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The Spatial Transmission of U.S. Banking Panics: Evidence From 1870 to 1929

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ABSTRACT

We examine the propagation of localised banking panics across the United States using digitised state-level balance sheet data from National Banks for the 1870–1929 period. Our findings reveal that such panics spill over beyond state borders, triggering moderately persistent credit contractions and liquid asset accumulation. We develop a tractable model illustrating a key trade-off: while interbank markets—exemplified by the pyramidal reserve structure of the National Banking Era—enable banks to access lower-cost funding, they also transmit panic effects nationwide.

JEL Classification: E32, G21, N11, N21

1 | Introduction

The United States has a long history of banking panics dating back to the eighteenth century, including at least fifteen waves between 1865 and 1930 (Jalil, 2015), many of which adversely affected the economy. In this paper, we examine how a banking panic originating in one state is transmitted to others using historical bank balance sheet data from 1870 to 1929.[1]

The instability of the U.S. banking system during this period is largely attributable to its institutional structure—specifically, the absence of a central bank until 1913[2] and unit banking regulations that limited banks' ability to branch and diversify risks (see Calomiris and Haber [2]). Consequently, banks formed an interbank market with a pyramidal reserve structure, with central reserve cities—especially New York—at the apex and reserve cities providing liquidity at regional and national levels.[3]

The interbank lending market presents a trade-off. On one hand, it enables banks to access lower-cost funding and maintain higher levels of credit. On the other hand, it exposes them to runs and panics from outside their home states, facilitating the spatial propagation of distress that the unit banking system would have otherwise contained. We develop a tractable model of interbank relationships within the overlapping inter-state financial network that captures this trade-off and estimates the degree of spatial transmission of panics across states. Our analysis draws on digitised state-level bank balance sheet data from the Annual Report of the Office of the Comptroller of the Currency and the historical banking panic series from Jalil [3]. Section 2 provides a detailed description of our data sources.

We find that regional banking panics transmit significantly across states. Specifically, our empirical analysis shows that such panics are associated with a moderate decline in banking activities across states: deposits and lending fall by 2%–4%, and banks subsequently accumulate additional liquid reserves as a buffer. These negative effects are largely transitory, with bank balance sheet indicators returning to pre-crisis trends within 2 years. Moreover, we observe a lagged but robust response in banks outside the originating state, which we attribute to inter-state financial linkages.

1.1 | Literature

Early documentation of historical panic episodes is provided by Kemmerer [4] based on newspaper reports. More recent studies by DeLong and Summers [5], Gorton [6],[4] Wicker [8], Reinhart and Rogoff [9], and Jalil [3] offer alternative classifications using different criteria and regional details. In particular, Jalil [3] provides quantitative estimates of the impact of major nationwide panics on industrial production and prices, indicating large and persistent negative effects. We use the historical banking panic series from Jalil [3] because of its comprehensive coverage of the geographical and temporal dimensions of panic episodes. Mitchener and Richardson [10] similarly document the role of interbank lending markets in amplifying lending reductions during the Great Depression,[5] while our analysis focuses on regional panics preceding the Great Depression.

Finally, Dordal i Carreras et al. [11] analyse contagion in the modern German interbank network. Drawing on some of their techniques for the aggregation of financial claims within bank network models, this paper develops a framework for the historical U.S. market.[6]

1.2 | Layout

Section 2 details our data sources, including state-level bank balance sheet data and the banking panic series. Section 3 introduces a tractable model of interbank markets and derives the equilibrium relationship between state-level balance sheet indicators. Section 4 presents our estimation strategy and main quantitative results. Section 5 concludes. Figures and tables are presented in Appendices A and B, respectively.

Supporting Information Appendix A provides additional proofs and derivations for Section 3. Supporting Information Appendix B examines the exogeneity of panics using Granger causality tests, and Supporting Information Appendix C presents further robustness checks on the estimation of panic propagation.

2 | Data

2.1 | Banking Panic Series

We rely on the historical banking panic series of Jalil [3], which provides detailed information on the geographical coverage and timing of panics. Table B2 reproduces this series on a quarterly basis for our sample period (1870–1929) and documents each panic's state of origin alongside the directly affected states. Jalil [3] defines a banking panic as a'widespread run by private agents in financial markets … [in order to] convert deposits into currency'[7] and distinguishes between major and minor panics. Minor panics are geographically localised and less severe, whereas major panics rapidly engulf most of the United States and entail widespread distress.[8] Given our focus on the spatial propagation of banking panics, we primarily concentrate on minor panics.[9]

2.2 | State-Level Bank Balance Sheets

During the National Banking Era (1864–1912), national banks (i.e., those chartered by the federal government) were subject to uniform regulations regardless of location and operated as unit banks (i.e., single-office banks). They were required to report to their primary regulator, the Office of the Comptroller of the Currency, via *call reports*—filed approximately four or five times per year—that provided bank balance sheet data.[10] We use these call reports for state-level bank balance sheet information.

We collect state-level bank balance sheet aggregates from the Abstract of Reports contained within the Annual Report of the Office of the Comptroller of the Currency. Although Weber [14] digitised the series for 1880–1910, we extend the dataset to cover 1870–1929 by digitising data for the remaining years. The dataset comprises self-reported balance sheets from all national banks, aggregated by reserve city and state.[11] Table B1 overviews the categories included, and Figure A7 shows an example of the Abstract of Reports for banks in Alabama (October 1913–September 1914). The District of Columbia is included and treated as a state, while Alaska and Hawaii are excluded due to their distance from the contiguous United States. We convert the reporting frequency to quarterly, as some years feature five reports.

The Abstract of Reports includes various categories (e.g., 'Overdrafts', 'Other bonds for deposits', 'Capital stock') that change over time as broader categories are sub-divided.[12] We group the reported items as follows. On the asset side: (i) loans and discounts; (ii) bonds and securities; (iii) real estate; (iv) cash and short-term assets; and (v) other assets. On the liability side: (i) bank capital; (ii) deposits; and (iii) other liabilities.[13]

Figure A1 displays the time series of U.S. aggregate log-deposits and New York deposits from 1870 to 1945, overlaid with the timing of minor and major panics from Jalil [3]. The series exhibit clear procyclicality for both New York and the overall United States. Notably, minor panics originating in New York (e.g., the 1884 panic) are associated with substantial declines in deposit levels nationwide.

Note that some works in the literature [15] use balance sheets of individual national banks during the National Banking Era at an *annual* frequency. We instead rely on state-level bank balance sheet aggregates at a *quarterly* frequency for two reasons: a minor panic in the banking panic series of tab. 2 from Jalil [3] only lasts for a quarter at most; also, the banking panic series of Jalil [3] defines each minor panic by a state where it originates and other affected states.

3 | Model

This section introduces a partial-equilibrium model linking deposit fluctuations to the spatial transmission of panics across U.S. states. Detailed derivations are provided in Supporting Information Appendix A.

The model is structured as follows. We consider an economy with N regions—hereafter 'states', reflecting the U.S. setting—each containing a representative bank split into a *deposit division* that

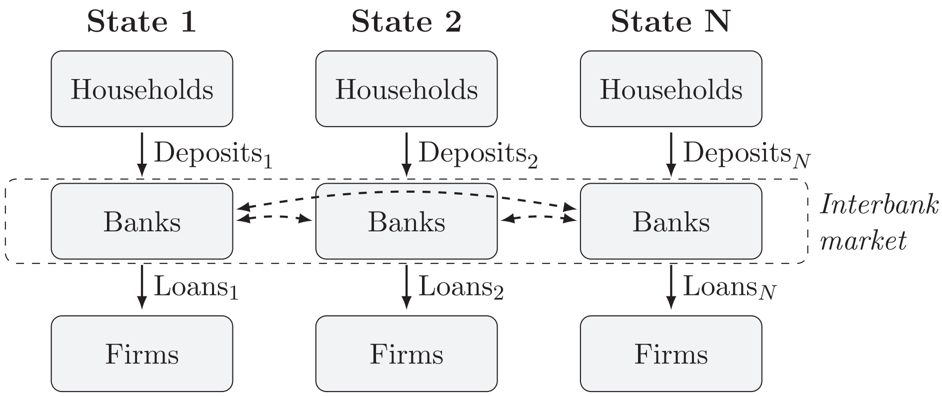

FIGURE 1 | Households in each state allocate savings across banks in the same state in the form of deposits. Banks lend these funds to firms in the same state. Banks in different states form an interbank market where they borrow and lend loanable funds.

draws local deposits and a *loan division* that lends to local firms. Due to 'liquidity gap' across states, banks form an inter-state interbank lending market in which deposit divisions with extra liquidity provide loanable interbank funds to loan divisions of all the states, with the following key characteristics: (i) a deposit division with larger sizes of deposit, due to economies of scale in converting deposits into loanable interbank funds, offers lower interbank rates; (ii) a loan division then picks the lowest offered rate, subject to stochastic trade frictions. In our setting, a key trade-off arises: while the interbank lending market allows banks to access higher levels of credit on average, improving the *allocative efficiency* of liquidity, credit supply in one state is now associated with deposit fluctuations in other states, allowing a banking panic to propagate across states.

Time is discrete in quarters t; within each quarter, contracts for credit and liquidity are signed continuously over $\tau \in [0,1]$. Figure 1 outlines the structure.

3.1 | Loan Division

The loan division of bank i supplies credit to the regional economy in the form of one-period loans, $L^S_{i,t}(\tau) \geq 0$, subject to the following constraint:

$$L^S_{i,t}(\tau) \leq M_{i,t}(\tau)$$

where $M_{i,t}(\tau)$ is the total funding available, raised from local depositors and/or via the interbank market. Profits of the loan division are given by

$$\max_{\left\{L^S_{i,t}(\tau)\right\}} \int_0^1 \left[R^F_{i,t}(\tau) L^S_{i,t}(\tau) - R^I_{i,t}(\tau) M_{i,t}(\tau)\right] \mathrm{d}\tau$$

where $R^F_{i,t}(\tau)$ is the interest rate on loans and $R^I_{i,t}(\tau)$ is the effective interest rate on funds obtained from the deposit division or from other banks via the interbank market. Under perfect competition in the credit market, the first-order condition entails $R^F_{i,t}(\tau) = R^I_{i,t}(\tau)$.

Interbank funds $M_{i,t}(\tau)$ are homogeneous and fungible. Accordingly, bank i obtains funds by borrowing from the cheapest available source at each moment τ. Formally,

$$\begin{aligned} R^I_{i,t}(\tau) &= \min_n \left\{ R^I_{ni,t}(\tau) \right\} \\ M_{i,t}(\tau) &= M_{ni,t}(\tau) \end{aligned}, \text{with } n = \arg\min_j \left\{ R^I_{ji,t}(\tau) \right\} \quad (1)$$

where $R^I_{ni,t}(\tau)$ is the interbank rate offered by bank n to bank i for a loan amount $M_{ni,t}(\tau)$.

3.2 | Deposit Division

The deposit division in state n collects deposits $D_{n,t}$ from local residents at the beginning of each quarter t and allocates these funds either to its own loan division or to banks in other states via the interbank market. Conversion of deposits into loanable interbank funds is subject to a production constraint given by

$$\sum_{i=1}^{N} \int_0^1 T_{ni}\, z_{ni,t}(\tau)\, M_{ni,t}(\tau)\, \mathrm{d}\tau = \left(D_{n,t}\right)^{\alpha} \quad (2)$$

where exponent $\alpha > 1$ captures economies of scale in processing deposits, and the parameters $T_{ni} \geq 1$ represent the costs of transferring funds across regions—accounting for trade costs, agency problems, or imperfect information. Without loss of generality, we normalise the cost of transferring funds within the same state by setting $T_{nn} = 1$ for all n. The variable $z_{ni,t}(\tau)$ is an exogenous technology shock following a Weibull distribution with unit scale and shape parameter κ, capturing within-quarter variations in the ease of creating loans.[14]

The deposit division faces an upward-sloping inverse deposit supply curve, $\rho^S_n\left(D_{n,t}\right)$, which specifies the interest rate paid on deposits when raising an amount $D_{n,t}$.[15] Its profit maximisation problem is therefore

$$\max_{\left\{M_{ni,t}(\tau)\right\}, D_{n,t}} \sum_{i=1}^{N} \int_0^1 R^I_{ni,t}(\tau)\, M_{ni,t}(\tau)\, \mathrm{d}\tau - \rho^S_n\left(D_{n,t}\right) D_{n,t} \quad (3)$$

subject to the loanable funds production constraint (2).[16]

The first-order condition for this problem pins down the interbank loan rate charged by the deposit division of state n on funds lent to state i at moment τ:

$$R^{I}_{ni,t}(\tau) = T_{ni}\, z_{ni,t}(\tau)\, \frac{1}{\alpha} \underbrace{\rho^{S}_{n}\left(D_{n,t}\right)\left(1 + \frac{1}{\varepsilon^{S}_{n,t,D,\rho}}\right)}_{\equiv \rho_{n,t}} \left(D_{n,t}\right)^{-(\alpha-1)} \quad (4)$$

where $\varepsilon^{S}_{n,t,D,\rho} \equiv \left[\frac{\rho^{S\prime}_{n}(D_{n,t})\, D_{n,t}}{\rho^{S}_{n}(D_{n,t})}\right]^{-1} > 0$ is defined as the deposit supply elasticity.

Equation (4) implies that an increase in $D_{n,t}$ reduces the interbank rate $R^{I}_{ni,t}(\tau)$ due to economies of scale ($\alpha > 1$). A less elastic deposit supply (i.e., a lower $\varepsilon^{S}_{n,t,D,\rho}$) raises the marginal cost of acquiring additional deposits, leading to a higher interbank rate. Finally, a higher trading cost T_{ni} results in a higher equilibrium rate charged by state n to state i. For simplicity, we abstract from state-specific heterogeneity by assuming $\rho_{n,t} \equiv \rho_t$ for all n.[17]

3.3 | Equilibrium

When bank i's loan division supplies credit to the regional economy, it faces an exogenous loan demand given by

$$L^{D}_{i,t}(\tau) \equiv \left(R^{F}_{i,t}(\tau)\right)^{-\beta} \varepsilon_{i,t}, \qquad \forall i$$

where $\varepsilon_{i,t}$ is a regional loan demand shock. The loan market clears in equilibrium, so that $L^{D}_{i,t}(\tau) = L^{S}_{i,t}(\tau)$ for all i, t, and τ.

By Equation (4) and the properties of Weibull random variables, the effective interbank rate is also distributed Weibull with shape parameter κ and scale parameter $\Phi_{i,t}$, given by[18]

$$\Phi_{i,t} = \left(\frac{\rho_t}{\alpha}\right)\left[\sum_{n=1}^{N} \left(T_{ni}\right)^{-\kappa} \left(D_{n,t}\right)^{\kappa(\alpha-1)}\right]^{-1/\kappa}$$

We find an expression for the aggregate loan demand in a competitive market as

$$L^{D}_{i,t} \equiv \int_0^1 L^{D}_{i,t}(\tau)\,\mathrm{d}\tau = \left[\sum_{n=1}^{N} \left(T_{ni}\right)^{-\kappa}\left(D_{n,t}\right)^{\kappa(\alpha-1)}\right]^{\beta/\kappa} \left(\frac{\alpha}{\rho_t}\right)^{\beta} \Gamma\left(1 - \frac{\beta}{\kappa}\right)\varepsilon_{i,t} \quad (5)$$

Equation (5) implies that the credit $L^{D}_{i,t}$ extended in state i is (i) increasing in deposits $D_{n,t}$ in all states n; (ii) decreasing in the transport cost T_{ni} from state n to state i; and (iii) decreasing in the uniform deposit rate, ρ_t. Consequently, a decline in $D_{n,t}$ in any state n can lead to a contraction in lending $L_{i,t}$ in other states i. This mechanism underpins our empirical analysis of the transmission of banking panics across states in Section 4.

3.4 | Key Trade-Off

To illustrate the model's implications, consider two special cases. First, assume that deposits are identical across states, that is, $D_{n,t} = \overline{D}_t$ for all n, and that transaction costs between different regions are prohibitively high ($T_{ni} \to \infty$ for $i \neq n$) with $T_{ii} = 1$ for all i. In this case, Equation (5) simplifies to

$$L^{D}_{i,t} = \left(\frac{\alpha}{\rho_t}\right)^{\beta} \overline{D}_t^{\beta(\alpha-1)} \Gamma\left(1 - \frac{\beta}{\kappa}\right)\varepsilon_{i,t}, \qquad \forall i$$

implying that banks rely solely on domestic deposits to fund their lending. Deposit fluctuations in other states do not affect state i's loan supply.

In contrast, consider the case with no transaction costs, that is, $T_{ni} = 1$ for all n, i. Then, Equation (5) becomes

$$L^{D}_{i,t} = N^{\frac{\beta}{\kappa}} \left(\frac{\alpha}{\rho_t}\right)^{\beta} \overline{D}_t^{\beta(\alpha-1)} \Gamma\left(1 - \frac{\beta}{\kappa}\right)\varepsilon_{i,t}, \qquad \forall i$$

which indicates that banks in any state can supply $N^{\frac{\beta}{\kappa}} > 1$ times more credit given homogeneous deposits. However, the increased credit supply also becomes $N^{\frac{\beta}{\kappa}}$ times more volatile, amplifying the impact of deposit fluctuations and potentially creating instability.

These cases highlight a fundamental risk–return trade-off in the interbank lending system. On one hand, interbank transactions improve the allocation of funds and allow the economy to sustain higher average levels of credit. On the other hand, as Equation (5) shows, credit supply becomes linked to deposit fluctuations outside a bank's own state, providing the theoretical foundation for the spatial transmission of banking panics. This mechanism is examined empirically in Section 4 using historical data from the National Banking Era.

4 | Empirical Estimation

This section estimates the degree of spatial and dynamic propagation of panics using Local Projections à la Jordà [18]. In specific, we rely on the banking panic series of Jalil [3] and see how a banking panic in one state affects state-level balance sheet variables in other states, for example, deposits and loans, depending on the geographic distances from the originating state. Supporting Information Appendix B, based on Granger causality tests, offers additional evidence that the minor panics listed in Jalil [3] are exogenous, supporting our identifying assumption.

In sum, a state-level banking panic propagates significantly out of the originating state. Deposits and lending fall by 2%–4% across most states, and banks subsequently accumulate additional liquid reserves. However, the propagation is largely transitory, with bank balance sheet indicators returning to pre-crisis trends within 2 years.

4.1 | Methodology

A log-linear approximation of Equation (5) yields[19]

$$\log\left(L_{i,t}\right) = \mu_i + s_t + \sum_{n=1}^{N} \tilde{T}_{ni} \log\left(D_{n,t}\right) + \epsilon_{i,t} \qquad \forall i \quad (6)$$

where μ_i and s_t denote state and seasonal fixed effects, respectively, and $\tilde{T}_{ni}$ captures the sensitivity of loans in state i to deposit fluctuations in state n. For instance, a higher trading cost T_{ni} between states n and i makes it harder for bank n to lend to bank i in the interbank market, thus lowering $\tilde{T}_{ni}$.

To examine the spatial propagation of panics, we specify $\tilde{T}_{ni}$ as

$$\tilde{T}_{ni} = \lambda_1 + \lambda_2 \log\left(Distance_{ni}\right) + \lambda_3 Neighbor_{ni} + \lambda_4 Own_{ni} \quad (7)$$

where $Distance_{ni}$ is defined as the Euclidean distance between the most populated cities (or geographical centroids) of states n and i, $Neighbor_{ni}$ is a binary indicator equal to one if states n and i share a border, and Own_{ni} is one if $n = i$, with values $\lambda_4 \neq 0$ of the associated coefficient reflecting the 'home bias' in interbank lending. In this specification, the sensitivity of loans in state i to deposit fluctuations in state n depends solely on their geographic proximity and neighbour status.

We also assume a linear relationship between deposits and panic events in the data:

$$\log\left(D_{n,t}\right) = c_n + \log\left(D_{n,t-1}\right) + \phi Panic_{n,t} + \upsilon_{n,t} \quad (8)$$

where $Panic_{n,t}$ is a binary variable equal to one if state n experiences a banking panic in quarter t.[20]

Combining Equations (6), (7), and (8)—which are derived from the partial-equilibrium model in Section 3—we evaluate the spatial and dynamic propagation of panics using Jordà's Local Projections [18]:

$$y_{i,t+h} = \eta^y_{i,h} + s^y_{t,h} + \sum_{j=1}^{4} \theta^y_{j,h} F^j_{i,t} + \sum_{l=1}^{L} \beta^y_{l,h} \mathbf{X}_{i,t-l} + \epsilon_{i,t+h} \quad h = 1, \ldots, H \quad (9)$$

where the factors $F^j_{i,t}$ are defined as

$$F^1_{i,t} = \sum_{n=1}^{N} Panic_{n,t} \qquad F^3_{i,t} = \sum_{n=1}^{N} Neighbor_{ni} \cdot Panic_{n,t}$$

$$F^2_{i,t} = \sum_{n=1}^{N} \log\left(Distance_{ni}\right) \cdot Panic_{n,t} \qquad F^4_{i,t} = \sum_{n=1}^{N} Own_{ni} \cdot Panic_{n,t}$$

In Equation (9), $\eta^y_{i,h}$ and $s^y_{t,h}$ denote state and seasonal fixed effects, respectively, and $\mathbf{X}_{i,t-l}$ is a set of control variables that includes four lags of $\left\{F^j_{i,t}\right\}_{j=1}^{4}$ as well as lags of the dependent variable $y_{i,t}$. For the dependent variable $y_{i,t}$, we consider (i) log deposits; (ii) log loans; (iii) liquidity ratio (the ratio of cash, specie, and short-term assets to total assets in state i); (iv) log average bank capital; and (v) log number of active banks.

4.2 | The Dimensionality Curse

The number of distinct connections between states is N^2, which rapidly exceeds the available observations. Consequently, the factorization in (9) is essential to reduce the number of parameters to a manageable level. This raises the question of whether the chosen specification adequately captures the spatial transmission of panic episodes. To address this, Supporting Information Appendix C examines alternative specifications by (i) employing a more restrictive definition of panics and (ii) incorporating an additional factor for deposit volume in the originating panic states to account for potential scale effects. In both alternatives, the empirical estimates of panic propagation closely align with those obtained from regression (9).

4.3 | Are Banking Panics Exogenous?

In order for regression (9) to be identified, the panic variable $Panic_{n,t}$ must be exogenous (i.e., uncorrelated with the error term $\epsilon_{i,t+h}$). Under this condition, the coefficients $\left\{\theta^y_{j,h}\right\}$ capture the causal and spatial dynamics of panic transmission.

Narrative evidence in Jalil [3] supports this exogeneity assumption. For instance, the 1884 panic in New York was triggered by rumours of misappropriation at the Metropolitan Bank—an event that led to its suspension and subsequent intervention by the New York Clearing House. Similarly, the 1907 panic was sparked by a group of New York financiers misappropriating funds to speculate on rising copper prices, which eventually led to widespread runs on banks. Our own tests in Supporting Information Appendix B, based on Granger causality, indicate that the minor panics in Jalil [3] are independent of the business cycle conditions in the originating state. Therefore, we restrict our analysis in regression (9) to the minor panics listed in Table B2.

Even if the exogeneity assumption were violated in the states where panics originate, the estimates $\left\{\theta^y_{j,h}\right\}$ for spatial transmission remain credible provided that the regional economies of non-origin states are uncorrelated with the causes of the panic in the origin states. This hypothesis is further supported by the unit banking system and restrictions on interstate branching during the sample period, which suggest that the interbank market is the primary channel for the spatial spread of panics.

4.4 | Spatial Transmission: Results

Based on the above discussion on panic exogeneity, we estimate regression (9) focusing exclusively on the minor (regional) panics identified in Jalil [3]. In our specification, if state n experiences a minor panic in quarter t (regardless of its origin), we set $Panic_{n,t} = 1$.

Figures A2–A6 summarise the regression results. They are constructed as follows:

1. We estimate Equation (9) for all horizons h and obtain $\left\{\hat{\theta}^y_{j,h}\right\}_{j=1}^{4}$.

2. Assuming a sudden panic in New York (i.e., $Panic_{NY,t} = 1$), we report the impact $\sum_{j=1}^{4} \hat{\theta}^y_{j,h} F^j_{i,t}$ for each dependent variable $y_{i,t+h}$.

p-values are computed using Driscoll-Kraay standard errors, which correct for spatial correlation, heteroskedasticity, and autocorrelation.

Figure A2 shows the evolution of deposits following a panic. The impact ranges from a 4% decline in the simulated origin state to approximately a 3% decline in distant states, indicating rapid spatial transmission across the United States. After 1 year, deposits in non-origin states display a lagged negative response, although these effects are not statistically significant. By 2 years, deposits have returned to their pre-panic trend. This pattern is consistent with Calomiris and Carlson [13] and can be interpreted as sequential deposit runs outside the origin state.[21]

Figure A3 presents a similar pattern for bank lending. An initial 4% drop in the origin state is accompanied by a 3%–4% decline across other states during the first year. Lending eventually returns to pre-crisis levels in most states, except in the origin and neighbouring states, though these differences lose statistical significance over time.

Figure A4 tracks the liquidity ratio—defined as the ratio of cash, specie, and short-term assets to total assets. The liquidity ratio rises immediately in the origin state and remains 4%–8% above pre-crisis levels nationwide, with significance emerging in many states after 6–7 quarters. This response, together with the stronger negative reaction of bank lending relative to deposits, suggests that banks reallocate their portfolios toward safer assets following panics.

Figures A5 and A6 show the evolution of average bank capital and the number of active banks, respectively. While there is no immediate impact, bank capital falls by up to 1.5% after 2 years in several states—particularly in neighbouring and distant regions—with significant effects appearing after three quarters. Similarly, the number of active banks declines by 1.5%–1.8% after 2 years, with statistically significant impacts mainly in the origin state and some neighbouring states.

Overall, these results align with previous literature on financial crises. In particular, our finding that bank lending declines significantly across states is consistent with the VAR analysis in Jalil [3], which documents negative effects on both price levels and output following a panic.

In summary, during our sample period, minor panics have a moderate impact on various dimensions of the banking sector, with most effects dissipating after 2 years. Notably, these panics exhibit robust spatial transmission—affecting even states that are geographically distant from the origin—conditional on the initial structure of interbank loan markets.

5 | Conclusions

This article quantitatively analyses the impacts and geographic propagation of historical banking panics in the United States. Our tractable model formalises a key trade-off inherent in the interbank relationships of the National Banking Era. On one hand, interbank loan networks enabled banks to access cheaper funding and expand credit supply; on the other hand, they exposed banks to runs and panics from outside their home states, thus facilitating the transmission of a minor panic in one state to others.

We find that during 1870–1929, a panic in one state was associated with moderate, temporary declines in deposits and lending, increased liquidity holdings, and a small negative impact on bank capital and the number of active banks in many other states. These effects were statistically significant for up to 2 years after the onset of a panic.

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Endnotes

[1] We limit our sample to 1870–1929 because the Great Crash of 1929 and the subsequent Great Depression engulfed the entire country simultaneously. Our results are robust even if we limit our sample period to 1870–1913 (i.e., before the Federal Reserve System was created).

[2] Even upon the creation of the Federal Reserve in 1913, Anderson et al. [1] find that less than 8% of state-chartered banks joined the Federal Reserve System in its first decade.

[3] During the National Banking Era, banks in central reserve cities were required to hold reserves equal to 25% of deposits in cash. Banks in reserve cities also had a 25% reserve requirement but could hold half of these reserves as deposits at correspondent banks in central reserve cities. Other national banks were required to hold 15% of deposits, with up to three-fifths of the reserve held as interbank deposits at correspondent banks in reserve or central reserve cities.

[4] Gorton [6] documents that early panics were largely driven by depositors revising their perceptions of fundamental risks in response to new information, rather than by self-fulfilling prophecies. More recently, Correia et al. [7] show that few bank failures in U.S. history were purely liquidity driven, with failures being highly predictable based on bank fundamentals.

[5] Mitchener and Richardson [10] show that interbank amplification reduced aggregate commercial bank lending by 15% between the summer peak of 1929 and the winter banking holiday of 1933.

[6] Anderson et al. [12] study the provision of public liquidity by the Federal Reserve and how it affects the banking system upon the creation of the Federal Reserve System. We abstract from the centralised public liquidity provision and focus on decentralised interbank markets.

[7] This narrow definition ensures a homogeneous set of events across the sample period.

[8] Table B2 identifies three major panics during the sample period: the 1873 panic originating in Europe, the 1893 panic studied by Calomiris and Carlson [13], and the 1907 panic originating in New York.

[9] Supporting Information Appendix B shows that only minor panics pass our exogeneity tests.

[10] Banks also submitted *examination reports* based on in-person visits by examiners. For example, in Calomiris and Carlson [13], inclusion in the sample required a September 1892 call report and at least one examination report prior to May 1893 (the onset of the 1893 major panic).

[11] For states with a reserve city, we aggregate the state-level variable with that of the corresponding reserve city to obtain the complete state-level balance sheet composition.

[12] For example, the category 'Loans and discounts' in Table B1 (and Figure A7) initially includes 'Overdrafts' in the earlier sample, which later becomes a separate category.

[13] For example, in Figure A7, 'Bonds for circulation' and 'Bonds for deposits' are grouped under 'bonds and securities', while 'Dividends unpaid' and 'Reserved for taxes' are grouped under 'bank capital'.

[14] Alternatively, this shock may also represent unmodeled seasonal fluctuations in the demand and supply of loanable funds.

[15] We assume that $\rho_n^S(D_{n,t})$ is sufficiently convex to guarantee the existence and uniqueness of the solution to the optimization problem in Equation (3) subject to (2). See Supporting Information Appendix A for details.

[16] The inverse deposit supply curve $\rho_n^S(\cdot)$ can be microfounded by linking deposit compensation to the prevailing risk-free rate on government bonds and to cash holdings with zero return, as in Drechsler et al. [16].

[17] Because $R^I_{ni,t}(\tau)$ is proportional to $T_{ni}\, z_{ni,t}(\tau)$ at the optimum, the deposit division is indifferent regarding the destination state. This is consistent with the fungibility of interbank funds and the fact that the loan division in state i borrows from the cheapest source at each moment τ.

[18] See, for example, Dordal i Carreras et al. [11] and Lee and Dordal i Carreras [17] for further applications and modelling techniques involving extreme value distributions in macroeconomics and finance.

[19] The derivation of Equation (6) is provided in Supporting Information Appendix A.

[20] For example, for the (minor) panic of 1884, we have $Panic_{NY,1884Q2} = Panic_{PA,1884Q2} = Panic_{NJ,1884Q2} = 1$, with 1884$Q$2 denoting the second quarter of 1884.

[21] Gorton [6] documents that, during the National Banking Era, panics were driven by depositors revising their perceptions of underlying risks rather than by self-fulfilling prophecies, leading to sequential deposit runs across states.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.

Appendix A

Figures

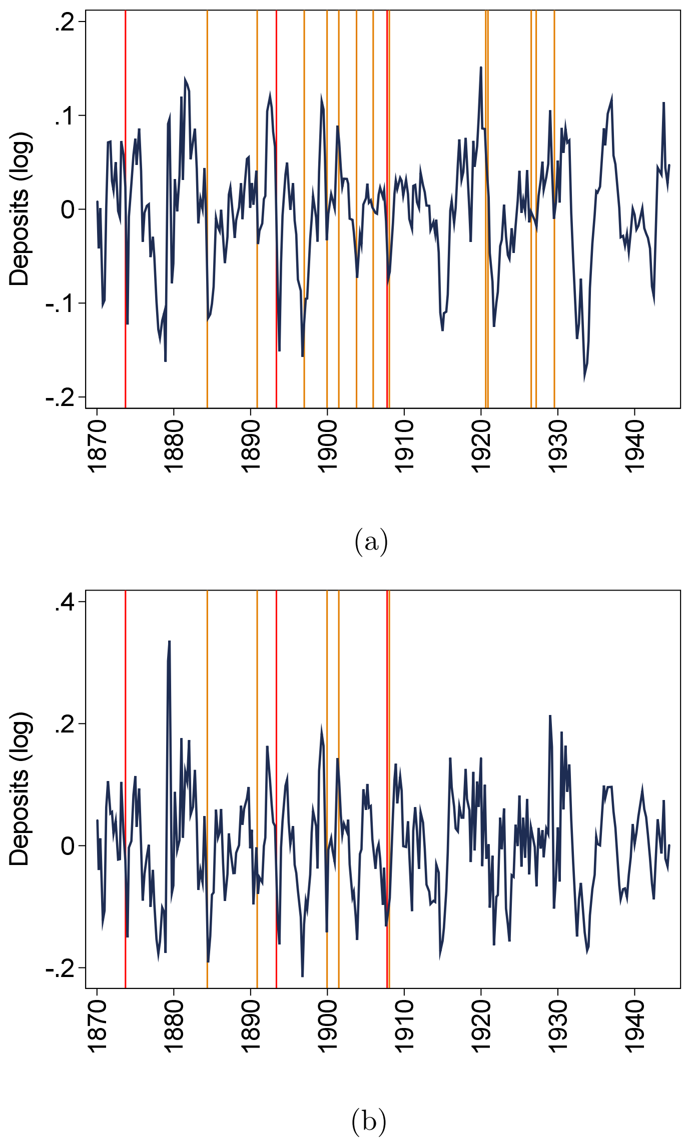

FIGURE A1 | Time-series deposits of the United States as a whole and the state of New York. (a) Filtered US aggregate (log)-deposits from 1870 to 1945: the red vertical lines represent major panics according to Jalil [3], while yellow lines represent the dates of minor panics documented by Jalil [3] as well. (b) Filtered (log)-deposits in the state of New York from 1870 to 1945: the red vertical lines represent major panics according to Jalil [3], while yellow lines represent the dates of minor panics that affected New York, documented by Jalil [3] as well. [Colour figure can be viewed at wileyonlinelibrary.com]

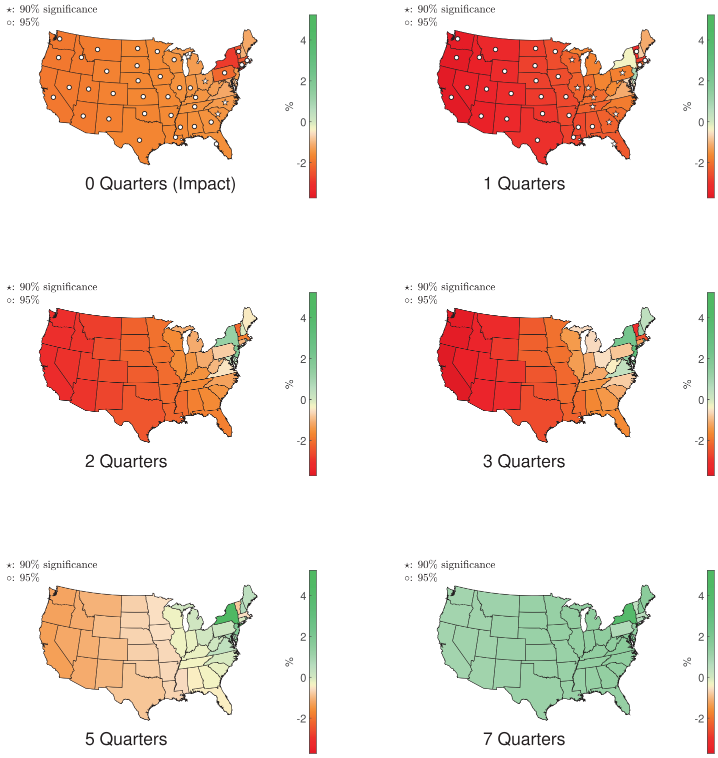

FIGURE A2 | Impulse responses of bank deposits to a panic from New York. Right bar shows colour scale. p-values use Driscoll-Kraay standard errors. [Colour figure can be viewed at wileyonlinelibrary.com]

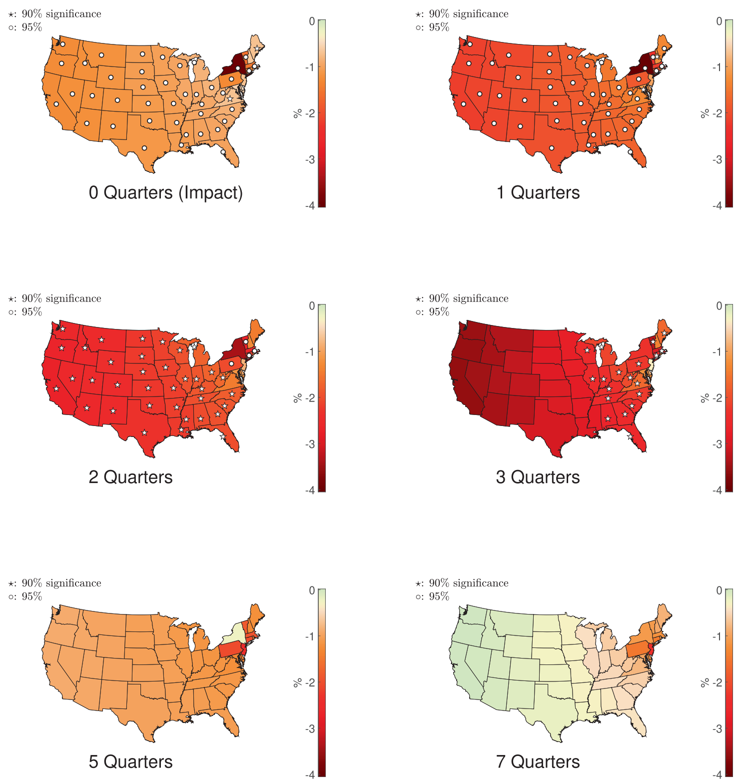

FIGURE A3 | Impulse responses of bank loans across states to a panic from New York. Right bar shows colour scale. p-values use Driscoll–Kraay standard errors. $\circ$ $p < 0.05$, $\star$ $p < 0.1$. [Colour figure can be viewed at wileyonlinelibrary.com]

FIGURE A4 | Impulse responses of state-level liquidity ratios to a panic from New York. Right bar shows colour scale. p-values use Driscoll-Kraay standard errors. $\circ$ $p < 0.05$, $\star$ $p < 0.1$. [Colour figure can be viewed at wileyonlinelibrary.com]

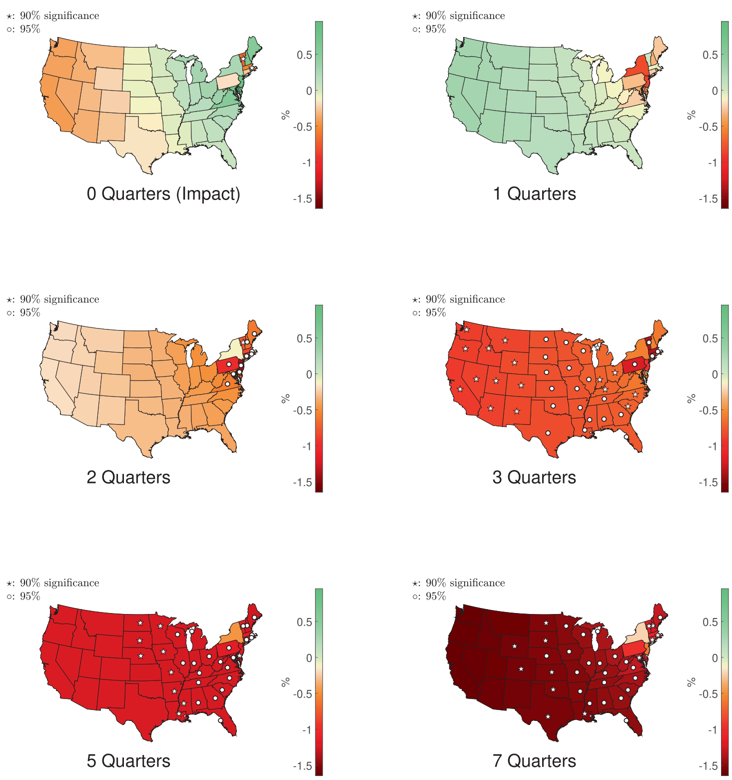

FIGURE A5 | Impulse responses of bank capital across states to a panic from New York. Right bar shows colour scale. p-values use Driscoll-Kraay standard errors. $\circ$ $p < 0.05$, $\star$ $p < 0.1$. [Colour figure can be viewed at wileyonlinelibrary.com]

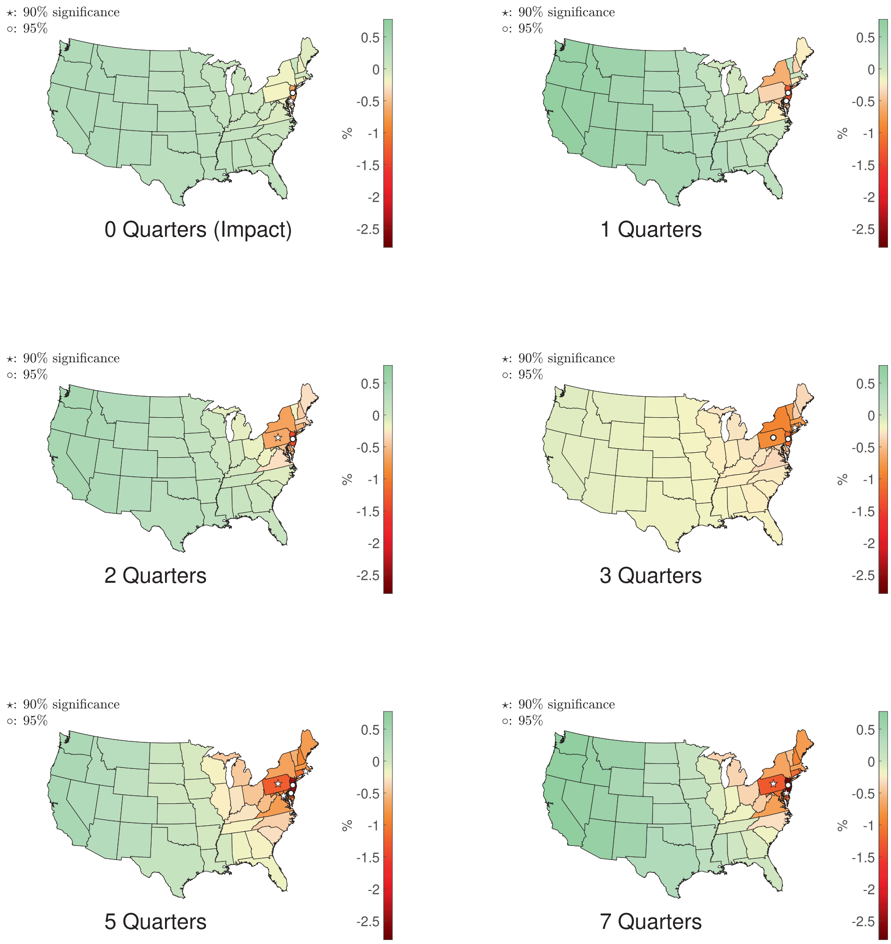

FIGURE A6 | Impulse responses of the number of banks across states to a panic from New York. Right bar shows colour scale. p-values use Driscoll-Kraay standard errors. ∘ $p < 0.05$, ⋆ $p < 0.1$. [Colour figure can be viewed at wileyonlinelibrary.com]

Resources.	Oct. 21, 1913.	Jan. 13, 1914.	Mar. 4, 1914.	June 30, 1914.	Sept. 12, 1914.
ALABAMA.	90 banks.	90 banks.	90 banks.	90 banks.	90 banks.
Loans and discounts	$45,513,715.05	$42,849,992.35	$42,905,637.89	$43,582,574.87	$41,812,117.43
Overdrafts	396,119.39	288,816.63	238,160.73	104,561.68	111,129.33
Bonds for circulation	8,747,750.00	8,935,750.00	8,934,750.00	9,101,750.00	9,103,749.95
Misc. securities	…	…	…	…	4,861,281.14
Bonds for deposits	411,000.00	485,000.00	505,713.00	410,000.00	397,000.00
Other b'ds for deposits	496,153.75	500,655.64	476,900.75	274,500.00	418,500.00
U.S. bonds on hand	9,000.00	9,000.00	9,000.00	9,000.00	10,000.00
Premiums on bonds	91,245.71	78,576.04	77,412.29	70,094.79	63,521.91
Bonds, securities, etc.	3,348,927.54	3,358,970.02	3,308,569.78	3,363,852.16	2,321,201.77
Stocks	…	…	…	143,858.49	179,144.71
Banking house, etc	2,173,798.88	2,169,921.91	2,169,114.21	2,190,582.18	2,196,334.97
Real estate, etc	322,342.75	311,914.19	322,095.64	333,964.56	333,918.44
Due from nat'l banks	4,195,515.45	4,300,854.48	3,666,789.64	2,169,436.13	1,727,789.62
Due from State banks	1,714,335.10	1,660,222.11	1,303,238.00	976,877.10	845,832.72
Due from res've agts	6,959,955.73	7,374,465.51	6,348,607.03	,403,111.15	3,215,822.55
Cash items	308,028.93	262,611.25	239,394.00	187,521.17	238,991.11
Clear'g-house exch'gs	324,608.67	250,191.01	311,139.61	270,994.99	179,617.99
Bills of other banks	889,950.00	1,124,469.00	978,233.00	964,975.00	1,535,034.00
Fractional currency	29,160.00	41,041.08	45,683.69	45,333.69	42,625.33
Specie	2,852,883.16	3,248,435.06	3,002,017.36	3,043,383.10	2,852,801.47
Legal-tender notes	662,485.00	709,896.00	531,574.00	459,927.00	341,739.00
5% fund with Treas	424,287.50	429,037.50	413,137.50	434,437.50	561,766.50
Due from U.S. Treas	33,700.00	39,750.00	14,902.00	21,625.00	5,350.00
Total	79,904,962.61	78,429,569.78	75,802,070.12	72,563,370.56	73,355,269.94

(a)

Liabilities.	Oct. 21, 1913.	Jan. 13, 1914.	Mar. 4, 1914.	June 30, 1914.	Sept. 12, 1914.
ALABAMA.	90 banks.	90 banks.	90 banks.	90 banks.	90 banks.
Capital stock	$10,180,290.00	$10,320,100.00	$10,375,500.00	$10,405,000.00	$10,405,000.00
Surplus fund	5,851,293.59	6,042,995.00	6,013,995.00	6,052,170.00	6,119,925.00
Undivided profits	1,452,249.96	1,345,635.01	1,623,606.48	1,662,905.41	1,599,714.20
Nat'l-bank circulation	8,694,175.00	8,885,470.00	8,803,060.00	8,984,400.00	11,008,827.50
State-bank circulation	…	…	…	…	…
Due to national banks	2,280,617.15	2,191,660.20	1,784,251.77	1,184,974.72	1,014,920.21
Due to State banks	2,549,617.27	2,500,465.48	1,927,496.87	1,073,390.53	890,665.68
Due to trust co.'s, etc.	224,690.83	367,524.10	207,992.96	148,529.49	107,222.25
Due to reserve agents	114,311.60	116,283.51	44,660.72	99,095.45	123,588.71
Dividends unpaid	35,842.00	65,113.41	9,985.42	209,618.42	39,996.50
Individual deposits	43,555,062.18	44,766,048.83	43,484,032.59	39,135,391.86	35,916,560.84
United States deposits	1,526,438.50	1,209,730.53	579,288.80	393,796.17	608,724.64
Postal savings deposits	47,602.83	48,465.95	53,074.55	52,905.32	56,663.19
Dep'ts U.S. dis. officers	31,631.18	124,907.27	164,556.38	…	…
Bonds borrowed	390,800.00	47,800.00	47,800.00	…	…
U.S. bonds borrowed	…	…	…	8,000.00	15,000.00
Other bonds borrowed	…	…	…	21,800.00	181,800.00
Notes rediscounted	726,613.10	183,648.36	9,000.00	146,602.99	765,222.31
Bills payable	2,199,018.25	183,000.00	635,000.00	2,919,054.89	4,440,750.00
Reserved for taxes	35,931.62	14,235.03	32,280.09	54,521.26	45,394.45
Other liabilities	8,777.55	16,487.10	6,488.49	11,204.05	15,294.36
Total	79,904,962.61	78,429,569.78	75,802,070.12	72,563,370.56	73,355,269.94

(b)

FIGURE A7 | Balance sheet original categories of the Abstract of Reports: Banks in the state of Alabama from October 1913 to September 1914. (a) An example of balance sheets: asset side of banks in the state of Alabama from October 1913 to September 1914. (b) An example of balance sheets: liability side of banks in the state of Alabama from October 1913 to September 1914.

Appendix B

Tables

TABLE B1 | Balance sheet original categories of the Abstract of Reports.

Resources	Liabilities
Loans and discounts	Capital stock
Overdrafts	Surplus fund
Bonds for circulation	Undivided profits
Bonds for deposits	National bank circulation
Other bonds for deposits	State bank circulation
U.S. Bonds on hand	Due to national banks
Premium on bonds	Due to State banks
Bonds, securities, etc.	Due to trust companies, etc.
Banking house, furniture, etc.	Due to reserve agents
Real state, etc.	Dividends unpaid
Current expenses	Individual deposits
Due from national banks	Certified checks
Due from State banks	U.S. deposits
Due from reserve agents	Deposits U.S. disbursing officers
Internal revenue stamps	Bonds borrowed
Cash items	Notes rediscounted
Clearing-house exchanges	Bills payable
Bills of other banks	Clearing-house certificates
Fractional currency	Other liabilities
Trade dollars	Specie
Legal-tender notes	
U.S. certificates of deposit	
3% certificates	
5% fund with Treasury	
Clearing-house certificates	
Due from U.S. Treasury	
Total	Total

Note: The Abstract of Reports, contained in the Annual Report of the Comptroller of the Currency, provides regional aggregates of the categories that we list in Table B1. The categories reported tend to vary slightly across time, typically due to the subdivision of big categories into smaller ones on the latest reports. For example, the category 'Loans and discounts' contained 'Overdrafts' in the initial years, and overdrafts eventually became a category on its own.

TABLE B2 | Banking panics chronology (in the sample period).

States	Panic, start	Panic, end	Reporting date	Time to start (days)
All (Major)–from **Europe**	18sep1873	30sep1873	26dec1873	99
NY, PA, NJ	13may1884	31may1884	20jun1884	38
NY	10nov1890	22nov1890	19dec1890	39
All (Major)	13may1893	19aug1893	12jul1893	60
IL, MN, WI	26dec1896	26dec1896	09mar1897	73
MA, NY	16dec1899	31dec1899	13feb1900	59
NY	27jun1901	06jul1901	15jul1901	18
PA, **MD**	18oct1903	24oct1903	17nov1903	30
All (Major) - from **NY**	12oct1907	30nov1907	03dec1907	52
NY	25jan1908	01feb1908	14feb1908	20
MA	12aug1920	02oct1920	08sep1920	27
ND	27nov1920	19feb1921	29dec1920	32
FL, **GA**	14jul1926	21aug1926	31dec1926	170
FL	08mar1927	26mar1927	23mar1927	15
FL	20jul1929	07sep1929	04oct1929	76
			Median	38.5

Note: The series is extracted from Jalil [3]. The first column reports the states in which the panic initially originated (bold font) and other "affected" states (normal font) where panics arose. The start and end dates of panics are obtained from the classification appendix of Jalil [3] when possible or by reading the original sources listed in Jalil [3]. The fifth column reports the number of days elapsed between the start of a crisis and the first Abstract of Reports from the Comptroller of the Currency observed after the crisis (There was a relatively minor panic in 1905 that stemmed in Chicago, Illinois. Starting on December 18, 1905 by the collapse of three banks (the Chicago National Bank, the Home Savings Bank and the Equitable Trust Company), these failures produced only mild consequence in Chicago and the United States due to the actions of the Chicago Clearing House Association. We omit the 1905 panic in Table B2 since the first reporting after this crisis occurred in the first quarter of the next year. See the classification appendix of Jalil [3] for more details.).