

Liquidity Dependence

Why Shrinking Central Bank Balance Sheets is an Uphill Task

Raghuram G. Rajan

w/ Viral V Acharya, Rahul Chauhan, and Sascha Steffen

October 2022



The University of Chicago Booth School of Business

Conundrum: Where did all the liquidity go?

- Unprecedented expansion of central bank balance sheets since the GFC
- Surprisingly fragile liquidity conditions in money markets
 - Repo rate spike in September 2019
 - Dash for cash in March 2020
 - Recent turmoil in UK gilts, Sep-Oct 2022
- Are central bank balance sheet expansion and liquidity stress related?
 - Focus on banking sector liability-side (see Acharya-Rajan 2021)
 - In contrast to the more common asset-side and asset-pricing approach to QE

QE : (i) Purchase from banks

Initial Balance Sheet Conditions

FEDERAL RESERVE	
Assets	Liabilities
Treasury securities	Reserves held by banks Cash

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

The Fed Purchases Assets from Banks
Balance Sheet Effects

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

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

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

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

PUBLIC	
Assets	Liabilities
Deposits	Net worth
Treasury securities	

The Fed Purchases Assets from the Public
Balance Sheet Effects

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

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

Bank balance sheets expand, financed with deposits

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...

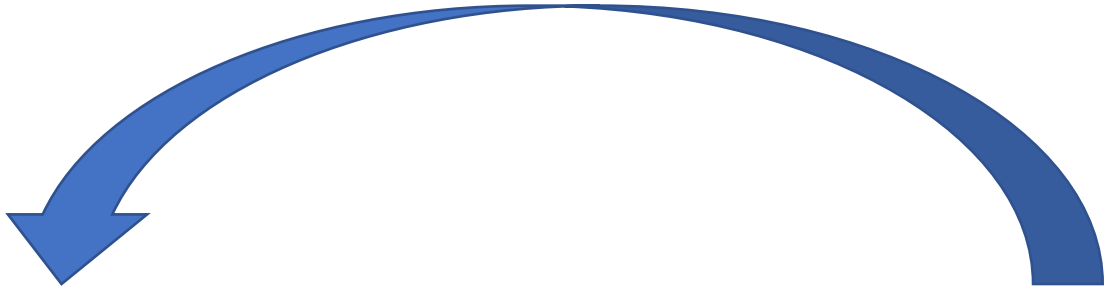
We seek to answer the following important questions:

- 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)?

QT is not simply a reversal of QE!

- QE => growth of on- and off-balance-sheet demandable bank liabilities
 - Demand deposits expand (akin to QE purchases from non-banks)
 - Plus shrinkage of deposit maturity; additional writing of credit lines
 - Why “portfolio balance” view of QE transmission may not work.
- QT => No shrinkage of these liquidity claims
 - they continue to grow post-QE and remain stable during QT
- “Liquidity dependence” in the banking system
 - Ratcheting up of central bank b/s size as it injects more reserves with each stress
- QT can be an uphill task

Traditional view: Exogenous demand for liquidity



Supply of Reserves

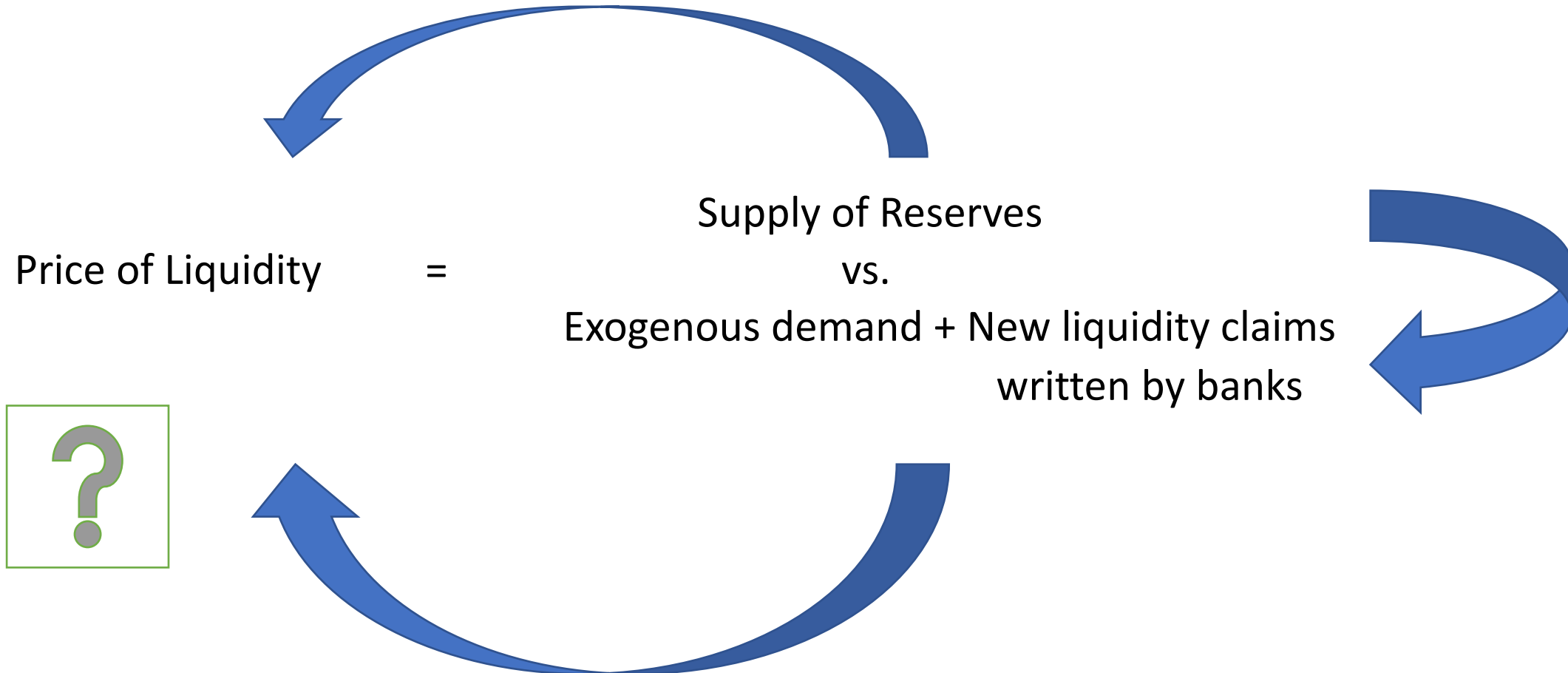
Price of Liquidity =

vs.

Exogenous demand for liquidity

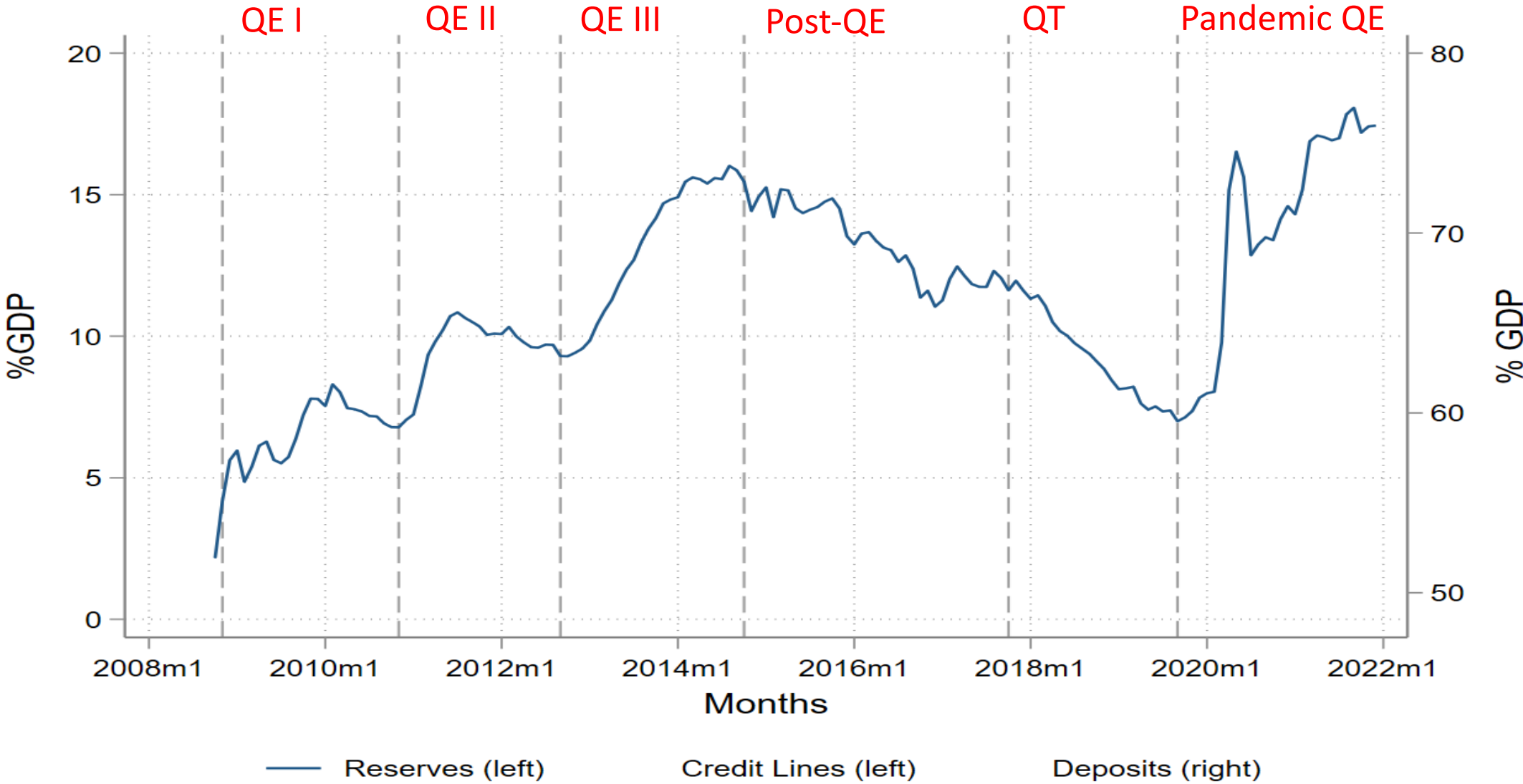
- As demand is exogenous, increasing supply of reserves is stabilizing

Dependence view: Liquidity demand affected by reserves

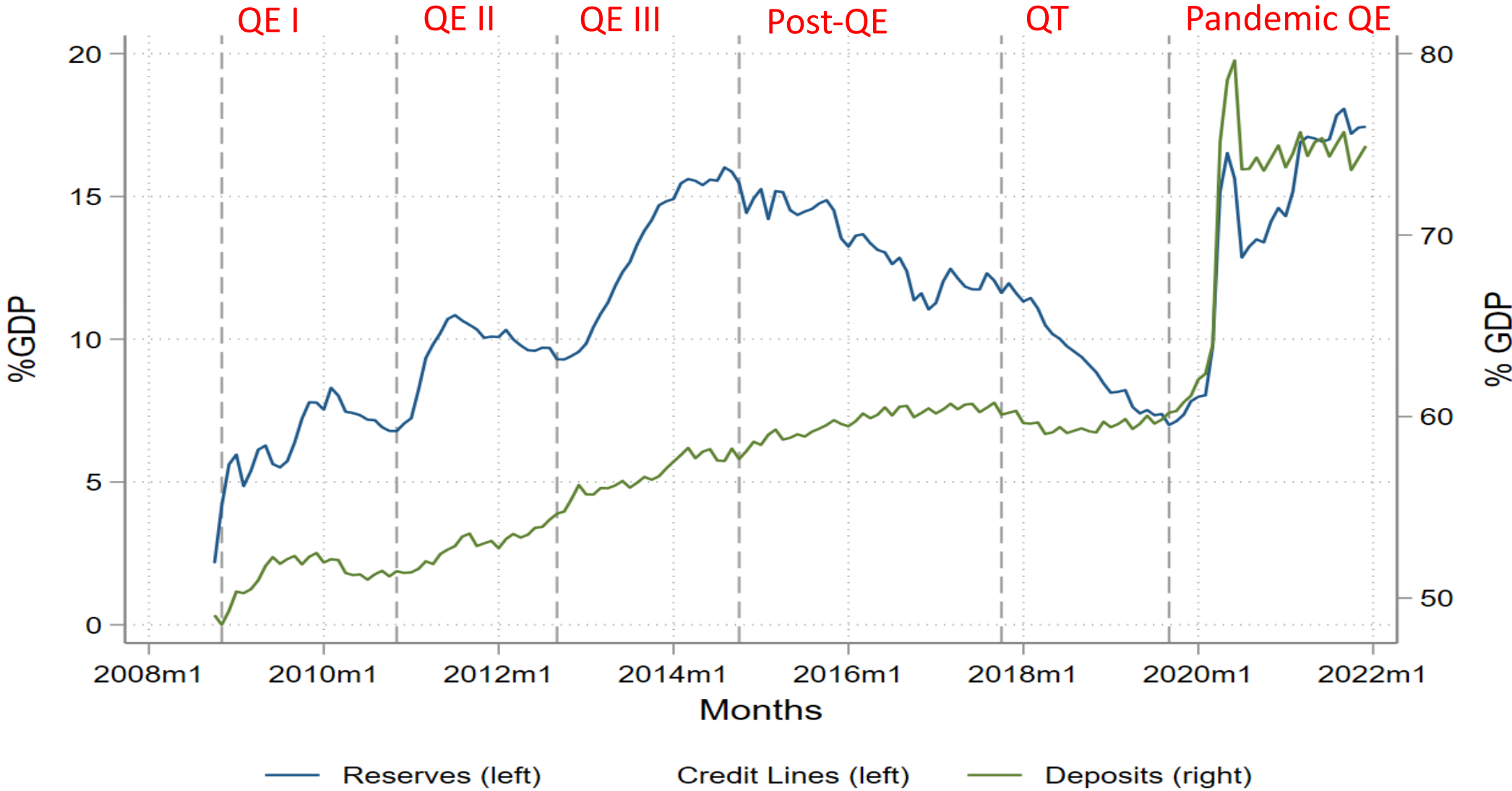


- Supply of reserves creates its own additional demand, new claims written by banks.
- Liquidity conditions and the effect of quantitative tightening depend on how these claims evolve.

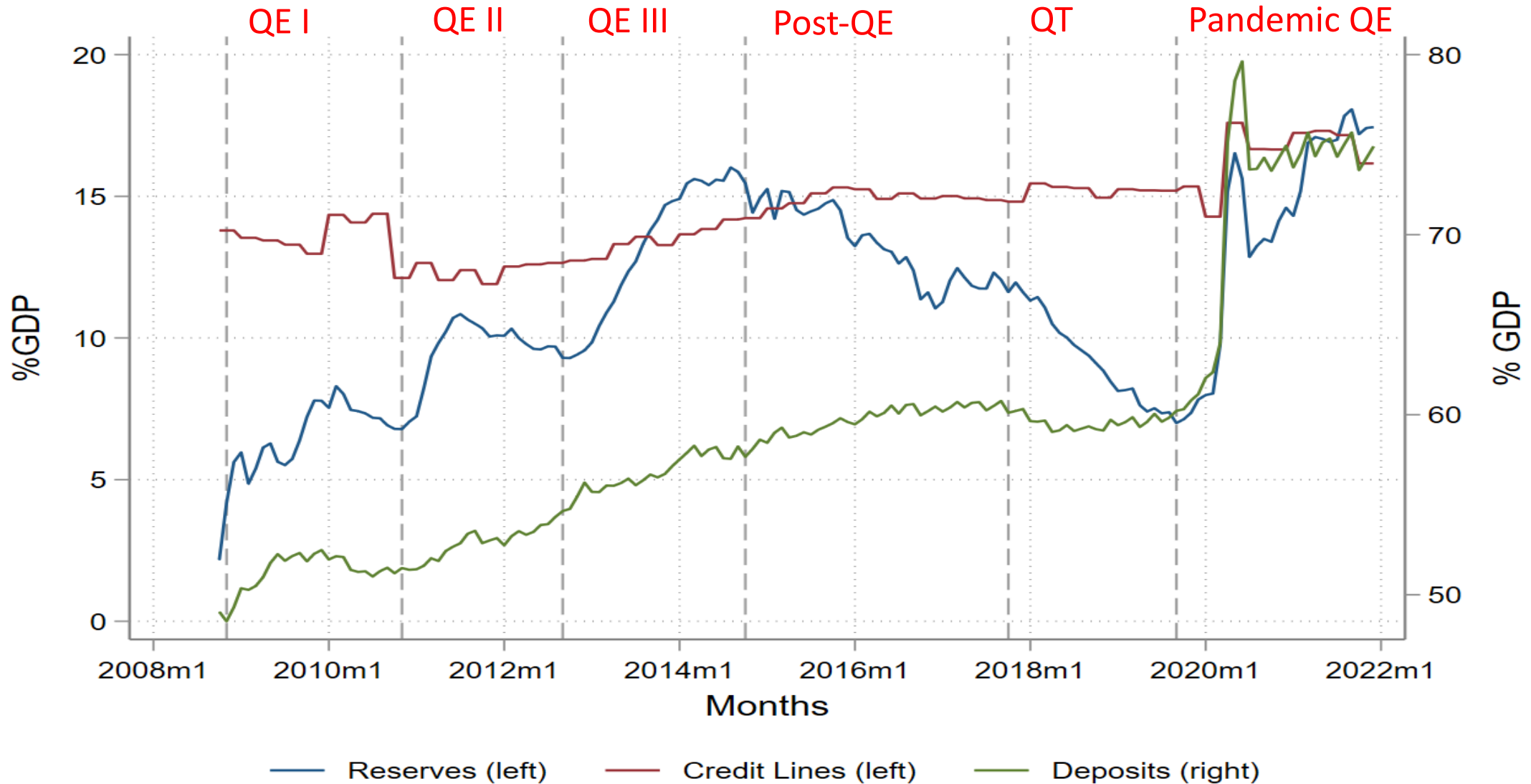
Reserves and Claims (% of GDP)



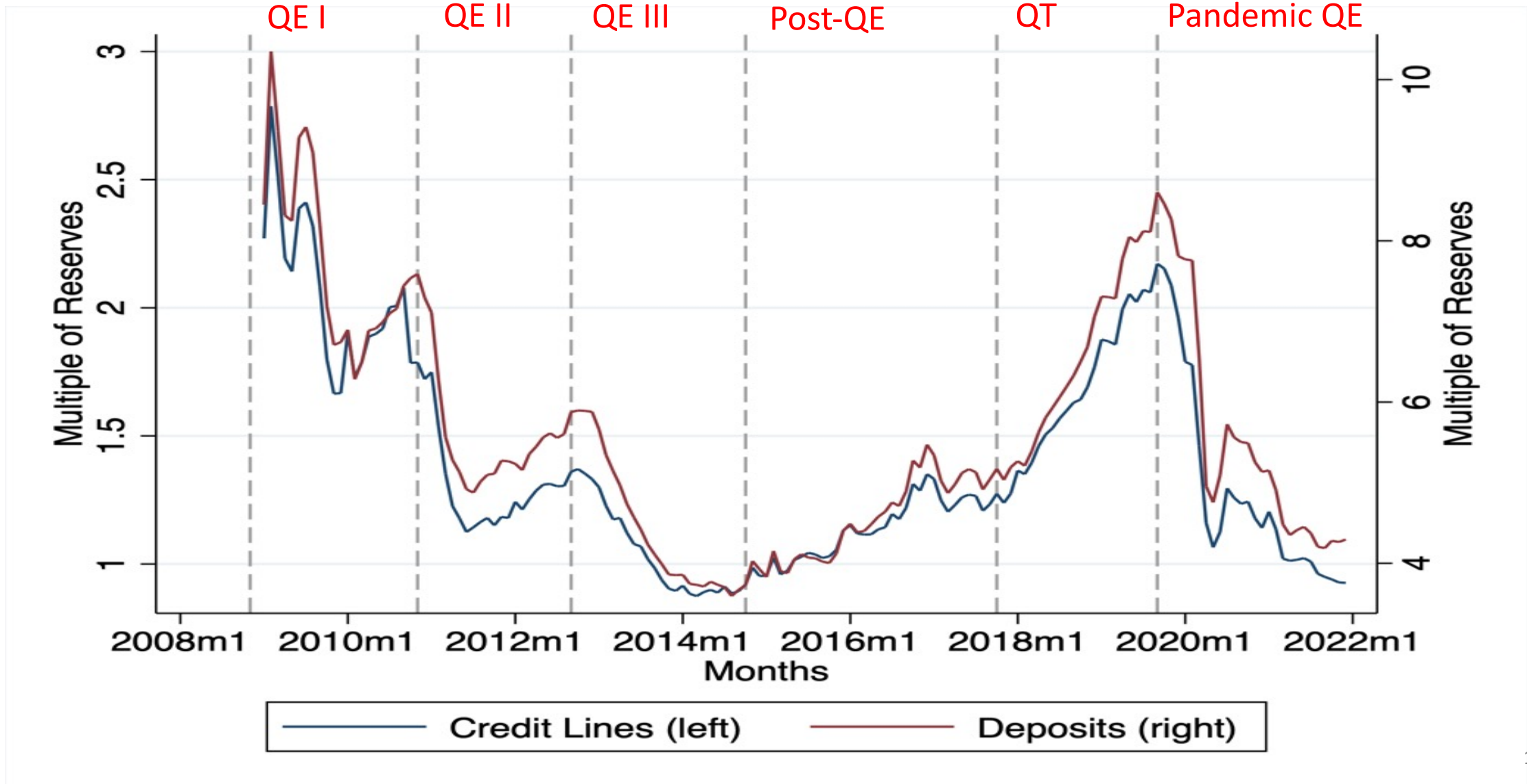
Reserves and Claims (% of GDP)



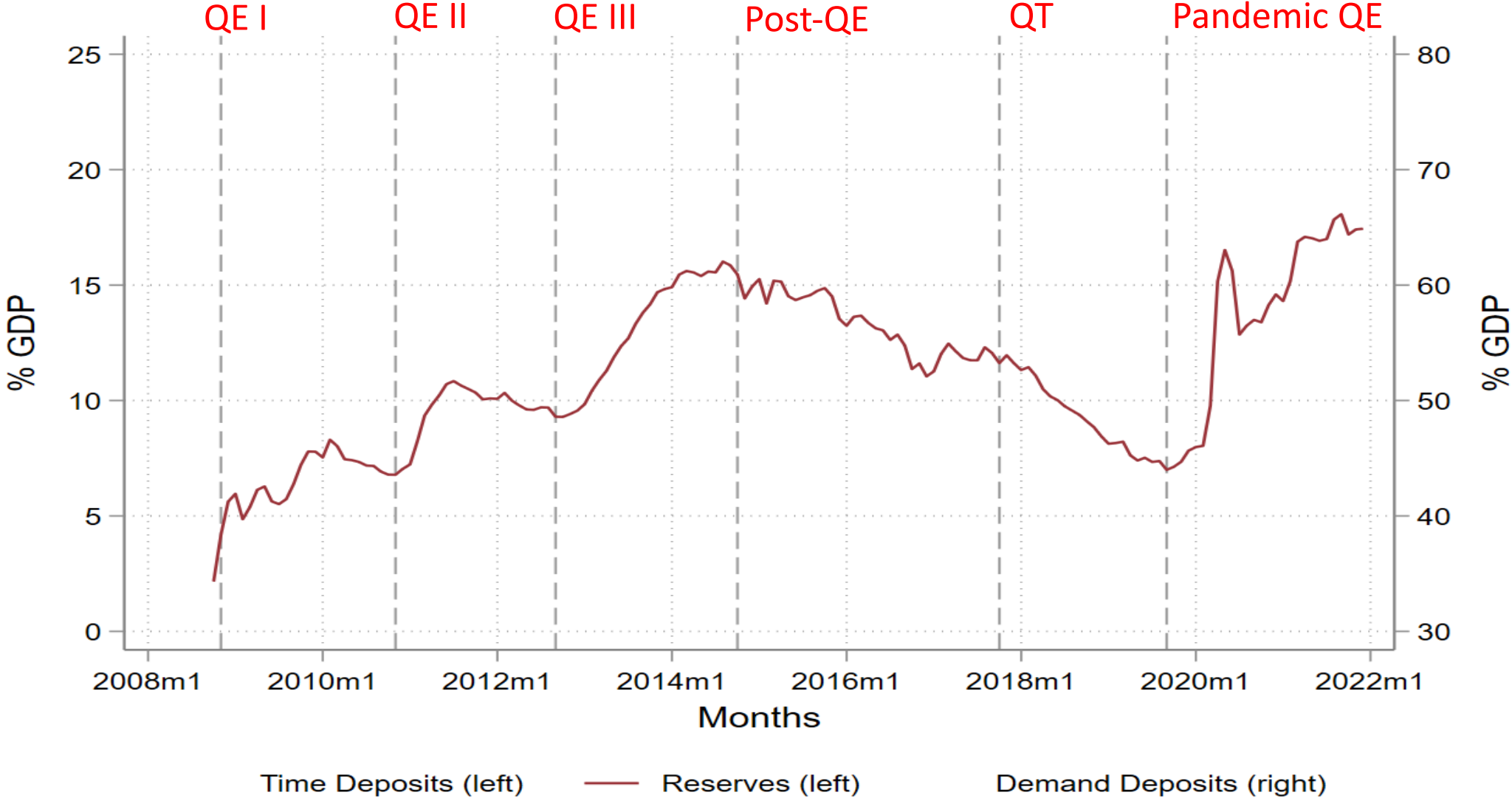
Reserves and Claims (% of GDP)



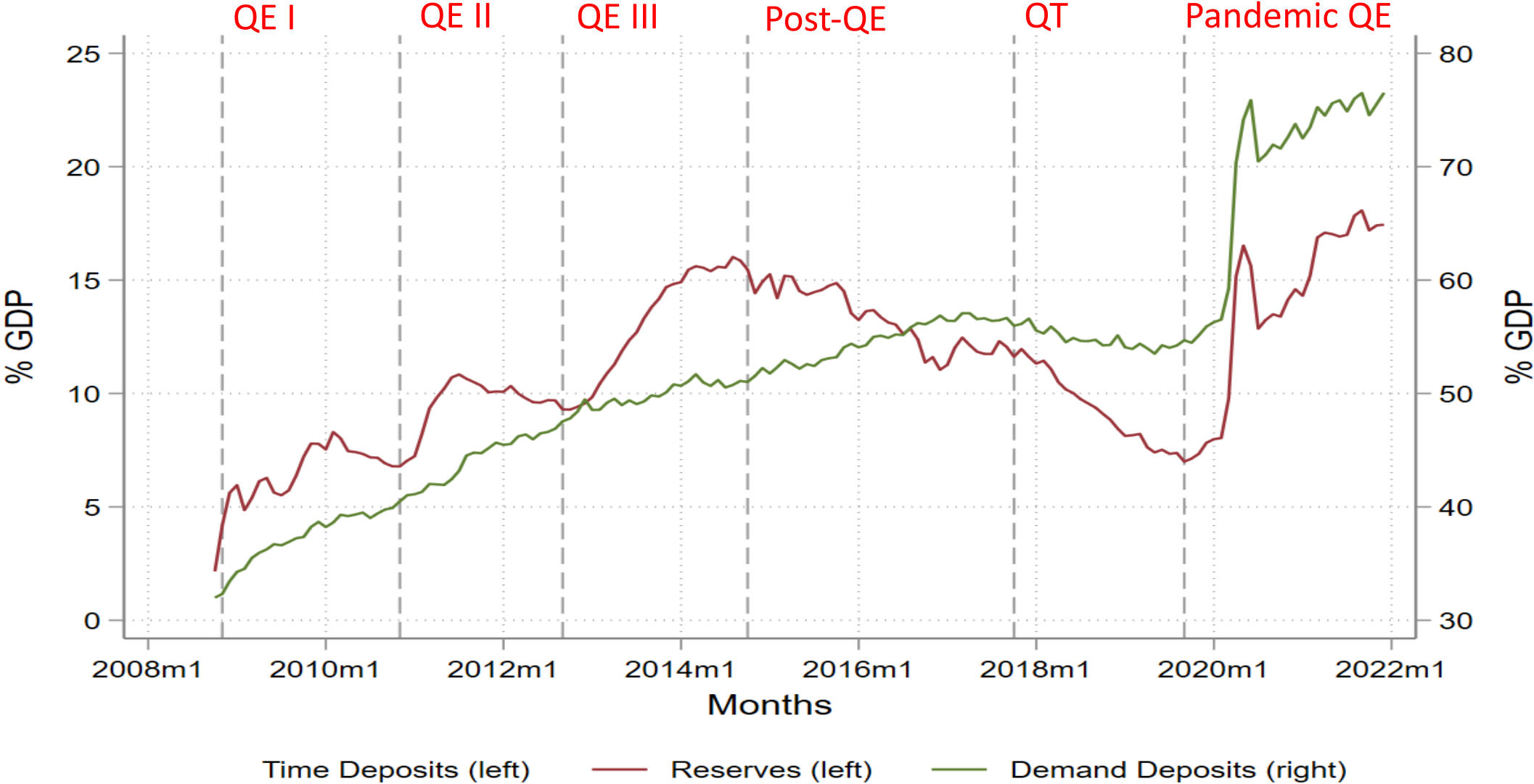
Claims on Liquidity (multiple of reserves)



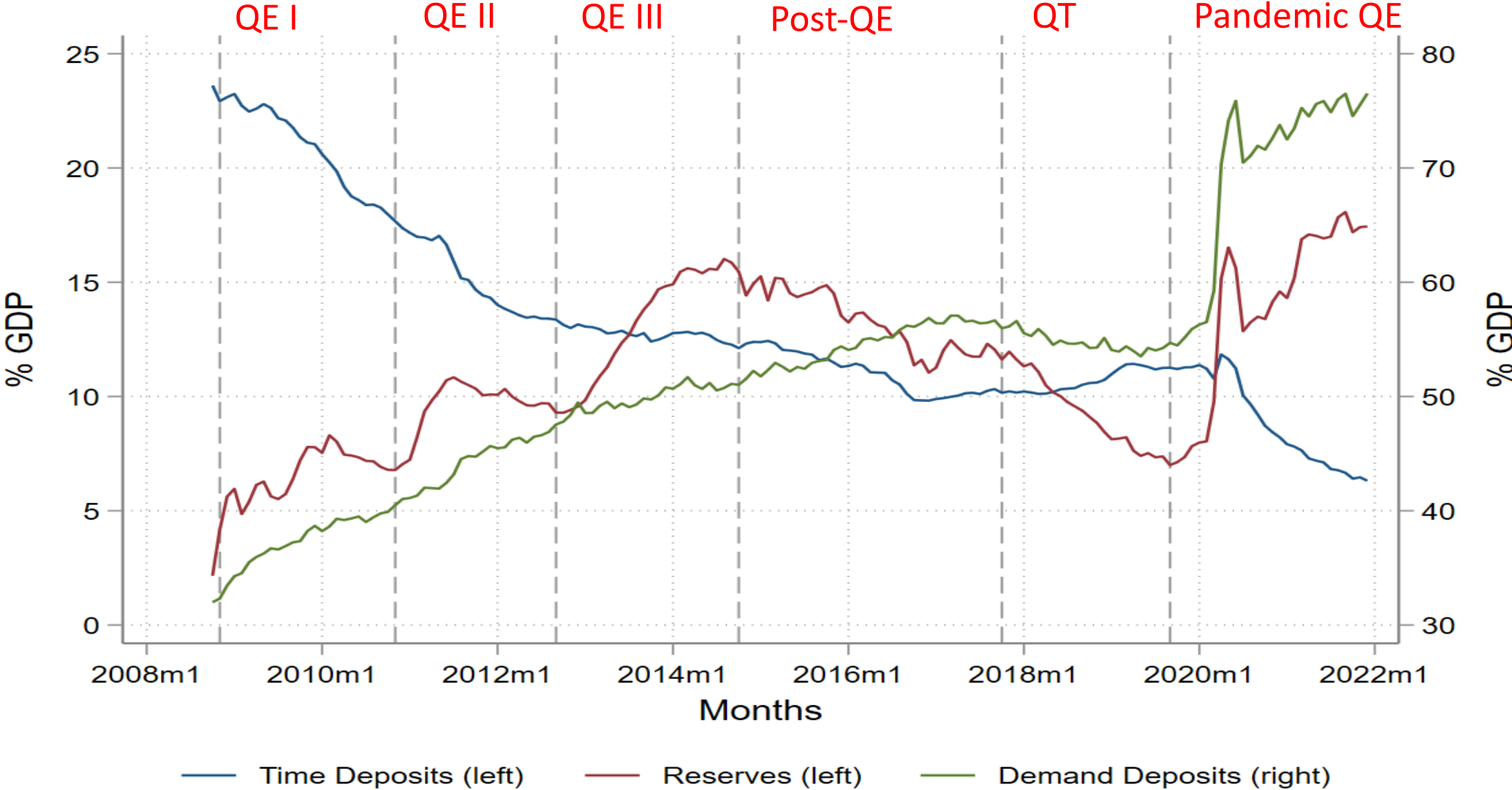
Demandable and Time Deposits (% of GDP)



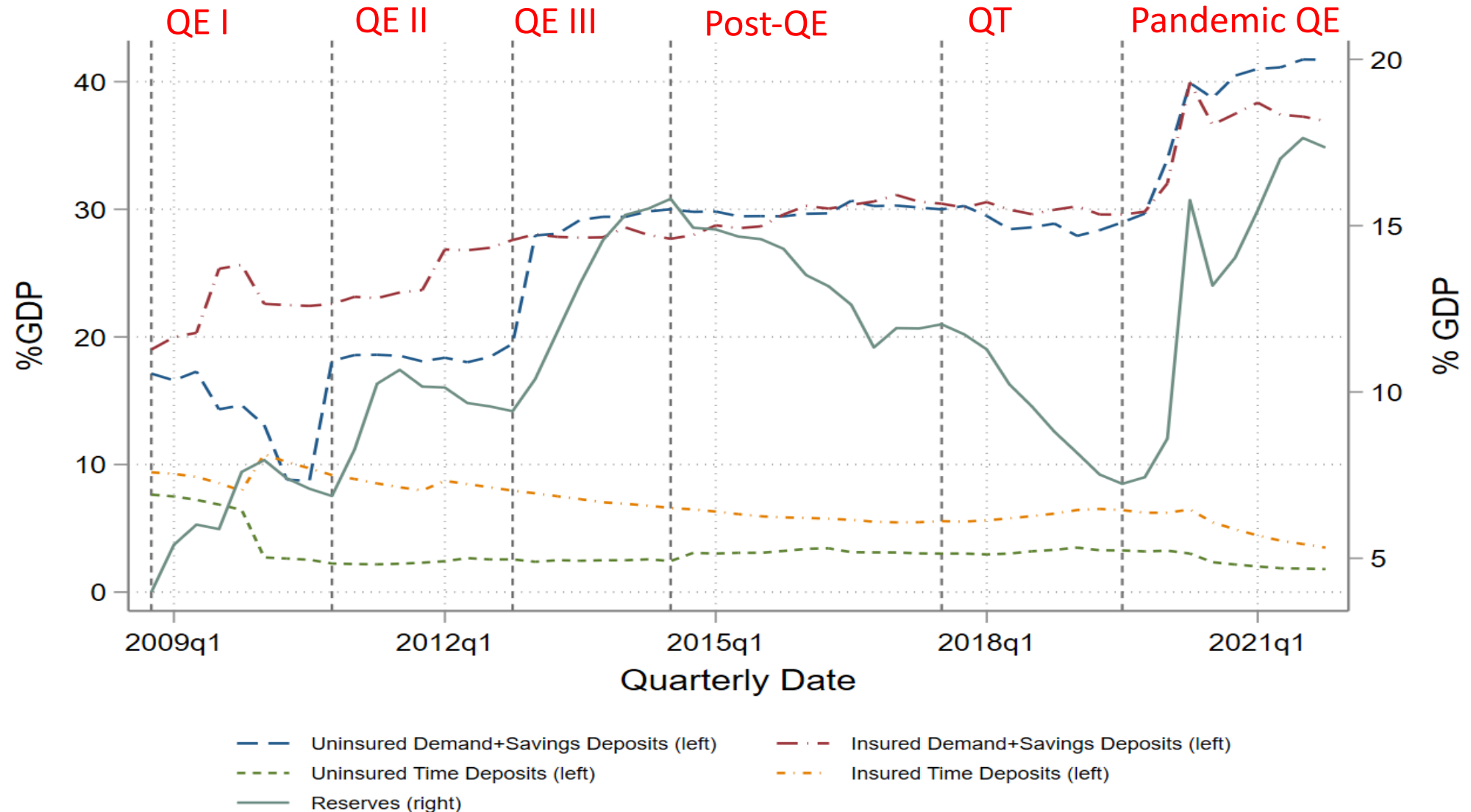
Demandable and Time Deposits (% of GDP)



Demandable and Time Deposits (% 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
 - Instrument for bank-level reserves and deposits
 - Reserves -> Price of liquidity -- Credit line fees
 - Instrument for bank-level reserves and credit line originations

Data Sources

We examine over the time period 2001Q1 – 2021Q4

- Aggregate Reserves, Deposits, Credit Lines Outstanding, GDP data – FRED and Flow of Funds (Financial Accounts of the United States) Data
- Bank Balance Sheet Data – FDIC’s Call Reports Data
- Bank-County Level Deposit Data – Branch Office Deposits in FDIC Summary of Deposits
- Bank-Deposit instrument-Level Interest Rate Data – S&P Global’s *RateWatch* database
- Credit Lines Originations and Pricing data – Dealscan *Refinitiv LoanConnector*

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 $\Delta \ln(\text{Deposits})$ or $\ln(\text{Credit Lines})$ or the Δ of Deposits or Credit Lines

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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \ln(\text{Deposits})$	$\Delta \ln(\text{Demand Deposits})$	$\Delta \ln(\text{Time Deposits})$	$\Delta \ln(\text{Credit Lines})$	$\Delta \text{ Deposits}$	$\Delta \text{ Demand Deposits}$	$\Delta \text{ Time Deposits}$	$\Delta \text{ Credit Lines}$
$\Delta \ln(\text{Reserves})$	0.137*** (0.0368)	0.180*** (0.0541)	-0.242** (0.114)	0.0802*** (0.0282)				
$\ln(\text{Reserves})_{t-12}$	0.0503*** (0.0140)	0.0136 (0.0227)	-0.0251 (0.0702)	0.0882*** (0.0323)				
$\Delta \text{ Reserves}$					0.999*** (0.242)	1.358*** (0.314)	-0.224** (0.0932)	0.147*** (0.0392)
Reserves_{t-12}					0.329*** (0.0691)	0.343*** (0.0838)	0.0726 (0.0684)	0.146*** (0.0399)
Constant	-0.327*** (0.106)	-0.0265 (0.172)	0.163 (0.533)	-0.616** (0.249)	-88.97 (169.3)	-15.98 (164.0)	-220.0 (150.2)	-162.4* (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
Reg-Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
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 20 (12)



Time-series analysis: Reserves -> Price of liquidity

LS-VJ (2022):

$$\begin{aligned} & EFFR - IOR_t \\ & = \alpha \text{Ln}(\text{Reserves})_t + \beta \text{Ln}(\text{Deposits})_t + \gamma \text{Ln}(\text{Credit Line})_t + \varepsilon_t \end{aligned}$$

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

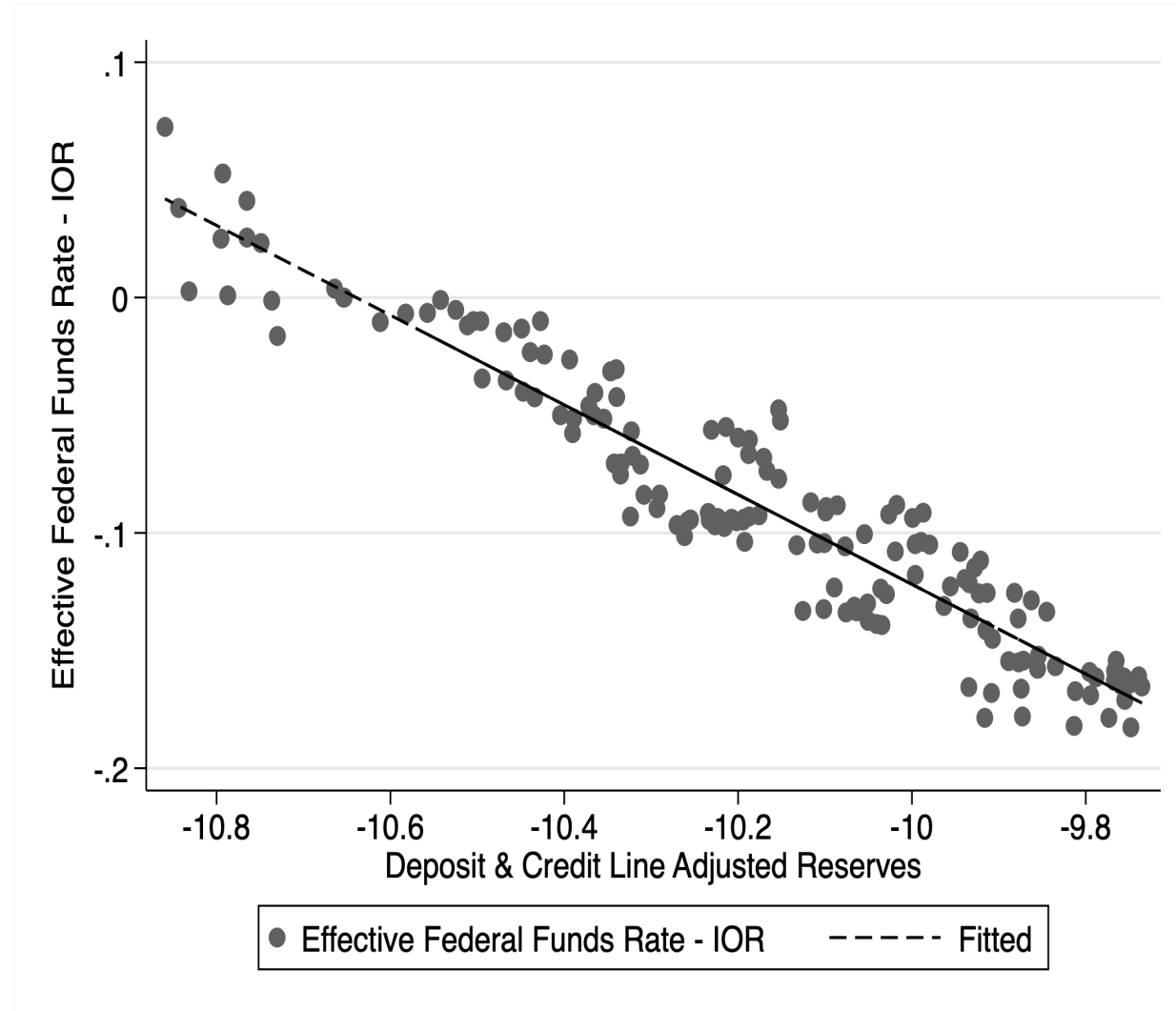
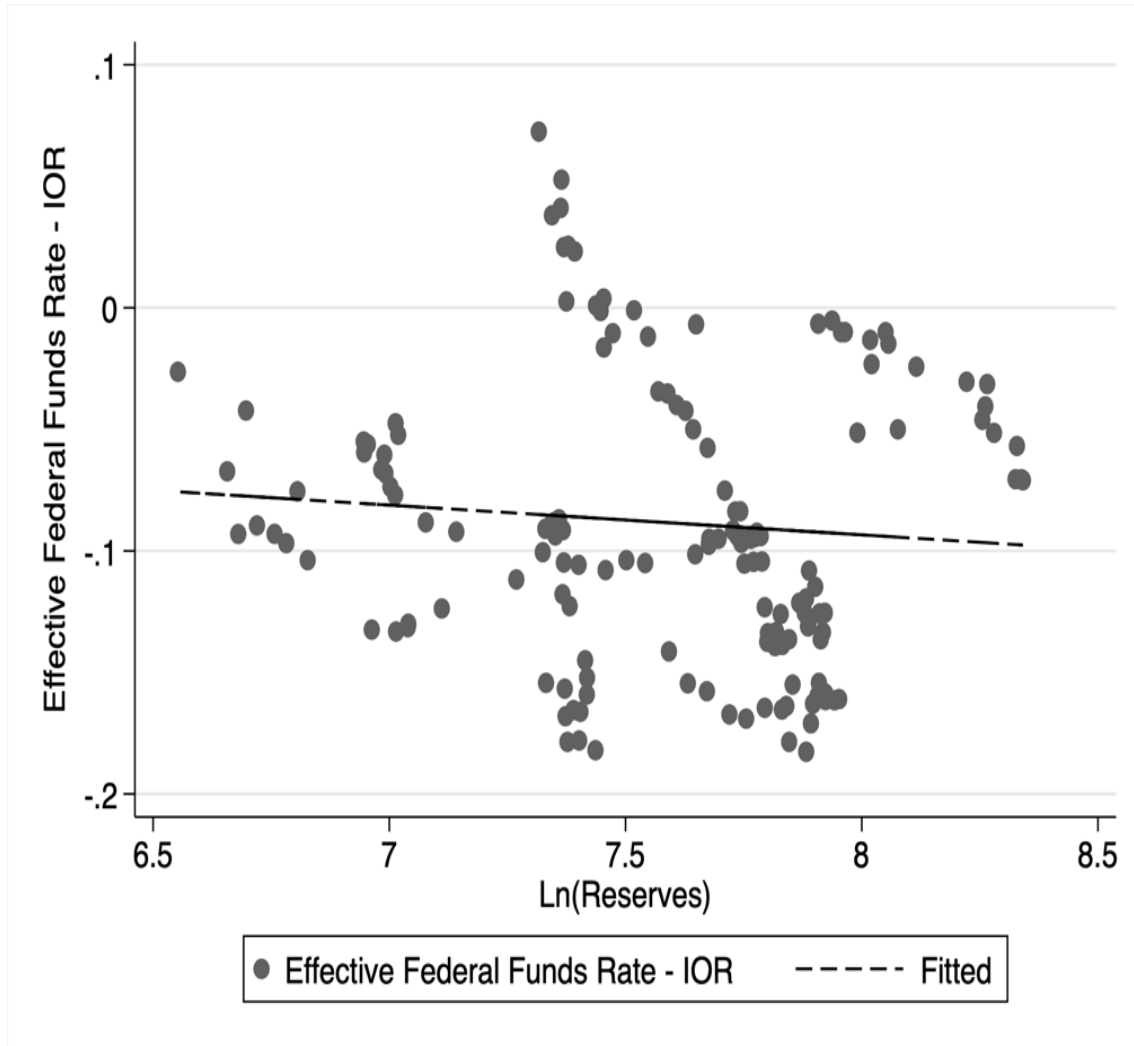
$$\begin{aligned} & \Delta(EFFR - IOR)_t \\ & = \alpha \Delta \text{Ln}(\text{Reserves})_t + \beta \Delta \text{Ln}(\text{Deposits})_t + \gamma \Delta \text{Ln}(\text{Credit Line})_t + \varepsilon_t \end{aligned}$$

$\Delta X_t = X_t - X_{t-4}$ for regressions with quarterly variables and

$\Delta X_t = X_t - X_{t-12}$ for regressions with monthly variables

	(1)	(2)	(3)	(4)	(5)	(6)
	EFFR-IOR	EFFR-IOR	EFFR-IOR	EFFR-IOR	EFFR-IOR	EFFR-IOR
Ln(Reserves)	-0.0122 (0.0266)	-0.188*** (0.0125)	-0.188*** (0.0148)	-0.150*** (0.0107)	-0.145*** (0.0103)	-0.191*** (0.0158)
Ln(Deposits)		0.365*** (0.0159)				
Ln(Demand Deposits)			0.315*** (0.0147)			0.251*** (0.0433)
Ln(Time Deposits)			0.105*** (0.0350)			0.0701 (0.0445)
Ln(Credit Lines)				0.333*** (0.0215)	0.294*** (0.0199)	0.0893* (0.0481)
Ln(Usage)					0.0200** (0.00781)	-0.00754 (0.00628)
Constant	0.00446 (0.198)	-2.048*** (0.113)	-2.355*** (0.408)	-1.570*** (0.164)	-1.709*** (0.180)	-2.028*** (0.478)
Obs	155	155	155	155	155	155
R-sq	0.00702	0.894	0.895	0.843	0.851	0.902
Reg-Type	OLS	OLS	OLS	OLS	OLS	OLS
S.E.(# Lags)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)	Newey-West (12)

Reserves, Claims, and the Price of Liquidity



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

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta\text{EFFR-IOR}$	$\Delta\text{EFFR-IOR}$	$\Delta\text{EFFR-IOR}$	$\Delta\text{EFFR-IOR}$	$\Delta\text{EFFR-IOR}$	$\Delta\text{EFFR-IOR}$
$\Delta\text{Ln}(\text{Reserves})$	-0.155*** (0.0319)	-0.188*** (0.0368)	-0.186*** (0.0308)	-0.161*** (0.0290)	-0.173*** (0.0313)	-0.220*** (0.0213)
$\Delta\text{Ln}(\text{Total Deposits})$		0.474** (0.211)				
$\Delta\text{Ln}(\text{Demand Deposits})$			0.344*** (0.125)			0.376*** (0.0961)
$\Delta\text{Ln}(\text{Time Deposits})$			-0.00215 (0.0612)			0.0460 (0.0610)
$\Delta\text{Ln}(\text{Credit Lines})$				0.140** (0.0523)	0.183*** (0.0496)	0.170*** (0.0482)
$\Delta\text{Ln}(\text{Usage})$					-0.0157*** (0.00518)	-0.0123* (0.00660)
Constant	0.00173** (0.000751)	-0.000692 (0.00120)	-0.000857 (0.00130)	0.00325 (0.00196)	0.00318 (0.00200)	-0.00385* (0.00210)
Obs	154	154	154	51	51	51
R-sq	0.277	0.305	0.314	0.521	0.561	0.607
Reg-Type	OLS	OLS	OLS	OLS	OLS	OLS
Standard-Error	Newey-West	Newey-West	Newey-West	Newey-West	Newey-West	Newey-West
#Lags	12	12	12	4	4	4

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 analyze individual QE/QT periods
 - Can't rule out confounding effects due to interest rates, economic activity
- Hence, panel tests...

Challenges in panel tests

- Reserves are exogenous for the banking system as a whole
- Reserves are however endogenous for each individual bank
- Reserves may correlate with higher time-deposits and lower demand deposits / credit-lines due to risk-aversion / regulations (LCR)
 - => Relation to overall deposits dampened or ambiguous
 - => Correlation of reserves positive with time-deposits
- Hence, we instrument bank-level reserves with
 - Exogenous variation in reserves (aggregate change in reserves)
 - Non-transient bank-level variation (bank's share over the past year)

Instrument for Reserves

$$z_{it}^R = \ln \left(\frac{\text{Aggregate Reserves}_t}{\text{Aggregate Reserves}_{t-1}} \right) \times \frac{1}{4} \sum_{k=1}^4 \text{Bank } i\text{'s share of aggregate reserves}_{t-k}$$

Bank i's share of aggregate reserves in quarter t is calculated by dividing the bank-level reserves by aggregate central bank reserves.

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”

Summary of Panel Test Results

- Mirror time-series quantity results with instrumented reserves
- Reserves → Demandable Deposits ↑ in QE, but no reversal of claims in post-QE / QT

Deposit Quantity (bank-level)

IV 1st Stage:

$$\Delta \ln(\text{Reserves})_{it} = \gamma_1 \text{Reserves Instrument}_{it} + \gamma_2 \ln(\text{Reserves}_{it-5}) + \delta_t + \mu_{it}$$

where $\Delta(Y)_{it} = Y_{it} - Y_{it-4}$, and δ_t represents (quarter) time-fixed effects

IV 2nd Stage:

$$\Delta \ln(\text{Deposits})_{it} = \beta_1 \text{Instr} \Delta \ln(\text{Reserves})_{it} + \beta_2 \ln(\text{Reserves})_{it-5} + \tau_t + \varepsilon_{it}$$

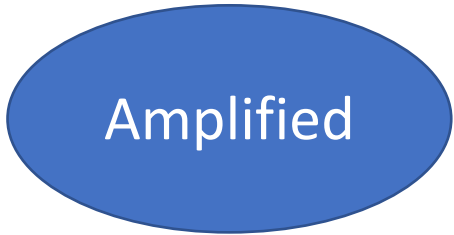
where $\Delta(Y)_{it} = Y_{it} - Y_{it-4}$, and τ_t represents (quarter) time-fixed effects

Total Deposits – IV 2nd Stage

Relative to OLS,
QE effect
amplified; QT
effect reversed

Panel A.2	(1)	(2)	(3)	(4)
	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$
$\Delta\text{Ln}(\text{Reserves})$	0.0252** (0.0112)	0.0248** (0.0101)	0.0248** (0.0100)	-0.130** (0.0617)
$\text{Ln}(\text{Reserves})_{t-5}$	0.00264** (0.00121)	0.00215 (0.00139)	0.00227 (0.00141)	-0.00771* (0.00401)
Obs	115680	50982	43177	30789
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	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 + QT 2014Q4 - 2019Q3

Demand & Savings Deposits– IV 2nd Stage



Panel B.2.1	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.128*** (0.0168)	0.121*** (0.0172)	0.124*** (0.0147)	-0.134** (0.0677)
$\text{Ln}(\text{Reserves})_{t-5}$	0.0136*** (0.00185)	0.0152*** (0.00246)	0.0156*** (0.00228)	-0.00929** (0.00436)
Obs	115533	50921	43130	30770
Time-FE	Y	Y	Y	Y
Bank & Time	Y	Y	Y	Bank only
Clustered Ses				
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

Time Deposits– IV 2nd Stage

Sign flip from OLS:
Reserves cause time deposits to fall

Panel B.2.2	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	-0.102*** (0.0323)	-0.0831** (0.0309)	-0.0789*** (0.0233)	0.125 (0.175)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.0138*** (0.00388)	-0.0198*** (0.00486)	-0.0175*** (0.00325)	0.0116* (0.0116)
Obs	114689	50555	42853	30551
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SEs	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

Summary of Panel Test Results

- Mirror time-series quantity results with instrumented reserves
 - Reserves → Demandable Deposits ↑ in QE, but no reversal of claims in post-QE / QT
 - Reserves → Credit lines to IG + non-rated firms ↑ in QE, but no reversal in post-QE / QT

Credit Lines – IV 2nd Stage

Reserves cause credit lines to rise in QE.
No reversal in QT

	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$
$\Delta \text{Ln}(\text{Reserves})$	0.0584** (0.0248)	0.0678** (0.0268)	0.0614** (0.0231)	0.440 (3.847)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00684 (0.00870)	-0.00207 (0.0126)	-0.00255 (0.0121)	0.00755 (0.174)
Obs	2263	910	679	575
Time-FE	Y	Y	Y	Y
Bank and Time Clustered Ses	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: Credit lines analysis is at bank-holding-company-level

Summary of Panel Test Results

- Mirror time-series quantity results with instrumented reserves
 - Reserves → Demandable Deposits ↑ in QE, but no reversal of claims in post-QE / QT
 - Reserves → Credit lines to IG + non-rated firms ↑ in QE, but no reversal in post-QE / QT
- Mirror time-series results on the price of liquidity (also instrument deposits)
 - Reserves → Term spread of deposits ↓ [3m/18m/24m CD rate - Savings rate]
 - Again, effects during QE, but no reversal in post-QE / QT

(Panel) Reserves -> Lower deposit term spreads

Panel B: IV	(1)	(2)	(3)	(4)
	3 month CD	12 month CD	18 month CD	24 month CD
	Rate - Savings	Rate - Savings	Rate - Savings	Rate - Savings
	Rate	Rate	Rate	Rate
Ln(Total Deposits)	0.179 (0.178)	0.330* (0.177)	0.496* (0.253)	0.400** (0.169)
Ln(Reserves)	-0.109*** (0.0304)	-0.0502 (0.0528)	-0.220*** (0.0558)	-0.111*** (0.0282)
Obs	85319	91212	76421	89830
Bank & Time-FE	Y	Y	Y	Y
Bank and Time Clustered SEs	Y	Y	Y	Y
Reg Type	IV	IV	IV	IV
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: Results robust to whether we include and instrument Total Deposits for exogenous variation

Summary of Panel Test Results

- Mirror time-series quantity results with instrumented reserves
 - Reserves → Demandable Deposits ↑ in QE, but no reversal of claims in post-QE / QT
 - Reserves → Credit lines to IG + non-rated firms ↑ in QE, but no reversal in post-QE / QT
- Mirror time-series results on the price of liquidity (instrument deposits/CLs)
 - Reserves → Term spread of deposits ↓ [3m/18m/24m CD rate - Savings rate]
 - Reserves → All-in-spread drawn/ spread undrawn of LCs to IG + non-rated firms ↓
 - Again, effects during QE, but no reversal in post-QE / QT

(Panel) Reserves -> AISD/AISU Ratio

Panel C: IV	(1)	(2)	(3)	(4)
	AISD/AISU	AISD/AISU	AISD/AISU	AISD/AISU
Ln(Reserves)	-0.840*** (0.301)	-1.545*** (0.360)	-1.581*** (0.379)	-3.380 (4.279)
Ln(Credit Lines)	-0.335 (0.572)	-2.208* (1.141)	-2.460 (1.483)	-5.722 (6.405)
Obs	2202	768	715	586
R-sq	-0.160	-1.355	-1.539	-0.696
Bank & Time- FE	Y	Y	Y	Y
Bank and Time Clustered SEs	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

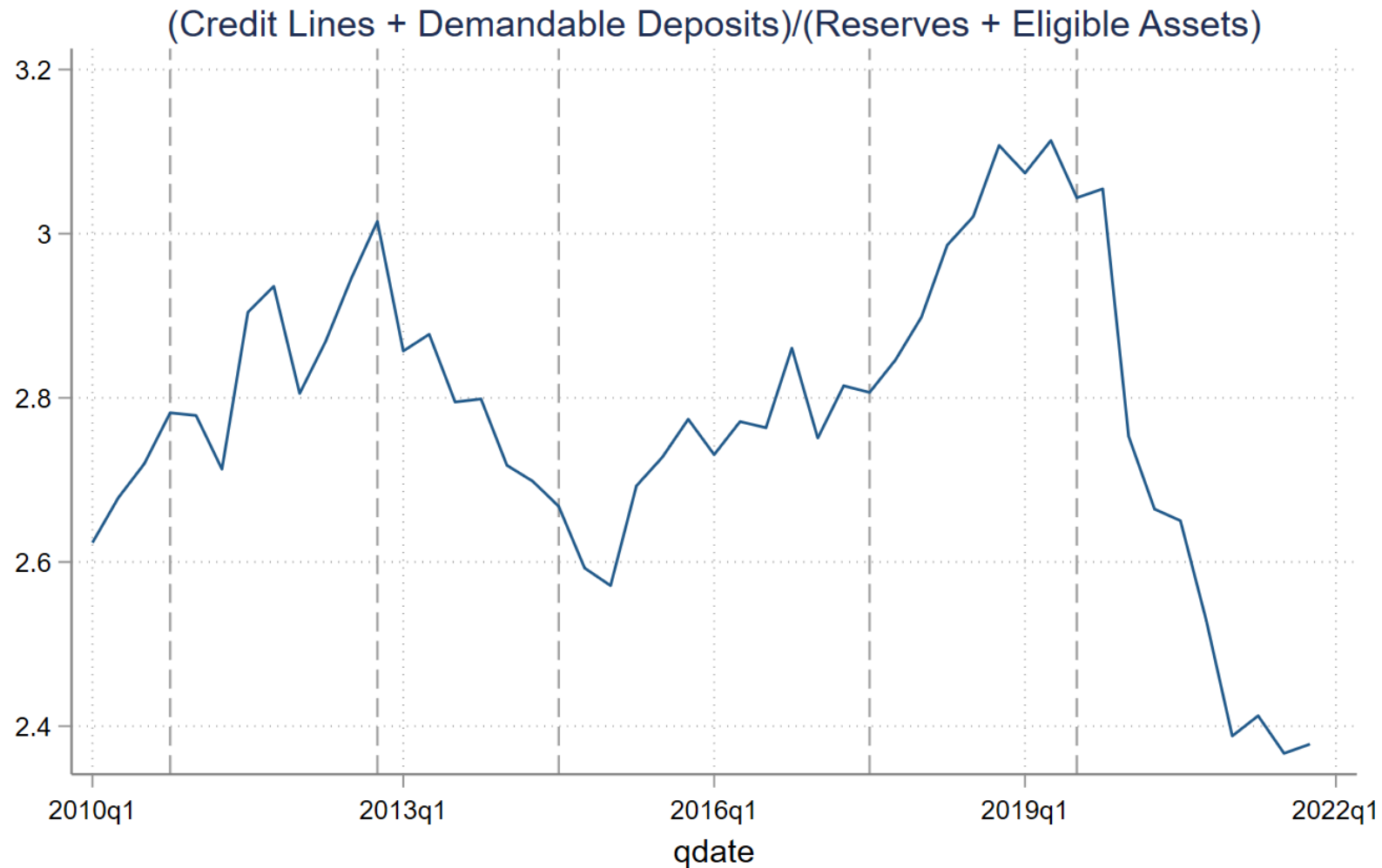
Bank preference to make it cheaper to draw down credit lines in QE. No reversal of this preference post-QE / QT

NOTE: Results robust to whether we include and instrument Credit Lines to separate supply from demand

Why do banks not shrink liquidity claims when reserves fall?

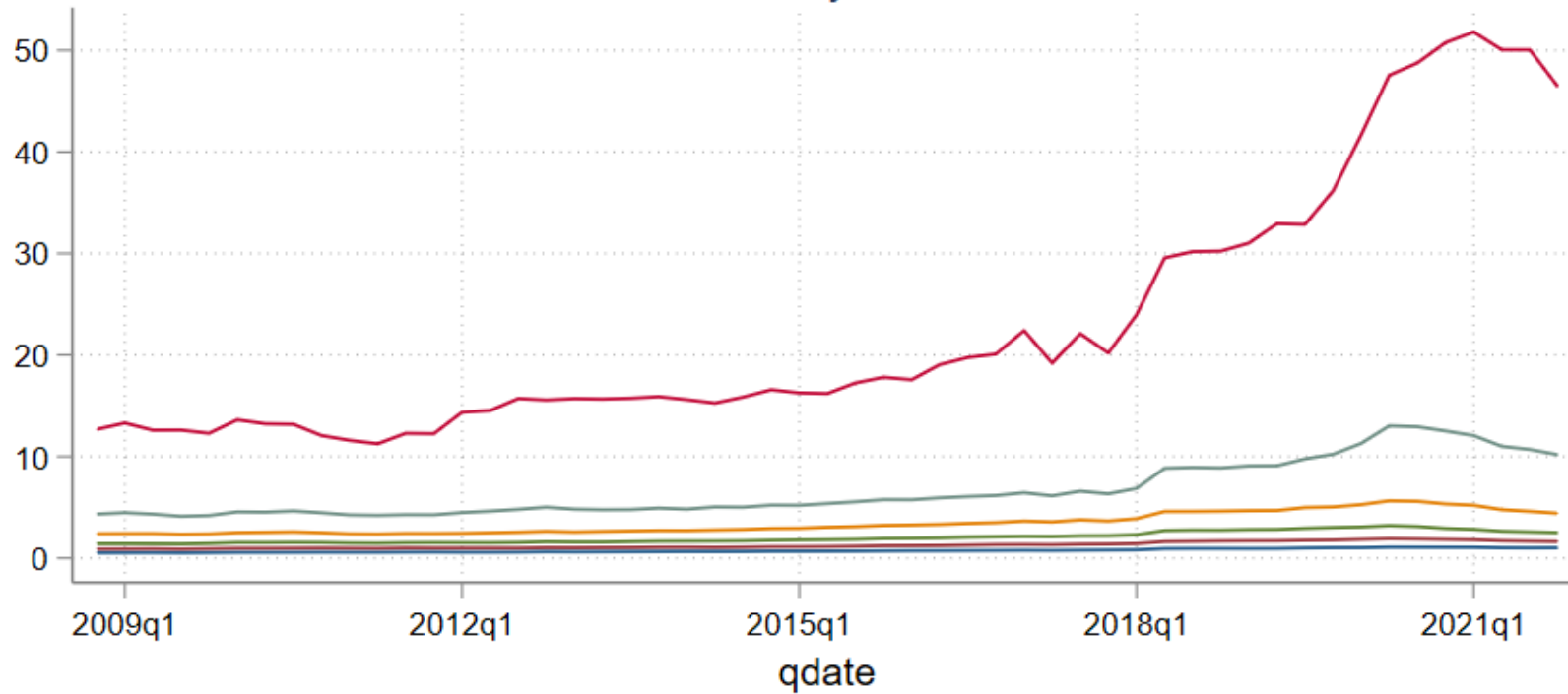
- Perhaps they substitute reserves with “eligible” assets?
 - Can be “repoed” for reserves with other banks
 - And with the Fed through the discount window and now the SRF

(Credit Lines + Demandable Deposits)/(Reserves + Eligible Assets)



Dispersion across time

Distribution of $(\text{Credit Lines} + \text{Demandable Deposits}) / (\text{Reserves} + \text{Eligible Assets})$
by

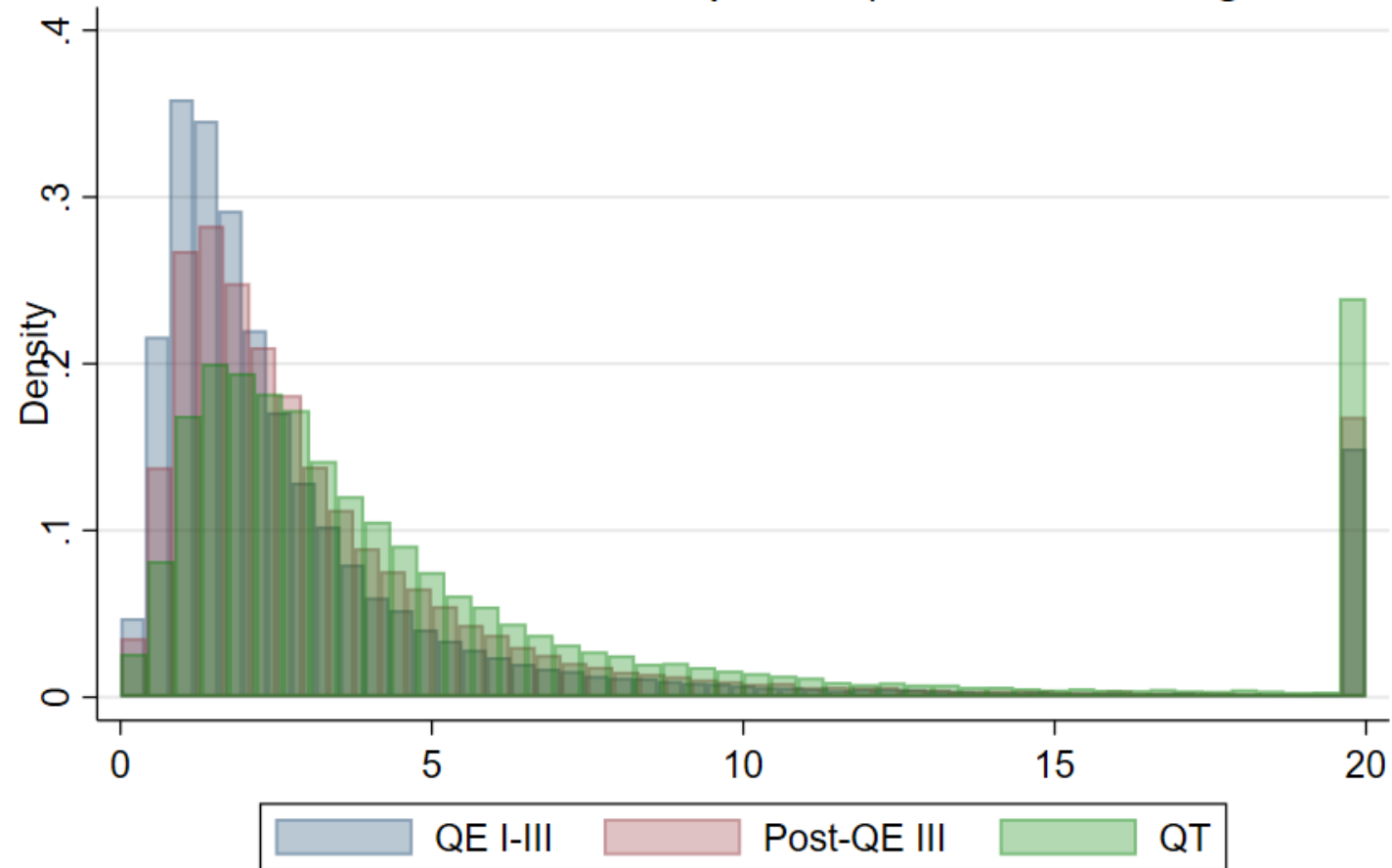


— Below 10th Percentile — 10-25th Percentile
— 25-50th Percentile — 50-75th Percentile
— 75-90th Percentile — Above 90th Percentile

Each line represents within-bucket medians across time

Histogram of the Distribution

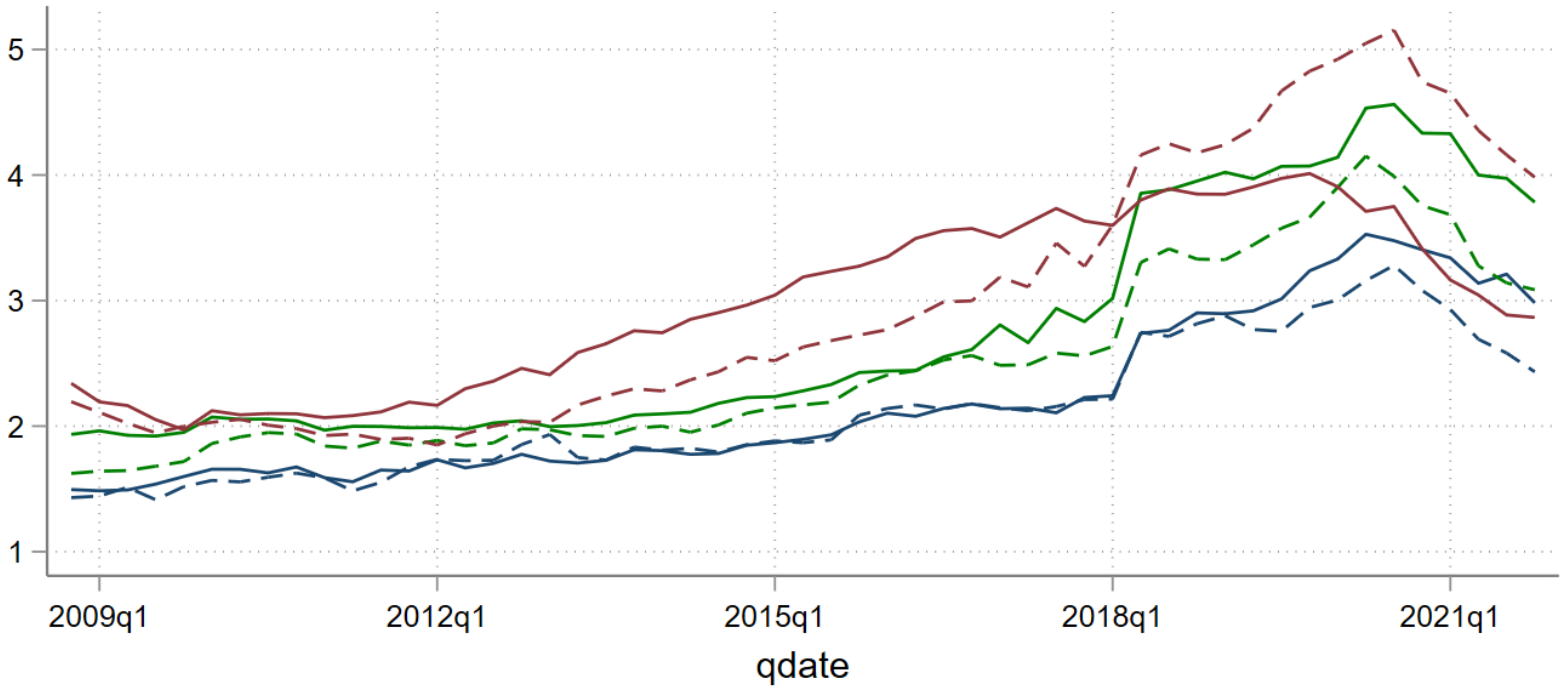
(Credit Lines + Demandable Deposits)/(Reserves + Eligible Ass



Note: Ratios above 20 are binned as 20

Dispersion across time, by Bank Size Buckets

Distribution of $(\text{Credit Lines} + \text{Demandable Deposits}) / (\text{Reserves} + \text{Eligible Assets})$
by Assets Buckets



- Below 10th percentile
- 10-25th Percentile
- 25-50th Percentile
- 50-75th Percentile
- 75-90th Percentile
- Above 90th Percentile

Each line represents within-bucket medians across time

Why do banks not shrink liquidity claims when reserves fall?

- Organizational constraints
 - How do you withdraw a line of credit from a relationship client?
 - Wholesale deposit desk may be hard to close.
- Moral hazard
 - Fed will come in in times of need since stress will show up in Treasury repos.

Is there a cost to repeated Fed liquidity provision?

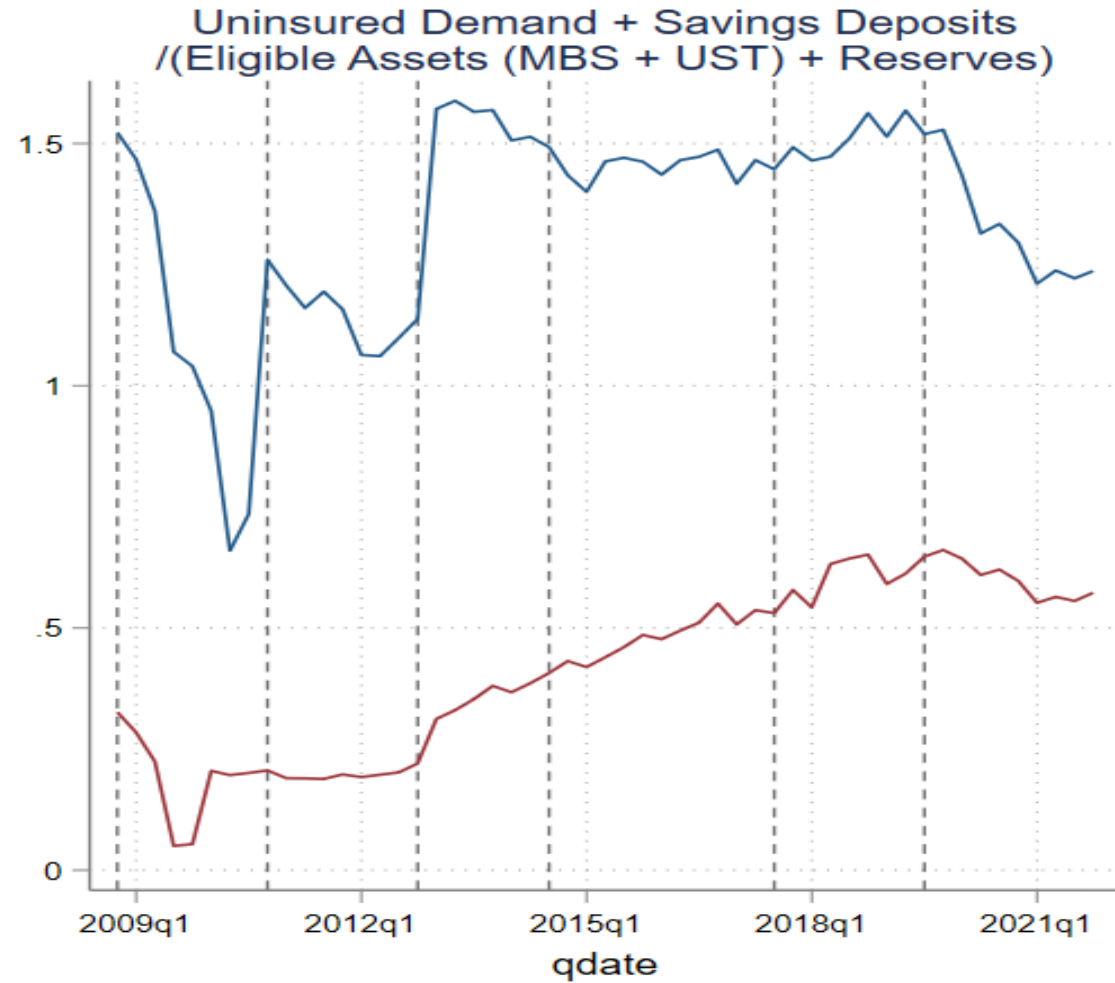
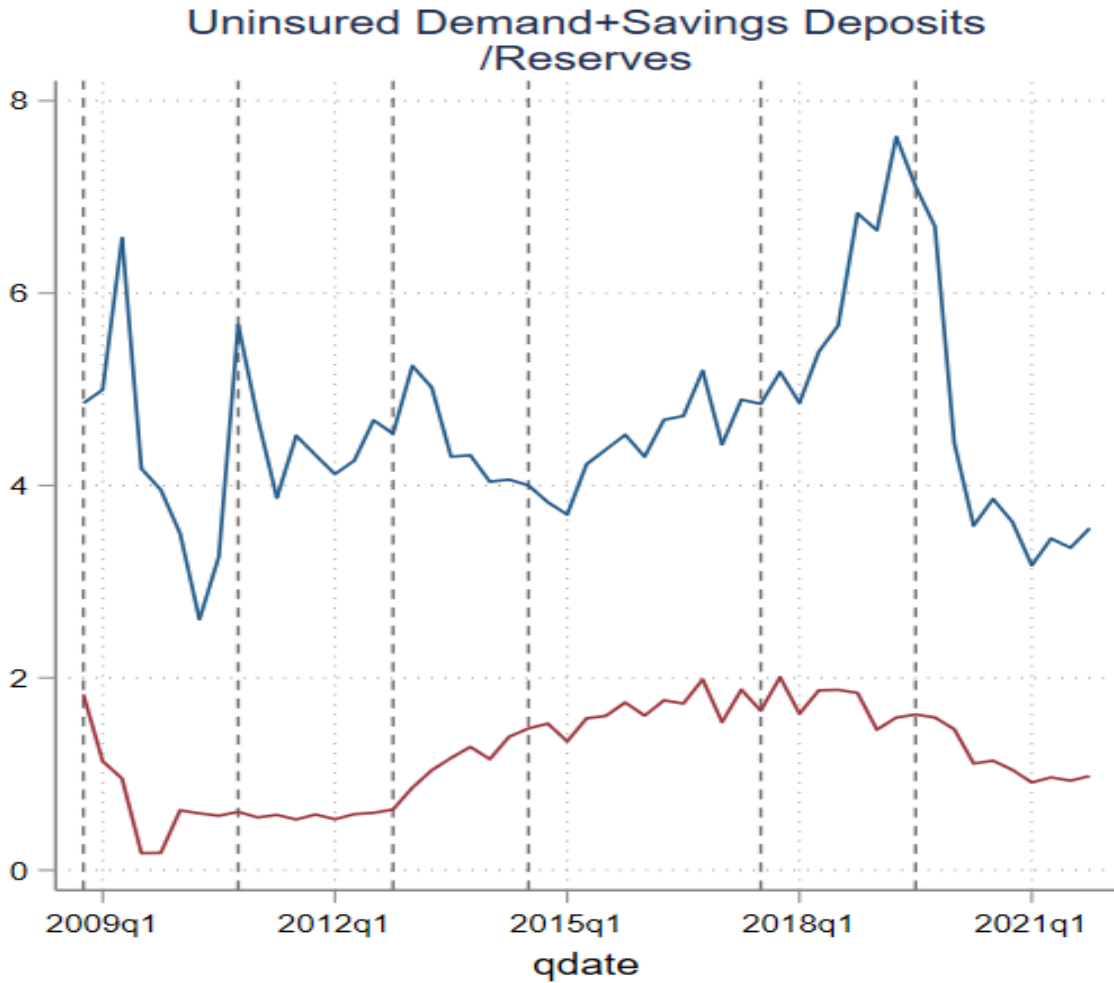
- Market underprices liquidity, enhancing need to intervene.
 - Easy for Fed to get in, hard to get out
 - Distortion in financial activity.
 - Distortion in real activity?
- Accidents/places Fed cannot reach
- Interferes with monetary function
- Permanent fiscal financing

Policy Implications

- Demandable bank claims do not reverse in QT →
 - Financial stability objectives vs monetary policy objectives
- Monitor, understand, and manage bank-issued liquidity claims in QE/QT
 - Make reserves mobile by requiring LCR, Resolution Planning be met fortnightly?
 - > Supervisory stigma with intra-day overdrafts (Nelson, 2019)
 - Countercyclical capital requirements (SLR policy of April 2020, 2021, e.g.)
- Access for non-banks?
 - Standing repo facility, subject to prudential requirements on “shadow banks”
- Engage in QT while “feeling the stones” for financial fragility
 - Revisit desirable scale, scope, duration of QE, when “pushing on a string”?

Appendix

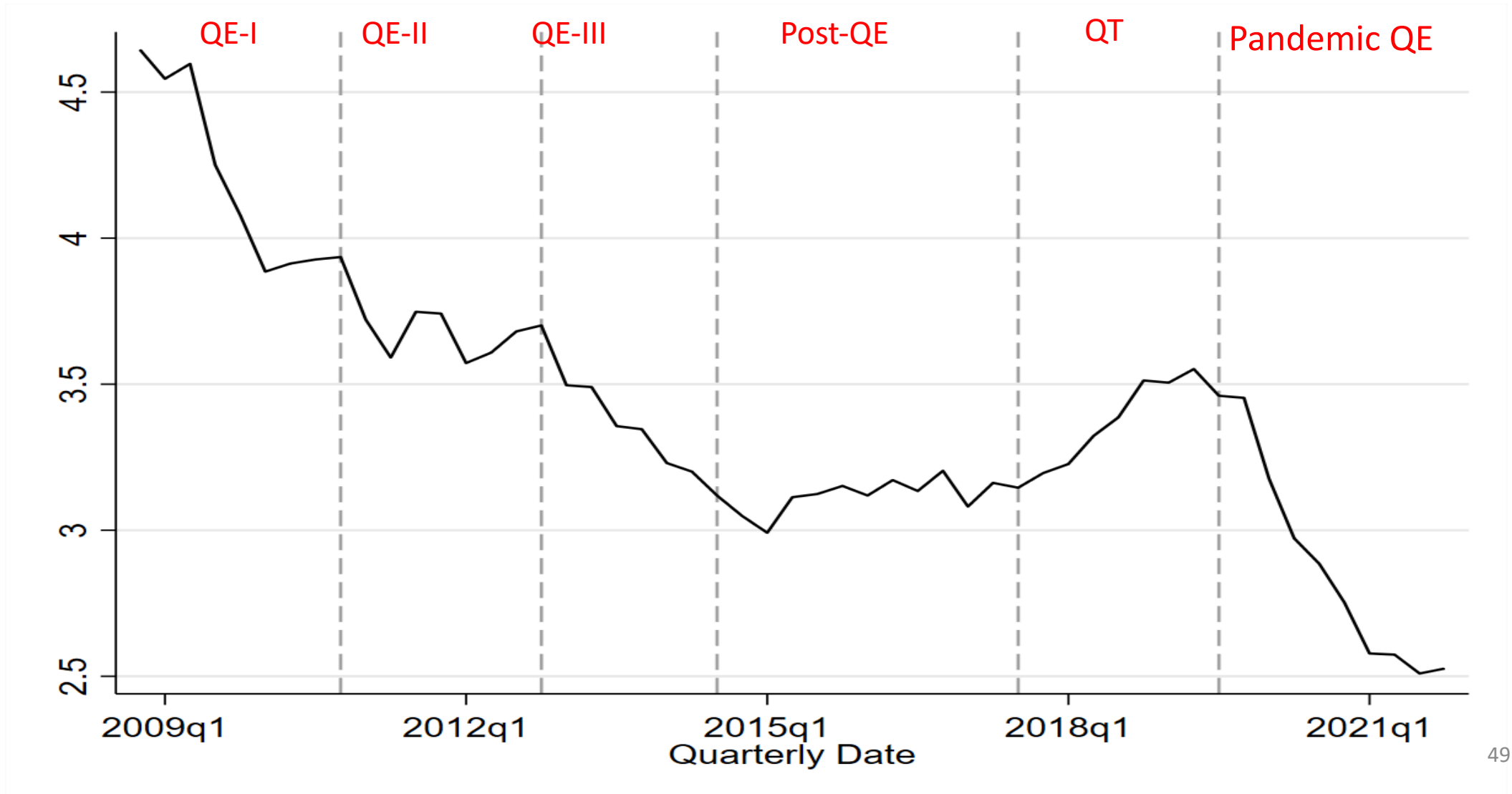
Uninsured Demandable Deposits (multiples) by size



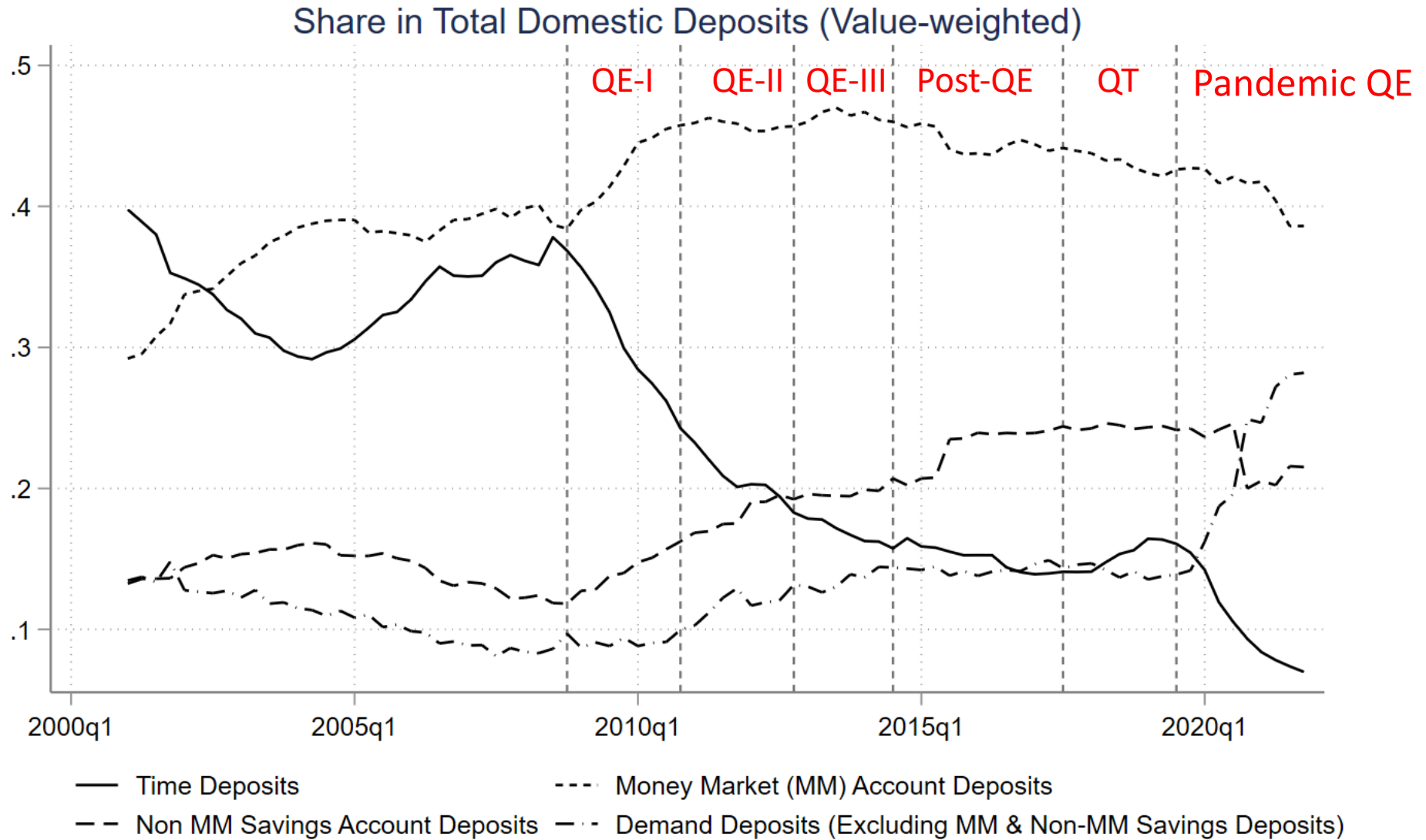
— Above 90th percentile assets

— Below 90th percentile assets

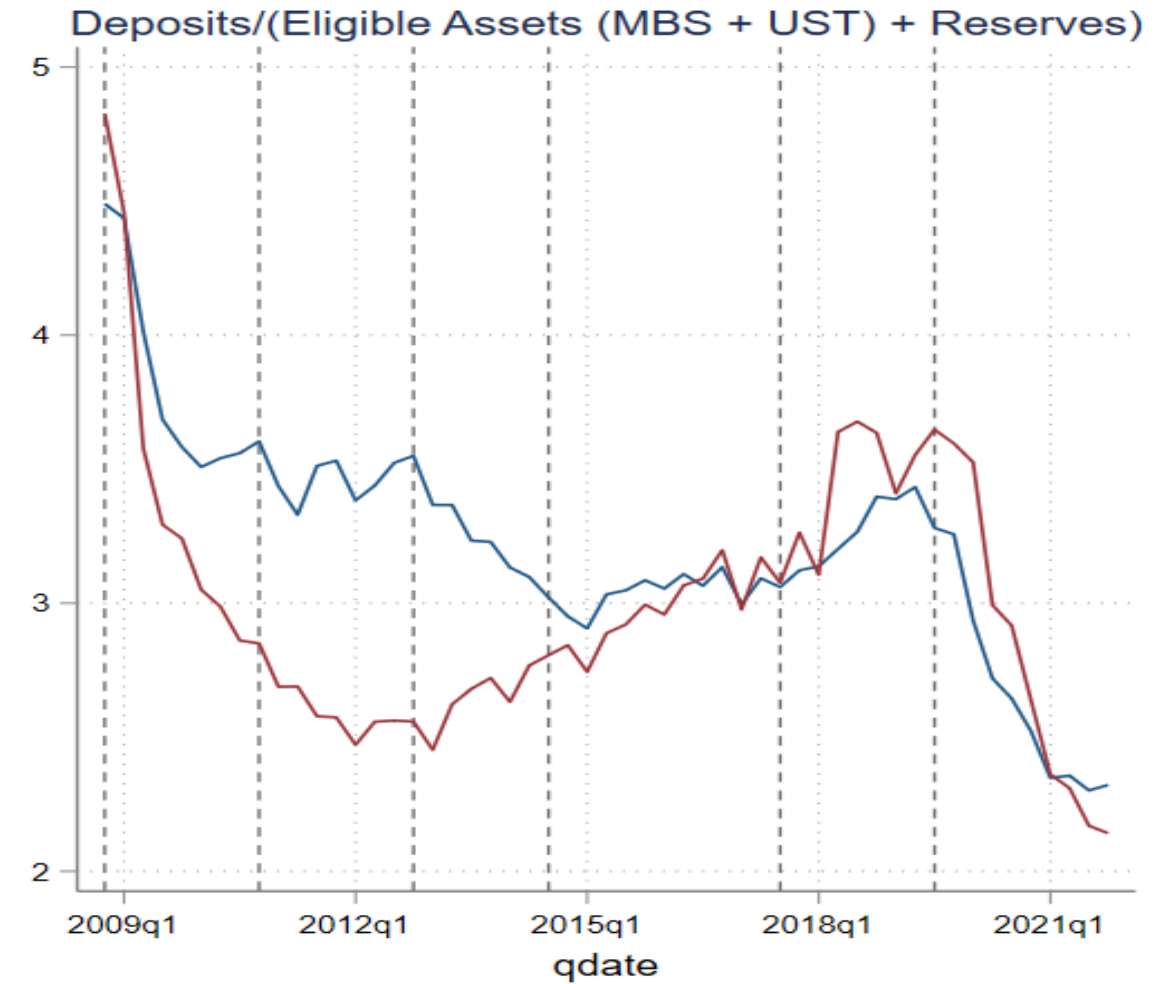
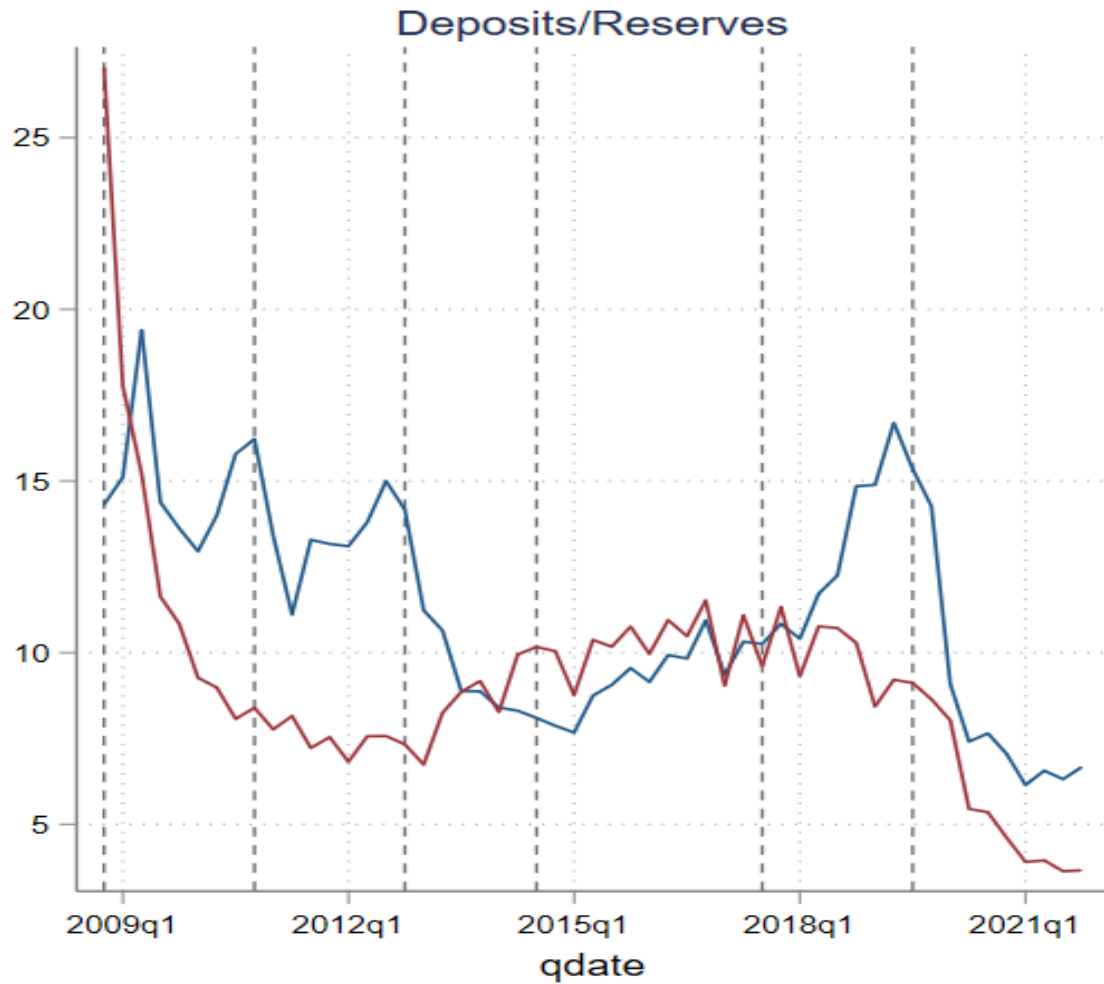
Total Deposits/(Reserves and Eligible Assets): Aggregate



Distribution of Deposit Types



Deposits (multiple of reserves and of HQLA) by size



— Above 90th percentile assets

— Below 90th percentile assets

First Stage - Deposit Quantities

	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$
z_{it}^R	17.55***	18.46***	18.25***	-63.22*
(=Ln(Reserves _t /Reserves _{t-1}) × Lagged Share in Agg. Reserves over 4Q)	(1.493)	(3.599)	(1.795)	(34.41)
Ln(Reserves) _{t-5}	-0.101*** (0.00597)	-0.124*** (0.00609)	-0.127*** (0.00967)	-0.0674*** (0.00576)
Constant	1.098*** (0.0518)	1.611*** (0.0584)	1.559*** (0.0858)	0.734*** (0.0564)
N	115839	51062	43236	30830
R-sq	0.111	0.137	0.139	0.0192
F-stat	152.6	211.5	96.05	68.40
Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Total Deposits – OLS

Panel A.1	(1)	(2)	(3)	(4)
	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$	$\Delta\text{Ln}(\text{Total Deposits})$
$\Delta\text{Ln}(\text{Reserves})$	0.0157*** (0.000951)	0.0157*** (0.00145)	0.0146*** (0.00150)	0.0188*** (0.00109)
Newey-West s.e.	(0.000748)	(0.00110)	(0.00117)	(0.000916)
$\text{Ln}(\text{Reserves})_{t-5}$	0.00171*** (0.000506)	0.00103 (0.000704)	0.000996 (0.000726)	0.00228** (0.000898)
Newey-West s.e.	(0.000417)	(0.000547)	(0.000599)	(0.000612)
Constant	0.0520*** (0.00434)	0.0470*** (0.00642)	0.0326*** (0.00641)	0.0463*** (0.00809)
Obs	117225	51009	43196	32279
Time-FE	Y	Y	Y	Y
Bank & Time	Y	Y	Y	Y
Clustered SE				
Reg Type	OLS	OLS	OLS	OLS
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Demand & Savings Deposits– OLS

Panel B.1.1	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.0128*** (0.00186)	0.0151*** (0.00292)	0.0152*** (0.00323)	0.0171*** (0.00125)
Newey-West s.e.	(0.00142)	(0.00233)	(0.00256)	(0.00105)
$\text{Ln}(\text{Reserves})_{t-5}$	0.00204*** (0.000693)	0.00223** (0.000953)	0.00197* (0.00104)	0.000952 (0.00125)
Newey-West s.e.	(0.000556)	(0.000715)	(0.000791)	(0.00105)
Constant	0.0804*** (0.00607)	0.0885*** (0.00844)	0.0767*** (0.00890)	0.0783*** (0.0114)
N	117076	50948	43149	32258
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Reg Type	OLS	OLS	OLS	OLS
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Time Deposits– OLS

Panel B.1.2	(1)	(2)	(3)	(4)
	$\Delta\text{Ln}(\text{Time Deposits})$	$\Delta\text{Ln}(\text{Time Deposits})$	$\Delta\text{Ln}(\text{Time Deposits})$	$\Delta\text{Ln}(\text{Time Deposits})$
$\Delta\text{Ln}(\text{Reserves})$	0.0134*** (0.00129)	0.0133*** (0.00184)	0.0139*** (0.00198)	0.0185*** (0.00138)
Newey-West s.e.	(0.00104)	(0.00163)	(0.00176)	(0.00134)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00219** (0.00109)	-0.00781*** (0.00147)	-0.00566*** (0.00103)	0.00436** (0.00187)
Newey-West s.e.	(0.000743)	(0.00102)	(0.000973)	(0.00145)
Constant	0.0275*** (0.00944)	0.0205 (0.0132)	0.00879 (0.00879)	-0.0162 (0.0173)
N	116227	50579	42872	32037
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Reg Type	OLS	OLS	OLS	OLS
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Total Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta\text{Ln}(\text{Deposits})$	$\Delta\text{Ln}(\text{Deposits})$	$\Delta\text{Ln}(\text{Deposits})$	$\Delta\text{Ln}(\text{Deposits})$
$\Delta\text{Ln}(\text{Reserves})$	0.0178*** (0.00162)	0.0193*** (0.00284)	0.0178*** (0.00299)	0.0208*** (0.00201)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00230*** (0.000794)	-0.00258* (0.00132)	-0.00248* (0.00138)	-0.00372** (0.00135)
Constant	0.119*** (0.00785)	0.112*** (0.0141)	0.0941*** (0.0143)	0.140*** (0.0153)
N	49119	19173	15237	11408
R-sq	0.0378	0.0700	0.0375	0.0369
Time-FE	Y	Y	Y	Y
Bank & Time Clustered	Y	Y	Y	Y
SE				
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Total Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.0118*** (0.000905)	0.0110*** (0.00105)	0.0103*** (0.00108)	0.0160*** (0.00108)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00240*** (0.000698)	-0.00280*** (0.000849)	-0.00303*** (0.000915)	-0.00105 (0.00153)
Constant	0.0652*** (0.00541)	0.0627*** (0.00684)	0.0515*** (0.00728)	0.0616*** (0.0125)
N	68106	31836	27959	20871
R-sq	0.0475	0.0890	0.0318	0.0199
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Total Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.0277** (0.0121)	0.0267** (0.0107)	0.0258** (0.0107)	-0.0825* (0.0451)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00125 (0.00147)	-0.00156 (0.00191)	-0.00136 (0.00200)	-0.0114*** (0.00314)
N	49119	19173	15237	11408
R-sq	0.0133	0.0247	0.0225	-0.642
F-stat	16.09	9.235	7.799	11.06
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Total Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$	$\Delta \text{Ln}(\text{Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.137 (0.107)	0.110* (0.0646)	0.127** (0.0600)	0.0608 (0.295)
$\text{Ln}(\text{Reserves})_{t-5}$	0.0149 (0.0149)	0.0134 (0.0109)	0.0157 (0.00994)	0.00306 (0.0285)
N	66561	31809	27940	19381
R-sq	-1.210	-1.009	-1.403	-0.106
F-stat	6.544	6.886	6.422	1.681
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Demand + Savings Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.0173*** (0.00345)	0.0215*** (0.00622)	0.0217*** (0.00690)	0.0189*** (0.00278)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00180 (0.00126)	0.0000709 (0.00184)	-0.000231 (0.00207)	-0.00634*** (0.00216)
Constant	0.139*** (0.0124)	0.134*** (0.0185)	0.121*** (0.0201)	0.178*** (0.0231)
N	49037	19144	15210	11395
R-sq	0.0355	0.0443	0.0268	0.0265
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Demand + Savings Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.00765*** (0.00132)	0.00873*** (0.00131)	0.00873*** (0.00144)	0.0149*** (0.00108)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.000830 (0.000837)	-0.00212* (0.00110)	-0.00281** (0.00116)	-0.0000153 (0.00153)
Constant	0.0882*** (0.00668)	0.111*** (0.00903)	0.104*** (0.00931)	0.0768*** (0.0127)
N	68039	31804	27939	20863
R-sq	0.0335	0.0547	0.0141	0.0137
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Demand + Savings Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.148*** (0.0163)	0.136*** (0.0176)	0.138*** (0.0156)	-0.0279 (0.0616)
$\text{Ln}(\text{Reserves})_{t-5}$	0.0122*** (0.00223)	0.0157*** (0.00334)	0.0160*** (0.00332)	-0.00981*** (0.00302)
N	49037	19144	15210	11395
R-sq	-0.477	-0.421	-0.465	-0.0394
Time-FE	Y	Y	Y	Y
Bank & Time Clustered SE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Demand + Savings Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$	$\Delta \text{Ln}(\text{Demand} + \text{Savings Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.213* (0.125)	0.172** (0.0718)	0.176** (0.0787)	0.0997 (0.317)
$\text{Ln}(\text{Reserves})_{t-5}$	0.0275 (0.0174)	0.0246* (0.0122)	0.0240* (0.0131)	0.00781 (0.0305)
N	66496	31777	27920	19375
R-sq	-1.831	-1.574	-1.642	-0.291
Bank & Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Time Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta \ln(\text{Time Deposits})$	$\Delta \ln(\text{Time Deposits})$	$\Delta \ln(\text{Time Deposits})$	$\Delta \ln(\text{Time Deposits})$
$\Delta \ln(\text{Reserves})$	0.0177*** (0.00267)	0.0210*** (0.00407)	0.0218*** (0.00445)	0.0214*** (0.00284)
$\ln(\text{Reserves})_{t-5}$	-0.00485*** (0.00171)	-0.0131*** (0.00240)	-0.0109*** (0.00196)	0.00452 (0.00362)
Constant	0.0794*** (0.0164)	0.0816*** (0.0244)	0.0786*** (0.0194)	0.0244 (0.0381)
N	48552	18923	15076	11220
R-sq	0.0867	0.0907	0.0716	0.0358
Bank & Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Time Deposits – Split by p90 assets - OLS

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	0.00820*** (0.000909)	0.00684*** (0.000994)	0.00655*** (0.00107)	0.0149*** (0.00143)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.00566*** (0.000849)	-0.00588*** (0.00119)	-0.00620*** (0.00130)	-0.00541*** (0.00117)
Constant	0.0371*** (0.00666)	0.0000679 (0.00978)	0.00352 (0.0105)	0.0486*** (0.00979)
N	67675	31656	27796	20817
R-sq	0.0994	0.0705	0.0680	0.0522
Bank & Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Time Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Above 90 th Percentile Assets	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	-0.121*** (0.0341)	-0.0947*** (0.0325)	-0.0930*** (0.0254)	-0.0267 (0.188)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.0199*** (0.00489)	-0.0293*** (0.00658)	-0.0271*** (0.00448)	0.000930 (0.0127)
N	48552	18923	15076	11220
R-sq	-0.339	-0.271	-0.326	-0.0216
Bank & Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Time Deposits – Split by p90 assets - IV

	(1)	(2)	(3)	(4)
Below 90 th Percentile Assets	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$	$\Delta \text{Ln}(\text{Time Deposits})$
$\Delta \text{Ln}(\text{Reserves})$	-0.400* (0.233)	-0.257*** (0.0827)	-0.250*** (0.0821)	-0.273 (0.180)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.0624* (0.0320)	-0.0494*** (0.0127)	-0.0475*** (0.0124)	-0.0320* (0.0154)
N	66137	31632	27777	19331
R-sq	-7.917	-3.811	-3.749	-3.672
Bank & Time-FE	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Credit Lines Origination (bank-holding-co-level)

IV 1st Stage:

$$\Delta \ln(\text{Reserves})_{it} = \gamma_1 \text{Reserves Instrument}_{it} + \gamma_2 \ln(\text{Reserves}_{it-5}) + \delta_t + \mu_{it}$$

where $\Delta(Y)_{it} = Y_{it} - Y_{it-4}$, and δ_t represents (quarter) time-fixed effects

IV 2nd Stage:

$$\Delta \ln(\text{Credit Lines})_{it} = \beta_1 \text{Instr} \Delta \ln(\text{Reserves})_{it} + \beta_2 \ln(\text{Reserves})_{it-5} + \tau_t + \varepsilon_{it}$$

where $\Delta(Y)_{it} = Y_{it} - Y_{it-4}$, and τ_t represents (quarter) time-fixed effects

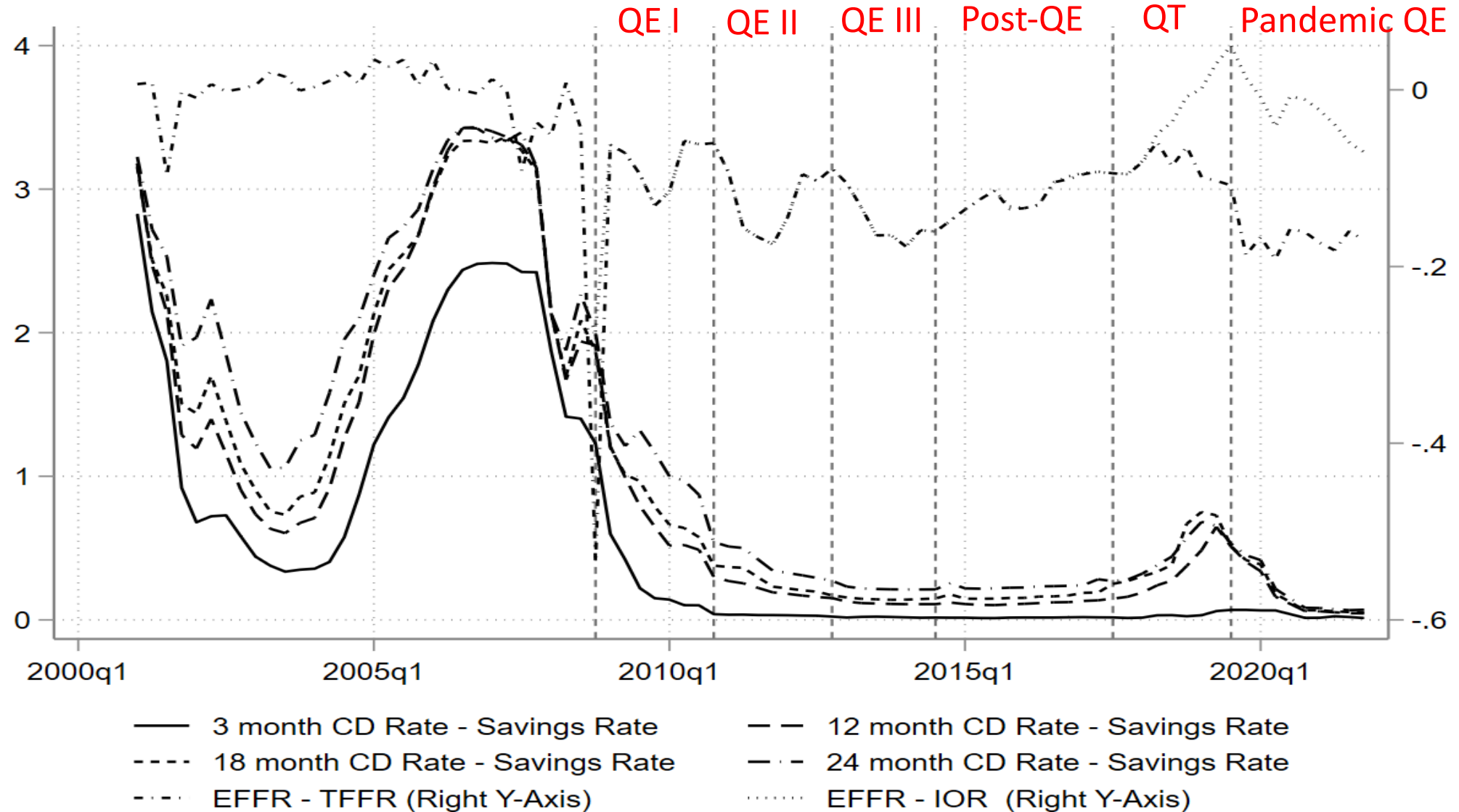
First Stage – Credit Lines Quantities

	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$	$\Delta \text{Ln}(\text{Reserves})$
z_{it}^R	7.270*** (0.928)	7.431*** (1.167)	5.246*** (0.752)	6.460 (19.79)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.0853*** (0.0203)	-0.104*** (0.0333)	-0.447*** (0.0545)	-0.0392* (0.0212)
Constant	1.374*** (0.265)	2.076*** (0.463)	6.766*** (0.758)	0.556* (0.315)
Obs	2268	911	678	578
R-sq	0.235	0.298	0.415	0.0808
Time-FE	Y	Y	Y	Y
Bank and Time Clustered SEs	Y	Y	Y	Y
F	35.09	20.16	400.9	4.758
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Credit Lines - OLS

	(1)	(2)	(3)	(4)
	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$	$\Delta \text{Ln}(\text{Credit Lines})$
$\Delta \text{Ln}(\text{Reserves})$	-0.0503*** (0.0149)	-0.0216 (0.0175)	-0.0318* (0.0184)	-0.122 (0.0798)
Newey-West s.e.	(0.0153)	(0.0224)	(0.0227)	(0.0567)
$\text{Ln}(\text{Reserves})_{t-5}$	-0.0157 (0.00954)	-0.0105 (0.0146)	-0.0116 (0.0145)	-0.0158 (0.0196)
Newey-West s.e.	(0.00850)	(0.0124)	(0.0138)	(0.0114)
Constant	0.299** (0.129)	0.273 (0.208)	0.279 (0.202)	0.295 (0.291)
Obs	2263	910	679	575
R-sq	0.187	0.270	0.210	0.117
Time-FE	Y	Y	Y	Y
Time Clustered SEs	Y	Y	Y	Y
Reg Type	OLS	OLS	OLS	OLS
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

Average Term Deposit Rate Spreads



Deposit Interest Rate Spread (bank-level)

IV 1st Stage:

$$\ln(\text{Deposits})_{it} = \gamma_{11}\text{Deposit Instrument}_{it} + \gamma_{12}\text{Reserves Instrument}_{it} + \rho_i + \delta_t + \mu_{it}$$

$$\ln(\text{Reserves})_{it} = \gamma_{21}\text{Deposit Instrument}_{it} + \gamma_{22}\text{Reserves Instrument}_{it} + \rho_i + \delta_t + \mu_{it}$$

where i represents bank, t represents quarterly data, ρ_i represents bank-fixed effects, and δ_t represents (quarter) time-fixed effects

IV 2nd Stage:

$$\text{Deposit Rate Spread}_{it} = \beta_1 \ln(\text{Deposits})_{it} + \beta_2 \ln(\text{Reserves})_{it} + \pi_i + \tau_t + \varepsilon_{it}$$

where i represents bank i , t represents the quarterly date, π_i represents bank-fixed effects and τ_t represents (quarter) time-fixed effects. *Deposit Rate Spread* is 3, 12, 18, 24 month Certificate of Deposit (CD) Rate – Savings Rate Spread

Instrument for Deposits (Bartik-style)

$$z_{it}^D = \ln \left(\sum_{c \in C_{i,t}} w_{ict} \frac{Dep_{c,t}}{Dep_{c,t-1}} \right) \text{ where } w_{ict} = \frac{Dep_{c,t-1}}{\sum_{c' \in C_{i,t}} Dep_{c',t-1}}$$

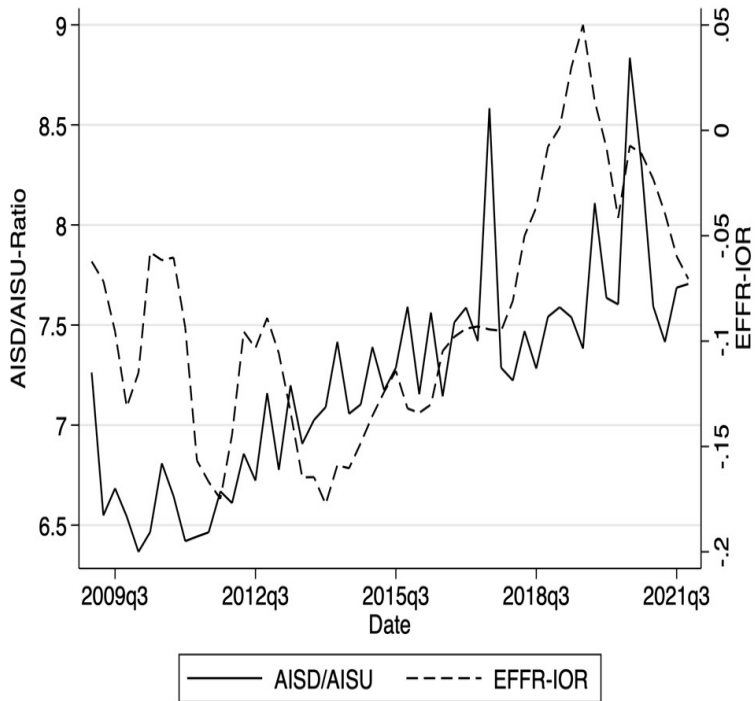
where w_{ict} is the bank-specific weight accorded to county c the bank operates in time t , and $\frac{Dep_{c,t}}{Dep_{c,t-1}}$ is the growth rate in aggregate deposits in that county over the past period.

The bank-specific weight is determined as the level of aggregate deposits in that county at time $t-1$ divided by the sum of aggregate deposits over all the counties the bank has a presence in.

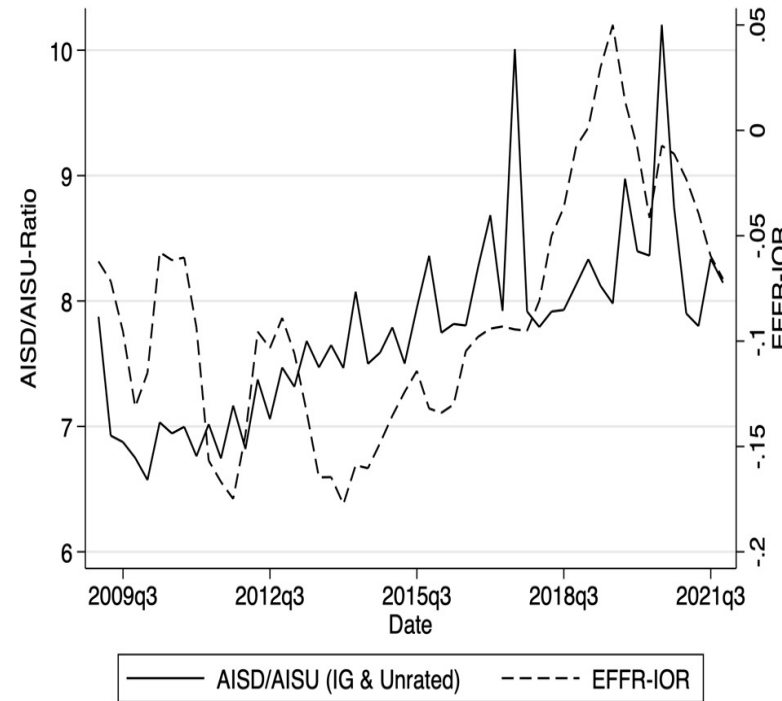
First Stage – Deposit Interest Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Ln(Total Deposits)				Ln(Reserves)		
Z_{it}^R	1.038*** (0.352)	0.329** (0.151)	0.0204 (0.131)	6.829 (5.595)	11.96*** (1.467)	9.537*** (0.843)	8.583*** (0.707)	38.13* (21.70)
Z_{it}^D	0.0449*** (0.00690)	0.0291*** (0.0101)	0.0439*** (0.00992)	0.0320*** (0.00773)	0.0296 (0.0241)	-0.00300 (0.0397)	0.0298 (0.0345)	0.0701** (0.0294)
Constant	13.48*** (0.000607)	13.47*** (0.000779)	13.29*** (0.000678)	13.66*** (0.000674)	8.968*** (0.00208)	9.643*** (0.00307)	9.309*** (0.00209)	9.802*** (0.00247)
N	133964	57975	49607	34682	121851	53372	45439	31354
R-sq	0.939	0.960	0.967	0.988	0.726	0.763	0.755	0.843
F-stat	26.79	6.886	10.69	10.72	34.59	64.84	73.78	4.650
Bank & Time-FE	Y	Y	Y	Y	Y	Y	Y	Y
Bank & Time Clustered FE	Y	Y	Y	Y	Y	Y	Y	Y
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

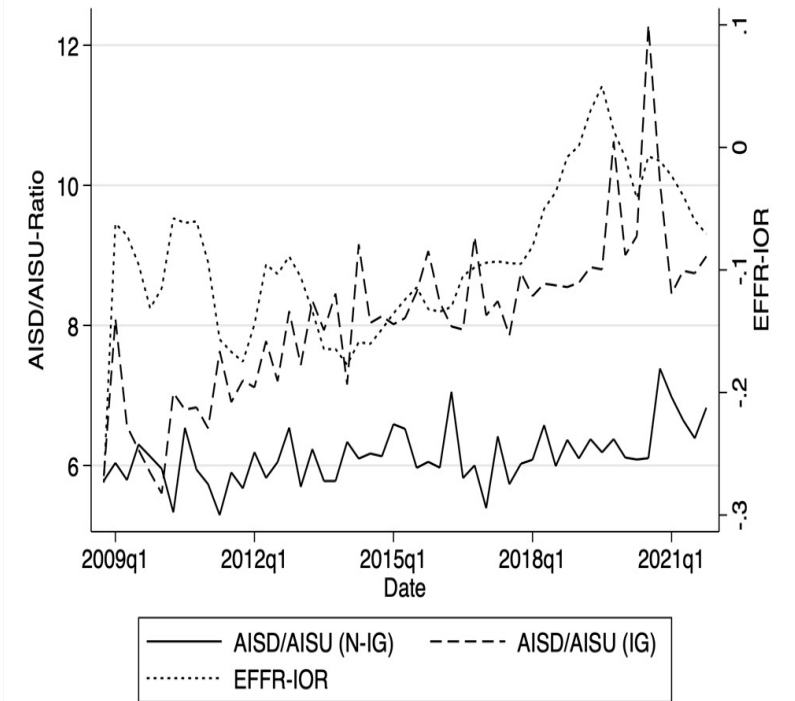
Pricing of Credit Lines and EFFR-IOR



All Loans



Only investment-grade rated and unrated loans



Investment-grade rated and non-investment-grade loans

Credit Lines Pricing (bank-holding-co-level)

IV 1st Stage:

$$\ln(\text{Credit Lines})_{it} = \gamma_{11}\text{Credit Lines Instrument}_{it} + \gamma_{12}\text{Reserves Instrument}_{it} + \rho_i + \delta_t + \mu_{it}$$

$$\ln(\text{Reserves})_{it} = \gamma_{21}\text{Credit Lines Instrument}_{it} + \gamma_{22}\text{Reserves Instrument}_{it} + \rho_i + \delta_t + \mu_{it}$$

where i represents bank, t represents quarterly data, ρ_i represents bank-fixed effects, and δ_t represents (quarter) time-fixed effects

IV 2nd Stage:

$$\text{AISD}/\text{AISU}_{it} = \beta_1 \ln(\text{Credit Lines})_{it} + \beta_2 \ln(\text{Reserves})_{it} + \pi_i + \tau_t + \varepsilon_{it}$$

where $\text{AISD}/\text{AISU}_{it}$ is the ratio of the all-in-spread-drawn and all-in-spread-undrawn from LoanConnector, collapsed at the BHC (i) and quarter (t) level. All regressions include bank (π_i) and quarter-time (τ_t) fixed effects

Instrument for Credit Lines

$$z_{it}^{CL} = \text{Ln}(\text{Credit Lines})_{it-1} \times \text{Excess Loan Premium}_{t-1}$$

we use the lagged credit line originations times the lagged aggregate *Excess Loan Premium (ELP)* from Saunders et al. (2022) to capture demand for credit lines

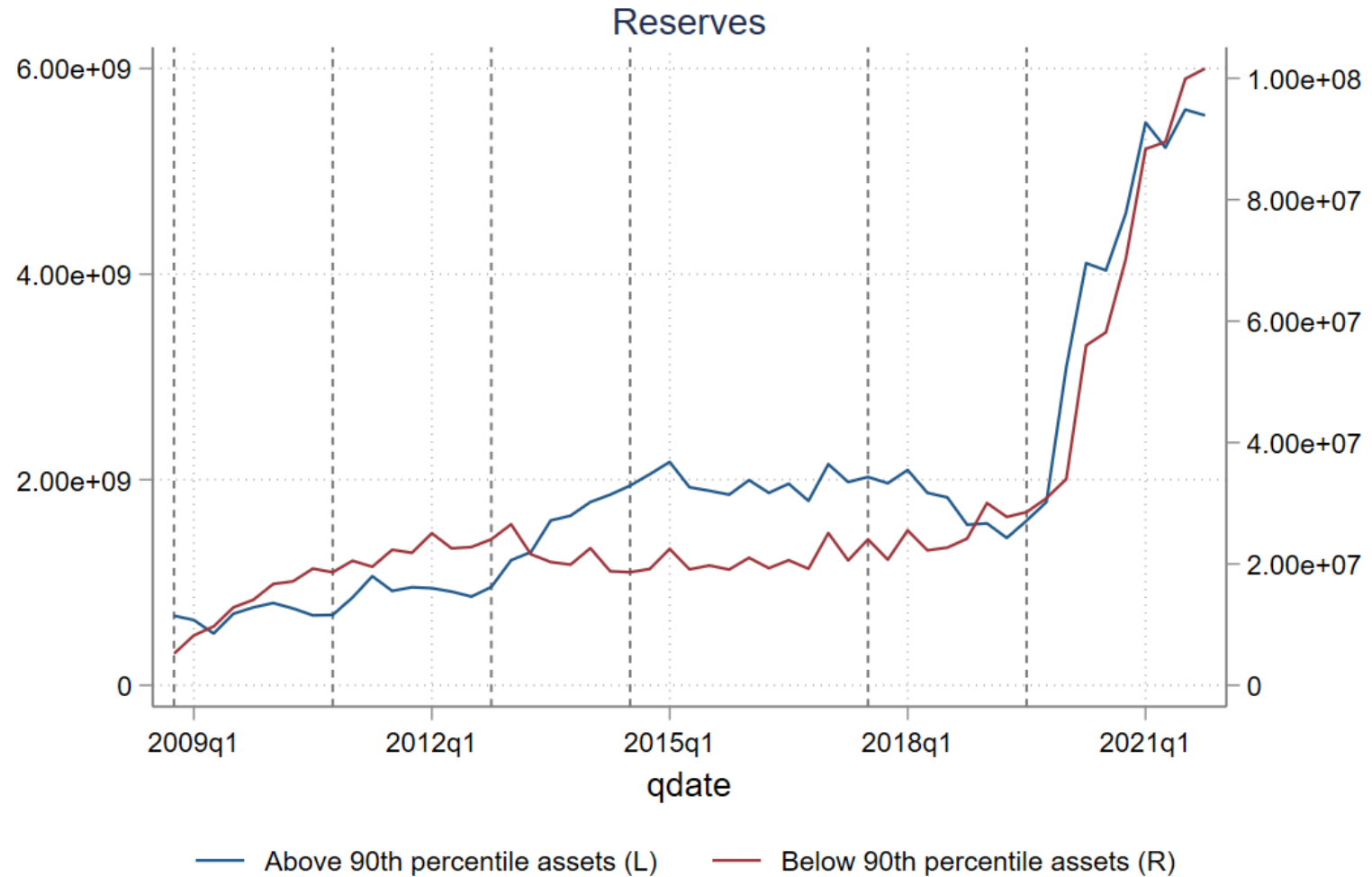
Rationale:

- A bank that is providing credit lines even in times of tight financial conditions (“excess loan premium”) has some inherent advantages in such provision
- Assumption: This variation is uncorrelated with the demand for credit lines, which would tend to raise credit line fees rather than lower them (supply effect)

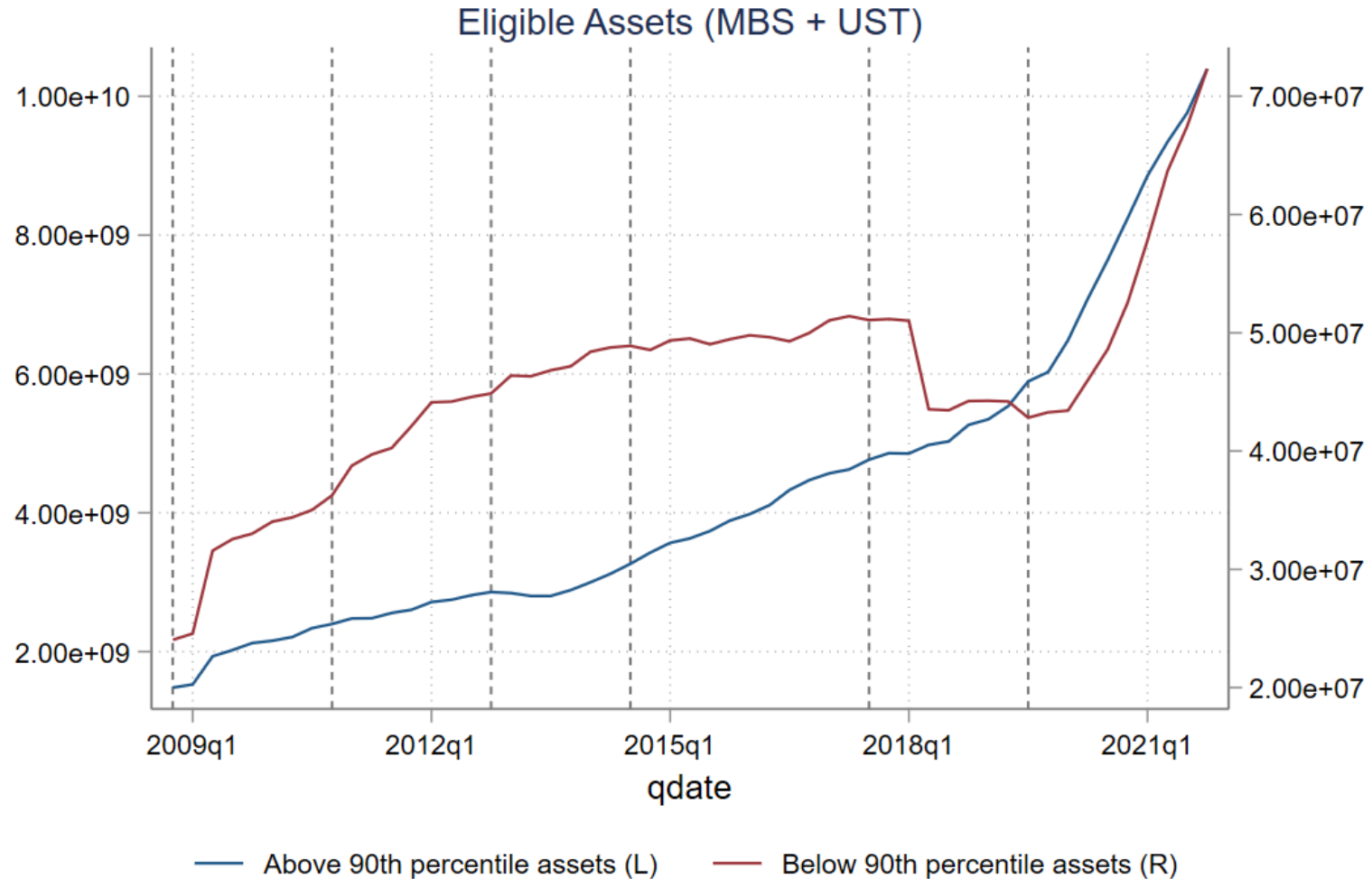
First Stage – AISD/AISU Ratios

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ln(Credit Lines)	Ln(Credit Lines)	Ln(Credit Lines)	Ln(Credit Lines)	Ln(Reserves)	Ln(Reserves)	Ln(Reserves)	Ln(Reserves)
Z_{it}^R	0.401 (1.159)	2.432*** (0.523)	0.458*** (0.151)	-259.9** (99.35)	11.37*** (1.504)	12.66*** (2.251)	3.846*** (0.422)	-536.7*** (147.7)
Z_{it}^{CL}	0.398*** (0.0473)	0.318*** (0.0428)	0.0407*** (0.0130)	1.204*** (0.211)	0.286*** (0.0571)	0.251*** (0.0610)	-0.0542*** (0.0148)	1.226*** (0.210)
Constant	5.280*** (0.509)	3.638*** (0.764)	8.472*** (0.250)	5.555*** (0.706)	10.39*** (0.590)	9.989*** (1.099)	15.51*** (0.285)	10.44*** (0.708)
Obs	2325	807	744	646	2213	774	720	588
R-sq	0.465	0.606	0.920	0.458	0.494	0.301	0.838	0.399
Bank & Time- FE	Y	Y	Y	Y	Y	Y	Y	Y
Bank and Time Clustered SEs	Y	Y	Y	Y	Y	Y	Y	Y
F-stat	38.95	109.8	9.037	43.25	172.1	54.48	50.32	45.66
Period	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3	Overall: 2001Q1 - 2021Q4	QE I-III + Pandemic QE: 2008Q4 - 2014Q3 & 2019Q4 - 2021Q4	QE I-III: 2008Q4 - 2014Q3	Post-QE III + QT2014Q4 - 2019Q3

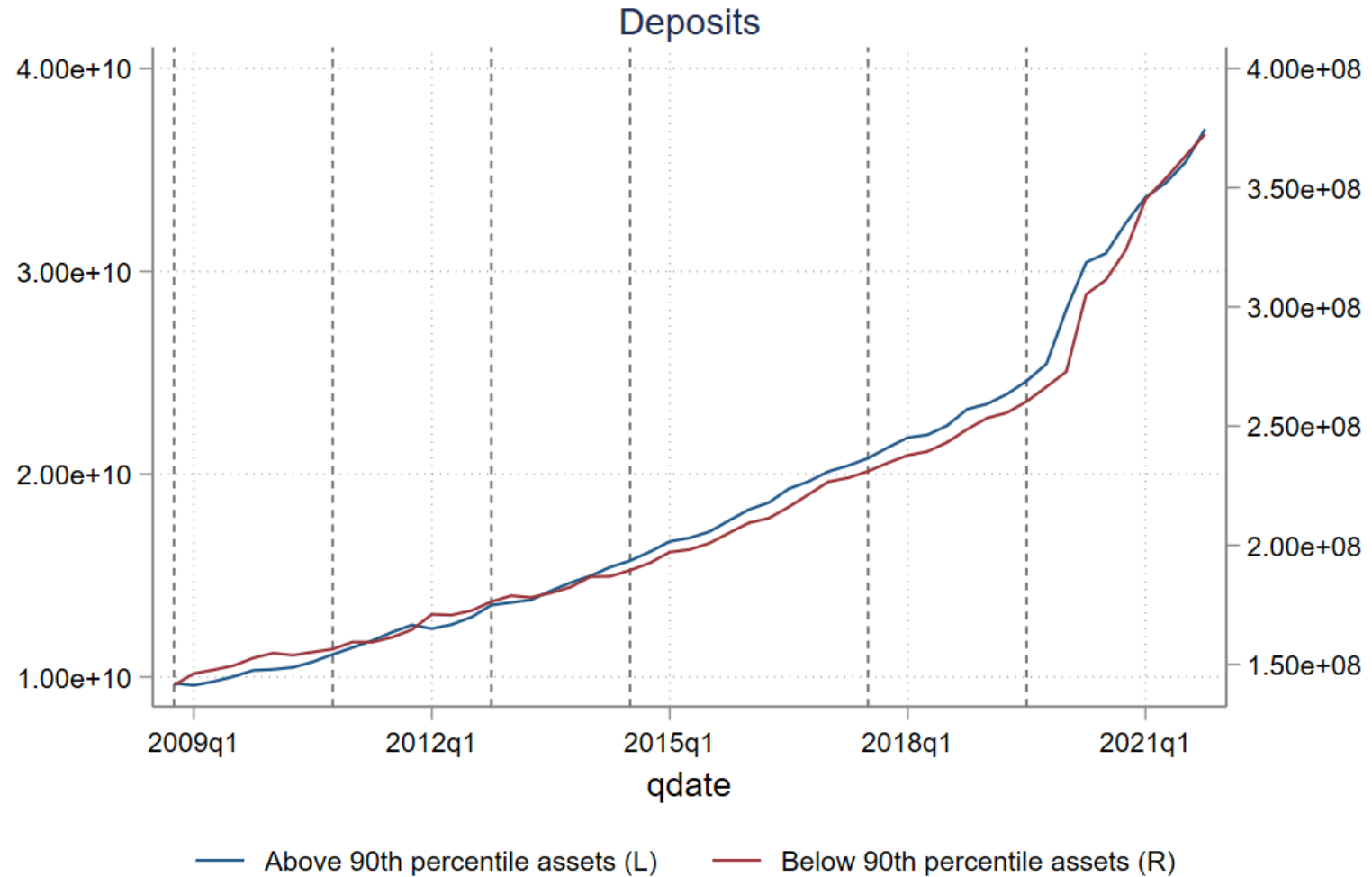
Reserves Levels



Eligible Assets Levels



Deposits Levels



Uninsured Demand + Savings Deposits Levels

