

# Failing Banks

Sergio Correia (Fed Board)

Stephan Luck (NY Fed)

Emil Verner (MIT Sloan)

**NBER SI 2024 Corporate Finance**

July 8-9, 2024

The views expressed here do not necessarily represent those of the Federal Reserve Bank of New York or the Federal Reserve Board.

# Motivation

- Bank failures are an endemic feature of banking
  - 20% of all national banks in existence between 1863 and 1934 failed
  - 15% of all commercial banks in existence between 1935 and 2023 failed
- Bank failures often lead to real economic disruptions

Bernanke (1983)
- Systemic banking crises are associated with severe macroeconomic downturns

Reinhart and Rogoff (2009)

# Why Do Banks Fail?

# Why Do Banks Fail?

- **Liquidity-driven failures** due to self-fulfilling panic runs
  - Diamond and Dybvig (1983) . . .
  - Original cause of bank failure: **depositor behavior**

# Why Do Banks Fail?

- **Liquidity-driven failures** due to self-fulfilling panic runs
  - Diamond and Dybvig (1983). . .
  - Original cause of bank failure: **depositor behavior**
- **Insolvency-driven failures**
  - Realized credit risk, interest rate risk, or fraud can cause insolvency
  - Original cause of bank failure: **weak fundamentals**

# Why Do Banks Fail?

- **Liquidity-driven failures** due to self-fulfilling panic runs
  - Diamond and Dybvig (1983). . .
  - Original cause of bank failure: **depositor behavior**
- **Insolvency-driven failures**
  - Realized credit risk, interest rate risk, or fraud can cause insolvency
  - Original cause of bank failure: **weak fundamentals**
- **Panic runs based on deteriorating solvency**
  - Allen and Gale (1998), Goldstein and Pauzner (2005). . .
  - Original cause of bank failure: **weak fundamentals**, but **amplified by coordination failures**
  - Affects weak but solvent banks due to flighty depositors

# Why Do Banks Fail?

- **Liquidity-driven failures** due to self-fulfilling panic runs
  - Diamond and Dybvig (1983) . . .
  - Original cause of bank failure: **depositor behavior**
- **Insolvency-driven failures**
  - Realized credit risk, interest rate risk, or fraud can cause insolvency
  - Original cause of bank failure: **weak fundamentals**
- **Panic runs based on deteriorating solvency**
  - Allen and Gale (1998), Goldstein and Pauzner (2005) . . .
  - Original cause of bank failure: **weak fundamentals**, but **amplified by coordination failures**
  - Affects weak but solvent banks due to flighty depositors

*Which types of failures are most empirically relevant?*

# This Paper

- **Challenge:** government interventions make liquidity-driven failures less likely



# This Paper

- **Challenge:** government interventions make liquidity-driven failures less likely
- **This paper:** study the history of **failing banks in the United States from 1863-2023**

# This Paper

- **Challenge:** government interventions make liquidity-driven failures less likely
  - **This paper:** study the history of **failing banks in the United States from 1863-2023**
- New dataset with **balance sheets for most banks** in the U.S. since the Civil War
- 38,630 distinct banks
  - 4,764 bank failures
  - Sample before/after Federal Reserve System and deposit insurance

# Main Finding

## 1. **Facts** about failing banks

- (i) **Deteriorating solvency** several years before failure
- (ii) Increasing **reliance on expensive/non-core funding**

# Main Finding

1. **Facts** about failing banks
  - (i) **Deteriorating solvency** several years before failure
  - (ii) Increasing **reliance on expensive/non-core funding**
2. **Bank failures are highly predictable** based on deteriorating fundamentals
  - Predictability extends to pre-FDIC/pre-FRS sample

# Main Finding

## 1. **Facts** about failing banks

- (i) **Deteriorating solvency** several years before failure
- (ii) Increasing **reliance on expensive/non-core funding**

## 2. **Bank failures are highly predictable** based on deteriorating fundamentals

- Predictability extends to pre-FDIC/pre-FRS sample
- Failures with runs are easier to predict than failures without runs

# Main Finding

## 1. **Facts** about failing banks

- (i) **Deteriorating solvency** several years before failure
- (ii) Increasing **reliance on expensive/non-core funding**

## 2. **Bank failures are highly predictable** based on deteriorating fundamentals

- Predictability extends to pre-FDIC/pre-FRS sample
- Failures with runs are easier to predict than failures without runs
- Aggregate waves of bank failures are predictable

# Main Finding

## 1. **Facts** about failing banks

- (i) **Deteriorating solvency** several years before failure
- (ii) Increasing **reliance on expensive/non-core funding**

## 2. **Bank failures are highly predictable** based on deteriorating fundamentals

- Predictability extends to pre-FDIC/pre-FRS sample
- Failures with runs are easier to predict than failures without runs
- Aggregate waves of bank failures are predictable

⇒ Deterioration of bank fundamentals is a necessary condition for failure

- To the extent that runs matter for failure, they only happen in very weakest banks
- Runs happen late, and depositors appear slow to react, even before deposit insurance

## Data and Context



# Data

## Bank fundamentals:

- OCC Call Reports of national banks, 1863-1941
  - Source: OCC's Annual Report to Congress
  - 1865-1904: [Carlson, Correia, and Luck \(2022\)](#)
  - 1905-1941: digitized for this project
    - OCR methods by [Correia and Luck \(2023\)](#)
- FFIEC Call Report, 1959-2023
  - Extend data back from 1976 to 1959

## Bank failures:

- Definition of failure: [receivership](#)
- OCC list of failing banks, 1863-1941
- FDIC list of failing banks, 1935-2023

REPORT OF THE COMPTROLLER OF THE CURRENCY. 7

**A L A B A M A.**  
**First National Bank, Eutaw.**

B. B. BARNES, *President.* No. 3931. JAMES MURPHY, *Cashier.*

Resources.		Liabilities.	
Loans and discounts.....	\$146,418.28	Capital stock paid in.....	\$50,000.00
Overdrafts.....	5,927.66	Surplus fund.....	11,000.00
U. S. bonds to secure circulation.....	17,500.00	Undivided profits, less current expenses and taxes paid.....	9,462.83
U. S. bonds to secure deposits.....		National-bank notes outstanding.....	17,500.00
U. S. bonds on hand.....		State-bank notes outstanding.....	
Premiums on U. S. bonds.....		Due to other national banks.....	212.20
Stocks, securities, etc.....	2,008.00	Due to State banks and bankers.....	48.22
Bank's house, furniture, and fixtures.....		Due to trust companies and savings banks.....	
Other real estate and mortg's owned.....	3,960.00	Due to approved reserve agents.....	454.62
Due from other national banks.....	11,754.13	Dividends unpaid.....	
Due from State banks and bankers.....	192.70	Individual deposits.....	92,205.51
Due from approved reserve agents.....	1,879.66	United States deposits.....	
Internal-revenue stamps.....		Deposits of U. S. disbursing officers.....	
Checks and other cash items.....	1,074.89	Notes and bills rediscounted.....	20,282.52
Exchanges for clearing house.....		Bills payable.....	
Bills of other national banks.....	450.00	Liabilities other than those above stated.....	
Fractional currency, nickels, cents.....	242.08		
Specie.....	5,311.50		
Legal-tender notes.....	3,581.00		
U. S. certificates of deposit.....			
Redemption fund with Treas. U. S.....	875.00		
Due from Treasurer U. S.....			
<b>Total.....</b>	<b>201,166.90</b>	<b>Total.....</b>	<b>201,166.90</b>

# Predicting Bank Failures

Consider the conditional probability of failure

$$\mathbb{P}(\text{Failure}_{b,t+1 \rightarrow t+3} | \text{Insolvency}_{b,t}, \text{Funding Vulnerability}_{b,t}),$$

Consider the conditional probability of failure

$$\mathbb{P}(\text{Failure}_{b,t+1 \rightarrow t+3} | \text{Insolvency}_{b,t}, \text{Funding Vulnerability}_{b,t}),$$

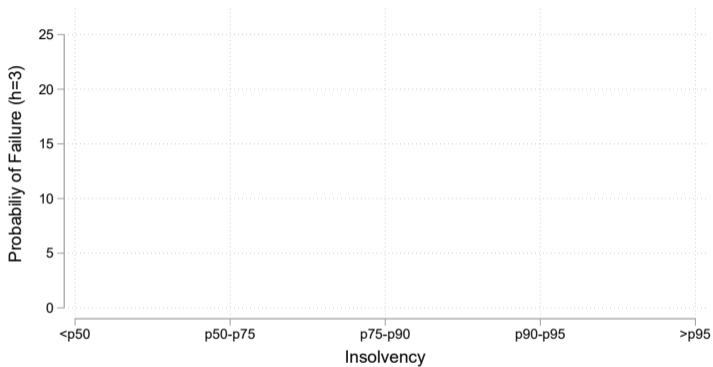
- $\text{Insolvency}_{bt}$ : proxy distance to default
  - Capitalization
  - Income
  - Non-performing assets

Consider the conditional probability of failure

$$\mathbb{P}(\text{Failure}_{b,t+1 \rightarrow t+3} | \text{Insolvency}_{b,t}, \text{Funding Vulnerability}_{b,t}),$$

- **Insolvency**<sub>bt</sub>: proxy distance to default
  - Capitalization
  - Income
  - Non-performing assets
- **Funding Vulnerability**<sub>bt</sub>: reliance on expensive funding
  - Wholesale funding
  - Time deposits
    - More sensitive to federal funds rate (Drechsler, Schnabl, and Savov, 2017)
    - More sensitive to bank risk (Martin, Puri, and Ufier, 2022)

# Conditional Probability of Failure: 1959-2023

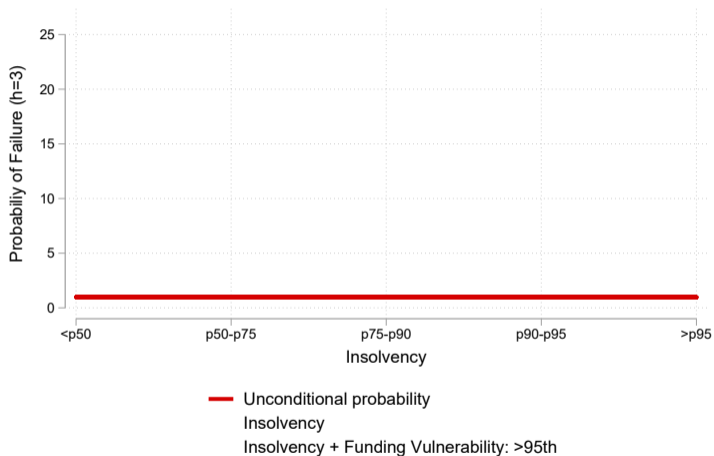


Unconditional probability

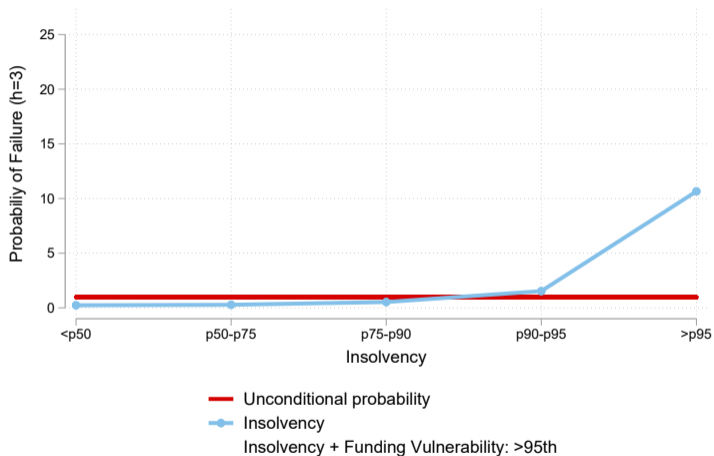
Insolvency

Insolvency + Funding Vulnerability: >95th

# Conditional Probability of Failure: 1959-2023

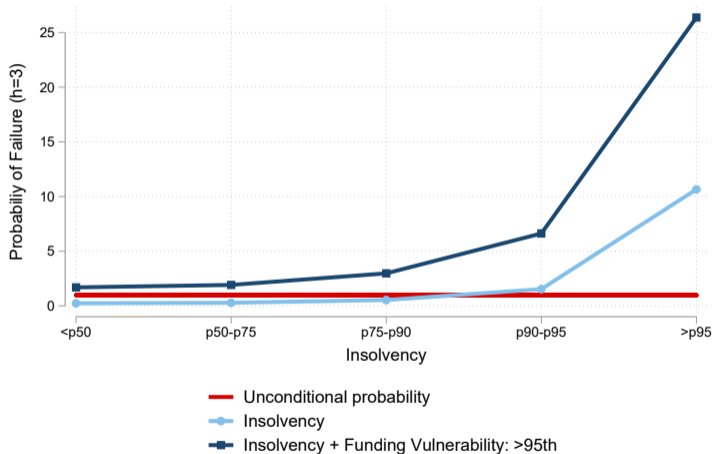


# Conditional Probability of Failure: 1959-2023

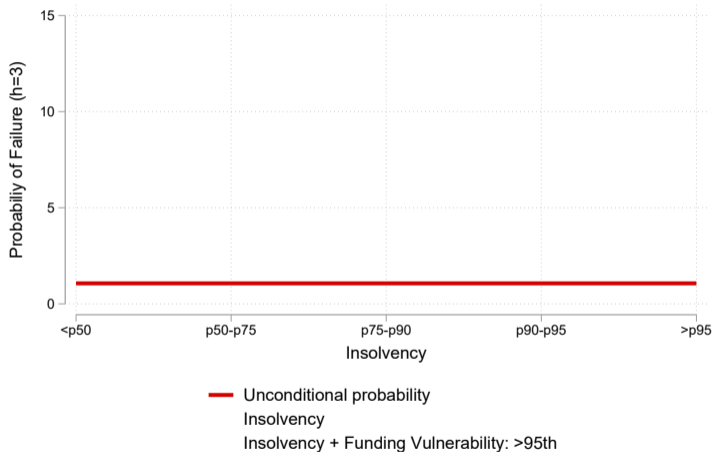




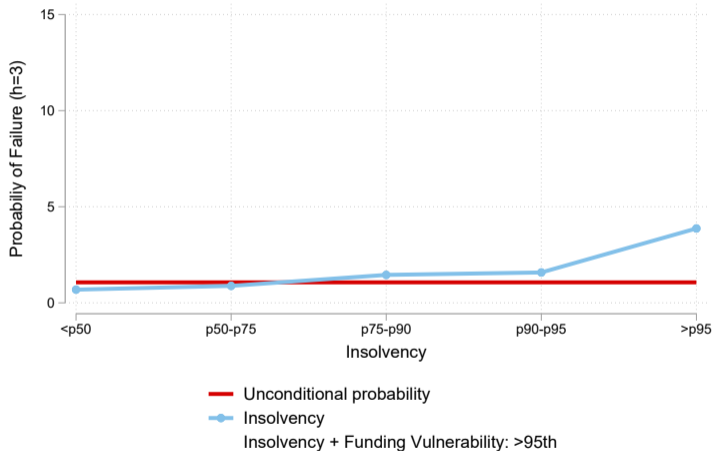
## Conditional Probability of Failure: 1959-2023



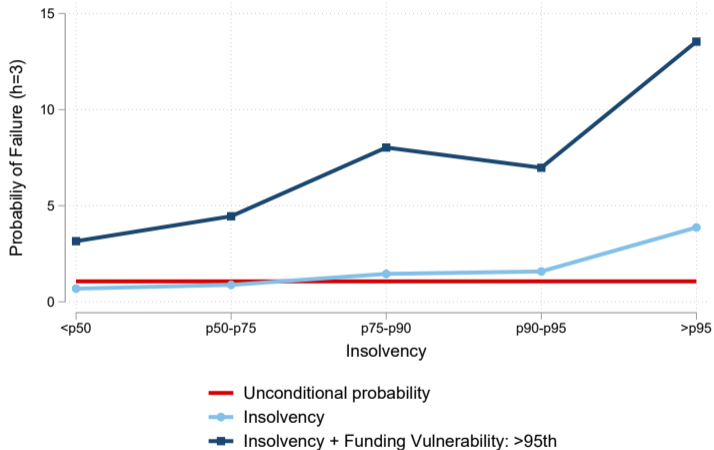
# Conditional Probability of Failure: 1865-1904



# Conditional Probability of Failure: 1865-1904



## Conditional Probability of Failure: 1865-1904



# Prediction Framework

- Predictive model:

$$\begin{aligned} \text{Failure}_{b,t+1 \rightarrow t+s} = & \alpha + \beta_1 \times \text{Insolvency}_{b,t} + \beta_2 \times \text{Funding Vuln.}_{b,t} \\ & + \beta_3 \times \text{Insolvency}_{b,t} \times \text{Funding Vuln.}_{b,t} + \epsilon_{b,t+1 \rightarrow t+s} \end{aligned}$$

# Prediction Framework

- Predictive model:

$$\begin{aligned} \text{Failure}_{b,t+1 \rightarrow t+s} = & \alpha + \beta_1 \times \text{Insolvency}_{b,t} + \beta_2 \times \text{Funding Vuln.}_{b,t} \\ & + \beta_3 \times \text{Insolvency}_{b,t} \times \text{Funding Vuln.}_{b,t} + \epsilon_{b,t+1 \rightarrow t+s} \end{aligned}$$

- What does predictability say about the nature of bank failures?
  - Purely liquidity-driven, self-fulfilling failures not predictable by fundamentals
  - Fundamental-based panics less predictable than insolvency-driven failures

# Prediction Framework

- Predictive model:

$$\begin{aligned} \text{Failure}_{b,t+1 \rightarrow t+s} = & \alpha + \beta_1 \times \text{Insolvency}_{b,t} + \beta_2 \times \text{Funding Vuln.}_{b,t} \\ & + \beta_3 \times \text{Insolvency}_{b,t} \times \text{Funding Vuln.}_{b,t} + \epsilon_{b,t+1 \rightarrow t+s} \end{aligned}$$

- What does predictability say about the nature of bank failures?
  - Purely liquidity-driven, self-fulfilling failures not predictable by fundamentals
  - Fundamental-based panics less predictable than insolvency-driven failures
- Predictability metric: Area Under the Receiver Operating Characteristics Curve (AUC)
  - AUC = 0.50 → Naive predictor (coin toss)
  - AUC > 0.50 → Informative predictor
  - Benchmark: predicting financial crises AUC  $\approx$  0.74
    - Greenwood, Hanson, Shleifer, Sorensen, 2022

# Bank Failures Are Highly Predictable

AUC Statistics: One-Year Horizon

Sample	AUC In-sample	AUC Out-of-sample
--------	------------------	----------------------



# Bank Failures Are Highly Predictable

AUC Statistics: One-Year Horizon

Sample	AUC In-sample	AUC Out-of-sample
NB Era (1880-1904)	0.840	0.836

# Bank Failures Are Highly Predictable

AUC Statistics: One-Year Horizon

Sample	AUC In-sample	AUC Out-of-sample
NB Era (1880-1904)	0.840	0.836
Early Fed (1914-1928)	0.888	0.806

# Bank Failures Are Highly Predictable

AUC Statistics: One-Year Horizon

Sample	AUC In-sample	AUC Out-of-sample
NB Era (1880-1904)	0.840	0.836
Early Fed (1914-1928)	0.888	0.806
Great Depr. (1929-1934)	0.818	0.690

# Bank Failures Are Highly Predictable

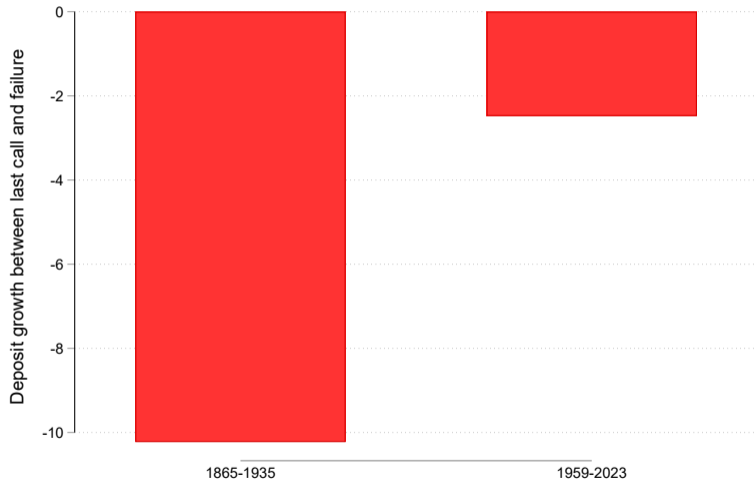
AUC Statistics: One-Year Horizon

Sample	AUC In-sample	AUC Out-of-sample
NB Era (1880-1904)	0.840	0.836
Early Fed (1914-1928)	0.888	0.806
Great Depr. (1929-1934)	0.818	0.690
Modern Era (1959-2023)	0.951	0.938

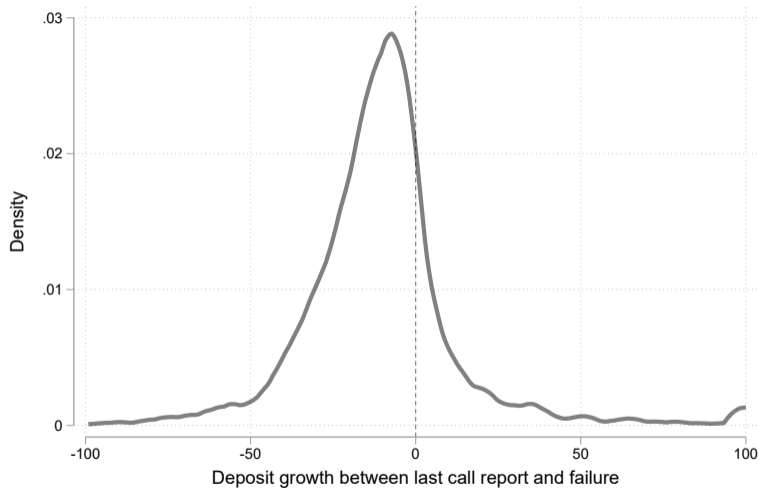
## Failures With Runs

# Deposit Outflows in Failing Banks Were Large Before Deposit Insurance

... But Small After

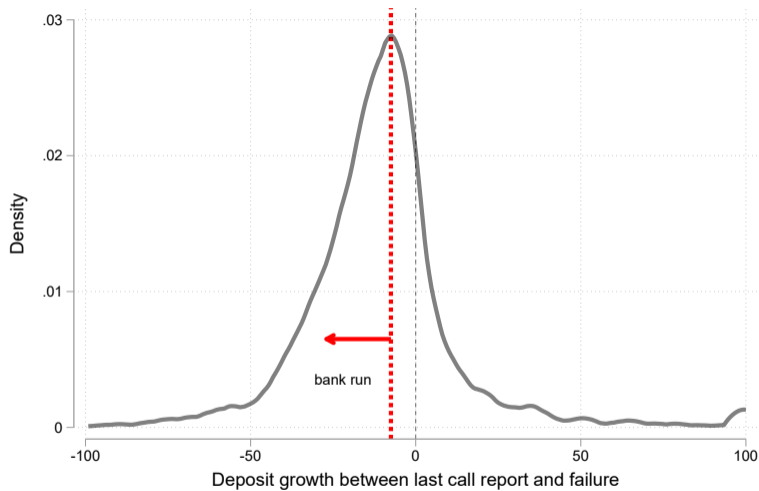


## Deposit Outflows Before 1935



- Define failures with runs as those with deposit outflow  $>7.5\%$

## Deposit Outflows Before 1935



- Define failures with runs as those with deposit outflow  $>7.5\%$



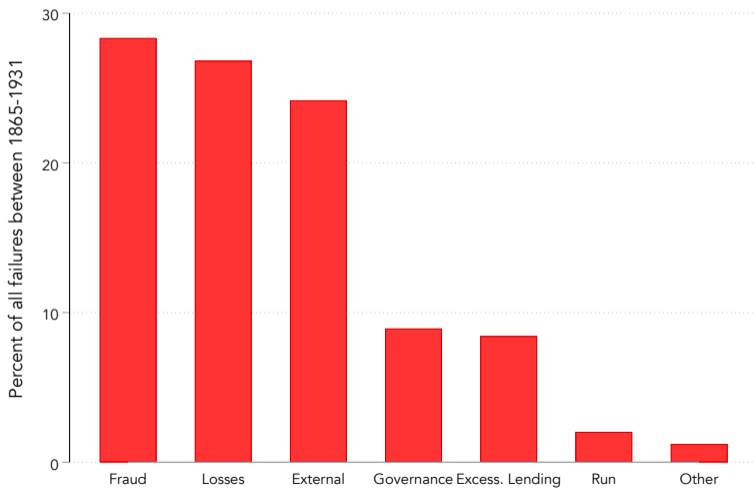
## Failures With Runs Are Easier to Predict Than Other Failures

Sample	AUC	
	With Run	No Run
NB Era (1880-1904)	0.892	0.798
Early Fed (1914-1928)	0.902	0.861
Great Depr. (1929-1934)	0.820	0.816

- Failures with runs are not disconnected from bank fundamentals, even in historical context where failures due to non-fundamental runs are possible

# Cause of Failure Assigned by OCC Examiner

Sample: Failures from 1865 to 1931



# Predicting Aggregate Waves of Bank Failures

## Does the Link between Fundamentals and Failures Hold During Crises?

$$FailureRate_{t+1} = \alpha + \beta_1 \text{Avg. Predicted Failure}_{t+1|t} + \beta_2 \text{Banks-at-Risk}_{t+1|t} + \epsilon_{t+1}$$

## Does the Link between Fundamentals and Failures Hold During Crises?

$$FailureRate_{t+1} = \alpha + \beta_1 \text{Avg. Predicted Failure}_{t+1|t} + \beta_2 \text{Banks-at-Risk}_{t+1|t} + \epsilon_{t+1}$$

Dependent variable	Failure Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Banks-at-Risk ( <i>BaR</i> )	11.81*** (1.55)		8.34*** (2.84)	4.07*** (0.76)		1.58*** (0.52)
Avg. predicted failure rate		3.94*** (0.60)	1.45 (1.00)		1.26*** (0.10)	0.93*** (0.12)
N	35	35	35	52	52	52
$R^2$	0.64	0.57	0.66	0.69	0.84	0.89
Sample	1865-1935	1865-1935	1865-1935	1959-2023	1959-2023	1959-2023

## Wrapping Up

## Which Theories Best Fit the Facts?

- Purely liquidity-driven, self-fulfilling failures

Diamond and Dybvig (1983), Allen and Gale (2000)...

- Inconsistent with strong predictability based on weak fundamentals

# Which Theories Best Fit the Facts?

- Purely liquidity-driven, self-fulfilling failures

Diamond and Dybvig (1983), Allen and Gale (2000)...

- Inconsistent with strong predictability based on weak fundamentals

- Panics based on fundamentals

Allen and Gale (1998), Goldstein and Puzner (2005), He and Xiong (2012)

- To extent runs based on coordination failures matter, they require weak fundamentals
- Challenges:
  - Despite high depositor loss rates, many failures without runs
  - And, while runs should happen immediately once signal is sufficiently strong ...
  - ... probability of failure between 13-40% not uncommon

→ Sleepy depositors, even before deposit insurance



# Which Theories Best Fit the Facts?

- Purely liquidity-driven, self-fulfilling failures

Diamond and Dybvig (1983), Allen and Gale (2000)...

- Inconsistent with strong predictability based on weak fundamentals

- Panics based on fundamentals

Allen and Gale (1998), Goldstein and Puzner (2005), He and Xiong (2012)

- To extent runs based on coordination failures matter, they require weak fundamentals
- Challenges:
  - Despite high depositor loss rates, many failures without runs
  - And, while runs should happen immediately once signal is sufficiently strong ...
  - ... probability of failure between 13-40% not uncommon

→ Sleepy depositors, even before deposit insurance

- Insolvency-driven failures

- Consistent with: predictability based on weak fundamentals; examiner-assigned cause of failure; failures in modern era without runs; low recovery rates

# Conclusion

- **Objective:** What causes bank failures and banking crises?
- **Approach:** Study the close to complete history of (failing) banks in the U.S.
- **Main Finding:** Bank failures and runs are highly predictable based on fundamentals
- **Policy:** Focus on solvency versus “fire-fighting”

*Bank failures are (almost) always and everywhere a phenomenon of deteriorating fundamentals.*