Contagion During the Initial Banking Crisis of the Great Depression

Erik Heitfield, Federal Reserve Board
Gary Richardson, UCI and NBER
Shirley Wang, Cornell
Conclusion

Contagion occurred during the initial banking panic of the Great Depression

Contagion flowed through two channels

• Bank Runs
  – Substantial
  – Expert observation and geographic correlation

• Counterparty Cascade
  – Limited in time and space (in this data set)
  – Expert observation and network correlation
Outline

• Conclusion
• Introduction
  – What is contagion?
  – Why does it matter?
  – Where and how should we look for contagion?
  – What does the literature say the topic?
• Data
• Structure of Financial System
• Statistical Method and Estimates
Financial Contagion - Definition

Failure of a financial institution increases the likelihood of failure of other financial institutions, through channels other than altering returns to entrepreneur’s projects.

Typical channels of contagion

- Coordination on equilibrium / expectations of investors.
  e.g. Diamond & Dybvig 1983, Badget 1873

- Interbank relationships
  e.g. Diamond & Rajan 2005, 2006; Allen and Gale 2000; Freixas, Parigi, and Rochet 2000
Financial Contagion – Implications

Important and contentious

Policy implications

– Contagion => intervention beneficial
  Diamond & Dybvig 1983, Gorton and Huang 2004, Diamond Rajan 2005

– No contagion => intervention redistributive
  Jacklin and Bhattacharya 1988, Calomiris and Kahn 1991
Financial Contagion – Incidence?

Contagion’s incidence in dispute

– Contemporary
  • Common view – contagion occurred in 2008
  • Contrarian view – no panic, intervention counterproductive

– Great Depression
  • Common view – financial crisis propagated contraction
    – Keynes, Friedman and Schwartz, etc.
  • Contrarian view – financial failures symptom of contraction
    – Temin, White, Calomiris and Mason,
Focus in this Paper
Initial Crisis of Great Depression

Initial Banking Panic
Bank suspensions are clustered in time
Why Study the Initial Panic

• Turning point in contemporary perceptions and macroeconomic time-series

• Influential observation for macro models
  – Bernanke 1983
  – Christiano, Motto, Rostagno 2003

• Nature of Events Disputed
Nature of Initial Banking Crisis Disputed

- Friedman and Schwartz (1963) – Failure of Bank of United States triggered nationwide panic
- Temin (1976) – Banks failed because economy contracted
- Wicker (2000) – Caldwell and Company then panic
Why does the dispute continue?

1. Data difficulties
2. Observational equivalence
3. Methodological issues

Fundamentalist fallacy:

• Logical claim: If fundamentals explain bank failures, then contagion did not occur, and discount lending could not have been effective.

• Regression implementation
Retort to Fundamentalists

1) Policy was effective. Discount lending mitigated initial panic (Richardson and Troost 2009)

3) Now, my research seeks to explain
   • Why policy worked
   • What were the channels of contagion during the initial banking panic of the Great Depression
Outline

• Conclusion
• Introduction
• Data
  – What data existed before
  – What data did we collect
• Structure of Financial System
• Method
• Estimates
Previous data

Bank balance sheet information

- Aggregated at state, FR district, or national level
- Individual for banks that were
  - Nationally chartered
  - Federal Reserve members
- Gaps in coverage: state chartered institutions

Qualitative information

- Principal regulators: Fed Board, Fed Districts, OCC
- Observers: major national news publications. Wicker adds many regional and local news publications.
- Gaps in coverage: regulators and publications from region of initial banking panic
New Data

1. Balance sheets of all banks
2. Information about all bank transitions
3. Examiners conclusions for all suspensions
4. Exogenous policy regimes
5. Information about paths of contagion
   a. Correspondent relationships
   b. Geographic locations

For info on 2, 3, 4 see Richardson 2006, 2007, 2008
Data Details

- 1086 banks operating in Tennessee, Mississippi and Alabama from September 1, 1930 to June 30, 1931.
- Dependent variable: date bank first suspended operations, whether through a voluntary or regulator-imposed liquidation, a merger, or a temporary closing.

- Independent variables
  - Observable bank characteristics – balance sheet information and regulatory status
  - Bank location – latitude and longitude of the bank’s “place” as defined by the Census Bureau
  - Counterparty links – a list of all banks with whom the bank had correspondence relationships
Bank location and regulatory status

- Nashville
- Memphis
- Chattanooga
- Jackson
- Birmingham
- Mobile

- District 6 State Bank
- District 6 National Bank
- District 8 State Bank
- District 8 National Bank
Outline

• Conclusions
• Introduction
• Data
• Structure of Financial System
  – Reserve pyramid => correspondent cascade
  – Unit banking => bank runs radiating geographically
• Statistical Method
• Estimates
Why consider counterparties?

Rational for intervention

Structure of 1930s Banking System

– Reserve pyramid
– Correspondent system
  • Richardson 2007
  • Carlson, Mitchener, Richardson 2011

Reports of Contemporaries

Patterns in the Data
Structure of Banking System
Correspondence network is highly centralized.
Suspensions Due to Closures of Correspondents
January 1929 through March 1933
Why consider bank runs and geography?

Rational for policy
  – Deposit insurance
  – Rigorous regulation

Structure of 1930s Banking System
  – Unit banking
  – Branching prohibited

Reports of Contemporaries

Patterns in the Data
1st week of July 1930
3rd Week of November 1930

Legend
- sw week adj 47
- eorCon = 1 and 0
- 2 < eor > 0
- eorCon = 1
- All other cases
2nd Week of December 1930
3\textsuperscript{rd} Week of December 1930
## Who Closed Banks?

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Crisis</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directors</td>
<td>40%</td>
<td>94%</td>
<td>68%</td>
</tr>
<tr>
<td>Regulators</td>
<td>60%</td>
<td>6%</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>141</td>
<td>191</td>
</tr>
</tbody>
</table>

Source: St. 6386 Database.
## Reasons for Suspension

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Crisis</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiquidity</td>
<td>38%</td>
<td>59%</td>
<td>47%</td>
</tr>
<tr>
<td>Insolvency</td>
<td>62%</td>
<td>41%</td>
<td>53%</td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>141</td>
<td>191</td>
</tr>
</tbody>
</table>

Source: St. 6386 Database. Richardson 2007.
Outcomes of Suspended Banks

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Crisis</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reopen</td>
<td>8%</td>
<td>33%</td>
<td>16%</td>
</tr>
<tr>
<td>Liquidate</td>
<td>92%</td>
<td>67%</td>
<td>84%</td>
</tr>
</tbody>
</table>

Source: St. 6386 Database.
Outline

• Conclusions
• Introduction
• Data
• Structure of Financial System
• Method
• Estimates
The frailty Weibull specification

• Assume a right-censored Weibull model of time to suspension \((t)\) in business days

\[
f(t; \alpha, \lambda) = \left[ \alpha t^{\alpha-1} \exp(\lambda) \right]_{t<T} \exp(-t^\alpha \exp(\lambda))
\]

• The bank-specific intensity parameter \(\lambda_i\) depends on bank characteristics \((X_{i1}, \ldots, X_{ik})\), a geographic frailty \((W_i)\) and a network frailty \((V_i)\)

\[
\lambda_i = \beta_0 + \left[ \sum_{k=1}^{K} x_{ik} \beta_k \right] + W_i + V_i
\]
Geographic frailties

- The study area is partitioned into grid-squares, 30 miles on a side. Associated with each region $r$ is a frailty parameter $w_r$.
- A conditionally autoregressive (CAR) specification describes the joint distribution of region frailties:
  
  $$g(w_r|w_{-r}; \sigma, \rho) = \frac{1}{\sigma} \phi \left( \frac{w_r - \rho \bar{w}_r}{\sigma} \right)$$

- All banks within a region share the same geographic frailty.

$$W_i = \sum_{r=1}^{R} 1\{i \in S_r\} w_r$$

where $S_r$ denotes the set of banks in region $r$. 
Network frailties

- We identified the $M$ most highly interconnected banks. All banks that are “closest” (in terms of network distance) to a highly-interconnected bank are assigned to its network group.
- Associated with each network group $m$ is a network frailty term $\nu_m$. No restrictions on the joint distribution of network frailties are imposed.
- Each bank is assigned the network frailty of its group. If a bank belongs to more than one group, it is assigned the average frailty for those groups.

\[ V_i = \sum_{m=1}^{M} \frac{1\{j_m \in J_i\}}{\max\{\#(J_i), 1\}} \nu_m \]

where $J_i$ is the set of network groups to which bank $i$ belongs.
Estimation approach

- A Bayesian framework is more practical than a traditional frequentist approach
- Assume vague (but proper) priors for all model parameters
- Markov Chain Monte Carlo is used to draw from the joint posterior distribution of model parameters
- An added bonus: the posterior distribution of geographic frailties can also be simulated
## Posterior distribution of model parameters

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>St. Dev.</th>
<th>2.5th Pct.</th>
<th>Median</th>
<th>97.5th Pct.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape Par. ((\alpha))</strong></td>
<td>1.24</td>
<td>0.08</td>
<td>1.09</td>
<td>1.24</td>
<td>1.39</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-8.12</td>
<td>1.02</td>
<td>-10.41</td>
<td>-8.06</td>
<td>-6.35</td>
</tr>
<tr>
<td><strong>National Bank</strong></td>
<td>0.07</td>
<td>0.23</td>
<td>-0.38</td>
<td>0.07</td>
<td>0.51</td>
</tr>
<tr>
<td><strong>Reserve District</strong></td>
<td>0.46</td>
<td>0.35</td>
<td>-0.21</td>
<td>0.46</td>
<td>1.16</td>
</tr>
<tr>
<td><strong>Mid-Size</strong></td>
<td>0.04</td>
<td>0.23</td>
<td>-0.41</td>
<td>0.04</td>
<td>0.47</td>
</tr>
<tr>
<td><strong>Large</strong></td>
<td>1.18</td>
<td>0.47</td>
<td>0.23</td>
<td>1.20</td>
<td>2.07</td>
</tr>
<tr>
<td><strong>Capital/Assets</strong></td>
<td>-3.36</td>
<td>1.06</td>
<td>-5.44</td>
<td>-3.36</td>
<td>-1.26</td>
</tr>
<tr>
<td><strong>Securities/Ass.</strong></td>
<td>-2.35</td>
<td>0.81</td>
<td>-3.98</td>
<td>-2.34</td>
<td>-0.81</td>
</tr>
<tr>
<td><strong>Cash/Deposits</strong></td>
<td>-1.23</td>
<td>0.60</td>
<td>-2.43</td>
<td>-1.22</td>
<td>-0.08</td>
</tr>
<tr>
<td><strong>Dispersion ((\sigma))</strong></td>
<td>1.53</td>
<td>0.08</td>
<td>1.05</td>
<td>1.52</td>
<td>2.08</td>
</tr>
<tr>
<td><strong>Correlation ((\rho))</strong></td>
<td>0.67</td>
<td>0.08</td>
<td>0.07</td>
<td>0.72</td>
<td>0.96</td>
</tr>
</tbody>
</table>
Information criteria slightly favor the full model

Deviance Information Criteria

<table>
<thead>
<tr>
<th>Specification</th>
<th>Information Measure</th>
<th>Complexity Measure</th>
<th>Penalized Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>3109.7</td>
<td>18.6</td>
<td>3128.2</td>
</tr>
<tr>
<td>Spatial Frailties</td>
<td>2910.8</td>
<td>35.5</td>
<td>2946.2</td>
</tr>
<tr>
<td>Network Effects</td>
<td>3085.6</td>
<td>26.6</td>
<td>3112.2</td>
</tr>
<tr>
<td>Spatial and Network</td>
<td>2889.4</td>
<td>39.3</td>
<td>2928.7</td>
</tr>
</tbody>
</table>
In-sample forecast diagnostics

![Graph showing the probability of suspension versus probability of not suspending operations. The graph has two curves, one for suspended operations and another for did not suspend. The y-axis represents the probability density, and the x-axis represents the probability of suspension. The y-axis has values from 0 to 8, and the x-axis has values from 0 to 1.]
Relative effect of bank characteristics
Relative effect of network frailties

Nashville
Memphis
Chattanooga
Jackson
Birmingham
Mobile

Lowest Quartile
2nd Quartile
3rd Quartile
Highest Quartile
Who was most likely to suspend operations?

- Observable characteristics
  - 8th District banks
  - Banks with over $10 million in assets
  - Banks with less liquid balance sheets
  - More leveraged banks

- Geography
  - Nashville and suburbs
  - Central Mississippi
  - Birmingham and southeastern Alabama

- Correspondence networks
  - Banks with links to Memphis, Jackson, and Chattanooga
    money center banks
Conclusions

- Banks that were less liquid and more levered suspended operations at higher rates than other banks, but bank balance sheet characteristics alone are not sufficient to explain clustering of bank suspensions.
- Spatial correlation suggests that banks were subject to localized asset shocks and/or liquidity contagion.
- Counterparty relationship were also a source of contagion, though they appear to have been less important than geographic proximity.