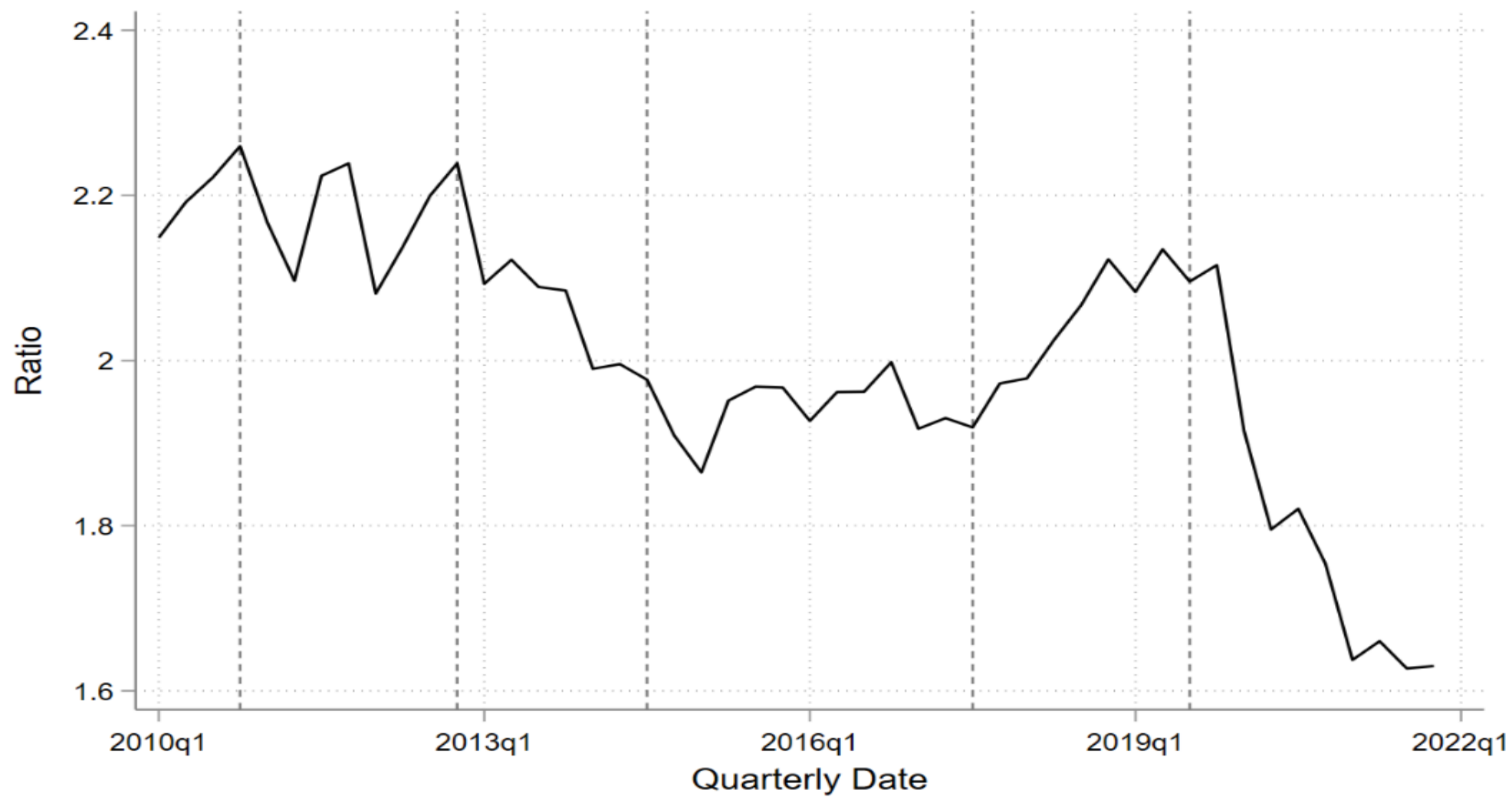
Panel B: Interactions with Size Indicator

Uninsured Demandable Claims (Deposits) and Fragility

Bank Stock Returns (1-13 Mar 2023)

and

UDD Drawdowns (Q1 23)

	(1)	(2)	(3)	(4)	(5)	(6)
	Excess Return			ΔLn(Uninsured Demandable Deposits)		
Claims to Potential Liquidity	0.0495**			0.168***		
	(0.0193)			(0.0531)		
Bank Assets<=$250 bn=1	0.00469	-0.0605	-0.0103	0.0641	-0.154	0.00804
	(0.0476)	(0.0576)	(0.0478)	(0.101)	(0.136)	(0.103)
Bank Assets<=$250 bn=1 # Claims to Potential Liquidity	-0.0769***			-0.201***		
	(0.0203)			(0.0535)		
Credit Lines to Potential Liquidity		0.00615			0.0440*	
		(0.0102)			(0.0238)	
Bank Assets<=$250 bn=1 # Credit Lines to Potential Liquidity		-0.0171			-0.0601**	
		(0.0131)			(0.0237)	
Uninsured Dem Deposits to Potential Liquidity			0.0575***			0.153**
			(0.0201)			(0.0735)
Bank Assets<=$250 bn=1 # Uninsured Dem Deposits to Potential Liquidity			-0.0863***			-0.189**
			(0.0216)			(0.0738)
N	305	299	304	4094	3800	4094
r2	0.0973	0.0814	0.0993	0.0116	0.0105	0.0134