Local Recessions: Evidence from Bank Liquidity Squeezes

Rajkamal Iyer
Imperial College and CEPR

Shohini Kundu
UCLA Anderson

Nikos Paltalidis
Durham University

Motivation

Business cycles are driven by a complex interaction of various factors

A common element: Banks play a pivotal role across business cycles

1. Source of funding
2. Source of savings

$\Rightarrow$ Fluctuations in business cycles are reflected in banks' balance sheet

Liquidity Conditions and Business Cycles

Research Question

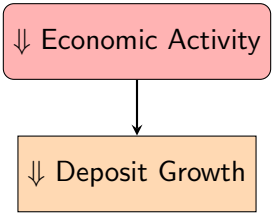
Can bank liquidity conditions predict business cycles?

- Predicting business cycles is challenging; factors underlying business cycle fluctuations are difficult to underpin
- Important implications for policy design

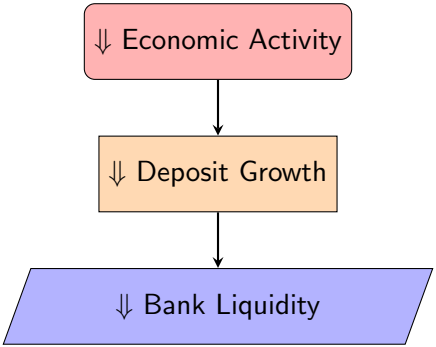
Liquidity Conditions and Business Cycles

⇓ Economic Activity

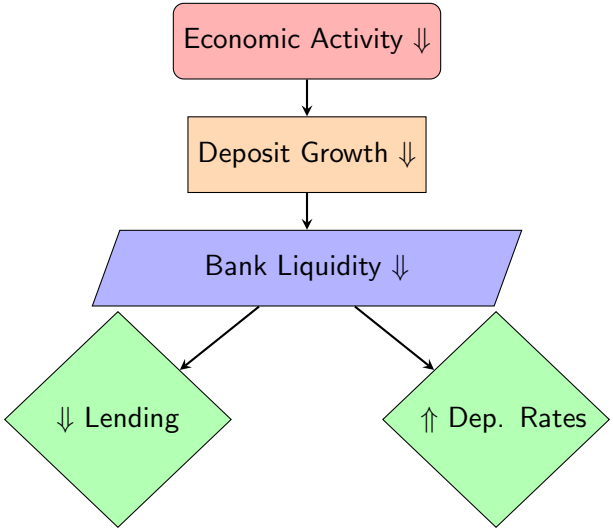
Liquidity Conditions and Business Cycles



Liquidity Conditions and Business Cycles



Liquidity Conditions and Business Cycles



State of the Art in Predicting Economic Contractions

- **Leading indicators use treasury yield curve data or survey-based indices to predict national recessions**

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- **We use a granular indicator of recessions:** dispersion of deposit rates
  - Can predict local recessions
  - Can predict recessions at longer horizons
  - Can predict recessions with a high degree of accuracy
  - Can predict recessions that are not accompanied by credit booms

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- **We highlight how banks change composition of deposits and rely more on insured deposits.**
  - Movement of insured and uninsured deposits at the onset of an economic contraction
  - Riskier banks substitute more to insured deposits
  - Raises concerns of moral hazard arising from deposit insurance

Contribution

1. **Indicators of Recessions:** e.g., Fama (1990), Schwert (1990), Estrella and Hardouvelis (1991), Estrella and Mishkin (1998), Levine and Zervos (1998), Campbell et al. (2001), Ang et al. (2006), Rudebusch and Williams (2009), Engstrom and Sharpe (2019)

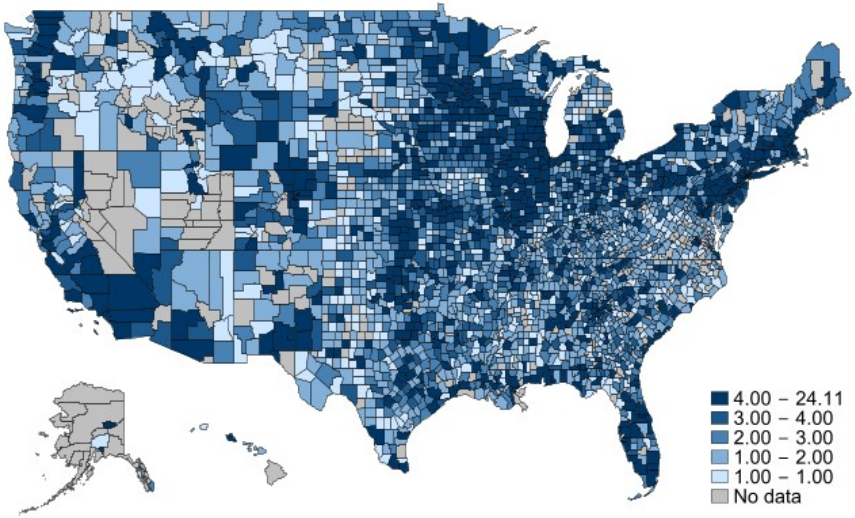
2. **Prediction of Financial Crises:** e.g., Mian and Sufi (2009), Schularick and Taylor (2012), Jord'a et al. (2013), Jord'a et al. (2016), Mian et al. (2017), Lopez-Salido et al. (2017), Baron and Xiong (2017), Bordalo et al. (2018), Mian et al. (2019), Krishnamurthy and Muir (2017), Muller and Verner (2021), and Greenwood et al. (2022)

3. **Moral Hazard due to Deposit Insurance:** e.g., Laeven (1983), Saunders and Wilson (1996), Calomiris et al. (1997), Acharya and Mora (2015), Iyer et al. (2016), Demirguc -Kunt et al. (2008), Martin et al. (2018), Calomiris and Jaremski (2019), Artavanis et al. (2022)

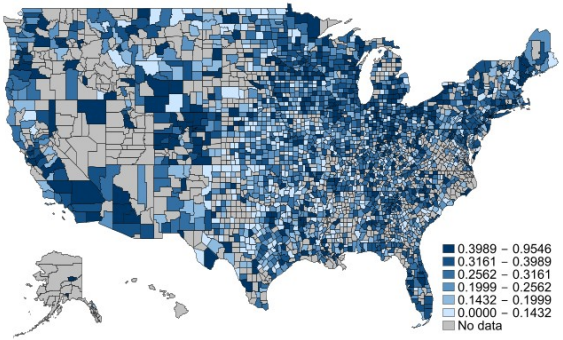
Deposit Rates and Recessions

Banks per County: 2001 - 2020

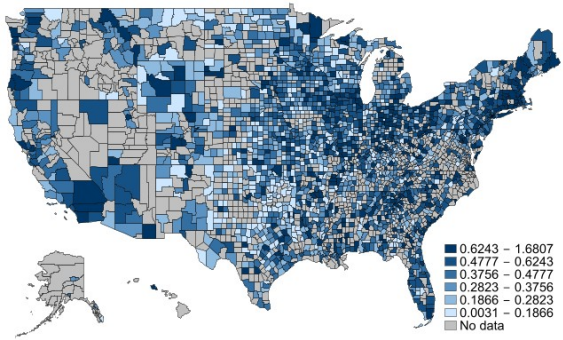
Focus: 12-month CDs with minimum account size of $10,000



Dispersion of Deposit Rates from 2001 through 2007



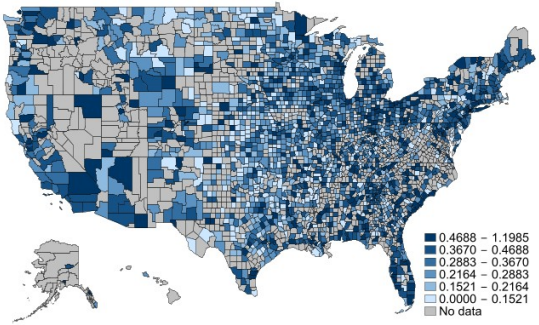
(a) 2001-2004



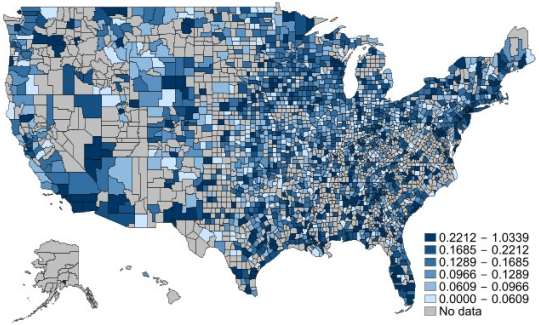
(b) 2005-2007

- Between 2001 and 2004, the first quantile ranged from 0.00 to 0.14 and the sixth quantile ranged from 0.40 to 0.95. Average dispersion was 0.27%
- Between 2005 and 2007, the first quantile in this period ranged from 0.00 to 0.19 and the sixth quantile ranged from 0.62 to 1.68. Average dispersion was 0.41%

Dispersion of Deposit Rates from 2008 through 2016



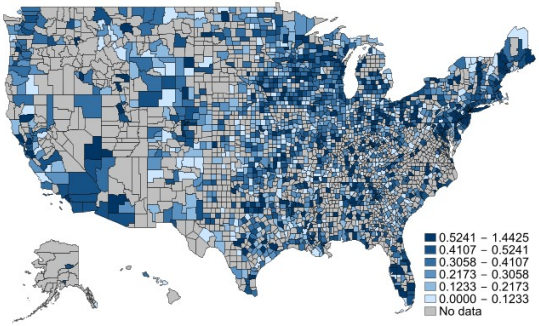
(a) 2008-2010



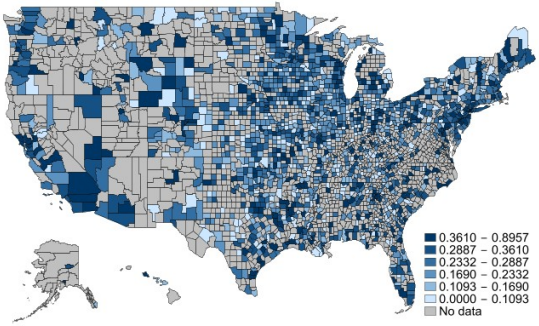
(b) 2011-2016

- Between 2008 and 2010, the first quantile ranged from 0.00 to 0.15 and the sixth quantile ranged from 0.47 to 1.20. Average dispersion was 0.31%
- Between 2011 and 2016, the first quantile in this period ranged from 0.00 to 0.06 and the sixth quantile ranged from 0.22 to 1.03. Average dispersion was 0.14%

Dispersion of Deposit Rates from 2017 through 2020



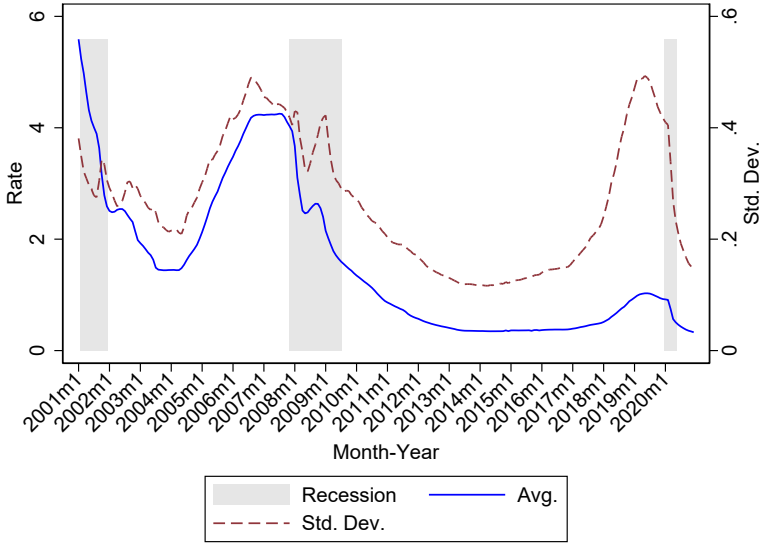
(a) 2017-2019



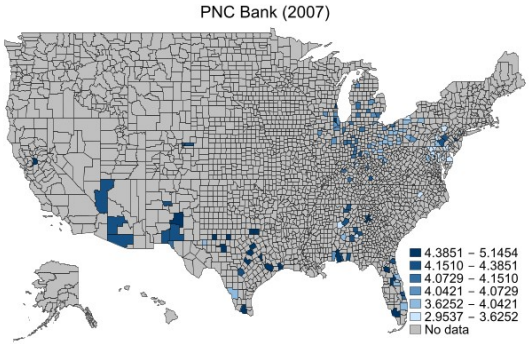
(b) 2020

- Between 2017 and 2019, the first quantile ranged from 0.00 to 0.12 and the sixth quantile ranged from 0.52 to 1.44. Average dispersion was 0.33%
- In 2020, the first quantile in this period ranged from 0.00 to 0.11 and the sixth quantile ranged from 0.36 to 0.90. Average dispersion was 0.23%

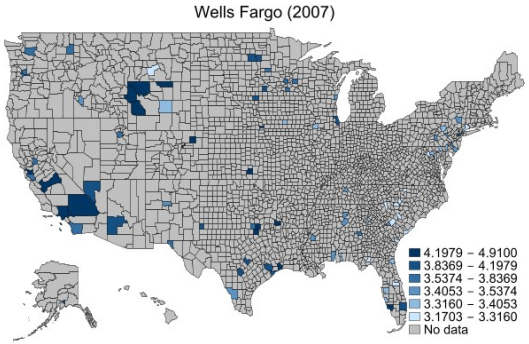
National Deposit Rate and Dispersion of Deposit Rate (2001-2020)



Geographic Variation in Deposit Rates of PNC and Wells Fargo in 2007



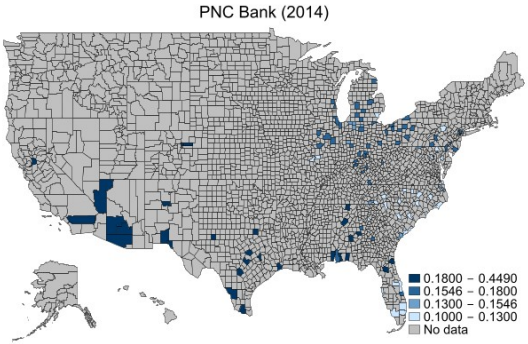
(a) PNC Bank



(b) Wells Fargo

- Large banks exhibit divergent pricing policies before GFC 2008
- Other banks ▸ US Bank, Regions ▸ Citi, BoA, JPM

Geographic Variation in Deposit Rates of PNC and Wells Fargo in 2014



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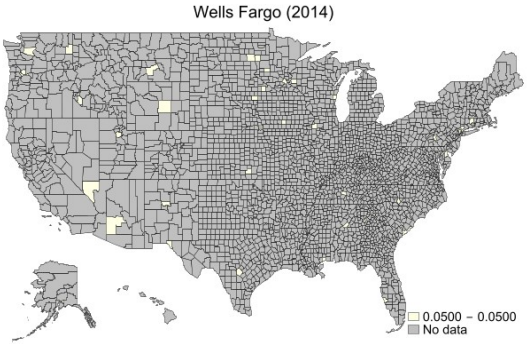

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- Large banks exhibit convergent pricing policies after GFC 2008
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Predicting Recessions

Predicting Recessions

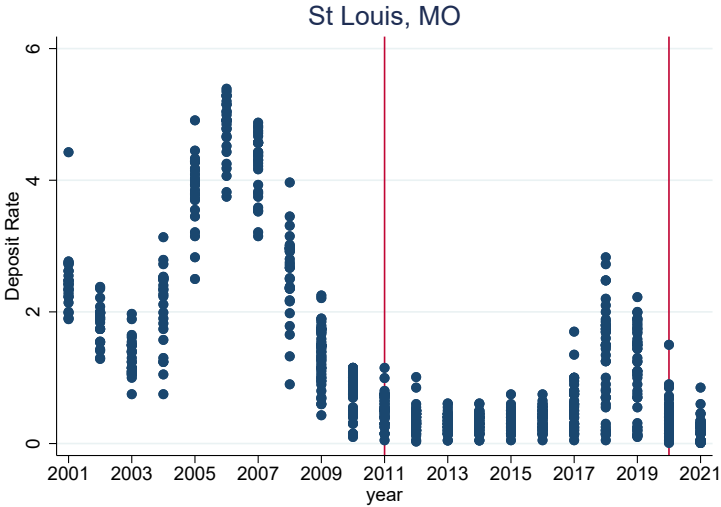
National recessions may reflect widespread economic decline but not all counties and states enter economic downturn at the same time

- Onset and duration of regional recessions depends on business cycle-specific factors, e.g., industrial composition of region or idiosyncratic shocks
- Statistically, there is neither any cross-sectional variation at the national level, nor is the frequency of recessions sufficiently large

$\Rightarrow$ Predict recessions at the county and state levels

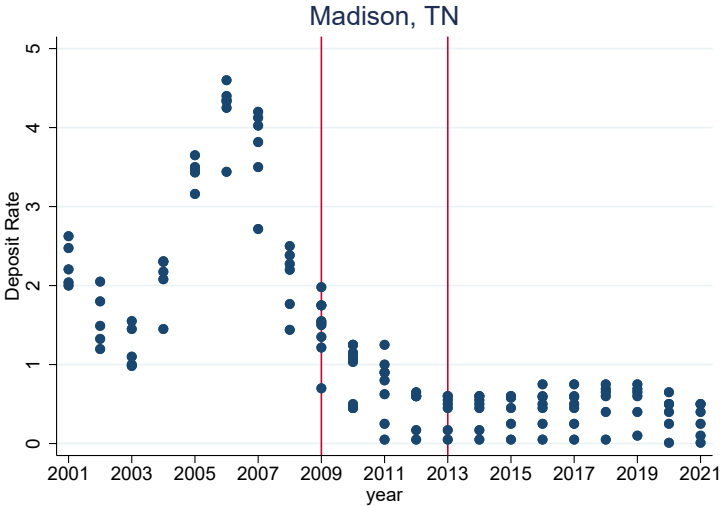
A Tale of Two Counties: St Louis, MO

St. Louis, MO experienced recessions in 2011 and 2020



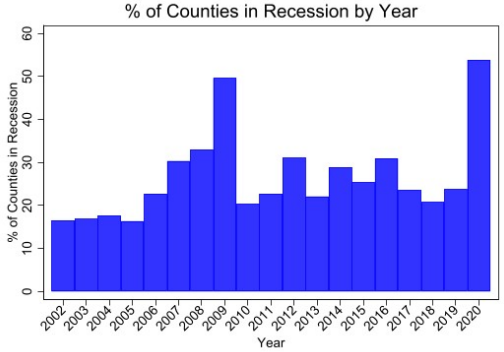
A Tale of Two Counties: Madison, TN

Madison, TN experienced recessions in 2009 and 2013

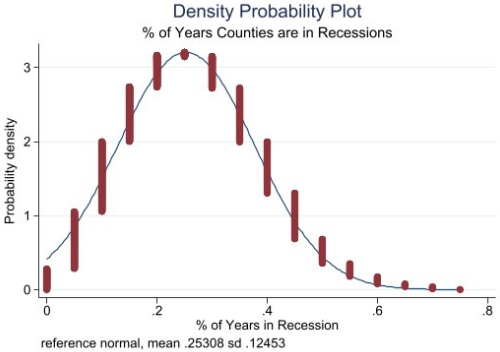


Timing and Duration of County Recessions

On average, 27% of counties are in recession



(a) % of Counties in Recession

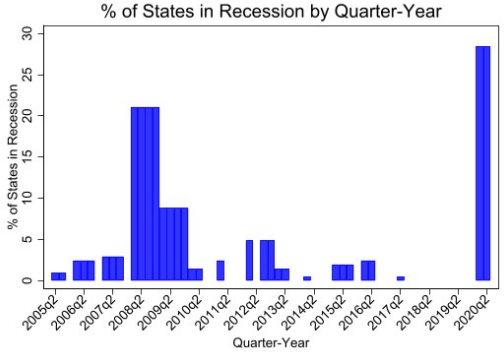


(b) % of Recessions within Counties

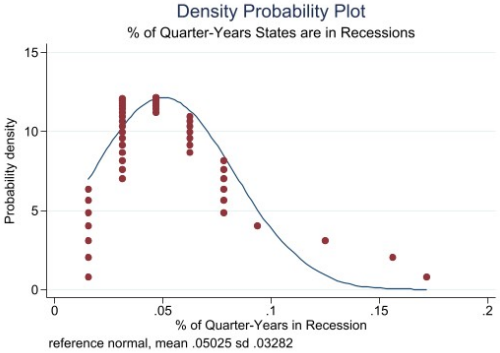
- Between 2005 and 2009, % of counties in recession ↑ from 16% to 50%; Between 2010 and 2019, 20-30% of counties in recession; During COVID-19 recession, 53% of counties in recession
- On average, counties were in recessions 25% of years with a standard deviation of 12.45%

Timing and Duration of State Recessions

On average, 7% of states are in recession



(a) % of States in Recession



(b) % of Recessions within States

- Between 2007 and 2008, % of states in recession ↑ from 2-3% to 21% in recession; During COVID-19 recession, 28% of states in recession
- On average, states were in recessions 5% of quarters with a standard deviation of 3.28%

Summary Statistics (2001-2020)

	N	P25	Median	P75	Mean	SD
Monthly Bank Deposit Rate	585,096	0.4500	1.1521	2.4500	1.5984	1.3574
Monthly Bank Dep. Rate SD	422,045	0.1061	0.2121	0.3754	0.2686	0.2181
Annual County Deposit Rate	54,327	0.3667	0.8632	2.1500	1.3873	1.2590
Annual County Dep. Rate SD	37,904	0.0995	0.1945	0.3585	0.2573	0.2177
Annual County GDP Growth	59,127	-0.0230	0.0122	0.0455	0.0125	0.0780
Quarterly State Deposit Rate	3,247	0.3859	0.6785	1.9781	1.3265	1.3075
Quarterly State Dep. Rate SD	3,247	0.1959	0.3067	0.4862	0.3517	0.1813
Quarterly State GDP Growth	3,197	-0.0026	0.0042	0.0105	0.0030	0.0198

Predicting County Recessions

Predicting Recessions

Dispersion in deposit rates is a salient indicator of economic recessions

Logit model of a recession:

$$logit(p_{c,t+k}) = \alpha + \beta_1 SD_{c,t} + \beta_2 Rate_{c,t} + \theta_c + \epsilon_{c,t}$$

- *SD* is the standard deviation of bank deposit rates
- *Rate* is the average bank deposit rate

Predicting Annual County Recessions (2001-2020)

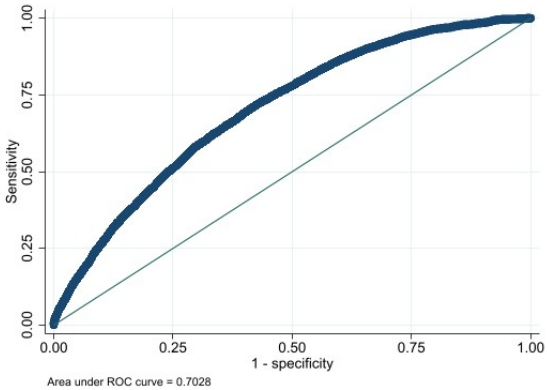
$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0441***	0.0368***	0.0145***
	(0.0029)	(0.0032)	(0.0035)
Rate	-0.0089***	0.0164***	0.0145***
	(0.0027)	(0.0029)	(0.0031)
County FIPS FE	✓	✓	✓
N	31,805	30,132	28,614
pseudo R^2	0.0874	0.0895	0.0826
AUC	0.7014	0.7028	0.6950
Overall test statistic, χ^2	2799.7020	2847.9940	2359.6318
p-value	0.0000	0.0000	0.0000

Increases in deposit rate dispersion increase the likelihood of an impending recession

- 1 SD ↑ in dispersion → 4.41 pp ↑ probability of recession one year ahead
- 1 SD ↑ in dispersion → 3.68 pp ↑ probability of recession two years ahead
- 1 SD ↑ in dispersion → 1.45 pp ↑ probability of recession three years ahead

Receiver Operating Characteristic Curve

- Efficient rank-based Area under the ROC Curve (AUC) algorithm
- Diagnostic test of accuracy and discrimination
  - AUC $= 1 \Rightarrow$ perfect classifier
  - AUC $\in [0.5\ 1] \Rightarrow$ greater predictive value than coin toss
  - AUC > 0.6 (0.7) indicates strong predictive value in information-scarce (rich) environments



County Recession in Two Years

Predicting Depth of Annual County Recessions (2001-2020)

Δln (GDP)	(1)	(2)	(3)
	1 Year Ahead	2 Years Ahead	3 Years Ahead
SD	-0.0058***	-0.0032***	-0.0007
	(0.0005)	(0.0006)	(0.0006)
Rate	0.0029***	0.0001	0.0007
	(0.0005)	(0.0005)	(0.0006)
County FIPS FE	✓	✓	✓
N	33,018	31,417	29,779
R^2	0.0680	0.0696	0.0797

Increases in deposit rate dispersion decrease economic growth

- 1 SD ↑ in dispersion → 0.58 pp ↓ in GDP growth one year ahead
- 1 SD ↑ in dispersion → 0.32 pp ↓ in GDP growth two years ahead
- 1 SD ↑ in dispersion → 0.07 pp ↓ in GDP growth three years ahead

Predicting State Recessions

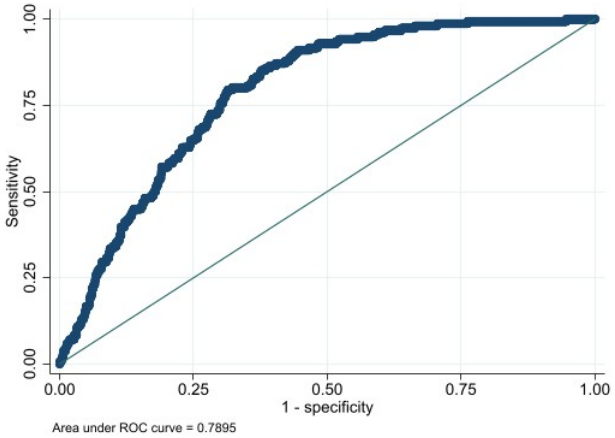
Predicting Quarterly State Recessions (2005-2020)

$\mathbb{1}_{Recession}$	(1) 4 Qtrs Ahead	(2) 8 Qtrs Ahead	(3) 12 Qtrs Ahead
SD	0.0490***	0.0424***	0.0088
	(0.0060)	(0.0071)	(0.0073)
Rate	0.0005	0.0008	0.0092
	(0.0044)	(0.0061)	(0.0068)
State FE	✓	✓	✓
N	3,041	2,837	2,634
pseudo R^2	0.1623	0.1227	0.0579
AUC	0.8163	0.7895	0.6958
Overall test statistic, χ^2	267.9579	229.5261	68.6178
p-value	0.0000	0.0000	0.0610

Increased deposit rate dispersion increases the likelihood of an impending recession

- 1 SD ↑ in dispersion → 4.90 pp ↑ probability of recession four quarters ahead
- 1 SD ↑ in dispersion → 4.24 pp ↑ probability of recession eight quarters ahead
- 1 SD ↑ in dispersion → 0.88 pp ↑ probability of recession twelve quarters ahead

State ROC



State Recession in Eight Quarters

Predicting National Recessions

Forecasting National Recessions

Use the state eight-quarters classifier to forecast national recessions

1. Estimate model parameters from the state eight-quarters moving average forward classifier (2005-2020 sample)
2. Forecast likelihood of state recession using 2001-2022 rate dispersion data
3. "Expected likelihood" of a national recession is calculated by the weighted sum of the predicted state probabilities, weighted by 2004 state GDPs
4. Country is in recession if expected likelihood is below the 25^{th} percentile of values
5. Compare to NBER's Business Cycle recession indicators

Model Forecasts National Recessions 8 Quarters Forward

Year	Quarter	Forecast	Actual
2003	1	0	0
2003	2	0	0
2003	3	0	0
2003	4	0	0
2004	1	0	0
2004	2	0	0
2004	3	0	0
2004	4	0	0
2005	1	0	0
2005	2	0	0
2005	3	0	0
2005	4	0	0
2006	1	0	0
2006	2	0	0
2006	3	0	0
2006	4	0	0
2007	1	0	0
2007	2	1	0
2007	3	1	0
2007	4	1	0
2008	1	1	1
2008	2	1	1
2008	3	1	1
2008	4	1	1
2009	1	1	1
2009	2	1	1
2009	3	0	0
2009	4	0	0

Year	Quarter	Forecast	Actual
2010	1	0	0
2010	2	0	0
2010	3	0	0
2010	4	0	0
2011	1	0	0
2011	2	0	0
2011	3	0	0
2011	4	0	0
2012	1	0	0
2012	2	0	0
2012	3	0	0
2012	4	0	0
2013	1	0	0
2013	2	0	0
2013	3	0	0
2013	4	0	0
2014	1	0	0
2014	2	0	0
2014	3	0	0
2014	4	0	0
2015	1	0	0
2015	2	0	0
2015	3	0	0
2015	4	0	0
2016	1	0	0
2016	2	0	0
2016	3	0	0
2016	4	0	0

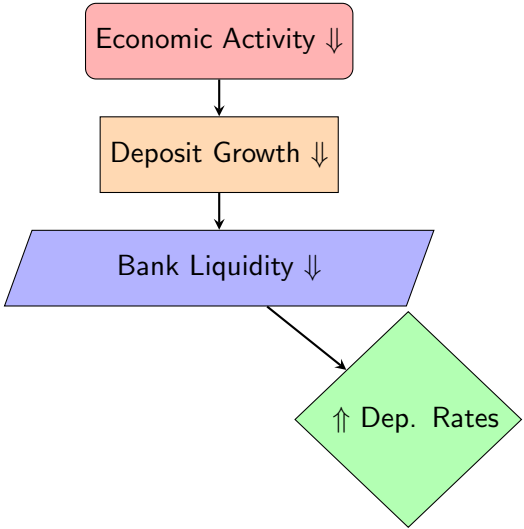
Year	Quarter	Forecast	Actual
2017	1	0	0
2017	2	0	0
2017	3	0	0
2017	4	0	0
2018	1	0	0
2018	2	0	0
2018	3	0	0
2018	4	0	0
2019	1	0	0
2019	2	0	0
2019	3	1	0
2019	4	1	0
2020	1	1	1
2020	2	1	1
2020	3	1	0
2020	4	1	0
2021	1	0	0
2021	2	0	0
2021	3	0	0
2021	4	0	0
2022	1	0	0
2022	2	0	0
2022	3	0	
2022	4	0	

Confusion Matrix: Forecasting National Recessions

		Prediction Outcome		
		p	**n**	**Total**
Actual Value	**p′**	True Positive = 8	False Negative =0	8′
	n′	False Positive = 7	True Negative =63	70′
	Total	15	63	

Bank Liquidity and Business Cycles

Do Banks that Increase Deposit Rates Experience Liquidity Stress?



Empirical Design: Bank-Level

$$\begin{aligned}\Delta ln(Y)_{b,t+k} = {} & \beta_0 + \beta_1 \mathbb{1}_{P25<\text{Dep Rate Change}\leq P50,b,t} \times \text{Rec.}_t \\ & + \beta_2 \mathbb{1}_{P50<\text{Dep Rate Change}\leq P75,b,t} \times \text{Rec.}_t + \beta_3 \mathbb{1}_{\text{Dep Rate Change}>P75,b,t} \times \text{Rec.}_t \\ & + \beta_4 \mathbb{1}_{P25<\text{Dep Rate Change}\leq P50,b,t} + \beta_5 \mathbb{1}_{P50<\text{Dep Rate Change}\leq P75,b,t} \\ & + \beta_6 \mathbb{1}_{\text{Dep Rate Change}>P75,b,t} + \alpha_t + \epsilon_{b,t}\end{aligned} \tag{1}$$

- $\mathbb{1}_{Px<\text{Dep Rate Change}\leq Px}$ is a quartile indicator for banks' quarterly changes in the deposit rate
- *Rec.* indicates whether there is a recession in the next eight quarters
- k ranges from -3 to $+3$

Insured Deposit Growth Declines before Deposit Rate Changes

ΔIn(Insured Deposits)	(1) t-3	(2) t-2	(3) t-1	(4) t	(5) t+1	(6) t+2	(7) t+3
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50} \times$ Rec.	-0.0018	-0.0034**	-0.0003	-0.0030**	-0.0036**	0.0004	-0.0005
	(0.0016)	(0.0014)	(0.0019)	(0.0014)	(0.0014)	(0.0012)	(0.0013)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75} \times$ Rec.	-0.0015	0.0018	0.0040**	0.0004	-0.0017	-0.0002	0.0020
	(0.0013)	(0.0016)	(0.0018)	(0.0014)	(0.0013)	(0.0011)	(0.0018)
$\mathbb{1}_{\text{Dep Rate Change}>P75} \times$ Rec.	-0.0018	-0.0027	-0.0009	-0.0017	-0.0020	-0.0027**	-0.0017
	(0.0013)	(0.0017)	(0.0016)	(0.0016)	(0.0019)	(0.0012)	(0.0014)
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50}$	0.0003	0.0010	-0.0022***	0.0029***	0.0046***	0.0022***	0.0021***
	(0.0007)	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0006)	(0.0007)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75}$	0.0009	-0.0023***	-0.0052***	0.0016**	0.0069***	0.0035***	0.0002
	(0.0007)	(0.0008)	(0.0011)	(0.0008)	(0.0009)	(0.0005)	(0.0010)
$\mathbb{1}_{\text{Dep Rate Change}>P75}$	0.0019**	0.0012	-0.0020*	0.0061***	0.0090***	0.0067***	0.0034***
	(0.0008)	(0.0008)	(0.0011)	(0.0008)	(0.0009)	(0.0008)	(0.0008)
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	317,672	323,595	329,908	330,109	323,901	317,997	312,268
R^2	0.0417	0.0462	0.0453	0.0437	0.0453	0.0475	0.0492

- Insured deposit growth declines in the quarters preceding rate changes, regardless of change in deposit rates
- ⇑ deposit rate on insured deposits → growth rate on insured deposits ⇑
- Aggregate county deposit growth declines as a county heads into a recession ▸ County Dep. Growth

Uninsured Deposit Growth Declines before Deposit Rate Changes

Δln(Uninsured Deposits)	(1) t-3	(2) t-2	(3) t-1	(4) t	(5) t+1	(6) t+2	(7) t+3
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50} \times$ Rec.	0.0004	0.0096*	0.0015	-0.0110**	-0.0013	0.0023	0.0010
	(0.0042)	(0.0051)	(0.0041)	(0.0049)	(0.0044)	(0.0051)	(0.0052)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75} \times$ Rec.	0.0053	0.0087**	0.0045	-0.0042	-0.0103**	-0.0074	-0.0025
	(0.0048)	(0.0043)	(0.0053)	(0.0051)	(0.0049)	(0.0068)	(0.0101)
$\mathbb{1}_{\text{Dep Rate Change}>P75} \times$ Rec.	-0.0035	0.0029	0.0030	-0.0138***	0.0008	0.0008	-0.0038
	(0.0039)	(0.0044)	(0.0045)	(0.0045)	(0.0042)	(0.0065)	(0.0052)
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50}$	-0.0005	-0.0018	-0.0034	0.0066*	0.0063*	-0.0011	-0.0004
	(0.0029)	(0.0033)	(0.0031)	(0.0037)	(0.0032)	(0.0033)	(0.0034)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75}$	0.0018	-0.0035	-0.0077**	-0.0010	0.0127***	0.0037	-0.0028
	(0.0034)	(0.0029)	(0.0038)	(0.0047)	(0.0032)	(0.0034)	(0.0047)
$\mathbb{1}_{\text{Dep Rate Change}>P75}$	0.0050*	0.0023	-0.0108***	0.0067	0.0070**	0.0029	0.0033
	(0.0027)	(0.0029)	(0.0034)	(0.0040)	(0.0033)	(0.0033)	(0.0034)
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	316,120	322,015	328,294	328,500	322,328	316,458	310,757
R^2	0.0671	0.0685	0.0681	0.0685	0.0683	0.0690	0.0692

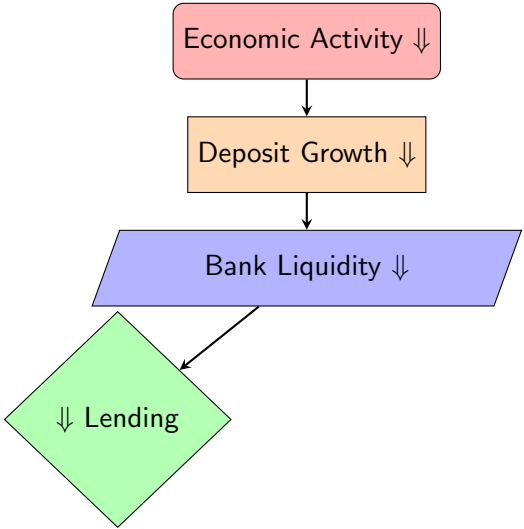
- Banks that experience higher uninsured deposit withdrawals, raise deposit rates more in the following quarters
- At onset of a recession, banks experience additional uninsured deposit withdrawals

Banks Increase Reliance on Insured Deposits

$\Delta ln(\frac{\text{Insured}}{\text{Uninsured}})$	(1) t-3	(2) t-2	(3) t-1	(4) t	(5) t+1	(6) t+2	(7) t+3
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50} \times$ Rec.	-0.0028	-0.0122**	-0.0011	0.0077	-0.0021	-0.0020	-0.0013
	(0.0040)	(0.0054)	(0.0042)	(0.0050)	(0.0043)	(0.0053)	(0.0054)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75} \times$ Rec.	-0.0056	-0.0059	-0.0003	0.0042	0.0089*	0.0069	0.0047
	(0.0052)	(0.0048)	(0.0051)	(0.0051)	(0.0050)	(0.0069)	(0.0093)
$\mathbb{1}_{\text{Dep Rate Change}>P75} \times$ Rec.	0.0008	-0.0033	-0.0027	0.0123***	-0.0030	-0.0038	0.0027
	(0.0038)	(0.0045)	(0.0043)	(0.0046)	(0.0045)	(0.0068)	(0.0052)
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50}$	0.0011	0.0031	0.0008	-0.0034	-0.0019	0.0031	0.0024
	(0.0031)	(0.0035)	(0.0032)	(0.0038)	(0.0034)	(0.0036)	(0.0035)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75}$	-0.0009	0.0017	0.0019	0.0026	-0.0058*	-0.0003	0.0031
	(0.0035)	(0.0030)	(0.0038)	(0.0045)	(0.0034)	(0.0033)	(0.0050)
$\mathbb{1}_{\text{Dep Rate Change}>P75}$	-0.0033	-0.0012	0.0084**	-0.0008	0.0019	0.0037	0.0001
	(0.0026)	(0.0030)	(0.0033)	(0.0040)	(0.0033)	(0.0035)	(0.0037)
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	310,330	316,137	322,218	328,496	322,324	316,244	310,441
R^2	0.0812	0.0813	0.0807	0.0805	0.0799	0.0804	0.0809

- Generally, growth in the ratio of insured to uninsured deposits exhibit little TS or XS variation
- Banks in the fourth quartile experience a significant increase in ratio growth in the quarter before rates are raised
- At the onset of a recession, banks in the fourth quartile experience an additional increase in ratio growth

Do Banks Alter their Lending Activity as a Response to Liquidity Stress?



Loan Growth and Deposit Rate Changes

Δln(Loans)	(1) t-3	(2) t-2	(3) t-1	(4) t	(5) t+1	(6) t+2	(7) t+3
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50} \times$ Rec.	-0.0029**	-0.0025*	-0.0026**	-0.0037**	-0.0034***	-0.0024	-0.0020*
	(0.0013)	(0.0013)	(0.0013)	(0.0016)	(0.0012)	(0.0015)	(0.0011)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75} \times$ Rec.	-0.0004	-0.0004	-0.0021	-0.0021	0.0001	-0.0004	-0.0008
	(0.0015)	(0.0015)	(0.0013)	(0.0013)	(0.0013)	(0.0010)	(0.0012)
$\mathbb{1}_{\text{Dep Rate Change}>P75} \times$ Rec.	-0.0011	-0.0041**	-0.0048***	-0.0054***	-0.0030***	-0.0036***	-0.0037***
	(0.0019)	(0.0017)	(0.0016)	(0.0015)	(0.0011)	(0.0012)	(0.0009)
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50}$	0.0007	0.0020***	0.0025***	0.0037***	0.0015**	0.0016***	0.0016***
	(0.0006)	(0.0006)	(0.0006)	(0.0008)	(0.0006)	(0.0006)	(0.0005)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75}$	-0.0009	0.0010	0.0038***	0.0024***	0.0005	0.0014*	0.0018**
	(0.0009)	(0.0009)	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0009)
$\mathbb{1}_{\text{Dep Rate Change}>P75}$	0.0026***	0.0053***	0.0084***	0.0077***	0.0035***	0.0044***	0.0043***
	(0.0009)	(0.0008)	(0.0009)	(0.0009)	(0.0008)	(0.0008)	(0.0006)
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	289,459	295,245	301,389	301,992	296,350	290,572	284,938
R^2	0.0210	0.0206	0.0206	0.0211	0.0227	0.0259	0.0267

- During periods of normal economic growth, banks in the fourth quartile report higher lending growth
- At the onset of a recession, banks in the fourth quartile experience lower lending growth
- At the onset of a recession, banks that raise their rates more do so to support their balance sheet, rather than to expand it

Non-Performing Loan Growth and Deposit Rate Changes

Δln(NPL)	(1) t-3	(2) t-2	(3) t-1	(4) t	(5) t+1	(6) t+2	(7) t+3
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50} \times$ Rec.	0.0057	0.0068	0.0044	-0.0132	-0.0043	-0.0077	-0.0139
	(0.0092)	(0.0094)	(0.0120)	(0.0115)	(0.0109)	(0.0077)	(0.0095)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75} \times$ Rec.	0.0178	0.0115	0.0091	0.0115	-0.0132	0.0060	-0.0129
	(0.0127)	(0.0127)	(0.0122)	(0.0105)	(0.0099)	(0.0102)	(0.0089)
$\mathbb{1}_{\text{Dep Rate Change}>P75} \times$ Rec.	-0.0011	0.0036	-0.0149	0.0020	-0.0075	-0.0069	-0.0075
	(0.0107)	(0.0095)	(0.0126)	(0.0104)	(0.0097)	(0.0090)	(0.0086)
$\mathbb{1}_{P25<\text{Dep Rate Change}\leq P50}$	-0.0024	-0.0015	0.0020	0.0036	-0.0044	0.0092*	0.0008
	(0.0047)	(0.0066)	(0.0062)	(0.0055)	(0.0049)	(0.0046)	(0.0055)
$\mathbb{1}_{P50<\text{Dep Rate Change}\leq P75}$	-0.0052	-0.0069	-0.0024	-0.0025	0.0089	0.0065	0.0067
	(0.0050)	(0.0076)	(0.0058)	(0.0056)	(0.0055)	(0.0058)	(0.0068)
$\mathbb{1}_{\text{Dep Rate Change}>P75}$	0.0019	0.0005	0.0016	0.0041	0.0109**	-0.0002	0.0050
	(0.0053)	(0.0050)	(0.0069)	(0.0062)	(0.0046)	(0.0045)	(0.0056)
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	228,730	232,654	236,770	237,306	233,706	230,297	226,953
R^2	0.0071	0.0070	0.0070	0.0069	0.0070	0.0071	0.0072

- Banks in the fourth quartile report higher NPL growth, following rate changes
- Banks that raise rates more experience an increase in their overall riskiness due to higher losses

Additional Findings

Effects vary across banks based on their existing liquidity and lending commitments

1. Less profitable firms experience lower cash growth during downturns ▸ Cash
2. Dispersion of deposit rates signify onset of recession – compare to dispersion of equity returns and CDS spreads (2001-2020) ▸ Comparison of dispersion

Robustness

Robustness

1. Standard deviation predicts recessions w/different rates ▸ 01M10KCD ▸ Uninsured
2. Standard deviation predicts recessions w/term spread ▸ County ▸ State
3. Standard deviation predicts recessions w/time fixed effects ▸ County ▸ State
4. Standard deviation predicts depth of recession w/time fixed effects ▸ County ▸ State

Results are robust to alternate methodologies, i.e., recession thresholds, deposit rates, construction of average deposit rate and standard deviation, and regression specifications

Deposit Rates and Credit Booms

Deposit Rates and Credit Booms

Can dispersion in deposit rates predict recessions that are not preceded by periods of high credit growth?

Dispersion can predict recessions, even after accounting for credit growth

1. **Dispersion can predict recessions, even after accounting for credit growth**
   - Examine credit growth using data on small business lending and mortgage lending
   - Run a horse-race between our lagged measures of dispersion against lagged measures of credit growth

2. **Dispersion can predict recessions, even in the absence of credit growth**
   - Deterioration in the economic fundamentals of a region at the onset of a recession may be sufficient to affect the riskiness of banks and raise deposit rates
   - Study county and state recessions between 2011 and 2016 – period when credit growth was stagnant

Dispersion Predicts County Recessions After Controlling for Mortgage Credit Growth

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0483***	0.0345***	0.0136***
	(0.0030)	(0.0032)	(0.0036)
Rate	-0.0053*	0.0240***	0.0223***
	(0.0028)	(0.0030)	(0.0031)
Δln(Mtg)	-0.0642***	0.0611***	-0.0719***
	(0.0077)	(0.0085)	(0.0089)
County FIPS FE	✓	✓	✓
N	29,788	28,263	26,686
pseudo R^2	0.0896	0.0934	0.0857
AUC	0.7039	0.7069	0.6984
Overall test statistic, χ^2	2731.6212	2865.3616	2362.2291
p-value	0.0000	0.0000	0.0000

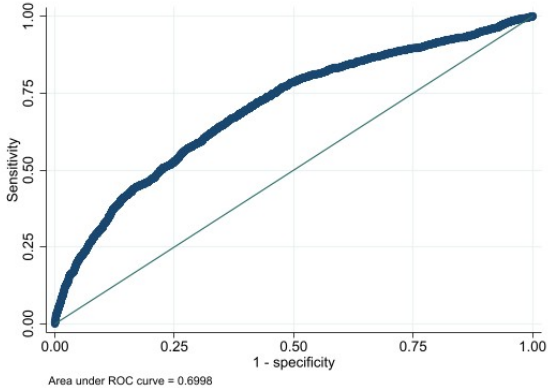
- 1 SD ↑ in dispersion → 3.45 pp ↑ probability of recession two years ahead
- **AUC:** 0.7069

Dispersion Predicts County Recessions After Controlling for Total Credit Growth

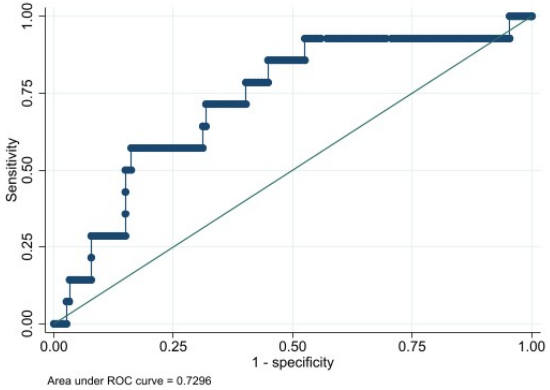
$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0478***	0.0347***	0.0136***
	(0.0030)	(0.0032)	(0.0036)
Rate	-0.0054*	0.0243***	0.0217***
	(0.0028)	(0.0030)	(0.0031)
Δln(Total)	-0.0735***	0.0805***	-0.0667***
	(0.0096)	(0.0105)	(0.0109)
County FIPS FE	✓	✓	✓
N	29788	28263	26686
pseudo R^2	0.0893	0.0936	0.0849
AUC	0.7034	0.7072	0.6974
Overall test statistic, χ^2	2722.6376	2877.8228	2327.3488
p-value	0.0000	0.0000	0.0000

- 1 SD ↑ in dispersion → 3.47 pp ↑ probability of recession two years ahead
- **AUC:** 0.7072

Dispersion Predicts Recessions without Credit Booms



(a) County



(b) State

When Do We Not Predict?

Falsification Test: Natural Disasters

- Predictive power of the dispersion of deposit rates reflects the gradual build-up of liquidity shortages

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- Therefore, dispersion of deposit rates should have little predictive power when economic contractions arise due to sudden shocks

Falsification Test: Natural Disasters

- Predictive power of the dispersion of deposit rates reflects the gradual build-up of liquidity shortages
- Therefore, dispersion of deposit rates should have little or no predictive power when contractions in an economy arise due to sudden shocks

How do natural disasters impact the dispersion of deposit rates?

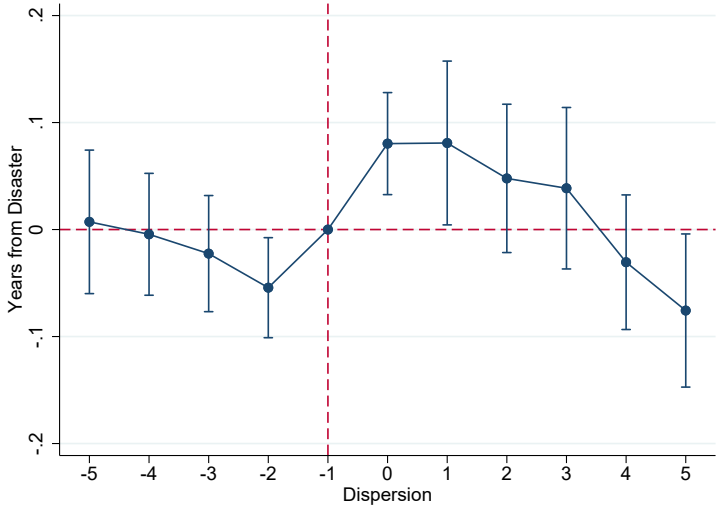
1. No increase in the dispersion of deposit rates prior to natural disasters – only after
2. Dispersion of deposit rates predicts recessions in non-disaster counties better

Hence, the dispersion of deposit rates effectively captures the liquidity stress of banks during economic contractions

Dispersion of Deposit Rates around Natural Disasters

Regressions Margins: SD for Disaster Counties by Year from Event

▸ Monthly Avg. ▸ Bank Rates



Dispersion Predicts County Recessions Better in Non-Disaster Counties

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
$\mathbb{1}_{Disaster} \times$ SD $\times$ Shock	-0.0689	0.0180	-0.1678
	(0.1242)	(0.0973)	(0.1125)
$\mathbb{1}_{Disaster} \times$ Rate $\times$ Shock	-0.0590	0.0188	0.1304
	(0.1065)	(0.0837)	(0.0988)
$\mathbb{1}_{Disaster} \times$ SD	0.0652**	0.0220	-0.0445
	(0.0262)	(0.0296)	(0.0302)
$\mathbb{1}_{Disaster} \times$ Rate	0.0658***	0.0666***	0.0662***
	(0.0191)	(0.0219)	(0.0223)
SD	0.0362***	0.0144***	0.0136***
	(0.0032)	(0.0035)	(0.0037)
Rate	0.0145***	0.0125***	-0.0097***
	(0.0030)	(0.0031)	(0.0031)
Shock	-0.0627	0.0932	0.4092***
	(0.0798)	(0.0646)	(0.0684)
County FIPS FE	✓	✓	✓
N	30,129	28,602	27,024
pseudo R^2	0.0909	0.0835	0.0812
AUC	0.7042	0.6963	0.6923
Overall test statistic, χ^2	2875.5387	2375.7655	2145.1290
p-value	0.0000	0.0000	0.0112

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Out-of-Sample Model Validation

Out-of-Sample Model Validation

Important aspect of predictive modeling is out-of-sample model validation – how accurately does the model perform in practice?

k-fold cross-validation to test a model's ability to generalize to new cases that were not used in estimation

1. Partition dataset into k subsamples of equal size
2. $k-1$ subsamples are used as the training set while one subsample is retained as the validation or testing set in which we evaluate the predictive performance (AUC)
3. Iteratively estimates AUC k times – each of the k subsamples is used as the testing set once
4. Plot the k-fold ROC curves and estimate the average AUC across the k-folds and bootstrapping the cross-validated AUC for statistical inference

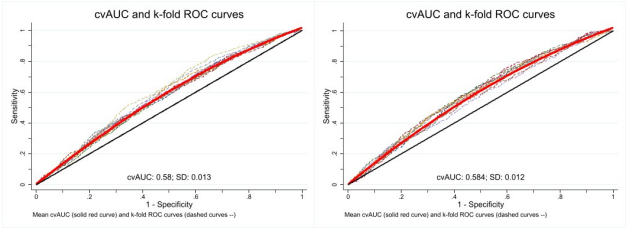
Out-of-Sample Findings

Predictive model generalizes well to independent datasets and reports high model prediction performance

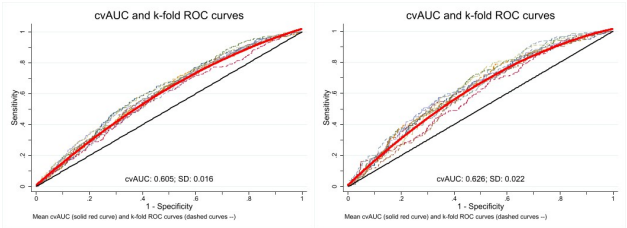
- Goodness of fit increases with the number of banks in each county
- Two-year forecast model at the county level produces:
  - AUC of 0.580 in counties with at least two banks
  - AUC of 0.584 in counties with more than two banks
  - AUC of 0.605 in counties with more than three banks
  - AUC of 0.626 in counties with more than four banks
- Eight-quarter forecast model at the state level produces:
  - AUC of 0.743 in states with at least two banks
  - AUC of 0.753 in states with more than two banks
  - AUC of 0.771 in states with more than three banks
  - AUC of 0.837 in states with more than four banks

Dispersion of bank deposit rates can accurately predict recessions two years in advance

Out-of-Sample Estimation: Counties

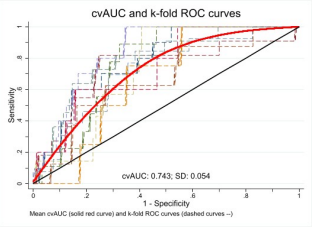


(a) All (b) $>$ 2 Banks

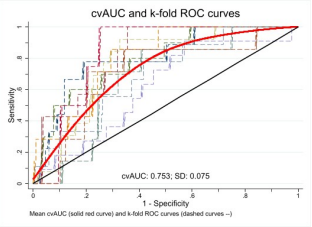


(c) $>$ 3 Banks (d) $>$ 4 Banks

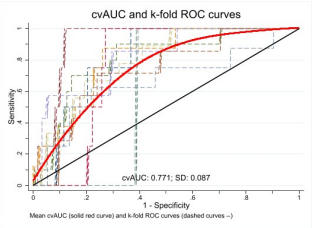
Out-of-Sample Estimation: States



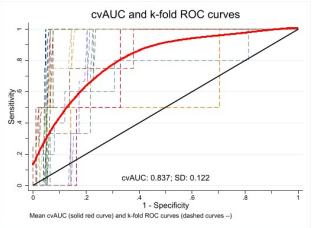
(a) All



(b) $>$ 2 Banks



(c) $>$ 3 Banks



(d) $>$ 4 Banks

Robustness

Examining the Heterogeneous Effects

- **Thus far, our proposed mechanism suggests that some banks face a funding squeeze at the onset of a recession $\Rightarrow$ higher deposit rates**

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- Does the predictive value of our model increase in areas where banks face more competition for deposits?
  - Areas with a greater number of banks face stiffer competition for deposit funding
  - Less of a need to raise rates to attract funding in areas with less competition, hence, dispersion has less predictive power

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  - Areas with a greater number of banks face stiffer competition for deposit funding
  - Less of a need to raise rates to attract funding in areas with less competition, hence, dispersion has less predictive power
- **Hypothesis:** When competition is higher, local economic conditions exhibit greater sensitivity to the standard deviation of deposit rates
  1. # of banks within a geographic area ▸ Estimation ▸ ROC
  2. Metropolitan, urban, rural areas ▸ Geography
  3. Banks with small and large # of branches ▸ Small # of Branches ▸ Large # of Branches

Conclusion

Conclusion

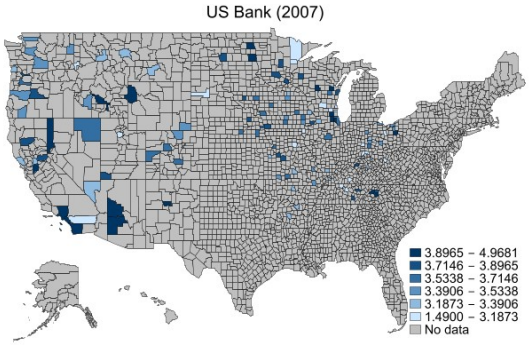
1. **Bank liquidity conditions predict business cycles**
   - Predict recessions and depth of county, state, and national recessions using the dispersion of deposit rates on insured deposits across banks
   - Predicts recessions that are not caused by a credit boom

2. **Mechanism: liquidity squeezes**
   - As economic growth slows, deposit growth slows
   - In response, banks either increase deposit rates or reduce lending growth to support their balance sheet

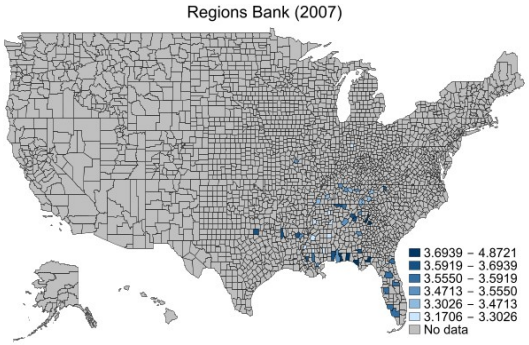
3. **Granular indicator of recessions with policy implications**
   - Allows for prediction of localized downturns
   - Market-based measure is easy to construct and is thus, a useful early warning signal of an impending recession
   - Riskier banks increase reliance on insured deposits as they approach a downturn, raising concerns of moral hazard arising from deposit insurance schemes

Appendix

Geographic Variation in Deposit Rates of US Bank and Regions Bank in 2007



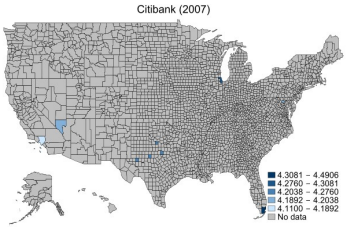
(a) US Bank



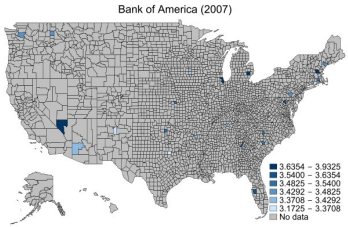
(b) Regions Bank

- Large banks exhibit divergent pricing policies before GFC 2008 Back

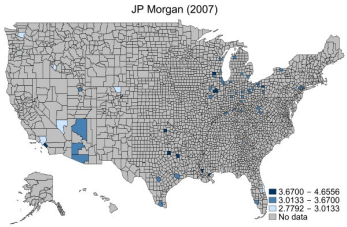
Geographic Variation in Deposit Rates of Citi, BoA, JPM in 2007



(a) Citi



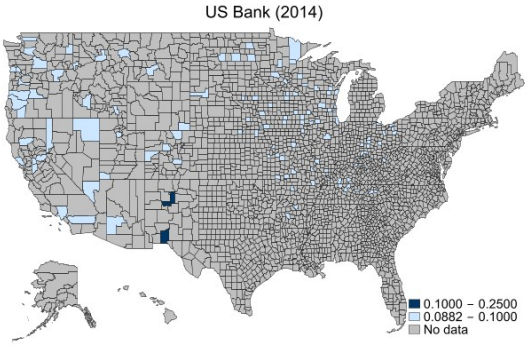
(b) BoA Bank



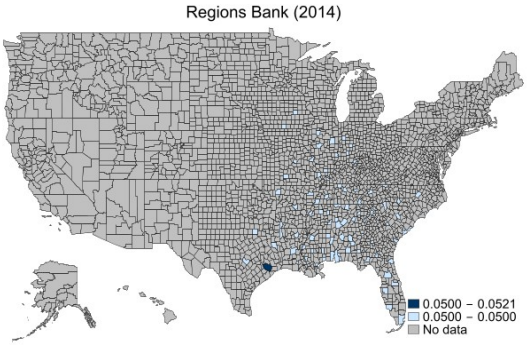
(c) JPM Bank

- Large banks exhibit divergent pricing policies before GFC 2008 Back

Geographic Variation in Deposit Rates of US Bank and Regions Bank in 2014 Back



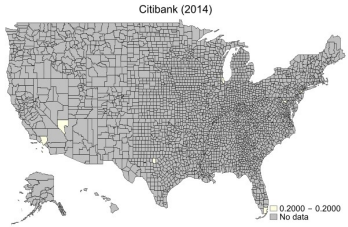
(a) US Bank



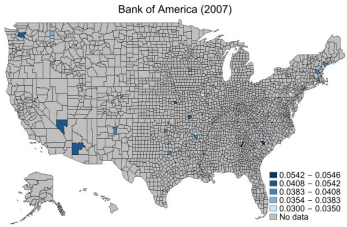
(b) Regions Bank

- Large banks exhibit convergent pricing policies after GFC 2008 Back

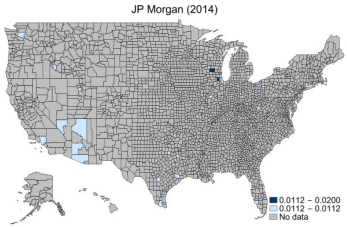
Geographic Variation in Deposit Rates of Citi, BoA, JPM in 2014



(a) Citi



(b) BoA Bank



(c) JPM Bank

- Large banks exhibit convergent pricing policies after GFC 2008 Back

Aggregate County Deposit Growth

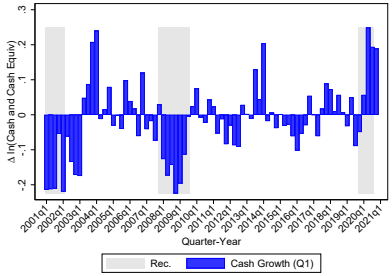
Back

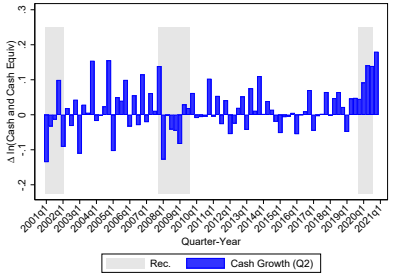
Δ ln(Dep Amt)	(1)	(2)	(3)
$\mathbb{1}_{\text{Recession in 1 Year}}$	-0.0041***		
	(0.0010)		
$\mathbb{1}_{\text{Recession in 2 Years}}$		0.0009	
		(0.0011)	
$\mathbb{1}_{\text{Recession in 3 Years}}$			0.0039***
			(0.0012)
County FE	✓	✓	✓
Year FE	✓	✓	✓
N	51,974	48,906	45,835
R^2	0.0859	0.0883	0.0916

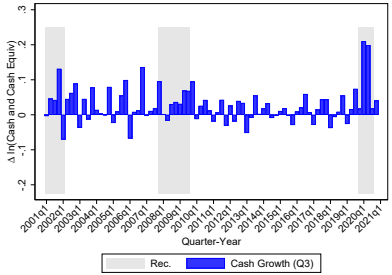
- Counties that approach a recession experience lower deposit growth relative to other counties

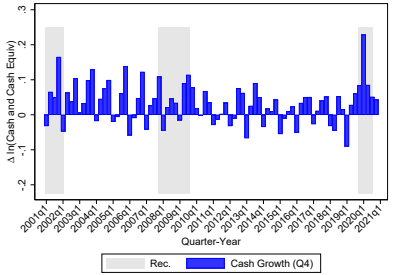
Growth in Cash and Cash Equiv. by Profit Quartile (2001-2020)

Back



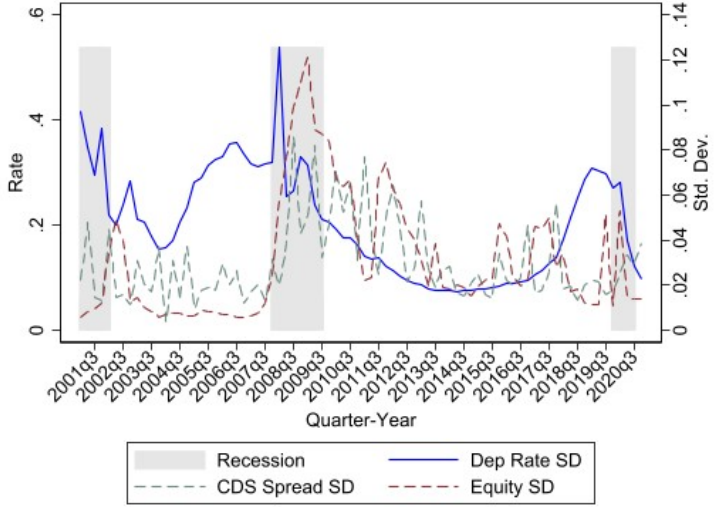






Dispersion of Deposit Rates, CDS Spreads, and Equity Returns (2001-2020)

Back



Predicting Annual County Recessions w/1-month 10K CD (2001-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0299***	0.0450***	0.0115
	(0.0090)	(0.0095)	(0.0108)
Rate	-0.0009	0.0135	0.0295***
	(0.0095)	(0.0099)	(0.0109)
County FIPS FE	✓	✓	✓
N	5,510	5,015	4,540
pseudo R^2	0.1163	0.1227	0.1176
AUC	0.7337	0.7397	0.7294
Overall test statistic, χ^2	618.3251	599.6467	508.6830
p-value	0.2936	0.3937	0.9824

Increases in deposit rate dispersion increase the likelihood of an impending recession

- 1 SD ↑ in dispersion → 2.99 pp ↑ probability of recession one year ahead
- 1 SD ↑ in dispersion → 4.50 pp ↑ probability of recession two years ahead
- 1 SD ↑ in dispersion → 1.15 pp ↑ probability of recession three years ahead

Predicting Annual County Recessions w/12-month uninsured CD (2001-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0532***	0.1154***	0.0808***
	(0.0047)	(0.0060)	(0.0091)
Rate	0.0033	-0.0007	-0.0225**
	(0.0054)	(0.0071)	(0.0092)
County FIPS FE	✓	✓	✓
N	14,015	12,060	10,745
pseudo R^2	0.1163	0.1407	0.1185
AUC	0.7295	0.7542	0.7318
Overall test statistic, χ^2	1784.6095	1960.9860	1383.3549
p-value	0.0000	0.0000	0.7919

Increases in deposit rate dispersion increase the likelihood of an impending recession

- 1 SD ↑ in dispersion → 5.32 pp ↑ probability of recession one year ahead
- 1 SD ↑ in dispersion → 11.54 pp ↑ probability of recession two years ahead
- 1 SD ↑ in dispersion → 8.08 pp ↑ probability of recession three years ahead

Predicting Annual County Recessions w/Term Spread (2001-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0245***	0.0196***	0.0044
	(0.0027)	(0.0027)	(0.0030)
Term Spread	-0.0378***	-0.0679***	-0.0526***
	(0.0023)	(0.0025)	(0.0026)
County FIPS FE	✓	✓	✓
N	31,805	30,132	28,614
pseudo R^2	0.0948	0.1105	0.0943
AUC	0.7101	0.7290	0.7094
Overall test statistic, χ^2	3094.3043	3617.7140	2889.0765
p-value	0.0000	0.0000	0.0000

Increases in deposit rate dispersion increase the likelihood of an impending recession

- 1 SD ↑ in dispersion → 2.45 pp ↑ probability of recession one year ahead
- 1 SD ↑ in dispersion → 1.96 pp ↑ probability of recession two years ahead
- 1 SD ↑ in dispersion → 0.44 pp ↑ probability of recession three years ahead

Predicting Quarterly State Recessions w/Term Spread (2005-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0432***	0.0215***	-0.0016
	(0.0056)	(0.0052)	(0.0058)
Term Spread	-0.0081**	-0.0317***	-0.0310***
	(0.0036)	(0.0053)	(0.0058)
State FE	✓	✓	✓
N	3,041	2,837	2,634
pseudo R^2	0.1653	0.1629	0.0910
AUC	0.8206	0.8161	0.7474
Overall test statistic, χ^2	262.3724	249.3268	151.2274
p-value	0.0000	0.0000	0.0000

Increased deposit rate dispersion increases the likelihood of an impending recession

- 1 SD ↑ in dispersion → 4.32 pp ↑ probability of recession four quarters ahead
- 1 SD ↑ in dispersion → 2.15 pp ↑ probability of recession eight quarters ahead

Predicting Annual County Recessions w/Time FE (2001-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0186***	0.0142***	0.0086**
	(0.0030)	(0.0032)	(0.0035)
Rate	0.0255**	0.0180	0.0896***
	(0.0124)	(0.0129)	(0.0141)
County FIPS FE	✓	✓	✓
Year FE	✓	✓	✓
N	31,805	30,132	28,614
pseudo R^2	0.1592	0.1559	0.1543
AUC	0.7787	0.7756	0.7735
Overall test statistic, χ^2	4996.1506	4705.5481	4478.6054
p-value	0.0000	0.0000	0.0000

Increases in deposit rate dispersion increase the likelihood of an impending recession

- 1 SD ↑ in dispersion → 1.86 pp ↑ probability of recession one year ahead
- 1 SD ↑ in dispersion → 1.42 pp ↑ probability of recession two years ahead
- 1 SD ↑ in dispersion → 0.86 pp ↑ probability of recession three years ahead

Predicting Quarterly State Recessions w/Time FE (2005-2020)

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0182	0.0269*	0.0165
	(0.0161)	(0.0155)	(0.0160)
Rate	0.0546	0.2100***	0.2608***
	(0.0639)	(0.0739)	(0.0758)
State FE	✓	✓	✓
Quarter-Year FE	✓	✓	✓
N	1,304	1,174	1,044
pseudo R^2	0.3240	0.3468	0.3647
AUC	0.9002	0.9134	0.9153
Overall test statistic, χ^2	147.5822	138.0154	129.8375
p-value	0.0000	0.0000	0.0000

Increased deposit rate dispersion increases the likelihood of an impending recession

- 1 SD ↑ in dispersion → 1.82 pp ↑ probability of recession four quarters ahead
- 1 SD ↑ in dispersion → 2.69 pp ↑ probability of recession eight quarters ahead
- 1 SD ↑ in dispersion → 1.65 pp ↑ probability of recession twelve quarters ahead

Predicting Depth of Annual County Recessions w/Time FE (2001-2020)

Back

$\Delta ln(GDP)$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	-0.0026***	-0.0011*	-0.0006
	(0.0006)	(0.0006)	(0.0007)
Rate	-0.0012	-0.0023	-0.0174***
	(0.0023)	(0.0023)	(0.0027)
County FIPS FE	✓	✓	✓
Year FE	✓	✓	✓
N	33,018	31,417	29,779
R^2	0.1020	0.1043	0.1147

Increases in deposit rate dispersion decrease economic growth

- 1 SD ↑ in dispersion → 0.26 pp ↓ in GDP growth one year ahead
- 1 SD ↑ in dispersion → 0.11 pp ↓ in GDP growth two years ahead
- 1 SD ↑ in dispersion → 0.06 pp ↓ in GDP growth three years ahead

Predicting Depth of Quarterly State Recessions w/Time FE (2005-2020)

Back

Δln (GDP)	(1) 4 Quarters Ahead	(2) 8 Quarters Ahead	(3) 12 Quarters Ahead
SD	-0.0027***	0.0005	0.0006
	(0.0010)	(0.0012)	(0.0007)
Rate	0.0004	-0.0017*	-0.0011
	(0.0007)	(0.0010)	(0.0007)
State FE	✓	✓	✓
N	3,041	2,837	2,634
R^2	0.0260	0.0175	0.0124

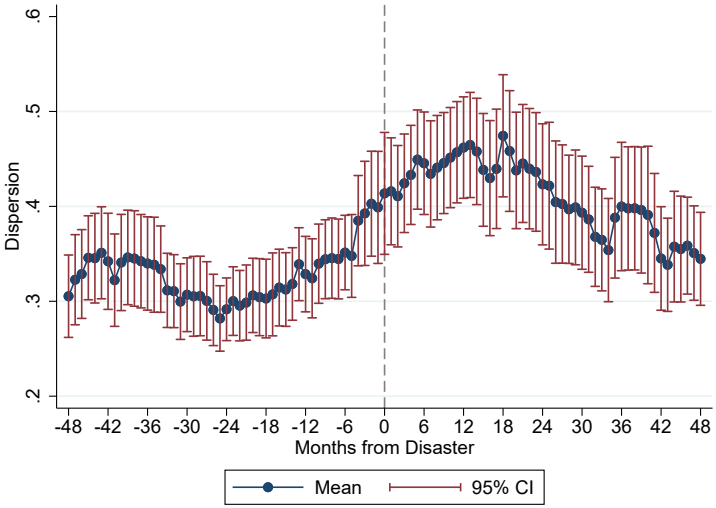
Increases in deposit rate dispersion decrease economic growth

- 1 SD ↑ in dispersion → 0.27 pp ↓ in GDP growth four quarters ahead

Dispersion of Deposit Rates around Natural Disasters

Average SD for Disaster Counties by Month from Event

Back



Bank Rate and Deposit Changes around Natural Disasters

Back

Δ ln(Dep Amt)	t-3	t-2	t-1	t	t+1	t+2	t+3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}_{Disaster}$	-0.0138	-0.0260	-0.0077	0.0189	-0.0474***	-0.0209*	-0.0084
	(0.0181)	(0.0192)	(0.0198)	(0.0221)	(0.0155)	(0.0122)	(0.0129)
County FIPS FE	✓	✓	✓	✓	✓	✓	✓
Bank × County FE	✓	✓	✓	✓	✓	✓	✓
N	364,956	413,283	468,935	534,915	534,915	469,184	413,665
R^2	0.2265	0.2251	0.2185	0.2103	0.2103	0.1681	0.1545

Standard errors are two-way clustered by county and bank in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

- After the disaster, deposit growth slows down

Heterogeneous Effects in Counties with >2 Banks

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0539***	0.0437***	0.0248***
	(0.0036)	(0.0041)	(0.0044)
Rate	-0.0135***	0.0168***	0.0148***
	(0.0034)	(0.0037)	(0.0038)
County FIPS FE	✓	✓	✓
N	21572	20587	19697
pseudo R^2	0.0931	0.0944	0.0861
AUC	0.7114	0.7123	0.7025
Overall test statistic, χ^2	2006.9224	2041.4684	1667.2815
p-value	0.0000	0.0000	0.0000

- **Baseline estimate:** 1 SD ↑ in dispersion → 3.68 pp ↑ probability of recession two years ahead
- **Baseline AUC:** 0.7028

Heterogeneous Effects in Counties with >3 Banks

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0682***	0.0616***	0.0321***
	(0.0043)	(0.0050)	(0.0055)
Rate	-0.0156***	0.0173***	0.0187***
	(0.0041)	(0.0045)	(0.0048)
County FIPS FE	✓	✓	✓
N	14,492	13,754	13,149
pseudo R^2	0.0991	0.1057	0.0910
AUC	0.7211	0.7294	0.7101
Overall test statistic, χ^2	1442.1974	1520.1871	1158.9102
p-value	0.0000	0.0000	0.0002

- **Counties with >2 banks:** 1 SD ↑ in dispersion → 4.37 pp ↑ probability of recession two years ahead
- **Counties with >2 banks AUC:** 0.7123

Heterogeneous Effects in Counties with >4 Banks

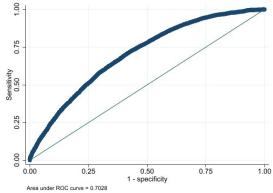
Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0750***	0.0667***	0.0230***
	(0.0051)	(0.0060)	(0.0066)
Rate	-0.0139***	0.0225***	0.0310***
	(0.0048)	(0.0054)	(0.0057)
County FIPS FE	✓	✓	✓
N	10,268	9,747	9,371
pseudo R^2	0.1056	0.1172	0.0907
AUC	0.7316	0.7442	0.7147
Overall test statistic, χ^2	1104.5077	1178.2014	799.6673
p-value	0.0000	0.0000	0.0065

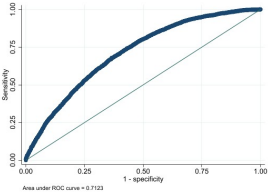
- **Counties with >3 banks estimate:** 1 SD ↑ in dispersion → 6.16 pp ↑ probability of recession two years ahead
- **Counties with >3 banks AUC:** 0.7294

Dispersion of Deposit Rates Predicts Recessions Better in Counties with More Banks

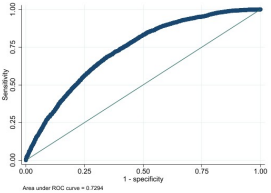
Back



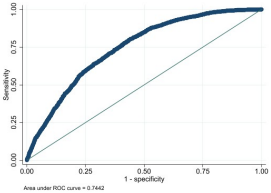
(a) All



(b) >2 Banks



(c) >3 Banks

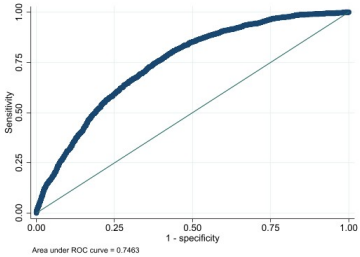


(d) >4 Banks

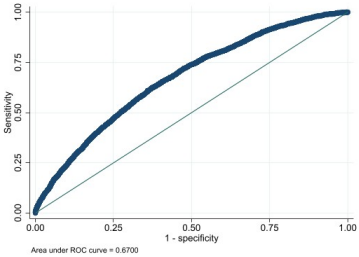
- AUC is 0.7028 in all counties; 0.7123 in counties with 2 banks; 0.7294 in counties with>3 banks; 0.7442 in counties with >4 banks

Heterogeneous Effects by Geography

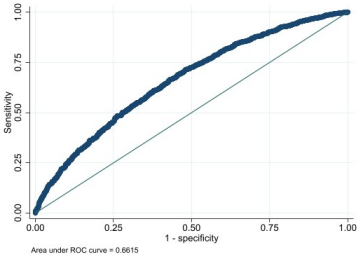
Back



(a) Metro



(b) Urban



(c) Rural

- AUC is 0.7463 in metro counties; 0.6700 in urban counties; 0.6615 in rural counties

Heterogeneous Effects by Banks with Small # of Branches

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0281***	0.0302***	0.0119***
	(0.0035)	(0.0039)	(0.0043)
Rate	0.0018	0.0199***	0.0114***
	(0.0034)	(0.0037)	(0.0039)
County FIPS FE	✓	✓	✓
N	19,565	18,443	17,386
pseudo R^2	0.0848	0.0902	0.0827
AUC	0.7000	0.7050	0.6955
Overall test statistic, χ^2	1620.6464	1735.7972	1422.0740
p-value	0.0000	0.0000	0.0002

- **Banks with small # of branches estimate:** 1 SD ↑ in dispersion → 3.02 pp ↑ probability of recession two years ahead
- **Counties with >3 banks AUC:** 0.7050

Heterogeneous Effects by Banks with Large # of Branches

Back

$\mathbb{1}_{Recession}$	(1) 1 Year Ahead	(2) 2 Years Ahead	(3) 3 Years Ahead
SD	0.0543***	0.0375***	0.0222***
	(0.0036)	(0.0040)	(0.0043)
Rate	-0.0050	0.0350***	0.0309***
	(0.0036)	(0.0038)	(0.0040)
County FIPS FE	✓	✓	✓
N	16,740	16,115	15,408
pseudo R^2	0.0966	0.1026	0.0926
AUC	0.7158	0.7220	0.7117
Overall test statistic, χ^2	1591.5501	1692.0144	1374.4130
p-value	0.0000	0.0000	0.0016

- **Banks with large # of branches estimate:** 1 SD ↑ in dispersion → 3.75 pp ↑ probability of recession two years ahead
- **Counties with >3 banks AUC:** 0.7220