# The Spatial Transmission of U.S. Banking Panics: Evidence from 1870-1929

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**Abstract**

We examine the propagation of localized banking panics across the United States using digitized 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.

**Keywords:** Interbank Markets, Spatial Propagation, Panics
**JEL Codes:** E32, G21, N11, N21

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# 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 and unit banking regulations that limited banks' ability to branch and diversify risks (see Calomiris and Haber (2014)). 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.[2]

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 estimate the degree of spatial transmission of panics across states. Our analysis draws on digitized 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 (2015). 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 two years. Moreover, we observe a lagged but robust response in banks outside the originating state, which we attribute to inter-state financial linkages.

[1] We limit our sample to 1870–1929 because the Great Crash of 1929 and the subsequent Great Depression engulfed the entire country simultaneously.

[2] 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.

**Literature** Early documentation of historical panic episodes is provided by Kemmerer (1910) based on newspaper reports. More recent studies by DeLong and Summers (1986), Gorton (1988),[3] Wicker (2006), Reinhart and Rogoff (2009), and Jalil (2015) offer alternative classifications using different criteria and regional details. In particular, Jalil (2015) 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 (2015) because of its comprehensive coverage of the geographical and temporal dimensions of panic episodes. Mitchener and Richardson (2019) similarly document the role of interbank lending markets in amplifying lending reductions during the Great Depression,[4] while our analysis focuses on regional panics preceding the Great Depression.

**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 Sections I and II, respectively.

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

# 2 Data

**Banking Panic Series** We rely on the historical banking panic series of Jalil (2015), which provides detailed information on the geographical coverage and timing of panics. Table II.2 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 (2015) defines a banking panic as a "widespread run by private agents in financial markets ... [in order to] convert deposits into currency"[5] and distinguishes between major and minor

[3] Gorton (1988) 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. (2024) show that few bank failures in U.S. history were purely liquidity driven, with failures being highly predictable based on bank fundamentals.

[4] Mitchener and Richardson (2019) show that interbank amplification reduced aggregate commercial bank lending by 15% between the summer peak of 1929 and the winter banking holiday of 1933.

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

panics. Minor panics are geographically localized and less severe, whereas major panics rapidly engulf most of the United States and entail widespread distress.[6] Given our focus on the spatial propagation of banking panics, we primarily concentrate on minor panics.[7]

**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.[8] We rely on 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 (2000) digitized the series for 1880–1910, we extend the dataset to cover 1870–1929 by digitizing data for the remaining years. The dataset comprises self-reported balance sheets from all national banks, aggregated by reserve city and state.[9] Table II.1 overviews the categories included, and Figure II.7 shows an example 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 vary over time as broader categories are subdivided.[10] 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.[11]

[6] Table II.2 identifies three major panics during the sample period: the 1873 panic originating in Europe, the 1893 panic studied by Calomiris and Carlson (2017), and the 1907 panic originating in New York.

[7] Online Appendix B shows that only minor panics pass our exogeneity tests.

[8] Banks also submitted *examination reports* based on in-person visits by examiners. For example, in Calomiris and Carlson (2017), 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).

[9] 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.

[10] For example, the category "Loans and discounts" in Table II.1 (and Figure II.7) initially includes "Overdrafts", which later becomes a separate category.

[11] For example, in Figure II.7, "Bonds for circulation" and "Bonds for deposits" are grouped under "bonds

Figure I.1 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 (2015). 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.

# 3 Model

This section introduces a partial equilibrium model that establishes the theoretical link between deposit fluctuations and the spatial transmission of panics across states.[12] Detailed derivations are provided in Online Appendix A.

Consider an economy with $N$ states, each hosting a representative bank divided into two units: a deposit division that raises local funds and a loan division that extends credit to local firms. To match local fund supply with credit demand, banks provide interbank loans to mitigate liquidity shortfalls. Time is modeled in discrete quarters $t$, each comprising a continuum of moments $\tau \in [0, 1]$ at which contracts for local credit and liquidity management are signed.

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

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

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

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

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 $R^F_{i,t}(\tau) = R^I_{i,t}(\tau)$.

and securities", while "Dividends unpaid" and "Reserved for taxes" are grouped under "bank capital".

[12] We draw on insights from Dordal i Carreras et al. (2024) and Lee and Dordal i Carreras (2024) regarding modeling techniques with extreme value distributions.

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 $\tau$. Formally,

$$\begin{array}{l} R^I_{i,t}(\tau) = \min\limits_n \Big\{ R^I_{ni,t}(\tau) \Big\} \\ M_{i,t}(\tau) = M_{ni,t}(\tau) \end{array} \quad \text{, with } n = \arg\min_j \Big\{ R^I_{ji,t}(\tau) \Big\} \ , \tag{1}$$

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

**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

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

where exponent $\alpha > 1$ captures economies of scale in processing deposits, and the parameters $T_{ni} \geqslant 1$ represent the costs of transferring funds across regions—accounting for trade costs, agency problems, or imperfect information. Without loss of generality, we normalize 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 $\kappa$, capturing within-quarter variations in the ease of creating loans.[13]

The deposit division faces an upward-sloping inverse deposit supply curve, $\rho^S_n(D_{n,t})$, which specifies the interest rate paid on deposits when raising an amount $D_{n,t}$.[14] Its profit maximization problem is therefore

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

subject to the loanable funds production constraint (2).[15]

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

[14] We assume that $\rho^S_n(D_{n,t})$ is sufficiently convex to guarantee the existence and uniqueness of the solution to the optimization problem in equation (3) subject to (2). See Online Appendix A for details.

[15] The inverse deposit supply curve $\rho^S_n(\cdot)$ 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.

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 $\tau$:

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

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 $n$.[16]

**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 $\tau$.

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

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

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

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

(2017).

[16]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 $\tau$.

Equation (5) implies that the credit $L_{i,t}^{D}$ 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, $\rho_t$. 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.

**Key Trade-off** To illustrate the model's implications, consider two special cases. First, assume that deposits are identical across states, i.e., $D_{n,t} = \bar{D}_t$ 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

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

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, i.e., $T_{ni} = 1$ for all $n, i$. Then, equation (5) becomes

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

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

## 4.1 Methodology

A log-linear approximation of equation (5) yields[17]

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

where $\mu_i$ 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

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

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 neighbor status.

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

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

where $Panic_{n,t}$ is a binary variable equal to one if state $n$ experiences a banking panic in quarter $t$.[18]

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

[17] The derivation of equation (6) is provided in Online Appendix A.

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

Jordà's Local Projections (Jordà, 2005):

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

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 $\{F^j_{i,t}\}^4_{j=1}$ 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.

**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, Online 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).

**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 $\{\theta^y_{j,h}\}$ capture the causal and spatial dynamics of panic transmission.

Narrative evidence in Jalil (2015) supports this exogeneity assumption. For instance, the 1884 panic in New York was triggered by rumors 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 Online Appendix B, based on Granger causality, indicate that the minor panics in Jalil (2015) 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 II.2.

Even if the exogeneity assumption were violated in the states where panics originate, the estimates $\{\theta^y_{j,h}\}$ 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.

## 4.2 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 (2015). In our specification, if state $n$ experiences a minor panic in quarter $t$ (regardless of its origin), we set $Panic_{n,t} = 1$.

Figures I.2 to I.6 summarize the regression results. They are constructed as follows:

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

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 I.2 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 one year, deposits in non-origin states display a lagged negative response, although these effects are not statistically significant. By two years, deposits have returned to their pre-panic trend. This pattern is consistent with Calomiris and Carlson (2017) and can be interpreted as sequential deposit runs outside the origin state.[19]

[19] Gorton (1988) 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.

Figure I.3 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 neighboring states, though these differences lose statistical significance over time.

Figure I.4 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 I.5 and I.6 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 two years in several states—particularly in neighboring and distant regions—with significant effects appearing after three quarters. Similarly, the number of active banks declines by 1.5–1.8% after two years, with statistically significant impacts mainly in the origin state and some neighboring 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 (2015), 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 two 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 paper quantitatively analyzes the impacts and geographic propagation of historical banking panics in the United States. Our tractable model formalizes 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 two years after the onset of a panic.

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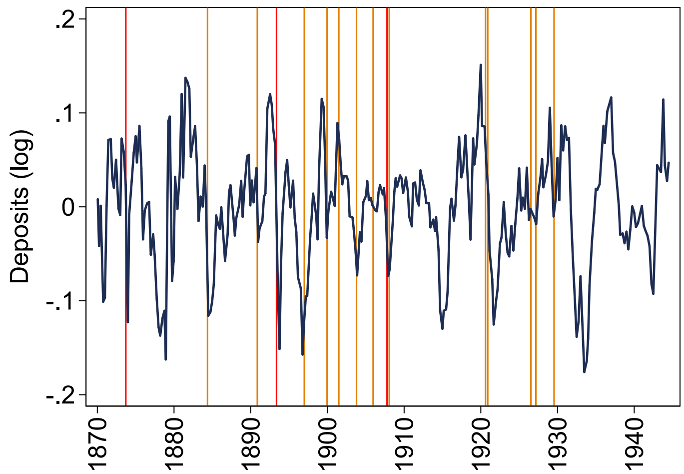
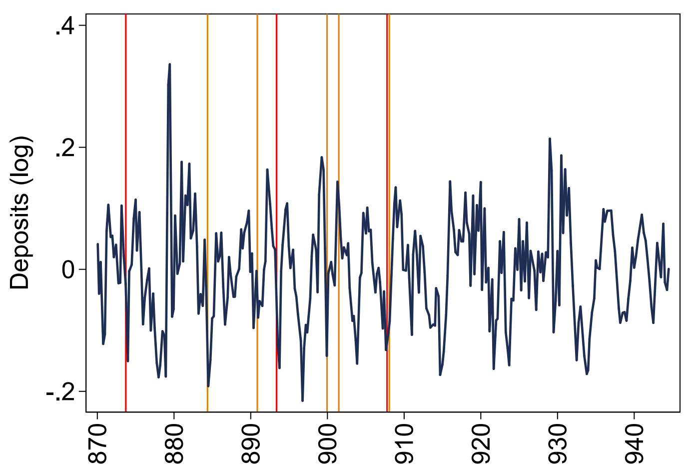
# I Figures




(a) Filtered US aggregate (log)-deposits from 1870 to 1945: the red vertical lines represent major panics according to Jalil (2015), while yellow lines represent the dates of minor panics documented by Jalil (2015) 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 (2015), while yellow lines represent the dates of minor panics that affected New York, documented by Jalil (2015) as well.

Figure I.1: Time-series deposits of the United States as a whole and the state of New York.

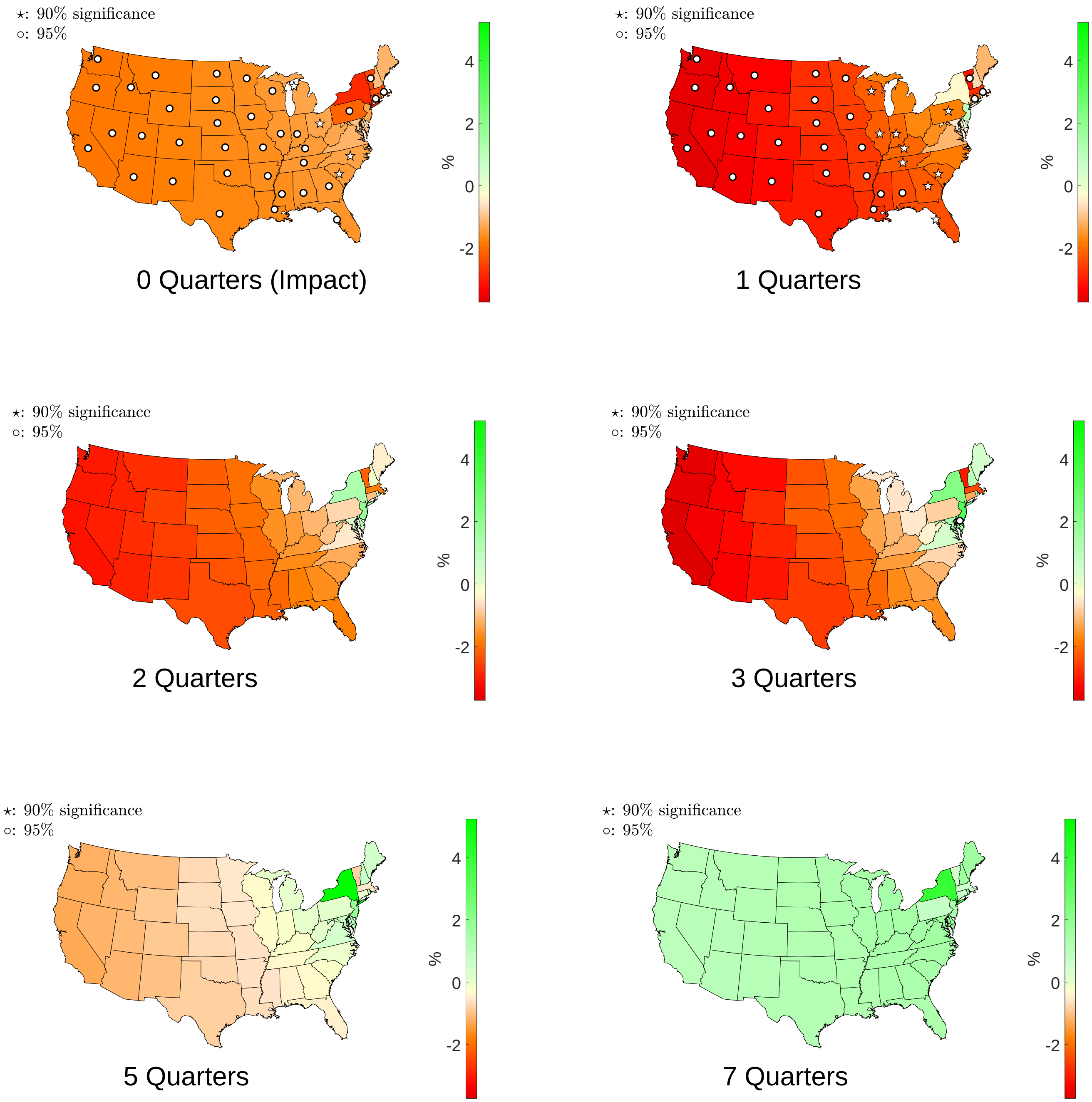



Figure I.2: Impulse-response of bank deposits to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors.

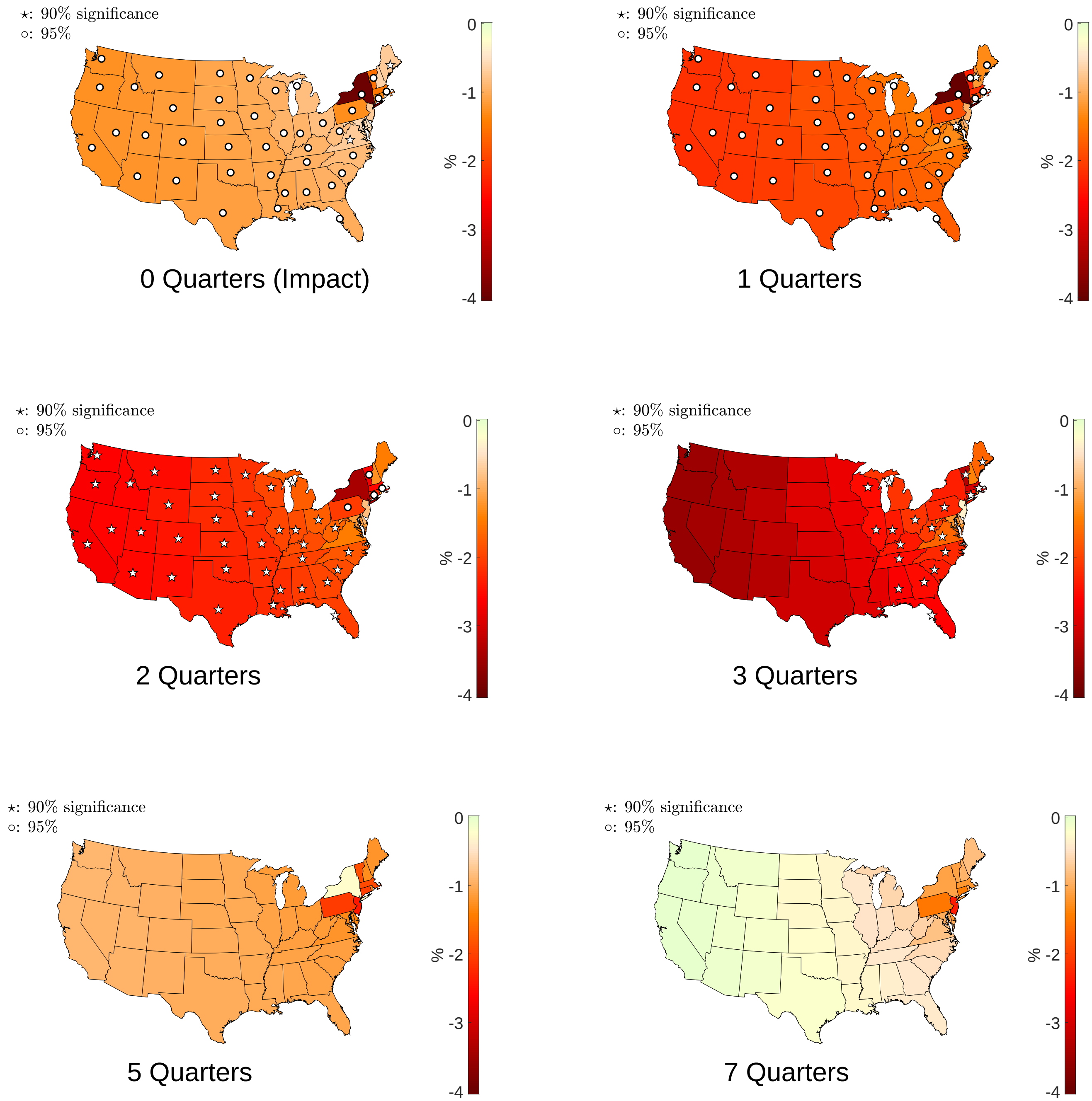



Figure I.3: Impulse-response of bank loans across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ$ $p < 0.05$, $\star$ $p < 0.1$

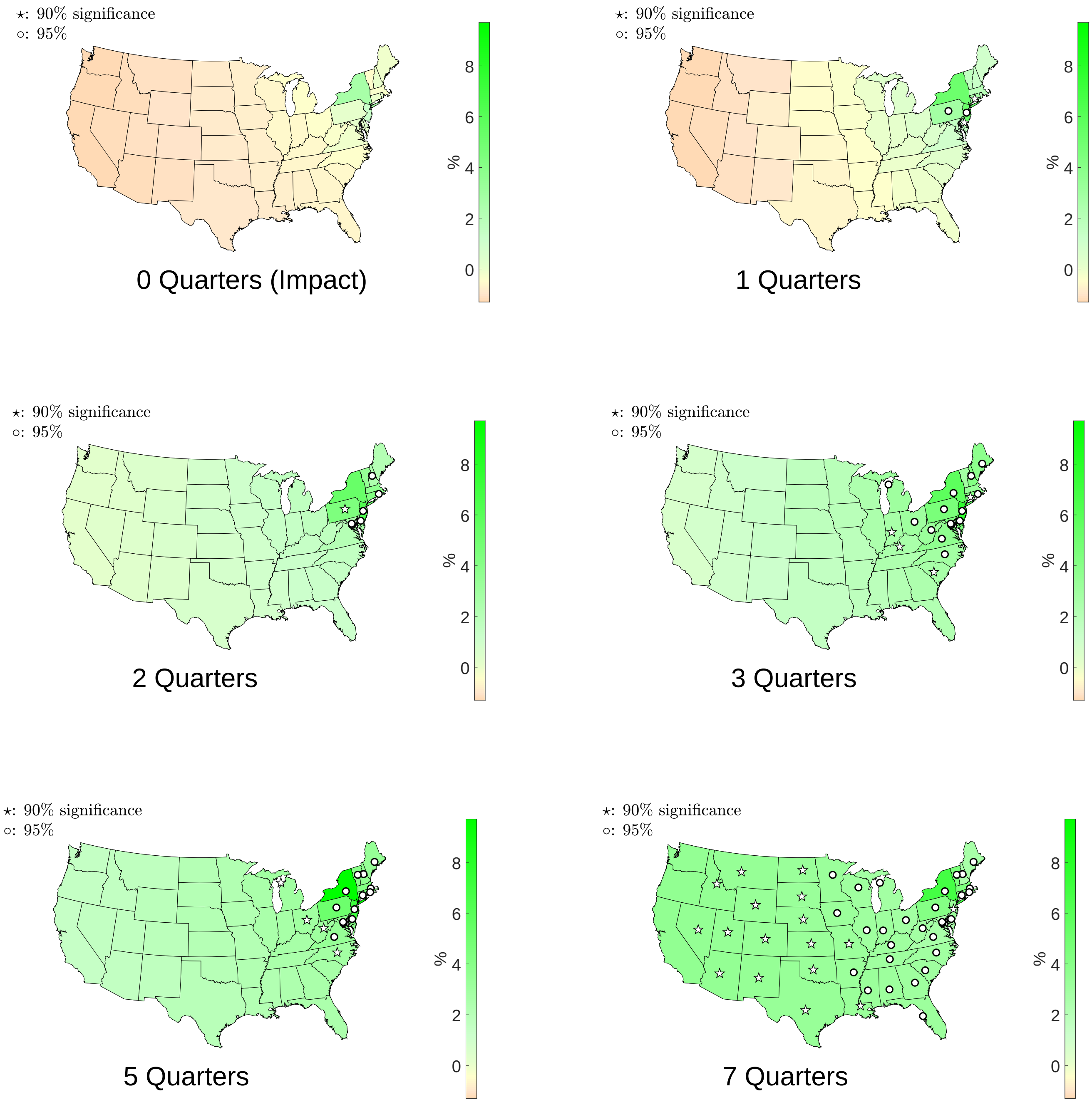



Figure I.4: Impulse-response of liquidity ratios across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$

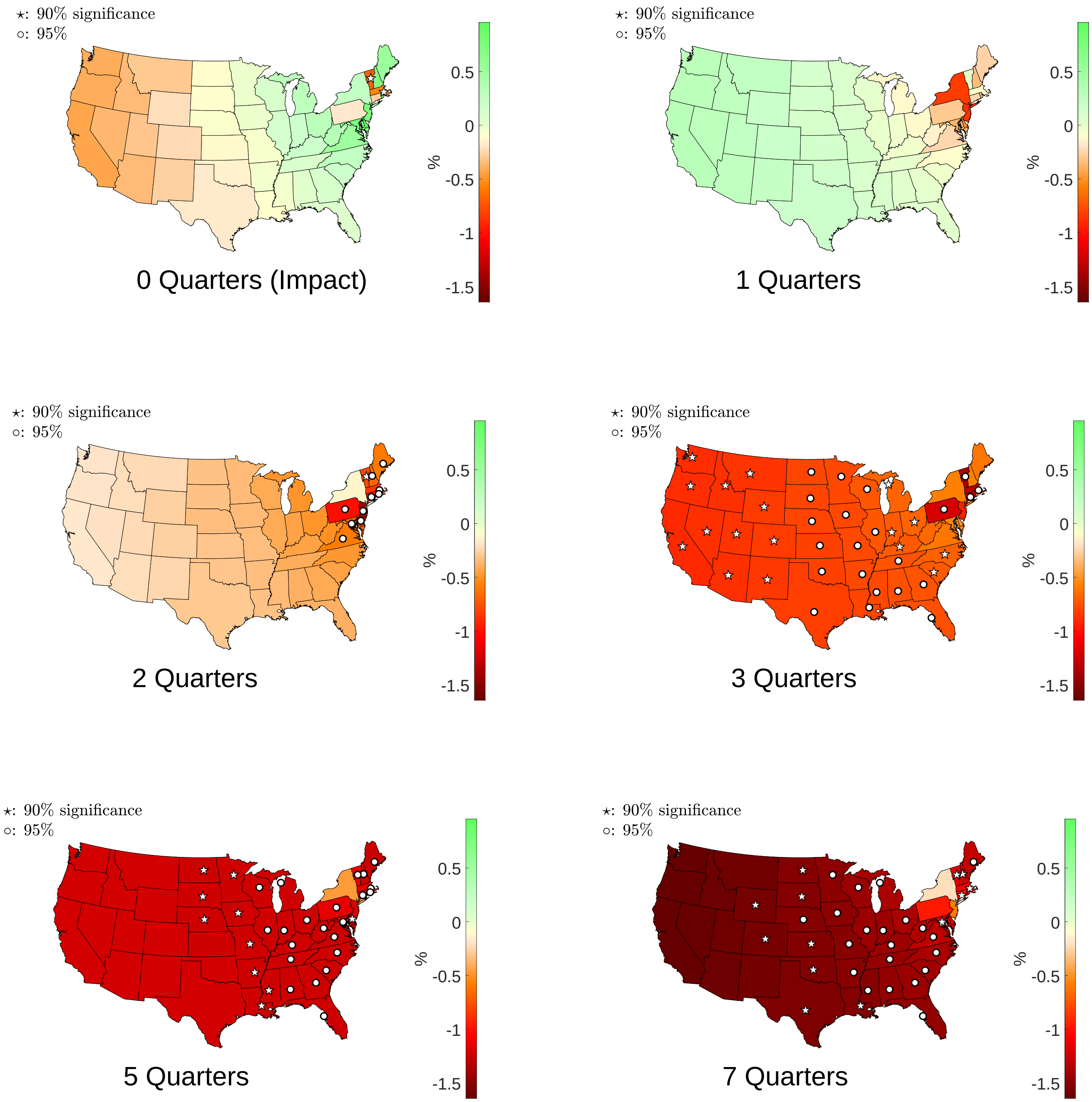



Figure I.5: Impulse-response of bank capital across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$

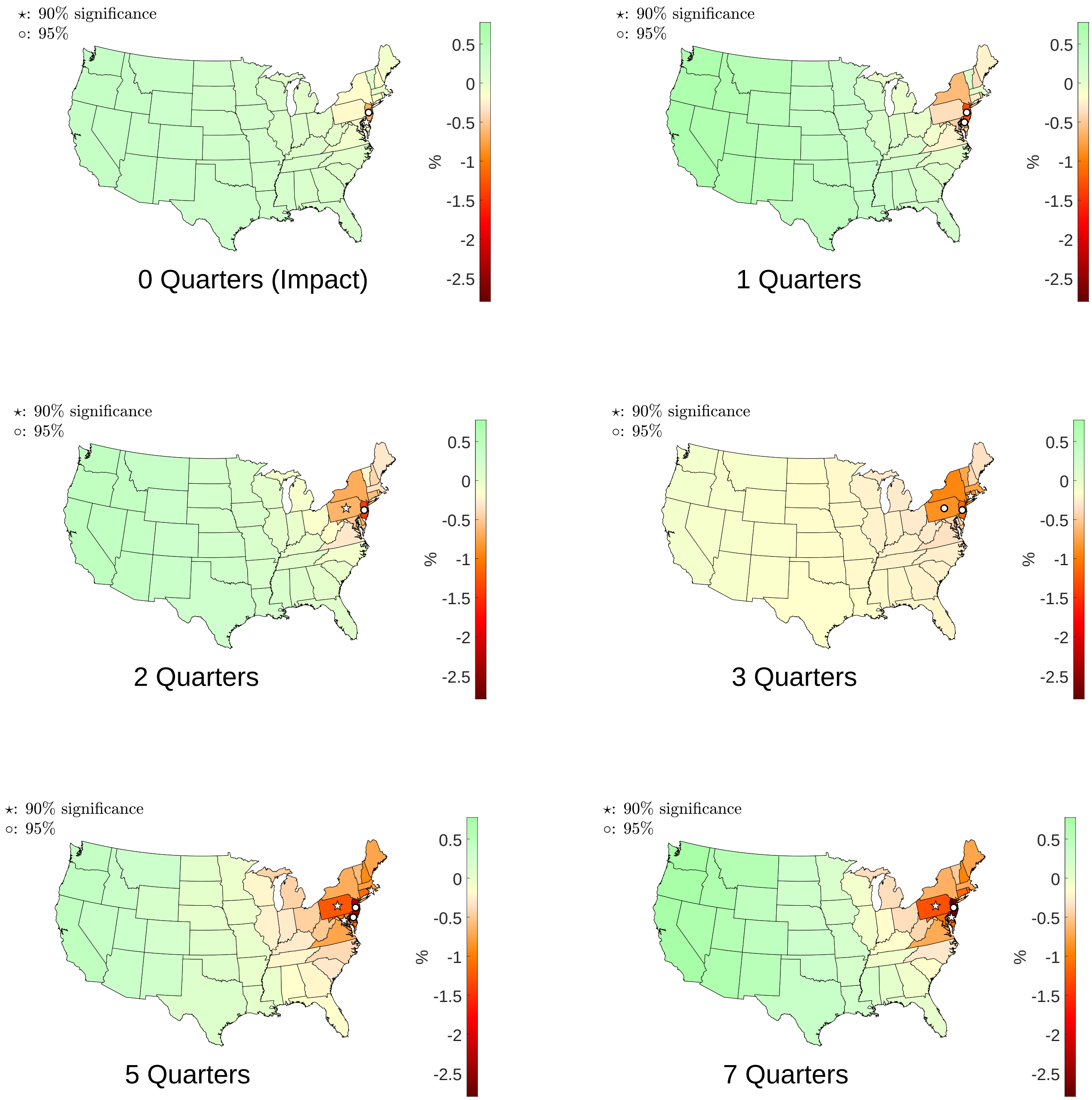



Figure I.6: Impulse-response of the number of banks across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$

# II Tables

| 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 | |
| Three per cent certificates | |
| 5% fund with Treasury | |
| Clearing-house certificates | |
| Due from U.S. Treasury | |
| Total | Total |

Table II.1: Balance sheet original categories of the Abstract of Reports. 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 II.1. 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.

| 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) An example of balance sheets: asset side of banks in the state of Alabama from October 1913 to September 1914.

| 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 | 55,916,560.84 |
| 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) An example of balance sheets: liability side of banks in the state of Alabama from October 1913 to September 1914.

Figure II.7: Balance sheet original categories of the Abstract of Reports: banks in the state of Alabama from October 1913 to September 1914.

| 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 |

Table II.2: Banking panics chronology (in the sample period). The series is extracted from Jalil (2015). 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 (2015) when possible or by reading the original sources listed in Jalil (2015). 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.[1]

[1] 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 II.2 since the first reporting after this crisis occurred in the first quarter of the next year. See the classification appendix of Jalil (2015) for more details.

# A Derivations and Proofs

**Problem of Loanable Fund Allocation** Deposit division of a bank in state $n$ solves

$$\max_{\{M_{ni,t}(\tau)\},D_{n,t}} \sum_{i=1}^{N} \int_0^1 R^I_{ni,t}(\tau) M_{ni,t}(\tau) d\tau - \underbrace{\rho_n^S(D_{n,t}) D_{n,t}}_{\text{Cost of loanable funds}}$$

subject to

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

The maximization problem thus becomes

$$\max_{\{M_{ni,t}(\tau)\}} \sum_{i=1}^{N} \int_0^1 R^I_{ni,t}(\tau) M_{ni,t}(\tau) d\tau - \rho_n^S \left( \underbrace{\left( \sum_{i=1}^{N} \int_0^1 T_{ni} z_{ni,t}(\tau) M_{ni,t}(\tau) d\tau \right)^{\frac{1}{\alpha}}}_{=D_{n,t}} \right) \cdot \left( \sum_{i=1}^{N} \int_0^1 T_{ni} z_{ni,t}(\tau) M_{ni,t}(\tau) d\tau \right)^{\frac{1}{\alpha}}. \tag{A.1}$$

We observe that if $\rho_n^S(\cdot)$ is convex enough, even with $\alpha > 1$, the assumed economies of scale in in allocating a large supply of deposits, the objective function in (A.1) becomes strictly concave in $\{M_{ni,t}(\tau)\}$, which guarantees the existence and uniqueness of the solution of optimization (A.1). The first order condition yields

$$R^I_{ni,t}(\tau) = T_{ni} \cdot z_{ni,t}(\tau) \cdot \left(\frac{1}{\alpha}\right) \underbrace{\rho_n^S(D_{n,t}) \left( 1 + \underbrace{\frac{\rho_n^{S'}(D_{n,t}) D_{n,t}}{\rho_n^S(D_{n,t})}}_{\equiv \left(\varepsilon^S_{n,t,D,\rho}\right)^{-1}} \right)}_{\equiv \rho_{n,t}} \cdot (D_{n,t})^{-(\alpha-1)},$$

where

$$\varepsilon^S_{n,t,D,\rho} \equiv \left[ \frac{\rho_n^{S'}(D_{n,t}) D_{n,t}}{\rho_n^S(D_{n,t})} \right]^{-1} > 0.$$

represents the elasticity of deposit supply, proving (4).

**Aggregation** We use the following properties of the Weibull distribution. When $\{X_i\}_{i=1}^N$ are mutually independent, and $X_i$ follows the Weibull distribution with $\lambda_i$ as the scale parameter and $\kappa$ as the shape parameter, i.e., $X_i \sim W(\lambda_i, \kappa)$:

**Property 1** (Scalar Multiplication)**.** $cX_i \sim W(c\lambda_i, \kappa)$ for some scalar $c$.

**Property 2** (Moments)**.** $\mathbb{E}((X_i)^n) = (\lambda_i)^n \Gamma\left(1 + \frac{n}{\kappa}\right)$ for $n \in \mathbb{R}$.

**Property 3** (Minimum of $\{X_i\}$)**.**

$$\min_i \{X_i\} \sim W\left(\left(\sum_{i=1}^{N} (\lambda_i)^{-\kappa}\right)^{-\frac{1}{\kappa}}, \kappa\right).$$

From (4) and using $z_{ni,t}(\tau) \sim W(1, \kappa)$, we obtain from Property 1 that

$$R^I_{ni,t}(\tau) = T_{ni} \cdot z_{ni,t}(\tau) \cdot \left(\frac{\rho_t}{\alpha}\right) \cdot (D_{n,t})^{-(\alpha-1)} \sim W\left(T_{ni}\left(\frac{\rho_t}{\alpha}\right) \cdot (D_{n,t})^{-(\alpha-1)}, \kappa\right),$$

which, with Property 3, leads to

$$R^I_{i,t}(\tau) = \min_n \left\{R^I_{ni,t}(\tau)\right\} \sim W\left(\Phi_{i,t}, \kappa\right),$$

where

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

as presented in the main text.

Finally, with the help of Property 2, and the fact that $R^F_{i,t}(\tau) = R^I_{i,t}(\tau)$,

$$\begin{aligned}
\mathbb{E}\left[R^F_{i,t}(\tau)^{-\beta}\right] &= \mathbb{E}\left[R^I_{i,t}(\tau)^{-\beta}\right] = (\Phi_{i,t})^{-\beta}\, \Gamma\left(1 - \frac{\beta}{\kappa}\right) \\
&= \left(\frac{\rho_t}{\alpha}\right)^{-\beta} \cdot \left[\sum_{n=1}^{N} (T_{ni})^{-\kappa} (D_{n,t})^{\kappa(\alpha-1)}\right]^{\frac{\beta}{\kappa}} \cdot \Gamma\left(1 - \frac{\beta}{\kappa}\right),
\end{aligned}$$

from which we can obtain the expression for equilibrium loan amounts in state $i$ as follows:

$$L^D_{i,t} = \mathbb{E}\left[R^F_{i,t}(\tau)^{-\beta}\right] \cdot \varepsilon_{i,t} = \left[\sum_{n=1}^{N} (T_{ni})^{-\kappa} (D_{n,t})^{\kappa(\alpha-1)}\right]^{\frac{\beta}{\kappa}} \left(\frac{\alpha}{\rho_t}\right)^{\beta} \Gamma\left(1 - \frac{\beta}{\kappa}\right) \varepsilon_{i,t} \qquad \forall i,$$

proving equation (5).

Note: Lending in each state is linked to deposits in all other states. Especially with $\alpha > 1$, a decrease in $D_{n,t}$ leads to a drop in $L^D_{i,t}$.

**Log-linearization** From equation (5),

$$\log L_{i,t}^{D} = \frac{\beta}{\kappa} \cdot \log \left( \sum_{n=1}^{N} \left(T_{ni}\right)^{-\kappa} D_{n,t}^{\kappa(\alpha-1)} \right) + \beta \log \frac{\alpha}{\rho_t} + \log \Gamma \left( 1 - \frac{\beta}{\kappa} \right) + \epsilon_{i,t},$$

which leads to

$$\begin{aligned}
\check{L}_{i,t}^{D} &= \frac{\beta}{\kappa} \left( \sum_{n=1}^{N} T_{ni}^{-\kappa} D_{n,t}^{\kappa(\alpha-1)} \right) \underbrace{-\beta \check{\rho}_t}_{\equiv s_t} + \epsilon_{i,t} \\
&= \frac{\beta}{\kappa} \sum_{n=1}^{N} \left( \underbrace{\frac{\left(T_{ni}\right)^{-\kappa} D_{n}^{\kappa(\alpha-1)}}{\sum_{n=1}^{N} \left(T_{ni}\right)^{-\kappa} D_{n}^{\kappa(\alpha-1)}}}_{\equiv \xi_{ni}} \right) \left( -\kappa \check{T}_{ni} + \kappa(\alpha - 1) \check{D}_{n,t} \right) + s_t + \epsilon_{i,t} \\
&= \left( \underbrace{-\beta \sum_{n=1}^{N} \xi_{ni} \check{T}_{ni}}_{=\mu_i} \right) + \sum_{n=1}^{N} \left( \underbrace{\beta(\alpha-1)\xi_{ni}}_{\equiv \tilde{T}_{ni}} \right) \check{D}_{n,t} + s_t + \epsilon_{i,t} \\
&= \mu_i + s_t + \sum_{n=1}^{N} \tilde{T}_{ni} \check{D}_{n,t} + \epsilon_{i,t},
\end{aligned}$$

deriving equation (6).

# B Are Panics Exogenous or Correlated with Business Cycles?

To verify that the panics listed in Table II.2 (or Jalil (2015)) can be treated as exogenous—a key assumption for our estimation in Section 4.1—we estimate the following Granger causality regression. This test examines whether a panic functions as an exogenous shock or is correlated with business cycle conditions:

$$Panic_{i,t} = \mu_i + \mu_t + \sum_{l=1}^{4} \left[\beta_l^D \Delta \log\left(D_{i,t-l}\right) + \beta_l^L \Delta \log\left(L_{i,t-l}\right) + \beta_l^B \Delta \log\left(Bank_{i,t-l}\right)\right] + \varepsilon_{i,t} \ ,$$

where $Panic_{i,t}$ is a binary variable equal to one if state $i$ experiences a banking panic in quarter $t$. We control for four lags of the growth rates of deposits, loans, and the number of banks in state $i$ to account for business cycle conditions. Finally, $\mu_i$ and $\mu_t$ represent state and quarter fixed effects, respectively.

| | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| Joint F-test, p-value | *** | *** | $H_0$ | $H_0$ |
| R-squared | 0.37% | 1.96% | 0.07% | 0.104% |
| All panics | X | X | | |
| Minor panics | | | X | X |
| Individual fixed effects | | X | | X |
| Seasonal dummies | | X | | X |

Table B.1: Granger causality test. We regress panic episodes on four lagged changes in deposits, loans, and the number of banks:

$$Panic_{i,t} = \mu_i + \mu_t + \sum_{l=1}^{4} \left[\beta_l^D \Delta \log\left(D_{i,t-l}\right) + \beta_l^L \Delta \log\left(L_{i,t-l}\right) + \beta_l^B \Delta \log\left(Bank_{i,t-l}\right)\right] + \varepsilon_{i,t}.$$

The table reports tests of the joint null hypothesis $H_0 : \beta_l^D = \beta_l^L = \beta_l^B = 0, \ \forall l$. An "X" indicates the inclusion of specific types of panics or controls. Significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$, and non-significant if $p \geqslant 0.1$.

Table B.1 presents the results of the Granger causality test under the joint null $H_0$ : $\beta_l^D = \beta_l^L = \beta_l^B = 0$ for all $l = 1, \ldots, 4$. Columns 1 and 2 report results using nationwide *major* panics from Jalil (2015), while Columns 3 and 4 use regional *minor* panics. The null is rejected for major panics (with and without fixed effects) but not rejected at the 10% level for the minor panics.

Because major panics, by their nationwide nature, offer little variation for identifying spatial transmission, we exclude them from our analysis as explained in Section 2. Accordingly, in Sections 4.1 and 4.2 we treat the minor panics of Jalil (2015) as exogenous.

# C Robustness Checks

This section examines the robustness of the empirical results presented in Section 4 with respect to variations in the factorization used in equation (7) to capture the spatial propagation of panics. We consider two alternatives: a more restrictive definition of panics and the inclusion of deposit volume in the origin panic states to account for potential scale effects.

**Panic Dummies for Origin States Only** In regression (9), we initially set $Panic_{i,t} = 1$ for any state $i$ experiencing a panic in quarter $t$, regardless of its origin (e.g., for the 1884 panic in Table II.2, $Panic_{NY,1884Q2} = Panic_{PA,1884Q2} = Panic_{NJ,1884Q2} = 1$, with $1884Q2$ denoting the second quarter of 1884). For robustness, we re-estimated (9) assigning $Panic_{i,t} = 1$ only for the origin state of each panic (see Table II.2 for the list provided by Jalil (2015)). The results, presented in Online Appendix C.1, are nearly identical to our baseline estimates. We conclude that our findings on the spatial transmission of panic shocks are robust to alternative definitions of the panic dummy.

**Deposit Size Effects** In our baseline specification (9), we abstract from the possibility that panics in states with larger financial markets have a greater impact on other states. To account for such size effects, we modify the regression by controlling for lagged deposit shares:

$$y_{i,t+h} = \eta^y_{i,h} + s^y_{t,h} + \sum_{j=1}^{5} \theta^y_{j,h} F^j_{i,t} + \sum_{l=1}^{L} \beta^y_{l,h} \mathbf{X}_{i,t-l} + \epsilon_{i,t+h}, \quad h = 1, \ldots, H \ , \tag{C.1}$$

where the factors are defined as:

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

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

$$F^5_{i,t} = \underbrace{\sum_{n=1}^{N} \log\left(\frac{D_{n,t-1}}{D_{t-1}}\right) \cdot Panic_{n,t}}_{\text{New control}}$$

with $D_{t-1} = \sum_n D_{n,t-1}$. Here, $\eta^y_{i,h}$ and $s^y_{t,h}$ denote state and seasonal fixed effects, and $\mathbf{X}_{i,t-l}$ includes four lags of the factors $F^j_{i,t}$ and lags of the dependent variable $y_{i,t}$. Online

Appendix C.2 replicates the empirical analysis of Section 4 using this alternative factorization. The results are very similar to our original estimates, indicating that the size effect in the spatial propagation of panics is limited.

## C.1 Panic Dummies for Origin States Only

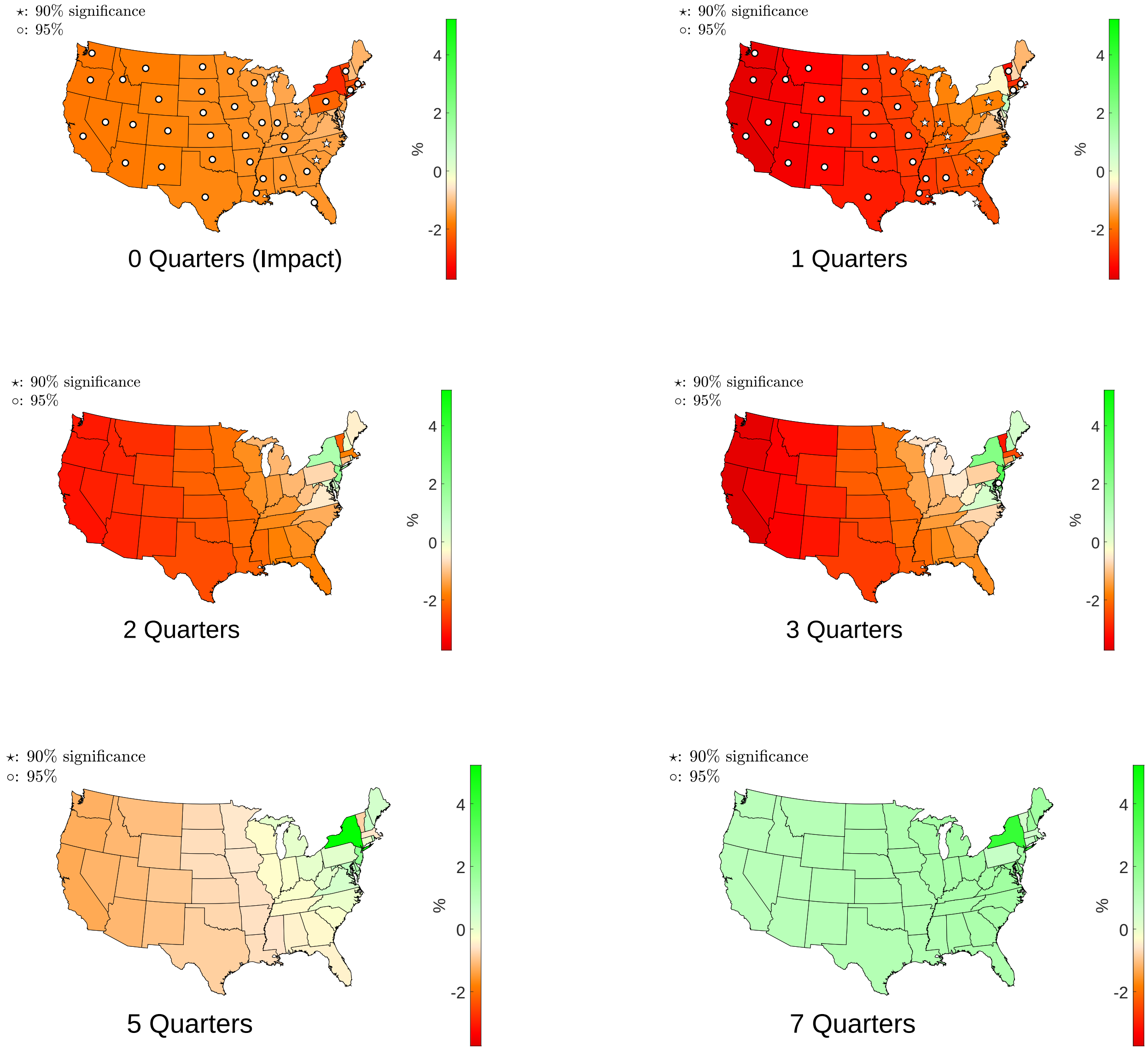



Figure C.1: Impulse-response of bank deposits to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. ○ $p < 0.05$, ⋆ $p < 0.1$. Here, we assume $Panic_{i,t} = 1$ only for the origin state $i$ where each panic listed in Table II.2 (Jalil, 2015) is known to have originated.

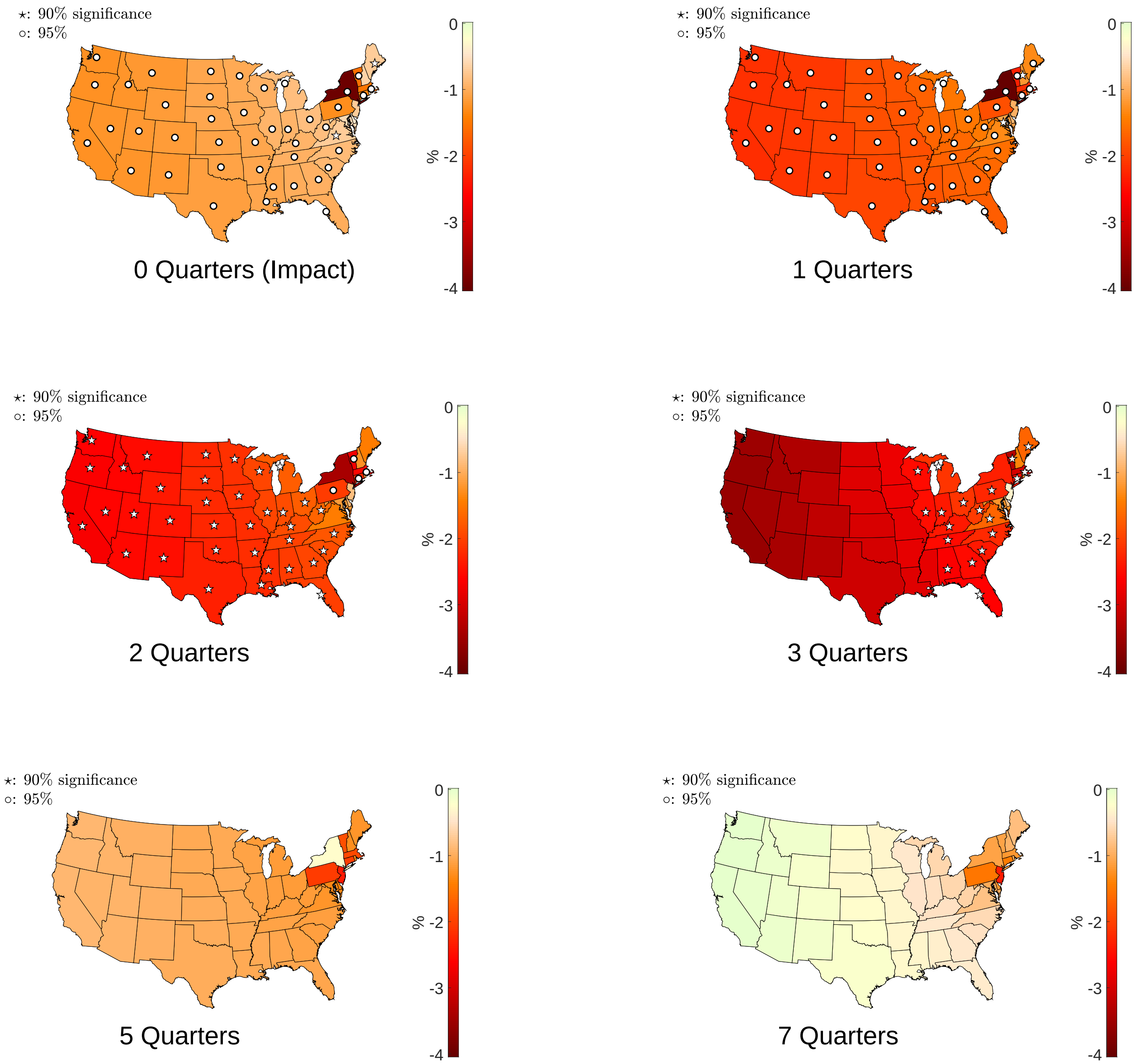



Figure C.2: Impulse-response of bank loans across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$. Here, we assume $Panic_{i,t} = 1$ only for the origin state $i$ where each panic listed in Table II.2 (Jalil, 2015) is known to have originated.


Figure C.3: Impulse-response of liquidity ratios across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$. Here, we assume $Panic_{i,t} = 1$ only for the origin state $i$ where each panic listed in Table II.2 (Jalil, 2015) is known to have originated.

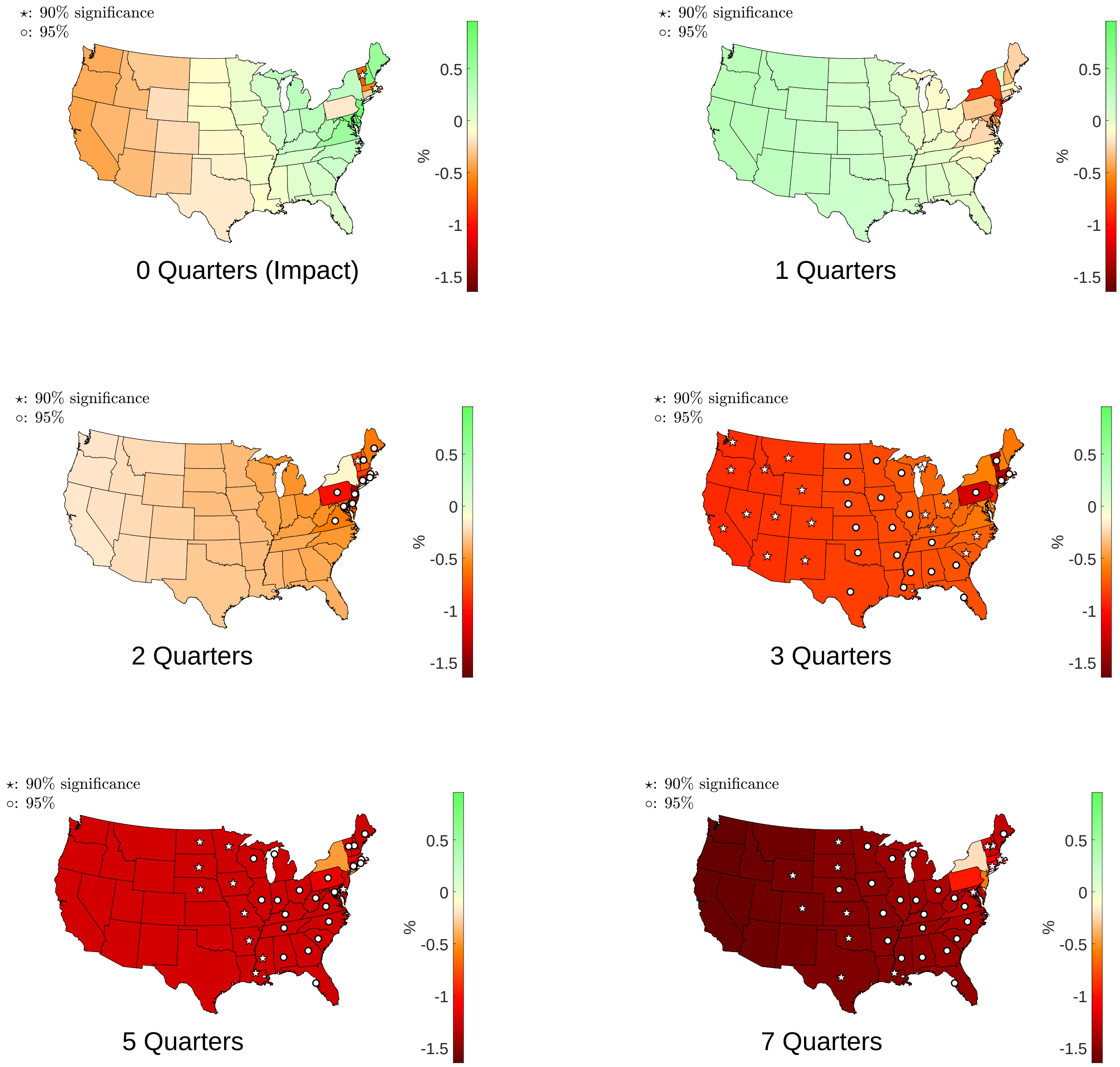



Figure C.4: Impulse-response of bank capital across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ$ $p < 0.05$, $\star$ $p < 0.1$. Here, we assume $Panic_{i,t} = 1$ only for the origin state $i$ where each panic listed in Table II.2 (Jalil, 2015) is known to have originated.

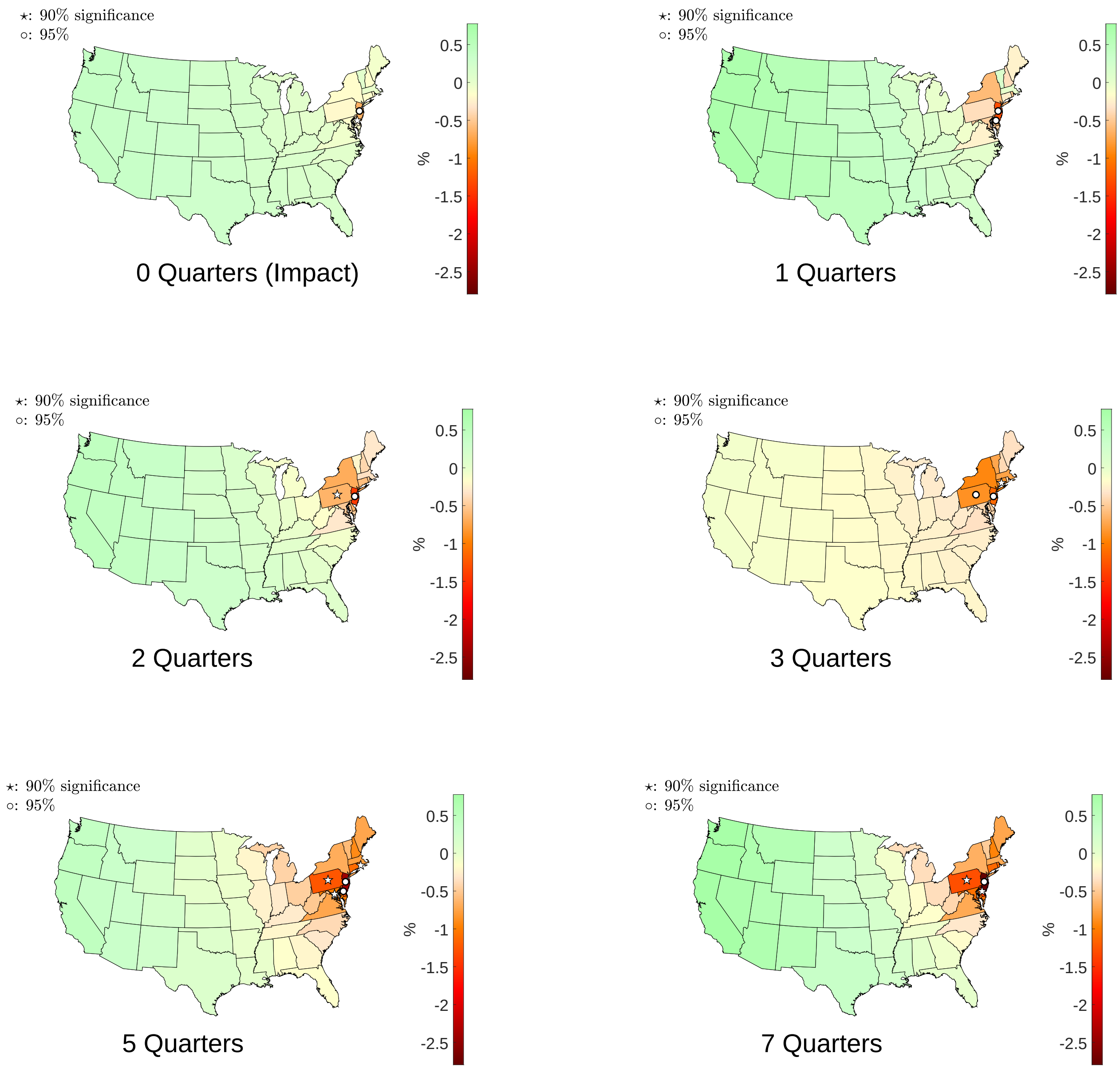



Figure C.5: Impulse-response of the number of banks across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ\ p < 0.05$, $\star\ p < 0.1$. Here, we assume $Panic_{i,t} = 1$ only for the origin state $i$ where each panic listed in Table II.2 (Jalil, 2015) is known to have originated.

## C.2 Deposit Size Effects

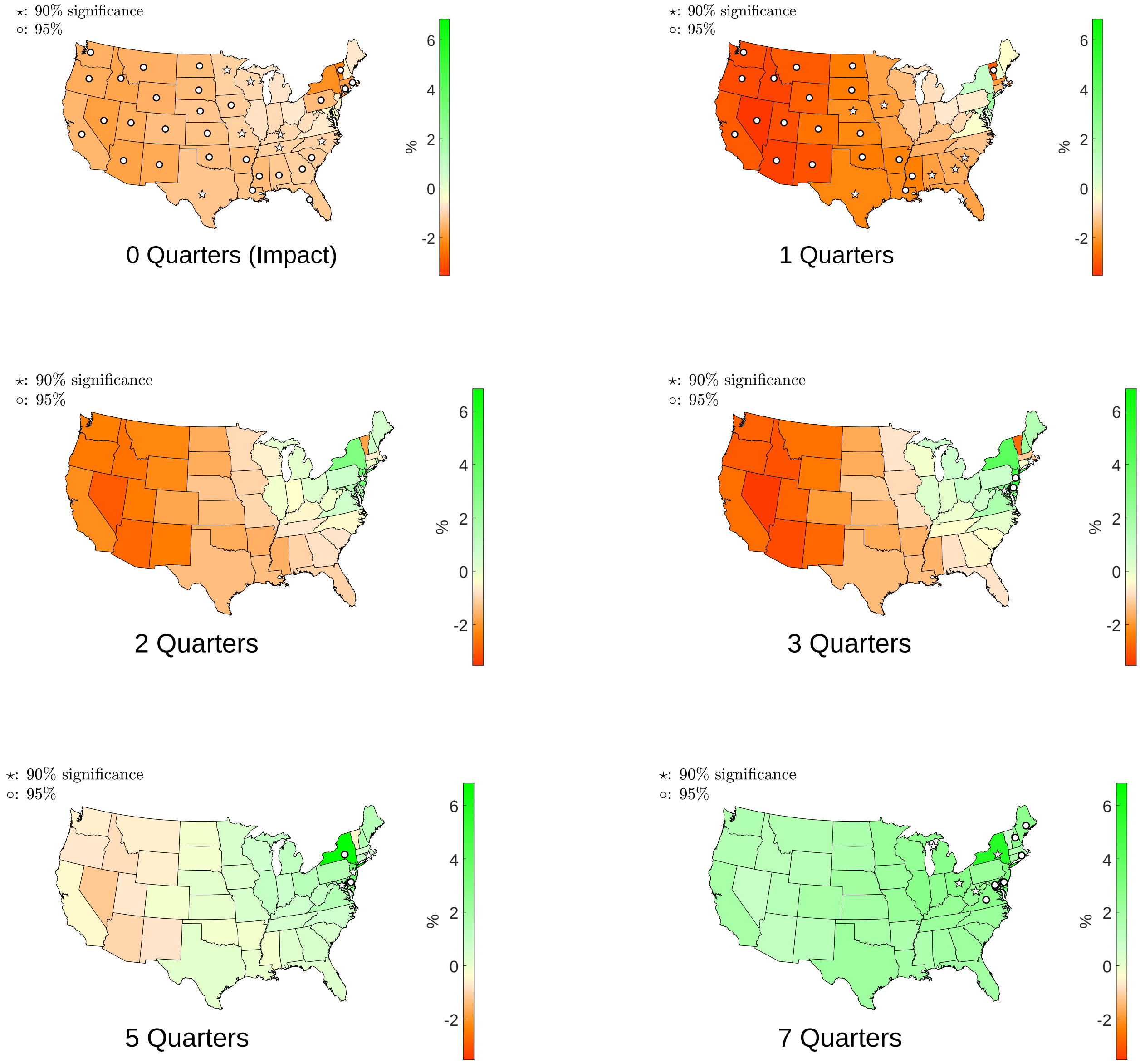



Figure C.6: Impulse-response of bank deposits to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. Here, we control the relative size of deposits in the previous quarter interacted with panic dummies.

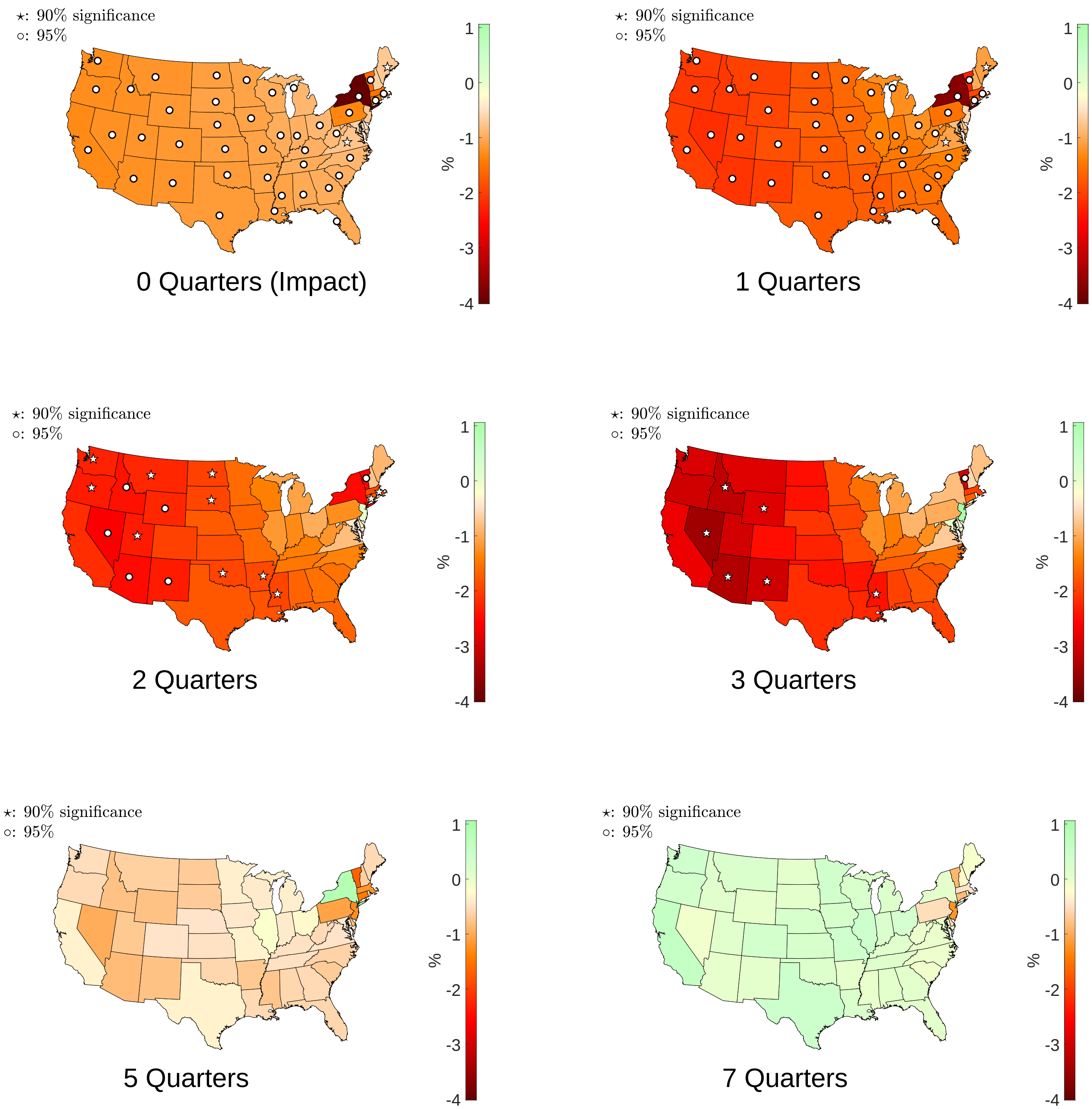



Figure C.7: Impulse-response of bank loans across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ p < 0.05, \star p < 0.1$. Here, we control the relative size of deposits in the previous quarter interacted with panic dummies.


Figure C.8: Impulse-response of liquidity ratios across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ p < 0.05, \star p < 0.1$. Here, we control the relative size of deposits in the previous quarter interacted with panic dummies.

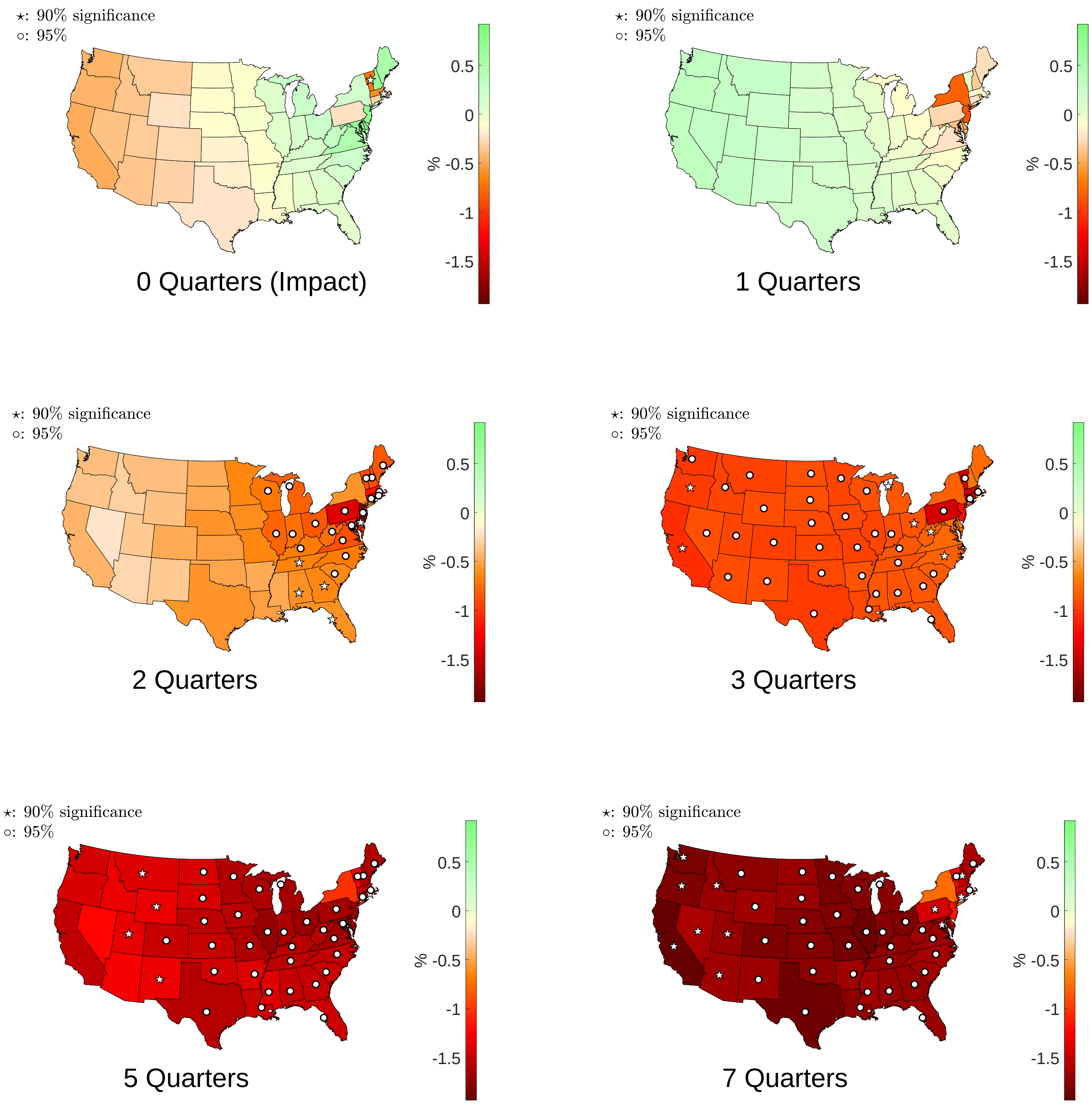



Figure C.9: Impulse-response of bank capital across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ p < 0.05, \star p < 0.1$. Here, we control the relative size of deposits in the previous quarter interacted with panic dummies.

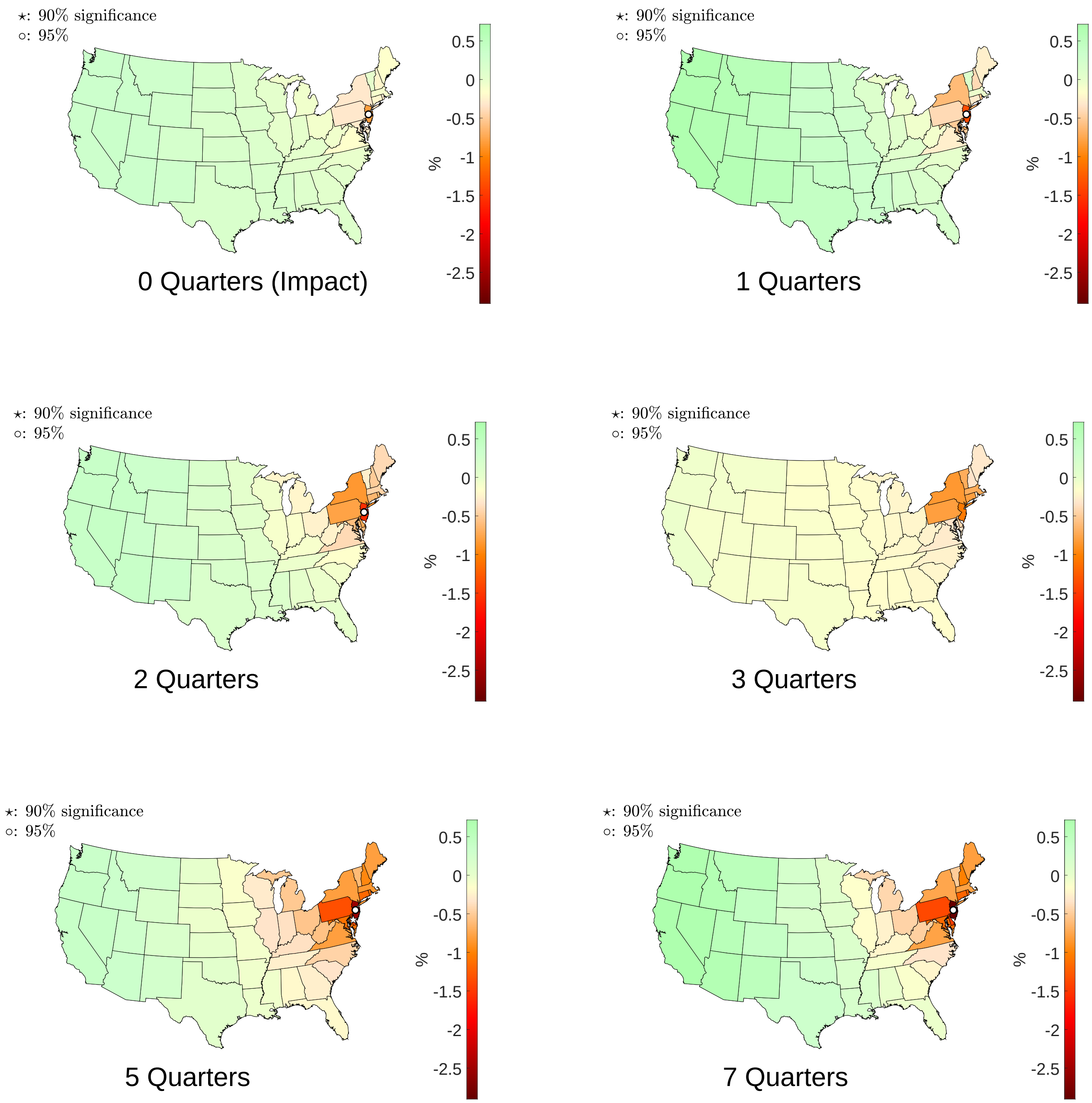



Figure C.10: Impulse-response of the number of banks across states to a panic from New York. Right bar reports graph estimates color scale. P-values constructed using Driscoll-Kraay standard errors. $\circ p < 0.05, \star p < 0.1$. Here, we control the relative size of deposits in the previous quarter interacted with panic dummies.

## References

**Jalil, Andrew J**, "A new history of banking panics in the United States, 1825–1929: Construction and implications," *American Economic Journal: Macroeconomics*, 2015, *7* (3), 295–330.