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Enhanced Liability and Bank Failure

Finance Working Paper N° 1169/2026
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Abstract

Does enhanced liability for shareholders and managers reduce bank failure? We compare the performance of ~4,200 state-regulated banks of similar size in neighboring U.S. states with different liability regimes during the Great Depression. The distress rate for limited liability banks was 29% higher than for banks with enhanced liability. Results are robust to a diff-in-diff analysis incorporating nationally regulated banks (that faced the same regulations everywhere) and are not driven by other differences in regulation, local characteristics, or differential selection into state-regulated banks. Our results suggest that exposing shareholders and managers to more downside risk can substantially reduce bank failure.

Keywords: Limited Liability, Bank Risk Taking, Financial Crises, Great Depression

JEL Classification: G21, G28, G32, N22

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Enhanced Liability and Bank Failure*

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15 May 2026

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This paper subsumes Aldunate, Felipe, Dirk Jenter, Arthur Korteweg, and Peter Koudijs, "Shareholder liability and bank failure," and Anderson, Haelim, Daniel Barth, and Dong Beom Choi, "Does increased shareholder liability always reduce bank moral hazard?" The authors declare that they have no relevant or material financial interests related to the research described in this paper. We thank conference participants at the 2020 SFS Cavalcade, the 2021 American Finance Association meetings, the 12th International Conference of Finance at UC, and the 2021 RFCS Winter Conference, and seminar participants at BI Oslo, ESCP Paris, Florida International University, King's College London, LSE, Queen's University Belfast, Stanford, Stockholm School of Economics, Temple University, Tulane University, UBC, Universidad Adolfo Ibañez, University of Chile, the University of Exeter, the University of Miami, the University of Montevideo, the University of Texas at Austin, USC, Yale, and Yeshiva University for feedback. We are grateful to Jack Liebersohn (RCFS Conference discussant), Justin Murfin (AFA discussant), Ulf Axelson, Markus Brunnermeier, Charles Calomiris, Vicente Cunat, Amil Dasgupta, Peter DeMarzo, Daniel Ferreira, Felipe González, Luca Lin, Naomi Lamoreaux, Martin Oehmke, Paul Pfleiderer, Gary Richardson, Sam Rosen, Amit Seru, and John Turner for valuable comments and suggestions. We thank Stanford Library for help digitizing the State bank reports. The views stated herein are those of the authors and are not necessarily the views of the Federal Reserve Board or the Federal Reserve System. All errors are our own. Aldunate acknowledges funding from Centro de Gobierno Corporativo Universidad Católica. Koudijs acknowledges support from ERC COG #HILL.

"If a bank gets to where it needs government assistance, the responsible CEO should lose his net worth and his spouse's net worth." (Warren Buffett, CNBC, May 4, 2019)

A corporation's shareholders and managers have different incentives from its creditors. This creates agency problems that are a core friction in corporate finance and which banking corporations are particularly prone to. Banks have the privilege of issuing deposits, which form the basis of the payment system. This allows banks to be highly levered. With limited liability for shareholders and managers, this creates strong risk shifting incentives. Excessive risk taking has large negative externalities: bank failures can lead to widespread financial crises and large output losses, and bailouts are costly.[1]

Since the beginning of modern banking in the early 19th century, policy makers and regulators have devised a variety of tools to rein in bank risk taking. One often-used tool was to force shareholders and managers to face some form of enhanced liability. From 1817 onwards, shareholders in most U.S. banks had double liability, meaning that for a bank share with a par (or paid-in) value of $100, they faced an additional penalty of (at most) $100 in case the bank failed. Bank managers, as large shareholders, faced the same enhanced liability.[2] When the National Banking system was set up in 1864, Senator Sherman, one of its architects, stated that double liability was meant to "prevent the *stockholders* and *directors* of a bank from engaging in *hazardous operations*." This system remained the norm until 1933, when the American banking system was restructured.

In this paper, we evaluate whether enhanced liability for shareholders and managers is an effective tool to reduce bank failures. To do so, we compare the performance of U.S. banks with different liability regimes during the Great Depression. While most U.S. banks had double liability, state-regulated ("State") banks had limited ("single") liability in some states. This allows us to compare double and single liability banks that were geographically close and similar in size.

[1] On the output losses associated with banking crises see, among others, Allen and Gale (2000), Diamond and Rajan (2005), Boyd, Kwak and Smith (2005), Allen and Carletti (2006), Acharya and Yorulmazer (2008), Reinhart and Rogoff (2009), Ivashina and Scharfstein (2010), Acharya, Shin, and Yorulmazer (2011), Iyer and Peydro (2011), Jorda, Schularick and Taylor (2013), Acharya, Le, and Shin (2017), and Baron, Verner, and Xiong (2021). On costly bailouts, see, for example, Acharya, Drechsler, and Schnabl (2014).

[2] We document, for a sample of banks, that typical managers could lose a substantial share (~20-50%) of their net worth in case of bank failure.

We find that single liability strongly increased the probability of bank failure. We consider four dimensions of distress: permanent suspensions, acquisitions (where we consider the acquired bank as failed), temporary suspensions (which typically led to a recapitalization), and "troubled raising" (the issuance of new equity to replenish capital). "Total trouble" (aggregating these four measures) was 29% higher for banks with single liability. The effect is strongest for permanent suspensions and acquisitions, with single liability banks 20% more likely to suspend and 69% more likely to be acquired. Acquisitions were commonly used to resolve bank distress during the Great Depression (Carlson 2010),[3] and they were associated with large capital write-downs, especially if the target was a single-liability bank. Conditional on survival, we find suggestive evidence that single liability banks wrote down more capital (indicative of larger losses) and lost more deposits (indicative of a greater reduction in confidence) than double liability banks. As a result, the size of their balance sheets shrank more.

In 1928, before the Great Depression, banks with single liability did not have higher leverage. This suggests that the higher failure rates were due to the extension of riskier loans before 1929, and/or due to more risk shifting once banks sustained their first losses ("gambling for resurrection"). Looking at a limited set of states with available data, we show that single liability banks had riskier assets in 1928. They also paid higher deposit rates and had a higher return on equity before the Great Depression; both of which are consistent with more risk taking. The perception of greater risk might have led to more runs on single liability banks (Goldstein and Pauzner 2005, Egan, Hortaçsu and Matvos 2017). However, using evidence from the Fed's bank failure forms, we find only limited evidence that single liability banks experienced more runs.

We use National banks in the same states to control for local shocks. National banks, like State banks, operated locally, but had a national regulator and, as such, faced uniform regulations and were subject to double liability everywhere. Our conclusions hold up in a diff-in-diff analysis. Relative to National banks, State banks were 10 percentage points more likely to experience "total trouble" if located in a state with single liability:

[3] Richardson (2007b) and Mitchener and Richardson (2020), amongst others, interpret banks being acquired during the Great Depression as a sign of distress.

Total trouble:	National banks	State banks	*Diff*
DL states	23.7%	28.5%	*4.8%*
SL states	21.0%	35.8%	*14.8%*
Diff	*-2.7%*	*7.3%*	***10.0%***

"DL/SL states": states with double or single liability for State banks. Source: Table 6, Panel B.

We investigate whether states differed on other regulatory dimensions that could explain our results. Although bank regulation varied from state to state, it was not systematically weaker in states with single liability. Also, we test whether Fed membership, the endogenous selection into State versus National banks, being located in (central) reserve cities, or other location characteristics can explain our results. None appear to do so.

Our results are important for at least three reasons. First, since the Global Financial Crisis of 2008, there have been ongoing efforts to make the banking system safer. One focus has been on raising capital requirements, in part to incentivize shareholders to reduce bank risk taking.[4] Empirical work on this idea has been hampered by the fact that there is little cross-sectional variation in capital requirements within countries, and by the difficulty of separating the incentive effect of additional capital on bank failures from the mechanical effect of higher capital buffers. Because double liability's penalty payments become available only after a bank fails (and therefore do not *directly* change its solvency), our study isolates the incentive effects of increasing shareholders' downside exposure. Our findings indicate that capital requirements stabilize banks not only by increasing capital buffers, but also by changing bank behavior.

Second, our results speak to proposals to increase the downside exposure of key decision makers in banks through, for example, deferrals or clawbacks in executive pay.[5] Several studies have shown that aligning bankers' incentives with limited liability shareholders, without additional downside exposure, is associated with worse performance during financial crises, excessive risk

[4] See, for example, Admati and Hellwig (2013) and Bhagat and Bolton (2014).

[5] The Squam Lake report by French et al. (2010), which discusses fixes for the financial system in the wake of the Global Financial Crisis of 2008, recommends withholding a fixed amount of compensation, effectively turning bank managers into inside creditors (Sundaram and Yermack 2007, Edmans and Liu 2011). Greenwood et al. (2017) echo this recommendation, and Van Bekkum (2016) finds that more inside debt held by bank managers induces less risk taking. See also Rajan (2008), Blinder (2009), Bolton, Mehran, and Shapiro (2015), Hill and Painter (2015, p. 190), Kay (2015, p. 279), Luyendijk (2015, p. 254), Cohan (2017, p. 146), and Goodhart and Lastra (2020).

taking, less equity issuance, and hiding of losses.[6] In contrast, our results suggest that increasing bankers' downside exposure reduces risk taking.

Third, even though the Great Depression has been analyzed widely, the causes of this largest banking crisis in U.S. history are still debated.[7] Our paper contributes by showing that greater risk-taking incentives by single liability banks magnified the severity of the crisis.

The effect of enhanced liability on bank failure is not obvious. Double liability stipulates that, in case of bank failure, the banking supervisor levies a penalty on shareholders (up to the par or paid-in value of their shares) that is used to satisfy the bank's depositors and other creditors. All else equal, the primary effect of this additional penalty should be to reduce shareholders' risk-taking incentives, leading to less failure (Macey and Miller 1992, Esty 1998). There are, however, several forces that might weaken or even reverse this effect (we discuss these in more detail in the next section). First, with no deposit insurance during our sample period, depositors might not allow single liability banks to lever up as much as those with double liability. Second, depositors in double liability banks might permit more risk taking (Calomiris and Wilson 2004). Finally, adverse selection of double liability shareholders might reduce its effectiveness (Winton 1993, Kane and Wilson 1998).

The small literature on the effects of enhanced shareholder liability on bank distress has found mixed results. Some studies indicate that limited liability increases distress probabilities. For example, Turner (2014) provides qualitative evidence that limited shareholder liability in 19th century U.K. was associated with more bank failures. Koudijs, Salisbury, and Sran (2021) find that New England banks whose managers had less personal liability lost more capital after the Panic of 1873. Goodspeed (2019), studying pre-1863 U.S. data, shows that banks with single liability were more likely to fail in the Panic of 1837, yet were (insignificantly) less likely to fail

[6] See, for example, Fahlenbrach and Stulz (2011), Berger, Imbierowicz, and Rauch (2016), Goetz, Laeven, and Levine (2025), and Flanagan and Purnanandam (2023).

[7] See, amongst many others, Friedman and Schwartz (1963), Wicker (1996), and Mitchener and Richardson (2020) on the role of bank runs and the fall in the money supply, Bernanke (1983) on the drop in intermediation capital, Eichengreen (1992) on the role of the international Gold Standard, Temin (1976), White (1984), and Calomiris and Mason (1997, 2003) on the role of fundamentals and regional shocks, Eichengreen and Mitchener (2004) on the role of credit booms, Richardson and Troost (2009) and Carlson, Mitchener, and Richardson (2011) on the role of regional Federal Reserve banks, and Richardson (2007a), Heitfield, Richardson, and Wang (2017), Carlson and Wheelock (2018), Das, Mitchener, and Vossmeyer (2022), Mitchener and Richardson (2019), Calomiris, Jaremski, and Wheelock (2022), and Jaremski and Wheelock (2020) on the role of interbank networks.

in non-crisis years compared to banks with double liability. Other studies are less supportive. Grossman (2001), using U.S. state-level data from 1892-1930, observes more bank failures in states with single liability during normal times, but fewer failures during periods of banking crises, in particular 1930.[8] Mitchener (2005, fn. 67), using U.S. county-level data from 1929-1933, finds no statistically significant relation between shareholder liability and bank suspensions.

Given the theoretical ambiguity and mixed empirical evidence, the effect of shareholder liability on bank distress remains an open question. Our paper offers new evidence by studying the effects of a large economic shock – the Great Depression – on banks with different liability regimes. We improve on the existing literature by assembling a large sample of individual banks based on hand-collected failure and balance sheet data, and, most importantly, by carefully creating comparison groups.

Our analysis compares the failures of state-regulated banks ("State banks") in states that had single liability with those in neighboring double liability states. We compare like-with-like to the best of our ability.[9] Wicker (1996) and Calomiris and Mason (2003) show that banking panics often had a strong regional character. Hence, we focus on neighboring states and require the paired states to have similar failure rates of National banks, which faced the same regulations everywhere. Richardson and Troost (2009) and Jalil (2014) show that the policies of different Federal Reserve banks varied greatly during the Great Depression, with significant impact on bank outcomes. Therefore, we analyze state pairs that were part of the same Federal Reserve district. Federal Reserve (1932) and Wheelock (1995) observe much higher failure rates for small banks during the Great Depression. Therefore, we restrict our sample to banks that are on the common support of bank size within each state pair, and we control for bank size in our regressions. Our hand-collected data also allows us to control for other covariates that may explain bank failure.

Our sample selection procedure, described in Section III.B and Internet Appendix C.1, leads us to consider six single liability states: Alabama, Connecticut, Missouri, New Jersey, Tennessee, and Virginia. These are matched to six neighboring double liability states: Georgia, Kentucky,

[8] Internet Appendix F compares our analysis to that of Grossman (2001) and shows that the latter result is not robust to using standard econometrics and better data.

[9] Internet Appendix F shows that matching comparable single and double liability states is crucial. Without it, there are large differences in economic fundamentals between the two sets of states, and no material difference in State bank failure rates.

Maryland, Massachusetts, New York, and Pennsylvania, respectively.[10] We split up states that were part of two different Fed districts (Connecticut, Kentucky, Missouri, New Jersey, Pennsylvania, and Tennessee). As a result, our analysis spans eight state-Fed district pairs. Figure 1 shows the selected pairs.

Our findings add to a broader literature on the effects of shareholder liability on bank risk taking. Using a sample of 84 publicly traded State banks in California, Illinois, and Missouri in the early 20th century, Esty (1998) finds that limited liability was associated with higher asset and equity return volatility. In contrast, looking at a sample of around 40 publicly traded New York City banks, Calomiris and Wilson (2004) show that between 1929 and 1933, limited liability was associated with lower asset return volatility. Koudijs, Salisbury, and Sran (2021) find that New England banks whose managers had less personal liability made riskier loans in the 1870s.[11] Other studies use bank leverage as measure of risk taking. Theoretically, the impact of limited liability on leverage is ambiguous. On the one hand, not having to pay a penalty in bankruptcy is an incentive to choose higher leverage. On the other hand, limited liability might increase the ex-ante cost of debt, so banks might choose to borrow less. Analyzing different datasets and time periods, some studies report a positive effect of limited liability on leverage (Grossman 2001, Mitchener and Richardson 2013, Koudijs, Salisbury, and Sran 2021), while others find no or a negative effect (Macey and Miller 1992, Evans and Quigley 1995, Bodenhorn 2015, Grodecka and Kotidis 2016).

Different from this literature, we measure risk taking using bank distress, an ex-post measure. This has three advantages. First, distress is widely observable, while detailed information about the composition and riskiness of bank assets is only available for a limited set of states. Second, if banks hide risk, it will be invisible on their balance sheet. Third, risk taking has a straightforward effect on distress probabilities, while its effect on variables such as leverage is ambiguous.

Even though we find that double liability was effective in reducing bank distress, it was repealed after 1933 (Mitchener and Richardson 2013). What explains this? Marquis and Smith (1937) question double liability's effectiveness because assessments were often incomplete and because

[10] In a robustness test, we include Illinois and West Virginia as additional double liability states.
[11] De Jong, Kooijmans and Koudijs (2025) show that Amsterdam investment bankers with less personal liability underwrote worse plantation mortgage-backed securities from the Dutch colony Suriname in the 1760s.

many double liability banks failed during the Great Depression. This ignores that bank failures might have been worse without double liability, which our evidence suggests.

In contrast, Macey and Miller (1992) argue that abolishing double liability was a political decision that was not economically optimal. During the Great Depression, many shareholders had to pay double liability claims, right at a moment when they were already in financial trouble. Many were not involved in the banks' management and not directly to blame for failure. This created political resentment. The creation of deposit insurance, in combination with increased government monitoring, appeared sufficient to safeguard the financial system, and double liability was repealed (White 2011).

The rest of this paper is organized as follows. Section I discusses single and double liability and their expected effects on risk taking and bank survival. Section II reviews the historical background, focusing on bank liability regimes and developments during the Great Depression. Section III explains our data and reports summary statistics. Section IV presents the main empirical analysis. Section V concludes.

I. Conceptual framework

In this section, we first discuss the differences between double liability and capital requirements. We then analyze the effects of double liability on banks' risk-taking incentives.

A. Double liability vs. capital requirements.

The key difference between single (SL) and double liability (DL) is that under DL shareholders pay a penalty in case the bank fails. This makes DL to some degree comparable to higher capital requirements (or adding contingent capital). The crucial difference, however, is the timing of when this additional capital becomes available. With higher capital requirements, it is available before banks fail, and before any bankruptcy costs are incurred. With DL, the additional capital is only available afterwards. As such, DL does not have the same "buffer" function as capital requirements. For example, if a DL bank has half the book capital of an SL bank – so both have the same total (contingent plus non-contingent) capital – the DL bank requires only half as large a drop in asset values to become insolvent.[12] Moreover, because shareholders' additional payments

[12] In addition, because shareholders had to sell illiquid assets, DL payments often arrived with delay (Macey and Miller 1992), which further reduces the buffer function of DL.

are made after failure, DL exposes them to bankruptcy costs. Consequently, DL provides strong incentives to limit risk.

If shareholders are liquidity constrained, having to deliver additional capital only after a bank fails is an advantage of DL over higher capital requirements. For example, bank shareholders might need the additional capital for their private businesses and might be unable to borrow using bank shares as collateral.[13] This increases DL banks' charter values (compared to SL banks with higher capital requirements) and makes failure more costly, so DL shareholders have an even stronger incentive to safeguard banks (Hellmann, Murdock, and Stiglitz 2000). This benefit has to be traded off against the larger administrative burden of collecting penalties after a bank fails.

B. Troubled banks[14]

A bank was "troubled" if it had sustained losses such that its paid-in capital (the lion's share of most banks' equity) was impaired. A troubled bank had multiple options. The most benign was to write down its capital and reduce the size of its balance sheet. This was constrained by the requirement to maintain capital at or above the regulatory minimum dollar amount. Alternatively, a bank could try to raise capital from outsiders or, in certain states, it could levy a (typically voluntary) assessment on existing shareholders to make up the deficit. Such recapitalizations might take place after a bank had temporarily suspended.

If a bank was unable to fix the capital impairment, it was forced to make a deal with another bank, or close. If still solvent, a bank would typically try to negotiate a deal. It could try to sell its assets to a non-troubled bank and use the proceeds to repay depositors, returning any surplus to shareholders. During the Great Depression, this was difficult to accomplish. Due to the Gold Standard and the occurrence of bank runs, there was high demand for cash by both the public and banks. Few banks were willing to use their cash to purchase "slow" assets.

Troubled banks could try to get acquired by a stronger bank that would take over both its assets and its liabilities, with no cash payment (Richardson 2007b, Carlson 2010). According to Upham and Lamke (1934, p. 117), such acquisitions, "important among state as well as national banks, were very numerous." An acquisition was risky for the acquirer. Dissenting shareholders of the

[13] National and state banking acts typically restricted banks from making loans on the collateral of bank shares.
[14] This section is based on Columbia Law Review, 32-8 (Dec. 1932), pp. 1395-1410, and Upham and Lamke (1934).

target bank could sue to be bought out at the "true" value of their shares. Moreover, acquiring additional liabilities might put the acquirer's other liabilities at risk, which in some states was forbidden by law.[15] Section IV.B.2 has a detailed analysis of the acquisitions in our sample.

If no acquirer could be found, a troubled bank could ask another bank to act as its liquidating agent. In this case, the stronger bank would (for a fee) liquidate the assets of the troubled bank. If the revenues were sufficient to meet liabilities, the surplus went to the shareholders of the failed bank. If the revenues were insufficient, the same shareholders, if subject to double liability, remained responsible for the deficit.

If no deal of any type was possible, the troubled bank would be taken into receivership. Depending on the state, either the court appointed a receiver, or the banking department assumed this role. The receiver typically sought to liquidate the bank's assets. It would sell off all "acceptable assets" to another bank, who would usually also handle (for a fee) the liquidation of all doubtful assets. If subject to double liability, the failed bank's shareholders remained liable for any deficit.

C. Double liability and bank risk taking

How do risk taking incentives, on the asset and/or the liability side of the balance sheet, differ for SL and DL shareholders?

First, hold book leverage constant. In that case, DL shareholders' additional downside exposure should make them more averse to increasing asset risk. Shareholders with SL, on the other hand, are protected by limited liability and have standard risk shifting incentives, especially if the bank cannot commit to safe lending and if the quality of its assets is unobservable. SL banks should therefore take more asset risk than DL banks and be more likely to fail in bad states of the world. Moreover, after a negative shock, SL banks have stronger incentives to further increase risk ("gamble for resurrection") and weaker incentives to raise new capital (Admati et al. 2018).

Of course, leverage may differ between SL and DL banks, potentially undoing any effect on asset risk. However, the effect of the liability regime on bank leverage is ambiguous. With leverage itself observed, there should be little incentive for shareholders to increase risk on the liability side, especially since deposits are callable. All else equal, DL banks might choose lower leverage simply

[15] This was true in Connecticut, Georgia, New Jersey, and New York. Granja, Matvos, and Seru (2017) find that in modern times, failed banks are predominantly acquired by well-capitalized local banks operating in similar lines of business. If local banks are undercapitalized, then less similar, remote banks step in.

because bank failure is more costly for their shareholders. Koudijs, Salisbury, and Sran (2021) show theoretically that if bankers are risk averse, they value the option to default on bank deposits since it shares risk between them and depositors. DL reduces this risk sharing and induces bankers to choose lower leverage. This, in turn, further reduces their risk taking on the asset side.

Conversely, DL banks might choose higher leverage, as depositors charge lower interest because of the additional payment in default and because they understand that DL banks take less asset risk. Higher leverage in turn encourages risk shifting and reverses some of the direct incentive effect of DL on risk taking. At the same time, SL banks might choose lower leverage to commit themselves to investing in safer assets. In the extreme, these effects might undo the effect of DL altogether and create a situation where DL banks are more highly levered than SL banks, yet take the same level of risk on the asset side.

Even without higher leverage, the literature has identified several other reasons why DL might be ineffective or even counterproductive. First, depositor discipline, highlighted by many as important for reducing bank risk (e.g., Calomiris and Kahn 1991, Diamond and Rajan 2001), might be weakened. Depositors in DL banks receive a payout in case the bank fails, which reduces their optimal monitoring effort (Calomiris and Wilson 2004). Second, DL shareholders might be adversely selected. That is, only people with little personal wealth might be willing to hold bank shares, and would have only weak incentives to rein in risk taking (Winton 1993, Kane and Wilson 1998).[16] Moreover, if skill and wealth are positively correlated, the quality of shareholder monitoring might decrease. New York Governor, and future U.S. President, Martin Van Buren voiced this concern in 1839 when he warned of the potential "low character" of shareholders with DL (Knox 1900, p. 400). Third, DL might have no effect if banks' charter values are so high that shareholders never want to take risks that might lead to bank failure.[17]

To summarize, DL provided regulators with a tool to curb bank risk taking that might have been equally or even more effective than modern capital requirements. However, bankers' and others'

[16] Empirical evidence does not support this concern. See, for example, Hickson and Turner (2003a, 2003b, 2005), Acheson and Turner (2006, 2008), Turner (2009), and Bodenhorn (2015).

[17] Keeley (1990), Suarez (1994), and Repullo (2004) model the link between charter values and risk taking. On the importance of charter values, see Petersen and Rajan (1994, 1995), Berger and Udell (1995), Demsetz, Saidenberg, and Strahan (1996), Dahiya, Puri, and Saunders (2003), Berger et al. (2005), Song and Thakor (2007), Hellmann, Lindsey, and Puri (2008), Drucker and Puri (2009), Bharath et al. (2011), Ivashina and Kovner (2011), Iyer and Puri (2012), Puri, Rocholl, and Steffen (2017), and Ben-David, Palvia, and Stulz (2020).

endogenous responses to DL may have undermined its effectiveness. It is ultimately an empirical question whether DL achieved its goal of reducing bank risk and failure.

II. Historical background

In this section, we provide more detail on the structure and regulation of the U.S. banking system during our sample period, and we briefly discuss how the Great Depression played out for the banking system.

A. Structure of the banking system in the 1920s

The American banking system of the 1920s was organized around local unit banks which were regulated at either the national or state level, depending on what type of charter a bank operated under.[18] The regulator for National banks was the Office of the Comptroller of the Currency (OCC); for State banks it was the local state banking department. Regulations could differ substantially. First, shareholders of National banks faced double liability, whereas in some states, State banks had single liability. Second, National banks typically had higher reserve and capital requirements. Third, National banks faced more restrictions on their loan portfolios; most notably, loans backed by real estate (important for rural banks) were restricted to 25% of total equity capital.[19] Fourth, the supervision by state banking departments was typically laxer than that by the OCC.[20] Finally, until the McFadden Act of 1927, National banks faced more restrictions on opening branches than State banks (White 1983, 2011, Robertson 1995, Jayaratne and Strahan 1996, Mitchener 2005, 2007).

National banks were automatically members of the Federal Reserve System, which gave them access to the Fed's discount window. State banks could decide to become members if they fulfilled the same capital and reserve requirements as National banks (White 1983, p. 98, 135). Smaller, rural banks typically decided not to do so: First, many did not have enough capital to qualify. Second, many had little collateral eligible at the Fed's discount window, and they could obtain indirect access through their Fed-member correspondent banks (we discuss correspondent banks

[18] Our State bank category contains both banks and trust companies. We combine the two because, for the states in our sample, few regulatory differences remained between them by the end of the 1920s (Federal Reserve 1932, p. 54, 58, White 1983, p. 40).
[19] Such loans were deemed too illiquid and long term, thus creating too much maturity mismatch (Federal Reserve 1932, p. 126).
[20] Agarwal, Lucca, Seru, and Trebbi (2014) show that this continues to be true in recent years.

in section IV.B.4). Third, they typically held few reserves, so the Fed's higher reserve requirements were particularly costly. Fourth, reserves at the Fed paid no interest, whereas money deposited at correspondent banks did (White 1983, p. 133-4, 156). Larger State banks often did become Fed members, typically passing through discount window liquidity to other banks in their network (Anderson, Calomiris, Jaremski, and Richardson 2018). Even though the Fed had the right to examine State member banks on an ad hoc basis, the local state banking department remained their primary regulator (Federal Reserve 1932, p. 25, 31, White 1983, p. 166). Compared to National banks, they continued to face fewer restrictions on their loan portfolios, and they were able to branch statewide (if allowed by state law), a right that National banks only obtained after 1927.

We can, therefore, distinguish between two types of State banks. The first were small, often rural banks, that did not have enough capital to become a National bank or join the Federal Reserve system, and for whom the costs likely far outweighed the benefits. The second were larger, often urban banks who became Fed members, but who valued more lenient regulation or preferred to deal with the state regulator, and therefore did not seek a national charter.[21] In Internet Appendix A.1 we show that SL banks were less likely to be a member of the Fed. In our robustness analysis, we show that our results continue to hold when only considering non-Fed members.

B. The regulation of State banks

Because state banking laws closely followed the National Banking Act (which regulated National banks), the laws were relatively homogenous. Nevertheless, important differences remained. The choice of single or double liability, discussed in the next section, was one of them. We hand-collected information about other banking regulations. There were differences in capital and reserve requirements, restrictions on particular loan types, the authority of state banking departments, and limits on branch banking.[22] There were barriers to entry: banks could only obtain a charter if they raised a minimum amount of equity capital (Federal Reserve 1932, White 1983, Mitchener 2005, 2007, Carlson and Mitchener 2009). Internet Appendices A.2 and A.3 provide

[21] Based on a questionnaire, the Federal Reserve concluded in 1932 that prestige was the main reason to apply for a national charter, while the ability to branch, fewer restrictions on real estate loans, greater ability to carry on a trust business, and laxer supervision were the main motivations for pursuing a state charter (Federal Reserve 1932, p. 100).
[22] No bank operated across state lines. Branching, if allowed, was typically restricted to the same town or (sometimes) county. In only two states in our sample, Virginia and Maryland, could banks branch statewide.

more detail and, importantly for interpreting our results, show that regulations were not systematically different between single and double liability states.

Several U.S. states experimented with deposit insurance schemes in the early 20th century, all of which ended during the 1920s or early 1930s (Chung and Richardson 2006, Aldunate 2019, Calomiris and Jaremski 2019; Federal Deposit Insurance was only introduced in 1934). As deposit insurance might have long-lasting effects on the structure of the banking system, for example by increasing the number of small banks, we exclude the affected states from our analysis.

C. Liability for bank shareholders

Additional liability for bank shareholders was seen as an important tool to curb risk taking. By 1830, most U.S. states limited shareholders' liability to their invested capital (Blumberg 1985). Banks were the exception, and many states increased bank shareholders' liability during the 19th century. For example, New York banks had double liability between 1827 and 1829, and then again after 1850. Massachusetts and Pennsylvania introduced it in 1811 and 1808, respectively. After limiting it in 1850 by only protecting banknotes, both states reintroduced full double liability around 1870 (Bodenhorn 2015, Mitchener and Jaremski 2015). The table below shows the years double liability was (re-)introduced in our sample states. By 1893, 36 years before the onset of the Great Depression, the laws had solidified and no further changes occurred.

GA	KY	MA	MD	NY	PA
1893	1893	Pre-1870	1851	1850	1876

Sources: Bodenhorn (2015), Mitchener and Jaremski (2015), state statutes

Upon the inception of the National Banking system in 1864, Senator Sherman, one of its architects, stated that double liability would "prevent the stockholders and directors of a bank from engaging in hazardous operations."[23] In 1919, at the Convention of the American Bankers' Association, it was argued that "the protection afforded by the double liability of their stockholders" was "paramount" for U.S. banks depositors.[24] At a Congressional hearing in 1932, Representative Louis T. McFadden, famous for the eponymous Act of 1927, stated that "banks have frequently used the double liability as a means of instilling confidence in the banks; and many banks have

[23] Congressional Globe, 1864, p. 1869.

[24] Virgil M. Harris, The Trust Department of a National Bank, *Proceedings of the Convention of the American Bankers' Association* (1919), p. 525.

announced their capital stock, and the stockholders' liability, as insurance to depositors," banker Ronald Ransom argued that to provide depositors with extra protection, "double liability of the stockholder is the answer", and banker William S. Elliot argued that double liability provides strong incentives: "there is a great loss that accrues to the managers and directors and stockholders of any bank that fails; and I want to tell you, in the great majority of bank failures, the officers and directors and stockholders use every effort to keep the bank from failing."[25]

There were multiple reasons why individual states introduced double liability for their banks. Mitchener and Jaremski (2015) suggest that shareholder liability was a cheap form of regulation compared to creating a costly banking regulator. Of the 39 states that eventually introduced double liability, 32 did so before the creation of their banking department. Another impetus was the banking act of 1864, which introduced double liability for National banks and nudged several states to do so as well. Finally, Grossman (2007) shows that states with a history of financial instability, and those with a larger financial sector, were more likely to adopt double liability.

Under double liability, shareholders faced a penalty in case the bank failed, up to the par value of their shares (equal to paid-in capital). Macey and Miller (1992) provide evidence that double liability was routinely enforced and widely upheld by courts, with no significant loopholes. There were a number of safeguards to prevent investors from escaping claims. If shares were sold after a bank had gotten into trouble, the seller remained liable. In some states, the seller remained liable for up to a year after a sale in case the purchaser became insolvent, even if the bank had not yet failed at the time of sale. During the Great Depression, many shareholders were hit by double liability claims (Roth 2009), and the recovery levels were similar to prior periods (Macey and Miller 1992).

D. Managerial ownership

Managers made the critical decisions in banks, including risk taking. Prior studies indicate that managerial ownership in banks was large, both as a fraction of shares outstanding and as a fraction of bankers' personal wealth (e.g. Macey and Miller 1992, Koudijs, Salisbury and Sran 2021, Jaremski 2024), even though the stock market boom of the 1920s widened ownership (Kane and Wilson 1998). This suggests that the liability regime may have affected bank outcomes by

[25] Congressional hearing "To Provide a Guaranty Fund for Depositors in Banks" (1932), p. 50, 176, 185.

changing managerial incentives. Because of data limitations – information about executive ownership is only available for National Banks – we cannot test for this. Instead, we provide suggestive evidence for the importance of this mechanism.

We use detailed information about managerial ownership and estimates of managers' private net worth from the OCC's annual examination reports. We collect information for a random 10% sample of National banks in New York and New Jersey. Information is available for bank presidents, vice-presidents and cashiers – the most important managers. Bank presidents were formally responsible for the management of the bank (like a CEO), while cashiers managed day-to-day affairs (like a combined COO and CFO). Vice-presidents typically had a supervisory role. The OCC reports private net worth as assets and liabilities that can be easily verified (stocks, bonds, real estate, mortgages, etc.). There is no data on wealth invested in less common assets or personal loans.

Panel A of Figure 2 shows the distribution of managerial ownership, defined as the fraction of shares held by bank managers. The mean and median are 19 and 15%, respectively, indicating that executives owned a substantial share of their banks.

Panels B and C show how this translates into personal exposure. Panel B has the fraction of personal net worth invested in bank shares. Panel C shows the maximum fraction of net worth at risk from bank failure (assuming losses large enough for the full double liability claim to be paid). We differentiate by type of executive. All types had a substantial fraction of their net worth invested in their banks. Taking double liability claims into account, their exposure to bank failures was even larger. This exposure increases with how close managers were to actual lending decisions; the median exposure is 16% of net worth for vice-presidents, 29% for presidents, and 52% for cashiers. Actual exposures might have been even larger if bank failures were more likely in states of the world in which bank managers' other assets (such as stocks and real estate) were worth less. Panel D shows that executives' exposure was substantial across banks of different sizes. In sum, bank managers, especially those in DL banks, had a lot to lose from their bank's failure.

E. Great Depression

Many U.S. banks became troubled during the Great Depression. After the stock (and real estate) markets crashed in October 1929, the banking system soon came under pressure, with three banking panics between 1929 and 1933 (Friedman and Schwartz 1963). In February 1933, many

states proclaimed a "bank holiday" for their banks, suspending withdrawals, which newly elected President Roosevelt extended to banks nationwide on March 6, 1933. After granting the Fed powers to create emergency currency, many banks were reopened and the crisis dissipated (Silber 2009). More than a third of all commercial banks in existence in 1929 vanished during the Depression.

The banking panics had a strong regional character (see, amongst others, Wheelock 1995, Wicker 1996, Calomiris and Mason 2003, Heitfield, Richardson, and Wang 2017, and Mitchener and Richardson 2019). The majority of banks that failed were small and rural. These banks had been hit hardest by the agricultural depression of the 1920s. Moreover, rural areas appear to have been "overbanked", that is, state regulators seem to have allowed too many bank charters (Wheelock 1995, Federal Reserve 1932, p. 125). We take these patterns into consideration when matching neighboring single and double liability states for our empirical analysis.

As is the case in much of the literature (see, for example, Wheelock 1995), our sample runs up to February 1933. It therefore excludes bank closures caused by the banking holidays. During the national banking holiday, all banks were closed and only those permitted by regulators could reopen. These decisions might have, at least in part, been driven by broader economic or political considerations rather than the health of each bank.[26] In addition, the bank failure data we use is based on a Federal Reserve reporting system that did not track bank closures during state or national banking holidays (Richardson 2007c).

III. Data and empirical strategy

A. Sources

Data is hand collected from Fed bank failure records, annual National and State bank records, national bank examiner reports, and 6-monthly bank balance sheet and dividend data published by RandMcNally. Details are in Internet Appendix B.

B. State selection

To deal with regional differences in bank failures, we match each of the nine single liability states in 1928 to one neighboring double liability state. Richardson and Troost (2009) and Jalil (2014)

[26] Many banks recapitalized by issuing preferred stock to the Reconstruction Finance Corporation (RFC). As with other Depression-era programs, it is possible that the allocation of RFC funds was at least in part political (Wallis 1998, Mason 2003, Wallis, Fishback, and Glaeser 2007).

provide evidence of significant variation in the policies of regional Federal Reserve banks. Therefore, we select state pairs that (1) are direct neighbors, (2) are in the same Federal Reserve district, (3) have similar failure rates of National Banks, and (4) have similar State bank sizes. Internet Appendix C.1 provides details of the procedure. We split states that were part of two different Federal Reserve districts and match at the state-Fed district level. We omit all state-Fed districts with fewer than 50 State banks in 1928, and all states that had state-level deposit insurance schemes in the early 20th century.[27] We use National bank failure rates to match states that suffered similar shocks during the Great Depression. National banks faced DL in all states, so their failure rates provide a useful measure of the severity of the banking crises in each state. We use average bank sizes to match states with similar types of banks.

Our final sample consists of six single liability states spanning eight state-Fed districts, each matched to one neighboring state-Fed district with double liability (see Figure 1). Georgia and the part of Kentucky in Fed district 8 each serve as a match to two SL states, so their banks enter the sample twice. We cluster standard errors at the bank level to account for this.[28]

Internet Appendix C.3 looks at pre-trends in the number of State banks and bank failures, both relative to National banks, for the matched states in our sample and for all 48 contiguous states. In absence of bank-level failure data before 1929, we use state-level aggregates from Federal Reserve (1937). For states in our matched sample, single and double liability State banks were largely on parallel trends during the 1920s, even though pre-trends were not considered in our selection algorithm. In contrast, in the full sample of 48 states, the banking systems of SL and DL states were on different trajectories.

C. Common support of bank size and county characteristics

The majority of banks that failed during the Great Depression were rural and small. According to Wheelock (1995), bank size itself, and characteristics related to size, such as lack of diversification, were an important cause of failure. On the other hand, Figure C.4 in the Internet Appendix shows that in our sample, larger banks had higher leverage in 1928, which might have made them more likely to fail. Therefore, to compare like with like, our analysis compares banks of similar size.

[27] The former eliminates two of the SL states, the latter eliminates all potential DL-matches to one SL state.
[28] In a robustness test, we add two additional neighboring state-Fed districts with double liability to the sample. Internet Appendix C.2 describes the selection of the additional states.

We restrict both the single and the double difference samples to the common support of bank sizes in each state-Fed district pair. We implement this as follows: for each SL State bank, we select all DL State banks in the paired state-FED district with total assets between 75% and 125% (or ±$25,000, whichever is greater) of the SL State bank. For the double difference sample, we use the same cut-offs to also select National banks in the same state-FED district pair. Each selected bank is retained only once, even if selected multiple times. We drop SL banks if there is no corresponding DL bank that satisfies the above criterion. Details are in Internet Appendix C.4.[29]

Table 1 summarizes the distribution of bank sizes, both before and after restricting the sample to the common support. Statistics for the single (double) difference samples are on the left (right). Panel A reports results for the unrestricted samples. Two patterns stand out. First, as expected, National banks were on average larger than State banks. Second, State banks in DL states were on average four times larger than those in SL states. Therefore, if larger banks failed less, DL State banks might appear safer even if the liability regime is irrelevant. This effect is largely (but not entirely) driven by a subset of the DL states in the sample – New York, Pennsylvania, and Massachusetts – that were home to some of the largest banks in the country. This also explains why our DL states have larger National banks.

Panel B describes the common support samples. The size differences are much smaller, as some of the largest and smallest banks in each pair have been omitted. In the single difference sample, the number of banks falls only slightly. In the double difference sample, it drops by around 15%, as many small State banks and some of the largest State and National banks drop out. Even though the differences are reduced, State banks in SL states remain smaller than other banks.

Panel C applies weights such that each state-Fed district pair is weighted equally in the regression, irrespective of the number of banks. In particular, we weight banks by the inverse of the number of banks in their respective pair. There are large differences in the number of banks across state-Fed districts, so without weights our estimates would skew towards the state-Fed districts with the most banks. Weighting further reduces the size differences. Nevertheless, State banks in SL states

[29] When attempting one-to-one matching, we repeatedly matched to the same banks, thereby overweighting a small number of banks and underweighting others of similar size. Focusing on the common support gives all banks with similar size equal weight.

are on average somewhat smaller than their counterparts in DL states. Their median size is almost indistinguishable, though, and both remain smaller than National banks.

Panel D shows that the SL and DL samples are balanced in terms of rural versus urban banks. Using data from the 1920 and 1930 censuses, we compare two measures of urbanization, as well as manufacturing and agricultural output per capita, of the counties in which our banks were located. Our analysis assigns the county characteristics to each bank and then averages across banks in the same state-Fed district. There are no systematic differences between single and double liability banks. This is perhaps not surprising given our careful matching of state pairs and our focus on the common support of bank sizes.

To summarize, the State banks in our final sample are of comparable size across SL and DL states, but are smaller than National banks. In terms of county characteristics, SL and DL banks look similar. To account for any remaining differences, we add size and county characteristics to some of our regressions and show that the results are unaffected.

D. Summary statistics

Internet Appendix C.5 provides descriptive statistics. At the end of 1928, State banks had mean and median leverage, measured as liabilities/assets, of 82% and 84%, respectively. Given such high leverage, it is unsurprising that many banks failed during the Great Depression. 17% of State banks suspended permanently, 12% were acquired, 3% suspended temporarily, and 3% undertook a troubled raising. Combining the four indicators identifies 33% of State banks and 22% of National banks as in trouble.[30]

From 1928 to 1932, both State and National banks saw their deposits shrink on average by almost 30% and their balance sheets by almost 20%. Surprisingly, capital write-downs were much more limited, especially for State banks. This suggests that banks were reluctant to recognize losses and write down equity, and that regulators did not force them to do so.

IV. Empirical results

We first examine bank risk taking before the Great Depression. For our full sample, we look at bank leverage. For subsamples with more detailed data, we also look at asset risk, deposit rates,

[30] These rates are lower than the 45% reported by Friedman and Schwartz (1963). The main reason is that our analysis ends in February 1933, before the National Banking Holiday.

and profits. Next, we present our main results on bank distress between 1928 and February 1933. Finally, we analyze the causes of bank suspensions and acquisitions, examine capital write-downs and deposit and asset reductions in surviving banks, and provide a number of robustness tests.

A. Bank Risk taking before the Great Depression

A.1. Leverage in 1928

We first compare leverage (liabilities/assets) in 1928. In the conceptual framework of Section I, the effect of the liability regime on leverage is ambiguous. On the one hand, SL banks have an incentive to choose higher leverage than DL banks because their shareholders have more downside protection. On the other hand, to compensate for their stronger risk-taking incentives, SL banks might have to pay higher deposit rates and choose lower leverage.

We compare bank leverage $L_{i,s}$ between the two state-Fed districts in each of the eight pairs, where i indexes a bank and s a state-Fed district within a pair. For the single-difference analysis, we restrict the sample to State banks and run the following regression for each state-Fed district pair:

$$L_{i,s} = \alpha + \beta SL_s + \varepsilon_{i,s} \quad (1)$$

The SL indicator identifies the state-Fed district with single liability. The intercept α measures the average outcome for banks in the state-Fed district with DL, while β measures the average difference in bank outcomes between the SL and DL state-Fed district. When combining all pairs in the same regression, we weight each observation such that each pair receives equal weight. This yields coefficients that are the simple average of the coefficients from the eight individual pairs.

Our careful selection of state pairs notwithstanding, the estimates from Eqn. (1) might be biased if DL and SL states are hit by systematically different economic shocks. Following the literature, we bring National banks, which faced DL in every state, into the analysis.[31] Due to regulatory differences, National and State banks are not directly comparable. However, we can use the differential outcomes of National banks in different states to control for state-level economic shocks. Given that our state selection minimizes differences in National bank failure rates within each pair, we expect this double difference analysis to yield similar results. In the extreme, if the

[31] See for example Grossman (2001) and Mitchener and Richardson (2013).

paired SL and DL states are hit by the exact same economic shocks, the inclusion of National banks only adds noise.

Concretely, we estimate the following difference-in-differences equation for each pair:

$$L_{i,s} = \alpha + \beta SL_s + \gamma SB_{i,s} + \delta SL_s SB_{i,s} + \varepsilon_{i,s} \ . \tag{2}$$

$SB_{i,s}$ is an indicator for State banks. The coefficient of interest, δ, is the diff-in-diff estimate of the impact of SL on bank outcomes. As in the single-difference analysis, when pooling pairs in the same regression, we weight observations such that each pair receives equal weight.

Throughout, we report standard errors that are clustered at the individual bank level because banks from Georgia and Kentucky (Fed district 8) enter the sample twice, resulting in duplicate observations. Residuals, however, might also be dependent across banks, for at least two reasons. First, state-level shocks might cause bank outcomes to be correlated within states. Second, regional shocks might cause bank outcomes to be correlated within pairs. For the pooled regressions combining all pairs, we therefore also show p-values from double-clustering at the state and state-Fed district pair level. Since both New Jersey and Tennessee are split into two Fed districts, and each occur in two different pairs, there is only partial overlap between these two levels of clustering. To account for the small number of clusters – there are 12 states and 8 pairs in our data – we obtain p-values using the wild cluster bootstrap (Cameron, Gelbach, and Miller 2008, Roodman, Nielsen, MacKinnon, and Webb 2019).[32]

Results from the leverage regressions are in Table 2, with the single difference estimates in Panel A and the double difference estimates in Panel B. There is no consistent effect of SL on leverage, with different signs on the estimate in different state-Fed district pairs. The standard errors for the individual-pair estimates, even though clustered at the bank level, do not allow for in-state correlations across banks. They should therefore be interpreted with caution. The combined estimate for leverage in Column (9) shows no systematic difference between SL and DL banks;

[32] We bootstrap coefficients, even though bootstrapping t-statistics is more standard. The latter requires estimating a variance-covariance matrix in each bootstrap iteration. If any of these estimates is not positive definite, the t-statistic is not defined, which we encounter in several regressions with additional control variables. Bootstrapping coefficients avoids this problem. Comparing approaches (where possible) suggests that ours yields more conservative p-values.

the point estimate is small, both in the single and double difference, and statistically indistinguishable from zero.

In Internet Appendix D.1, we examine whether SL and DL banks held different amounts of cash as buffer on their balance sheets. Table D.1 replicates the leverage analysis from Table 2 with cash/deposits in 1928 as outcome variable. The estimated effect of SL on cash holdings has different signs in different state-Fed district pairs. The combined estimate has different signs in the single and double difference and is small and insignificant in both. Hence, there is little evidence that SL and DL banks chose different cash buffers before the Great Depression. This is perhaps not surprising given the strict reserve requirements banks had to adhere to (see Internet Appendix A.2).

A.2. Asset risk

The conceptual framework of Section I predicts that, with equal leverage, SL banks take more asset risk. For most banks, we lack detailed data on bank assets. Exceptions are State banks in New Jersey (SL) and New York (DL). For both, state bank examiner reports provide a relatively detailed composition of assets. We manually collect and clean this data for 1928 for New York and New Jersey (Fed district 2), the part of New Jersey in the same Fed district as New York. The two states used a different reporting system, and we aggregate balance sheet items up to uniform categories (see Internet Appendix D.2). We measure asset safety by the fraction of *non-cash assets* invested in relatively safe assets (collateralized loans, real estate loans, and securities). We exclude cash from our measure since cash (or reserve) requirements were strictly regulated.[33] The largest *risky* asset class is uncollateralized loans (typically, discounts of uncollateralized commercial paper). Under the National Banking Act of 1920, National banks could make such loans only up to 50% of the value of their book equity, confirming that regulators viewed them as especially risky. State banks in NJ and NY faced no such restriction.

Table 3 shows that asset safety was significantly lower for SL State banks in NJ(2) than for their DL counterparts in NY. This is robust to controlling for bank size and for being located in a Reserve city, i.e., NY banks in New York City and Buffalo. These banks specialized in providing liquidity to the national financial system and had a relatively high likelihood of failure in the Great

[33] Results are robust to defining relatively safe assets as including cash.

Depression (e.g., Richardson and Van Horn 2009). The difference in asset safety of around 0.08 is about 12.5% of the average share of relatively safe assets of 0.64 in the pooled sample.

In Internet Appendix D.2, we verify that asset safety predicts lower rates of failure during the Great Depression. Controlling for banks in Reserve cities, this is the case within both NJ(2) and NY and when pooling NJ(2) and NY together. We then use mediation analysis to determine to what extent the difference in failure rates between NJ(2) and NY banks is explained by observable differences in asset composition. Controlling for banks in Reserve cities, SL banks in NJ(2) had failure rates that were about 11 percentage points higher. About 20% of this difference is explained by observed asset risk.[34]

In sum, the evidence suggests that SL banks had riskier assets. Further, observable differences in asset risk explain part of the effect of SL on bank failure, although most of it comes from unobservable factors. This is unsurprising: even the relatively detailed asset data for NY and NJ is quite opaque. For example, the safety of collateralized loans depends on their loan-to-value ratios and the type of collateral. Thus, further differences in risk-taking could easily be hidden in these asset categories.

A.3. Deposit rates

If SL banks were indeed riskier, we would expect that they paid higher deposit rates. Such data is generally unavailable for State banks. The only exception is New Jersey, where we can compare the rates paid by State banks, which all had SL, with National banks, which all had DL. We manually collect data from New Jersey State bank reports and National bank examination reports for December 1927. Of the 131 State banks with full balance sheet information, we have deposit rates for 115. Of the 77 National banks with balance sheet data, we have rates for 29. Data is for the minimum and maximum rates paid. The maximum rate was typically paid on large time deposits, primarily reflecting bank riskiness. The minimum rate was typically for checking deposits, primarily reflecting convenience yields.

[34] Without controlling for Reserve cities, the effect of SL is only about 6 percentage points and not statistically significant. Reserve city banks had higher failures rates and were all located in New York state.

Internet Appendix D.3 reports balance sheet characteristics and Fed membership for all New Jersey banks and for those with deposit rate information. The sub-sample of banks with rates is representative of New Jersey banks, and State and National banks look comparable.

Table 4 analyzes whether State banks paid higher deposit rates than National banks. We focus on the maximum rate. Column (1) shows that, on average, State banks paid maximum rates that were about 1.5 percentage points higher than the 2.4% paid by National banks. This suggests that depositors viewed SL banks as riskier than DL banks.

Internet Appendix A.3 shows that New Jersey State banks faced laxer regulations than National banks, which could explain this difference.[35] To assess the importance of regulatory differences, we control for Fed membership. Member banks faced tighter regulation and supervision than non-members (White 1983, pp. 166-7). If Fed membership does not affect deposit rate differences between State and National Banks, it is less likely that other regulatory differences do. Column (2) shows that the rate difference with National banks is virtually the same for State Fed-member and non-member banks. Columns (3) and (4) shows that this is still the case when controlling for a Fed district fixed effect and balance sheet characteristics.[36] Thus, Fed regulation and supervision had little to no effect on deposit rates. This makes it unlikely that other regulatory differences explain SL banks' higher rates.

A.4. Profits

To further explore differences in risk-taking we look at profitability. If SL banks took more risk, we would expect them to have had higher profitability between 1923 and 1929, when the U.S. economy expanded and risk-taking should have paid off. Data on banks' income statements is generally unavailable for this period. However, we can back out profitability from balance sheet information and dividend payments using the clean surplus method. In years without any other capital events, bank profits Π_t should equal the change in the book value of paid-in capital C_t and surplus S_t (retained earnings) plus dividend payments D_t:

[35] Of the eight regulatory dimensions we identify, New Jersey State banks were laxer in three.

[36] There might be a concern that State Banks are more likely to be located in more rural areas with higher local market interest rates. However, when controlling for county fixed effects, the State Bank coefficient only drops from 1.55 to 1.54. County fixed effects alone produce an adjusted R2 of only 0.028. To preserve statistical power, we therefore do not include county fixed effects.

$$\Pi_t = (C_t + S_t) - (C_{t-1} + S_{t-1}) + D_t. \quad (3)$$

This approach measures profits after interest payments. The results in Table 4 suggest that SL banks in New Jersey paid higher interest rates. If this holds more broadly, then higher profitability for SL banks would imply an even higher return on assets, indicative of even more risk taking.

Adjustments need to be made to calculate profits during capital events, such as capital raises, mergers, and acquisitions. Further, if a bank is acquired or closed, capital and surplus may be written down, reflecting the realization of losses. Internet Appendix D.4 explains how we adjust profitability in each of these cases.

We hand-collected individual banks' semi-annual balance sheet and dividend data from RandMcNally's *Banking Directory*. We link banks over time to deal with name changes, acquisitions, and bank exits. Using detailed notes in RandMcNally, we identify the specific reason for each exit (i.e., failure or acquisition). Our data starts in 1923, when dividends started to be reported. Given the time and effort required, we collected data up to 1929 for three pairs only, CT(1)-MA, NJ(2)-NY, and NJ(3)-PA(3), the most financially developed states in our sample.

We scale profits by the previous period's total equity to arrive at the return on book equity: $\pi_t = \Pi_t/(C_{t-1} + S_{t-1})$, expressed as a percentage. We winsorize at the 2.5th and 97.5th percentiles to deal with outliers (results are robust to not winsorizing).

To estimate the effect of the liability regime, we estimate a panel regression using either a single difference, comparing State banks only,

$$\pi_{i,s,t} = \beta SL_s + \delta \ln(size_{i,s}) + \tau_t + \varepsilon_{i,s,t} \quad (4)$$

or a double difference, also incorporating National banks that had double liability everywhere:

$$\pi_{i,s,t} = \beta_1 SL_s + \beta_2 SB_{i,s} + \beta_3 SL_s \times SB_{i,s} + \delta \ln(size_{i,s}) + \tau_t + \varepsilon_{i,s,t} \quad (5)$$

where i is bank, s is state, t is time measured in semi-annual increments (January and July of each year), and τ_t are period fixed effects. We use pair-specific weights or pair fixed effects to aggregate results from individual pairs to the full sample. We limit ourselves to banks whose size

(total assets) lies in the common support of each pair, and we control for $\log(size_{i,s})$ in 1923[37] to absorb any remaining cross-sectional size effects. We cluster standard errors at the bank level.

Table 5 shows that SL State banks were more profitable than their DL counterparts during the 1920s. This holds both in the single and double difference, and the gap is economically significant. On average, profitability is about 0.6-0.75 percentage points higher for SL State banks, a difference of about 13-17% of the sample means. This result is all the more remarkable considering that SL banks had similar leverage (Table 2) and appear to have paid higher deposit rates (Table 4).

In sum, SL banks were more profitable when the economy was growing. This is consistent with SL banks loading up more on risk, which paid off during good economic times.

B. Bank outcomes during the Great Depression

B.1. Bank distress, 1929 - February 1933

We now turn to our main analysis of bank distress. The previous results show that SL banks had similar leverage as DL banks but took more asset risk, as evidenced by lower asset safety, higher deposit rates, and higher profitability in good times. We therefore expect SL banks to suffer greater losses in the Depression and, thus, to be more likely to be suspended, acquired, or to raise capital.

We consider four indicators of distress: (1) permanent suspensions, (2) being acquired, (3) temporary suspensions, and (4) troubled raising. Category (1) is self-explanatory. For (2), we determine which bank in a merger or acquisition disappeared based on the charter under which the combined bank continued. Category (3) means that a bank suspended but reopened at a later point in time. Such banks were typically recapitalized in the interim, with shareholders and directors putting in fresh equity and depositors relinquishing some of their claims (Carlson 2010). Information on categories (1) through (3) was collected on forms St. 6386 by the Fed Board of Governors.[38] For (4), we use balance sheet data to identify new equity raisings as an increase in paid-in capital in any year between 1929 and 1932. We do not classify an equity raising as troubled if the bank's total equity in its last year in our sample was higher than in 1928, or if it acquired another bank in the year its paid-in capital increased. The goal is to omit equity raisings that are unlikely to result from banks' need to recapitalize. We miss troubled raisings if a bank wrote down

[37] Or the earliest year that is available for new banks entering the sample. Time variation in bank size is likely endogenous and a "bad control", e.g., more profitable banks might grow faster.
[38] See Richardson (2007b, 2007c) and references therein for a detailed description of this source.

paid-in capital and raised less new equity within the same fiscal year. This is an unfortunate limitation of using annual data.[39]

For our baseline regressions, we aggregate the four distress outcomes into (5) "total trouble." This simplifies the predictions and addresses the concern that different state regulators may have treated troubled banks differently. For example, some regulators may have assisted in arranging acquisitions, while others may have pushed for liquidations. Using total trouble makes our analysis robust to such differences.

Table 6 reports estimates from the single and double difference specifications in Eqns (1) and (2), using our total trouble measure as the dependent variable. SL banks had a higher probability of distress in all eight pairs in the single difference, and in seven pairs in the double difference (although, again, standard errors for the individual pair regressions in columns (1)-(8) should be interpreted with caution). The effect is not restricted to a specific geographic area. For example, the single difference estimates are largest for Connecticut-Massachusetts, Alabama-Georgia, and Missouri-Kentucky, three very different state pairs. The aggregate effect in Column (9) is large. In the single difference, SL banks faced an 8.4 percentage point higher probability of distress (p-value = 0.030), 29% more than the baseline rate in DL states. The effect is even larger in the double difference, but, with a p-value of 0.105, also more noisily estimated.

Internet Appendix E.1 provides estimates with additional controls. Table E.1 adds bank-level controls for 1928 leverage, the ratio of cash to deposits, and log(assets). As these balance sheet characteristics might be endogenous to the liability regime, their inclusion could bias the SL coefficient. Results suggest that neither observable ex-ante balance sheet conditions nor bank size can explain the much higher distress rate of SL banks.

Table E.2 adds controls for different State bank regulations. One possibility is that regulators in SL states tried to compensate for stronger risk-taking incentives by tightening other regulations. If that were the case, our already large estimates of the effect of SL on distress rates would be downward biased. A more concerning possibility is that regulators in SL states were generally

[39] Some banks experienced multiple forms of distress. In 30 cases, a bank suspended temporarily before a permanent suspension or being acquired. In 12 cases, a bank conducted a troubled raising before a permanent or a temporary suspension or being acquired. In 17 cases, a bank suspended (without reopening) before being acquired, which we code simply as an acquisition and not also as a permanent suspension.

more lenient, leading to upward bias. Internet Appendix A.2 shows that minimum reserve and capital requirements did not differ systematically between SL and DL states. Internet Appendix A.3 shows that state level restrictions on bank risk taking, bank regulator quality and branching restrictions did not differ systematically either. Table E.2 shows that when we control for these state-level differences, results are unchanged.

Table E.3 adds controls for county characteristics, such as manufacturing and agricultural output and urbanization. The Great Depression proved especially harsh for small rural banks. Table 1, Panel D shows that the counties of single and double liability State banks in our sample had similar characteristics. Table E.3 shows that the coefficient on the SL indicator remains virtually unchanged after adding county-level controls.

Table E.4 presents estimates using pair fixed effects instead of pair-specific weights. As expected, this produces similar results. In the single difference, the effect of SL on total trouble is 9.2 percentage points when using fixed effects, slightly larger than the 8.4 percentage points estimated using weights. In the double difference, the effect is 8.8 percentage points, slightly smaller than the 10.0 percentage points with weights. Results remain statistically significant.

Table E.7 in Internet Appendix E.4 shows estimates using an extended sample with two additional matched DL state-Fed districts, Illinois (district 8) and West Virginia (district 5), which were close runners-up to our preferred matches. Internet Appendix C.2 describes the selection of the additional state-Fed districts. The effect of SL on total trouble is smaller at 6.1 percentage points in the single difference, but it is unchanged at 10.0 percentage points in the double difference. Since West Virginia, due to its dependence on coal, suffered much worse from the Great Depression than its SL match Virginia, the single difference is likely to be biased.

In Table 7 we split the "total trouble" variable into its constituent parts – permanent suspensions, acquisitions, temporary suspensions, and troubled raising. Given similar leverage ratios, we expect SL banks to suffer more permanent suspensions. The predicted effects of SL on acquisitions, temporary suspensions, and troubled raising are, however, ambiguous. Other banks and shareholders (old or new) will only invest in a bank if it has positive net value. If losses are too large, no one will agree to contribute new equity or assume the bank's liabilities, ruling out acquisitions, most temporary suspensions (which typically involved a recapitalization by existing shareholders), and equity issuance. Moreover, SL shareholders might have had weaker incentives

to recapitalize. Therefore, if SL banks had sufficiently large losses, it is possible that they suffered (many) more permanent suspensions but fewer of the other distress outcomes.

Empirically, Table 7 shows SL banks suffering more permanent suspensions, acquisitions, and troubled raisings. In absolute terms, the largest effect is on acquisitions, followed by suspensions and troubled raising. Using the single difference estimates, SL banks had a 5.9 percentage point higher probability of being acquired (69% more than DL banks), a 3.1 percentage point higher probability of a permanent suspension (20% more), and a 0.7 percentage point higher probability of a troubled raising (33% more). SL banks suffered 0.9 percentage point fewer temporary suspensions, so were slightly less likely to close, recapitalize and reopen, consistent with SL shareholders being less willing to contribute new equity. The magnitude of the SL effect on both troubled raising and temporary suspensions is small, in part because few banks experienced these outcomes (DL baselines of 2.1 and 3.3%, respectively). The double difference results in Panel B are similar, with somewhat larger effects of SL on acquisitions and troubled raising.

The last column of Table 7 considers permanent suspensions and acquisitions together as an indicator of failure. In the single difference, SL banks had a 9.0 percentage point higher probability of failure (p-value = 0.042), 37.5% more than the failure rate of DL banks. The effect increases to 9.7 percentage points in the double difference but is more noisily estimated (p-value = 0.145).

B.2. Causes of bank suspensions and acquisitions

The exit forms St. 6386 list the immediate causes of permanent suspensions. In Table 8 we look at differences between SL and DL State banks. The most important difference is in "slow paper," an indication of solvency problems. There is also a difference in "heavy withdrawals" – bank runs – but this is only about a third as large as for slow paper. There is no evidence that SL banks suspended more frequently because of failures of correspondent banks or large debtors, or because of fraud ("defalcation").

There is no qualitative information about the reasons for acquisitions in forms St. 6386. Instead, we use the balance sheets of acquirer and target on the forms and in RandMcNally to explore solvency and liquidity issues. If targets were in trouble, we would expect to see large declines in their equity or deposits. The forms have no data on deposits, but they do allow us to estimate changes in liabilities, which mostly consisted of deposits (roughly 90% on average). Details on the data construction are in Internet Appendix E.2.

Figure 3, Panels A and B show changes in equity and estimated total liabilities in the period *before* the acquisition (between $t-2$ and $t-1$) for both targets and acquirers. Liabilities declined moderately before the acquisition by, on average, 5.6% for targets and 2.8% for acquirers (the difference has a p-value of 0.002). This was not driven by bank runs – large declines (e.g., of more than 25%) were rare. Equity reductions were even smaller, with an average decline of 3.8% for targets and 2.3% for acquirers (difference p-value of 0.072). For comparison, banks in our sample not involved in an acquisition in a given year experienced on average no change in total equity.

Figure 3, Panels C-F show changes in equity and estimated liabilities for the merged entities *around* the acquisition (between $t-1$ and t (immediately after the acquisition if balance sheet information is on the form) or $t+1$ (the next issue of RandMcNally)).[40] There was little change in liabilities, indicating that acquisitions were not immediately preceded by deposit outflows, let alone bank runs. This is perhaps to be expected: bank runs happen quickly while acquisitions take time to negotiate. In contrast, there were large declines in equity, with write-downs in 92% of cases. The average write-down for the merged entity is 24.6% up to t and 24.7% up to $t+1$. For targets and acquirers with the same initial levels of equity, and assuming that declines can be fully attributed to the target, a decline of 25% would represent a 50% write-down of the target's equity. Often, acquiring banks were larger, suggesting even larger write-downs for targets. This suggests that the assets of many targets were severely impaired – a strong indication of solvency problems.

In Figure 4, we limit the analysis to acquisitions with State banks as targets and compare outcomes between SL and DL states. Panels A and B compare targets' changes in equity and liabilities *before* the acquisition ($t-2$ to $t-1$). Both SL and DL targets experienced small average pre-acquisition declines in equity. The average declines in liabilities were somewhat larger, but, if anything, smaller for SL targets (the difference in means has a p-value of 0.335, in medians 0.031). Panels C and D compare consolidated banks' changes in equity and liabilities *around* the acquisition ($t-1$ to t). Large equity write-downs were much more common in acquisitions involving SL targets, with most of the mass of the distribution between -50% and -25%. For DL targets most of the mass was between -25% and 0% (the difference in means has a p-value of 0.110, in medians 0.053). The

[40] Around 30% of acquisition forms are incomplete and do not report the banks' capital positions or liabilities.

contemporaneous change in liabilities was small for both SL and DL banks. All results are similar when post-acquisition balance sheets are observed at $t+1$ instead of t (Panels E and F).

This evidence suggests that the higher failure likelihood of SL banks was mainly due to solvency problems. The difference in suspension rates was mostly driven by "slow paper." Acquisitions were preceded by modest declines in targets' deposits and other liabilities, but there is no evidence of significant declines right before acquisitions. Thus, they were unlikely to be the result of bank runs. In contrast, large amounts of equity were written down during acquisitions. Moreover, large write-downs were much more common for SL than for DL targets. This suggests that many bank acquisitions during the Great Depressions were due to solvency problems, and that these problems were worse for SL targets.

B.3. Capital, deposits, and total assets conditional on survival

Internet Appendix E.3 examines whether the greater distress of SL banks was also reflected in the balance sheets of banks that had not (yet) failed. We look at capital write-downs, changes in deposits, and changes in total assets (the size of bank balance sheets) from 1929-32, using the last available observation for banks that failed or dropping failing banks altogether.

Despite the severity of the Depression, capital write-downs were on average only around 3% for DL State banks, suggesting that banks were slow to recognize losses. SL banks wrote down an additional 3.6 percentage points based on the single difference and 9.6 percentage points in the double difference. Only the latter is statistically significant. DL banks lost on average around 33% of their deposits; SL banks lost an additional 4.5 percentage points in the single difference and 3.8 percentage points in the double difference.[41] Neither estimate is statistically significant. The pattern is similar for total assets: a 19% average decline for DL banks, plus an insignificant additional 4.6 and 3.4 percentage point drop for SL banks in the single and double difference, respectively. Thus, balance sheet changes provide some evidence that SL worsened bank outcomes, but with limited statistical significance. Banks' apparent unwillingness to recognize losses makes it difficult to detect distress from balance sheets.

[41] These deposit declines predate bank failure, so they do not imply that SL banks suffered more bank runs. They are, however, consistent with a gradual loss of trust and with banks trying to unlever.

B.4. Robustness: sub-sample analyses

Fed membership: Some State banks were members of the Federal Reserve system, which gave them access to the Fed's discount window and may have reduced their probability of failure (Richardson and Troost 2009, Carlson, Mitchener, and Richardson 2011). Averaging across the state-Fed district pairs, Internet Appendix A.1 shows that Fed membership rates were 8% for SL State banks and 12% for DL State banks. Thus, our results might be in part driven by Fed membership. However, there are several reasons that speak against this. First, the differences in membership vary across state-Fed district pairs: in four pairs the membership rate is higher for the DL state, in the other four it is higher for the SL state. Second, becoming a Fed member is an endogenous choice, so higher membership rates might indicate that DL banks sought to constrain risk by submitting to a stricter regulator. In other words, Fed membership might be a channel through which DL made banks safer. Third, Fed membership could have *increased* the probability of bank failure. During the Great Depression, Fed policies were not as liberal as expected, which might have led member banks to hold too little liquidity (Carlson and Wheelock 2016, 2018).

To test whether our results are affected by Fed membership, we restrict the sample to non-members and rerun the analyses of total trouble and its four distress types. Each state-Fed district has at least 50 non-member banks, satisfying our state selection algorithm (see Internet Appendix C.1). Since National banks were Fed members by default, we only estimate the single difference regressions. Results are in Table 9, Panel A. The SL effects are quantitatively similar to the full sample estimates, suggesting that Fed membership is not driving our results.

Selection into State and National banks: It was possible for State banks to re-charter as National banks, and vice versa. In SL states, the charter directly determined the liability regime, as State (but not National) charters came with single liability, while in DL states it did not. Consequently, different types of banks might have selected different charters in SL and DL states.

In SL states, riskier banks might have chosen State charters (and thus SL) to protect their shareholders. On the other hand, they might have chosen National charters (and thus DL) to convince depositors of the banks' trustworthiness. The first mechanism would bias our estimate of the SL effect upwards, as we would attribute bank failures to SL rather than to the greater inherent riskiness of the banks. The second mechanism would result in a downward bias.

To assess whether selection into SL is driving our results, we restrict the sample to State banks whose paid-in capital was too low to be eligible for a National charter. Specifically, we only retain State banks with at most 80% of the paid-in capital required of a National bank in their location. These banks could not have easily switched charters. We again require at least 50 State banks in each state-Fed district, which forces us to drop four of our eight pairs.[42] Since the remaining banks are by design not comparable to National banks, we only present the single difference.

Results are in Table 9, Panel B. If anything, the effect of SL on total trouble is larger. This suggests that differential selection into State and National banks does not explain our results.

Reserve city banks: The Great Depression might have affected banks in reserve and central reserve cities more severely.[43] Most banks that were not Fed members met their reserve requirements in part by holding interbank deposits at correspondent banks in (central) reserve cities. In addition, Fed member banks deposited excess reserves at correspondent banks as they paid higher interest than reserves at the Fed (Mitchener and Richardson 2019, Jaremski and Wheelock 2020, Anderson, Erol and Ordoñez 2020).

Interbank deposits exposed correspondent banks to rapid outflows when other banks suffered shocks or runs. Mitchener and Richardson (2019) and Calomiris, Jaremski, and Wheelock (2022) document severe contagion effects of panics that originated at country banks on (central) reserve city banks.[44] Aggregating across our state pairs, only 3.4% of our SL State banks were located in (central) reserve cities, compared to 9.7% of DL State banks. This is mainly because our DL states contain New York City, Boston, and Philadelphia. Thus, if reserve city banks were more likely to fail, we might underestimate the effect of SL.

To examine this further, we restrict the sample to banks not located in (central) reserve cities and rerun the analyses of our six ex-post outcome variables. We again require at least 50 State banks in each state-Fed district, which is the case for all pairs. Results for the single difference are in Table 9, Panel C. As conjectured, the effects of SL are slightly larger than in the full sample. For example, the effect on total trouble is 10.3 percentage points, compared to 8.4 percentage points

[42] We are forced to drop CT(1)-MA, NJ(2)-NY, NJ(3)-PA(3), and VA-MD. The results are robust to requiring 25 State banks per state-Fed district and to dropping this requirement altogether.
[43] The only two central reserve cities were New York City and Chicago. Sixty-four other cities were reserve cities.
[44] Calomiris and Carlson (2017) document the role of interbank networks in the Panic of 1893.

in the full sample, and less noisily estimated (p-value of 0.020 vs 0.030). The untabulated double difference results are similar, with an SL effect on total trouble of 10.7 percentage points (compared to 10.0 in the full sample).

V. Summary and discussion

Our evidence points to a clear conclusion: limited liability for bank shareholders increased bank risk taking and the likelihood of subsequent bank distress. During the 1920s, SL banks had lower asset safety, paid higher deposit rates, and had higher profitability, all consistent with more risk-taking. During the Great Depression, SL banks had a distress rate of 37%, 8.4 percentage points higher than DL banks. SL banks were more likely to suspend or be acquired with large capital write-downs. The higher failure rate of SL banks does not seem driven by more bank runs; SL and DL banks had similar rates of suspensions due to bank runs, and few acquisitions appear to have been preceded by large deposit outflows. Finally, surviving SL banks appear to have suffered greater capital write-downs, deposit outflows, and asset declines, even though these differences are mostly not statistically significant.

While our analysis shows that DL reduced bank failures, it does not consider potential costs. For example, lower risk taking by DL banks might have had negative effects on economic growth before the Great Depression. The net effect on growth, and the extent to which policymakers would sacrifice growth in a boom for more stability in a crisis, are important questions for future research.

What do these results imply for today's banking system? Modern regulations often focus on capital requirements, which also increase bank shareholders' downside exposure. Our results suggest that downside exposure reduces risk taking incentives. Consequently, higher capital requirements might stabilize banks not only by increasing capital buffers, but also by changing bank behavior (Admati and Hellwig 2013).

An important question is whether increasing shareholder liability would still be effective today. One key difference between then and now is that bank shareholders in the 1920s were less dispersed: we show that bank managers were typically also large shareholders, reducing the distance between shareholder liability and decision-making authority. We conjecture that the effect we document mainly comes from increasing bank managers' and directors' downside exposure.

This suggests that current proposals to increase the downside risk of banks' key decision makers, through compensation clawbacks or other means, are likely to increase bank stability.

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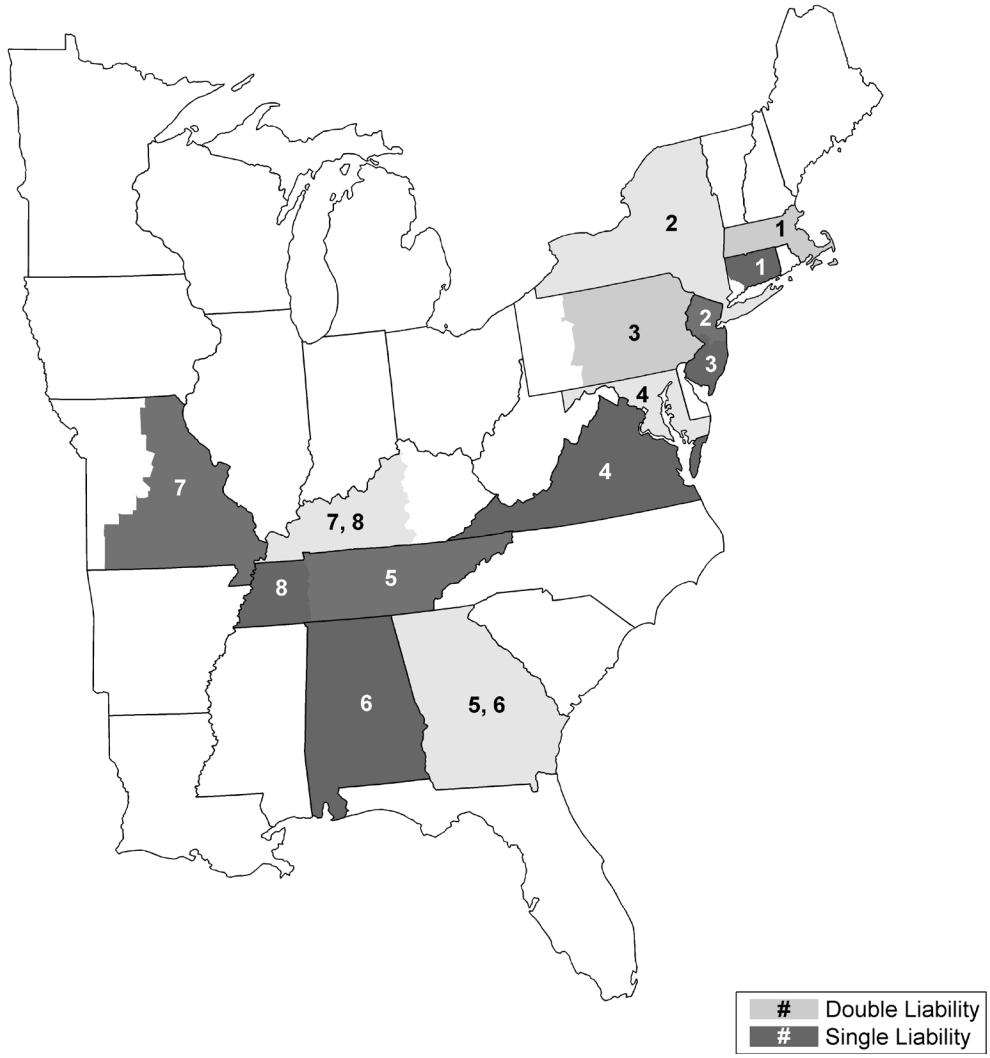
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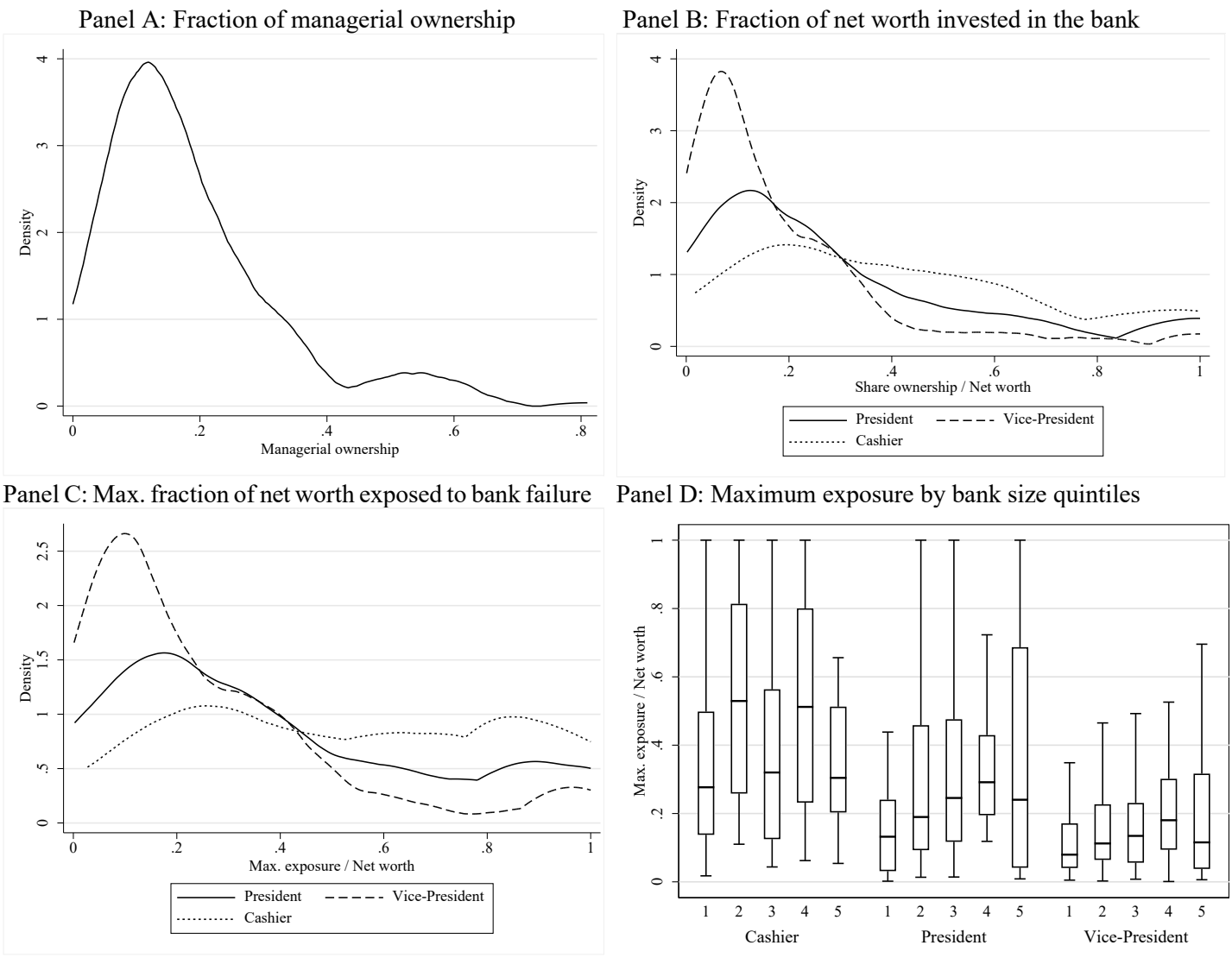
Figures and Tables

Figure 1: State-Fed district pairs



The numbers identify the eight state-Fed district pairs used in the analysis. Numbers in dark font on a light background indicate districts in double liability states, while white numbers on a dark background indicate districts in single liability states. Some states, such as New Jersey, are split into two Federal Reserve districts, with each part belonging to a separate pair. Other states, such as Georgia, serve as control for two single liability states.

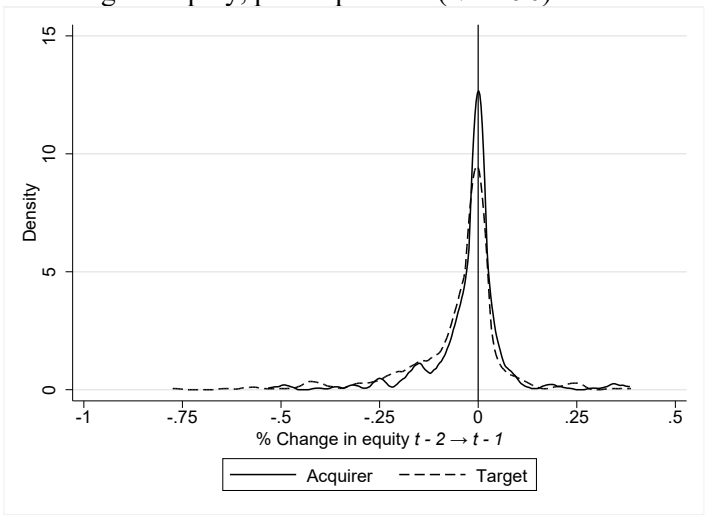
Figure 2: Managerial ownership and exposure



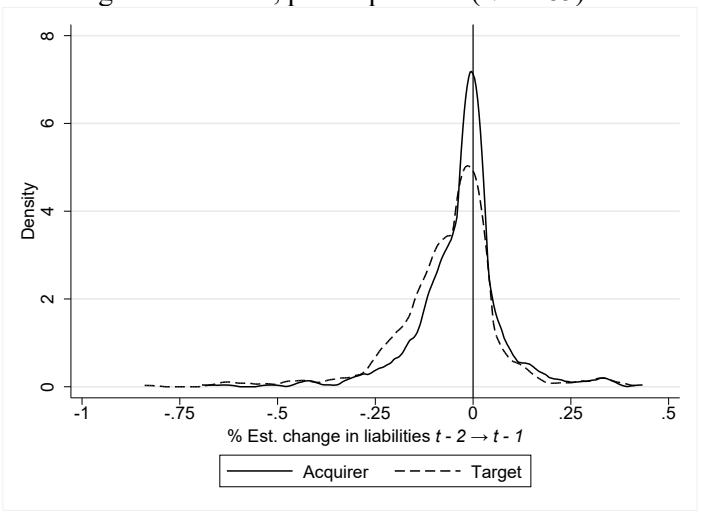
Random sample of 10% of National banks in New York and New Jersey in 1929. *Managerial ownership*: fraction of bank shares owned by presidents, vice-presidents, and cashiers. *Net worth*: estimate by national bank examiner. *Max. exposure*: current value of shares + maximum double liability claim. Panels A-C: Kernel densities with Epanechnikov kernel and optimal bandwidth. Panel D: boxplots excluding outer values. Bank size quintiles from small to large.

Figure 3: Changes in equity and liabilities before and during acquisitions

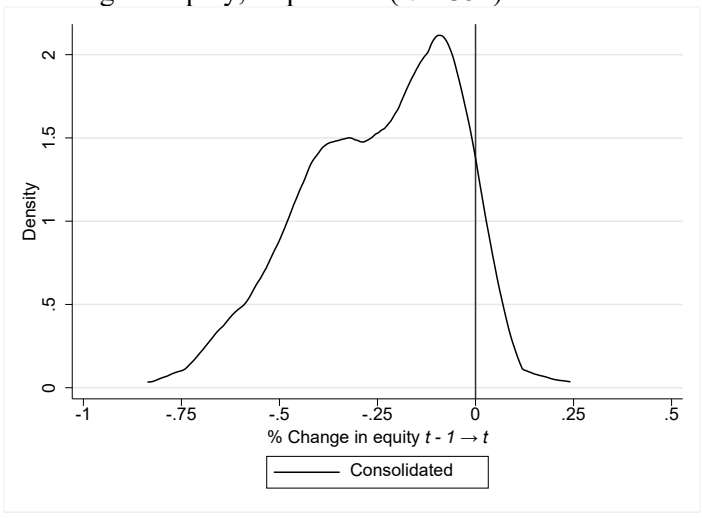
A. Change in equity, pre-acquisition ($N = 490$)



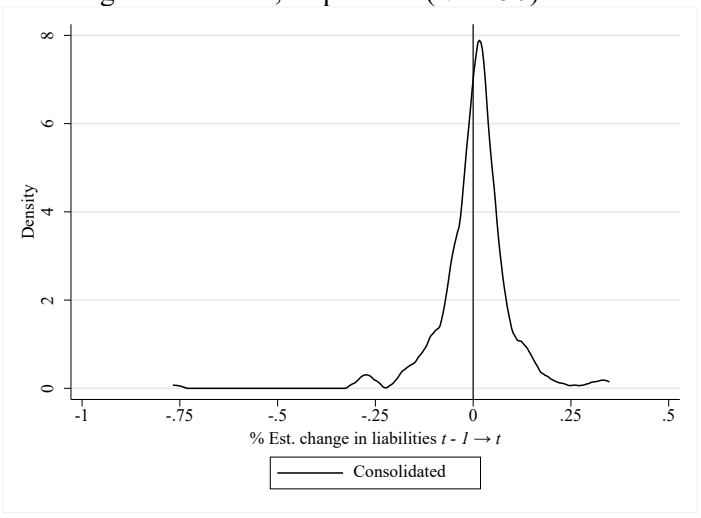
B. Change in liabilities, pre-acquisition ($N = 485$)



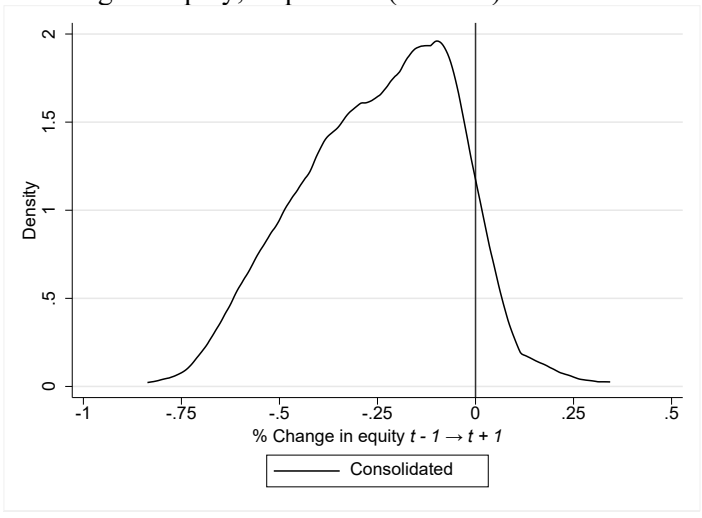
C. Change in equity, acquisition ($N = 352$)



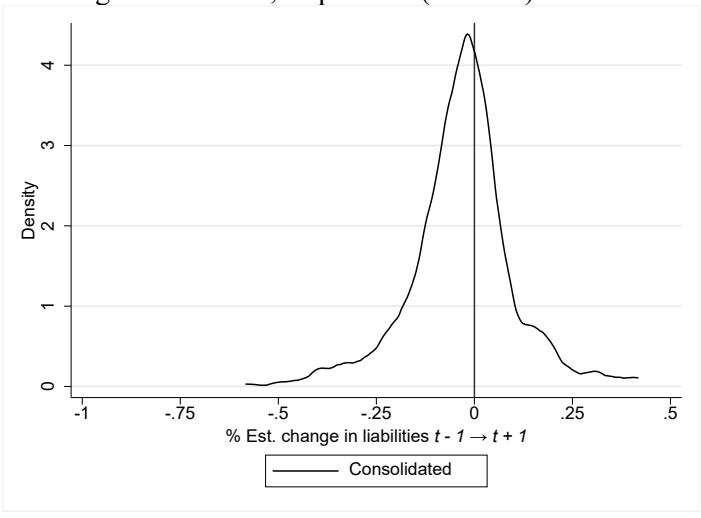
D. Change in liabilities, acquisition ($N = 297$)



E. Change in equity, acquisition ($N = 479$)



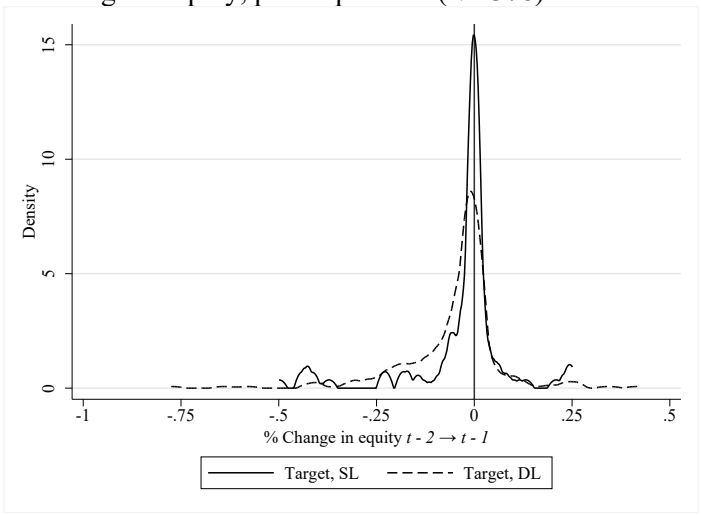
F. Change in liabilities, acquisition ($N = 467$)



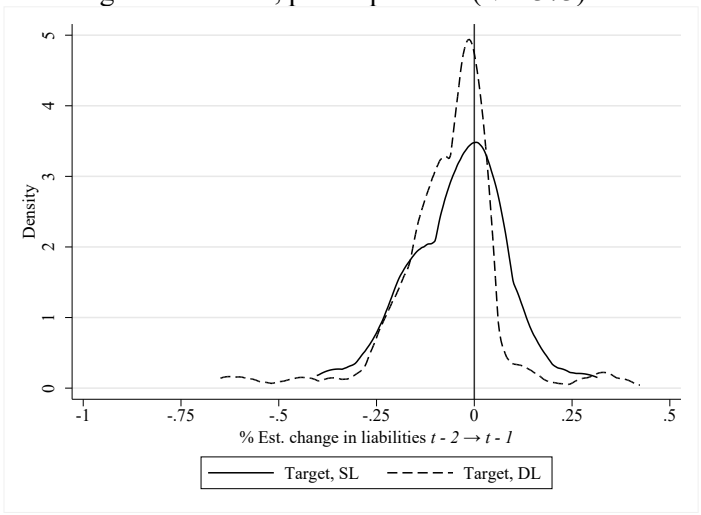
Period: 1930-1933. Kernel densities with Epanechnikov kernel and optimal bandwidth. Internet Appendix E.2 has details on the data construction. Data source: $t-2$ and $t+1$: RandMcNally, $t-1$ and t: acquisition forms. Change in equity: change in paid-in capital and surplus. Change in liabilities: change in loans and discounts & bonds minus changes in equity. Panels A-B: before acquisition, Panels C-D: during acquisition based on forms alone, Panels E-F around acquisition based on forms and RandMcNally.

Figure 4: Changes in equity and liabilities before and during acquisitions: SL vs DL (State bank targets only)

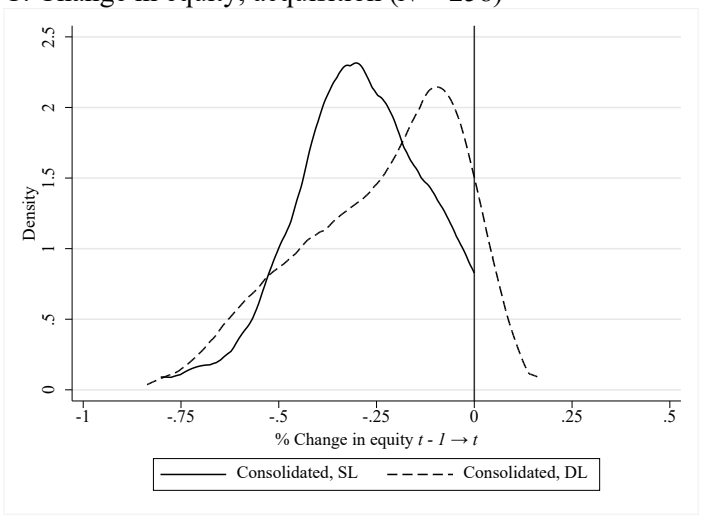
A. Change in equity, pre-acquisition (N =378)



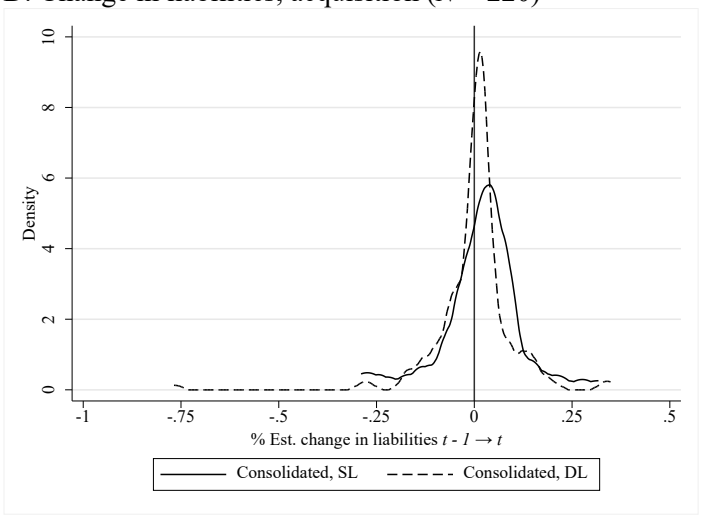
B. Change in liabilities, pre-acquisition (N = 373)



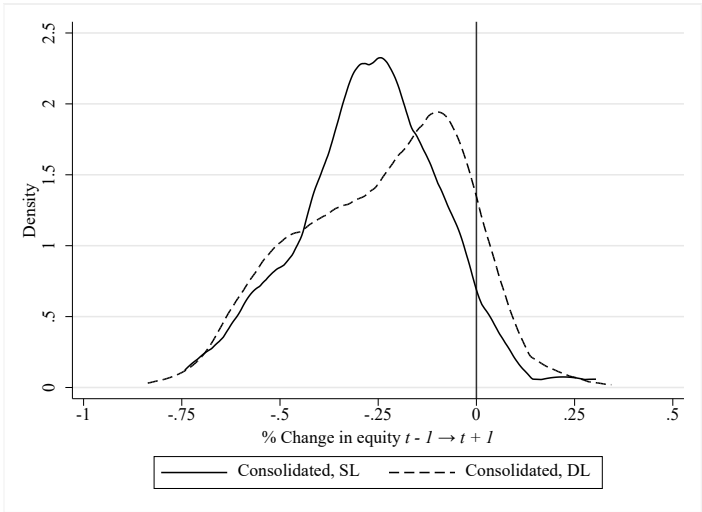
C. Change in equity, acquisition (N = 258)



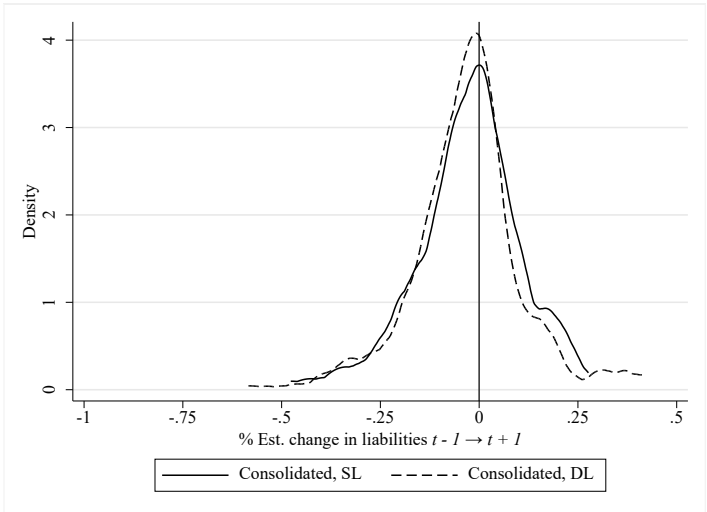
D. Change in liabilities, acquisition (N = 220)



E. Change in equity, acquisition (N = 369)



F. Change in liabilities, acquisition (N=357)



Period: 1930-1933. Kernel densities with Epanechnikov kernel and optimal bandwidth. Internet Appendix E.2 has details on the data construction. State bank targets only. Data source: $t-2$ and $t+1$: RandMcNally, $t-1$ and t: acquisition forms. Change in equity: change in paid-in capital and surplus. Change in liabilities: change in loans and discounts & bonds minus changes in equity. Panels A-B: before acquisition, Panels C-D: during acquisition based on forms, Panels E-F around acquisition based on forms and RandMcNally.

Table 1: Bank size and economic fundamentals

Bank type	State bank liability regime	Single difference sample					Double difference sample				
		Mean	Median	Min	Max	N	Mean	Median	Min	Max	N
Panel A: Complete sample											
State	Single	1,365	282	12	160,496	2,086	1,365	282	12	160,496	2,086
State	Double	5,342	540	26	1,049,597	2,212	5,342	540	26	1,049,597	2,212
National	Single						3,237	1,182	93	160,095	784
National	Double						6,688	1,407	120	1,471,817	1,579
Panel B: Common support sample											
State	Single	1,319	282	12	160,496	2,078	1,396	447	121	48,648	1,455
State	Double	2,887	532	26	198,413	2,144	2,245	625	91	57,978	1,920
National	Single						2,540	1,162	93	48,011	756
National	Double						2,499	1,375	150	44,892	1,502
Panel C: Common support sample with weights											
State	Single	2,256	492	12	160,496	2,078	1,836	604	121	48,648	1,455
State	Double	3,055	595	26	198,413	2,144	2,399	634	91	57,978	1,920
National	Single						2,370	1,043	93	48,011	756
National	Double						2,137	1,113	150	44,892	1,502

Panel D: County characteristics

Pair	State-Fed district	Single liability	Manufacturing output (per capita)		Crop value (per capita)		Urban population (%)		Population in cities over 25k (%)	
			1920	**1930**	**1920**	**1930**	**1920**	**1930**	**1920**	**1930**
1	CT (1)	1	982	896	38	21	65.37	69.39	48.35	52.61
	MA	0	992	745	14	8	93.91	89.13	62.48	63.31
2	NJ (2)	1	1199	1009	19	8	80.58	87.37	54.97	55.47
	NY	0	763	812	93	41	60.81	62.12	39.32	39.09
3	NJ (3)	1	630	551	66	36	58.94	60.00	36.83	31.05
	PA (3)	0	738	680	60	27	61.99	65.59	36.13	37.91
4	VA	1	208	264	164	93	21.37	23.47	13.03	13.03
	MD	0	342	386	151	85	28.71	31.2	18.76	18.99
5	TN (6)	1	150	164	152	80	14.86	18.49	5.98	7.98
	GA	0	174	170	204	97	15.75	17.71	6.84	6.78
6	AL (6)	1	155	148	141	92	13.91	17.23	5.88	6.13
	GA	0	175	172	204	97	15.62	17.65	6.53	6.50
7	MO (8)	1	161	181	250	96	18.33	21.67	5.14	5.79
	KY (8)	0	122	138	204	103	17.10	18.67	7.68	8.65
8	TN (8)	1	103	120	215	143	13.01	16.12	5.68	6.45
	KY (8)	0	104	115	209	106	14.98	16.49	5.72	6.32
All	Average	1	449	417	131	71	35.79	39.22	21.98	22.31
	Average	0	426	402	142	70	38.61	39.82	22.93	23.44

Note: Panel A shows the distribution of bank sizes (defined as total assets in thousands of U.S. dollars) and the number of banks in the full sample in 1928, separately for State and National banks in single and double liability states. Panel B shows the size distribution after restricting the sample to the common support within each state-Fed district pair. Panel C weights the banks from Panel B such that each state-Fed district pair has equal weight, irrespective of the number of banks in the pair. The single difference and double difference samples, as well as the construction of the common support samples, are described in Internet Appendix C. Panel D has averages of State banks' county characteristics, by state-Fed district, for the single difference common support sample. Data are from the 1920 and the 1930 censuses. The table reports the weighted average of the different variables across counties in the relevant Fed-district, with weights proportional to the number of State banks per county. *Manufacturing output (per capita)*: manufacturing output (in U.S. dollars) divided by total population. *Crop value (per capita):* value of crops (in U.S. dollars) divided by total population. *Urban population (%):* urban population divided by total population, times 100. Urban areas are defined as cities and other incorporated places with at least 2,500 inhabitants and include other political subdivisions with at least 10,000 inhabitants and a population density of at least 1,000 per square mile. *Population in cities over 25k (%):* population in cities with over 25,000 inhabitants divided by total population, times 100. The last two rows (labeled "All") report equal-weighted averages of the results across the state-Fed district pairs. Source: Haines, M.R. and Inter-university Consortium for Political and Social Research (ICPSR). Historical, Demographic, Economic, and Social Data: The United States, 1790-2002.

Table 2: Leverage (Liabilities/Assets), 1928

	(1) CT(1)-MA	(2) NJ(2)-NY	(3) NJ(3)-PA(3)	(4) VA-MD	(5) TN(6)-GA	(6) AL-GA	(7) MO(8)-KY(8)	(8) TN(8)-KY(8)	(9) All-Weighted
Panel A: Single difference									
SL	-0.011	-0.022	0.014	-0.033	0.047	0.024	-0.006	-0.010	0.001
	(0.015)	(0.008)	(0.012)	(0.008)	(0.009)	(0.008)	(0.005)	(0.009)	(0.004)
									[0.973]
Cons.	0.851	0.863	0.796	0.849	0.757	0.757	0.825	0.824	0.815
	(0.011)	(0.004)	(0.005)	(0.007)	(0.006)	(0.006)	(0.004)	(0.004)	(0.003)
N	164	510	461	431	580	563	1,127	386	4,222
Adj. R^2	-0.003	0.016	0.004	0.040	0.047	0.013	0.001	0.001	-0.000
Panel B: Double difference									
SL x	0.039	-0.031	0.006	-0.025	-0.009	-0.003	0.004	-0.020	-0.005
State bank	(0.021)	(0.009)	(0.014)	(0.009)	(0.012)	(0.013)	(0.010)	(0.017)	(0.006)
									[0.705]
SL	-0.058	0.011	0.008	-0.007	0.061	0.021	0.002	0.020	0.007
	(0.017)	(0.005)	(0.008)	(0.006)	(0.010)	(0.011)	(0.009)	(0.015)	(0.005)
State bank	0.013	0.001	-0.027	-0.005	-0.020	-0.025	-0.020	-0.016	-0.012
	(0.011)	(0.004)	(0.004)	(0.007)	(0.010)	(0.010)	(0.008)	(0.008)	(0.004)
Cons.	0.847	0.863	0.826	0.863	0.798	0.802	0.858	0.854	0.839
	(0.006)	(0.003)	(0.002)	(0.005)	(0.009)	(0.008)	(0.007)	(0.007)	(0.003)
N	342	1,216	1,057	532	597	638	897	354	5,633
Adj. R^2	0.086	0.025	0.031	0.067	0.169	0.042	0.023	0.066	0.012

Note: The dependent variable is total liabilities divided by total assets in 1928. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. Columns (1) through (8) present estimates for individual state-Fed district pairs. Column (9) reports estimates for the aggregate sample, using pair-specific weights such that each pair has equal weight. The estimates in Column (9) are therefore the average of those in Columns (1) to (8). Standard errors clustered at the individual bank level are in parentheses. In Column (9), p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table 3: Asset safety, 1928

	(1)	(2)	(3)	(4)
SL	-0.078***	-0.080***	-0.081***	-0.082***
	(0.013)	(0.013)	(0.013)	(0.013)
Reserve city				-0.006
				(0.023)
Mean dep. var.	0.643	0.642	0.642	0.642
Common size support	N	Y	Y	Y
Controls	None	none	ln(Assets)	ln(Assets)
N	618	602	602	602
Adj. R^2	0.0584	0.0603	0.0988	0.0989

Note: This table tests whether single liability (SL) State banks in New Jersey Fed district (2) had a lower proportion of safe assets than double liability State banks in New York. Dependent variable: (Collateralized & Real estate loans + Securities)/Non-cash assets as of 1928. Reserve city: a bank is located in New York City or Buffalo. Common size support: see details in the text. Assets: total balance sheet value as of 1928. Standard errors are in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

Table 4: Maximum deposit rates (in %), December 1927

	(1)	(2)	(3)	(4)
State Bank	1.472***			
	(0.115)			
State Fed-Member		1.468***	1.477***	1.448***
		(0.119)	(0.116)	(0.116)
State Non-Member		1.476***	1.481***	1.476***
		(0.126)	(0.122)	(0.119)
t-statistic of difference		-0.089	-0.045	-0.321
Cash/Deposits				0.004
				(0.003)
Liabilities/Assets				-0.000
				(0.006)
Log(Assets)				0.001
				(0.000)
Fed district FE	No	No	Yes	Yes
Mean rate for National banks	2.410	2.410	2.410	2.410
N	144	144	144	144
Adj. R^2	0.605	0.602	0.601	0.603

Note: This table tests whether State banks in New Jersey had to pay higher maximum deposit rates than National banks as of December 1927. The sample includes 115 State banks and 29 National banks (see Internet Appendix D.3 for details). Standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. The t-statistic is for the difference between the coefficients for State Fed-member and non-member banks.

Table 5: Profitability (semi-annual return on book equity in %), 1923-1929

	(1)	(2)	(3)	(4)
SL	0.722***	-0.033	0.584***	0.234
	(0.178)	(0.160)	(0.176)	(0.250)
SB		0.351***		1.470***
		(0.124)		(0.234)
SLxSB		0.748***		0.585**
		(0.240)		(0.235)
Mean dep. var.	4.47	4.35	4.47	4.35
Time FE	Y	Y	Y	Y
Pair weights	Y	Y	N	N
Pair FE	N	N	Y	Y
Controls	ln(Assets)	ln(Assets)	ln(Assets)	ln(Assets)
Sample and common support	State banks	All banks	State banks	All banks
Cluster	Bank	Bank	Bank	Bank
N	10,518	24,366	10,518	24,366
Adj. R^2	0.017	0.023	0.022	0.021

Note: This table tests whether SL State banks were more profitable between 1923 and 1929. Dependent variable: semi-annual return on book equity in %. Sample: CT(1)-MA, NJ(2)-NY, NJ(3)-PA(3). SL: Single Liability. SB: State Bank. Common size support: see details in the text. Assets: total balance sheet value as of 1923 (or the earliest year available for new banks). Standard errors clustered at the bank level are in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Total trouble

	(1) CT(1)-MA	(2) NJ(2)-NY	(3) NJ(3)-PA(3)	(4) VA-MD	(5) TN(6)-GA	(6) AL-GA	(7) MO(8)-KY(8)	(8) TN(8)-KY(8)	(9) All-Weighted
Panel A: Single difference									
SL	0.122	0.050	0.052	0.108	0.060	0.115	0.149	0.018	0.084
	(0.076)	(0.042)	(0.067)	(0.046)	(0.039)	(0.041)	(0.032)	(0.048)	(0.019)
									[0.030]
Cons.	0.284	0.237	0.448	0.218	0.282	0.287	0.266	0.264	0.286
	(0.047)	(0.023)	(0.025)	(0.037)	(0.025)	(0.025)	(0.027)	(0.027)	(0.013)
N	164	510	461	431	580	563	1,127	386	4,222
Adj. R^2	0.010	0.001	0.001	0.012	0.003	0.013	0.024	-0.002	0.008
Panel B: Double difference									
SL x	0.176	0.077	0.013	0.112	0.151	0.149	-0.038	0.161	0.100
State bank	(0.096)	(0.054)	(0.080)	(0.076)	(0.090)	(0.085)	(0.086)	(0.122)	(0.036)
									[0.105]
SL	-0.065	-0.035	0.048	-0.072	-0.072	-0.016	0.151	-0.154	-0.027
	(0.058)	(0.033)	(0.041)	(0.056)	(0.078)	(0.072)	(0.078)	(0.107)	(0.029)
State bank	0.104	0.027	0.326	0.014	-0.087	-0.052	0.035	0.019	0.048
	(0.057)	(0.029)	(0.029)	(0.063)	(0.065)	(0.062)	(0.064)	(0.069)	(0.026)
Cons.	0.179	0.211	0.121	0.219	0.358	0.329	0.232	0.245	0.237
	(0.033)	(0.018)	(0.014)	(0.049)	(0.059)	(0.055)	(0.057)	(0.062)	(0.022)
N	342	1,216	1,057	532	597	638	897	354	5,633
Adj. R^2	0.053	0.006	0.130	0.006	0.002	0.006	0.017	0.024	0.015

Note: The dependent variable is *total trouble*, which combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. Columns (1) through (8) present estimates for individual state-Fed district pairs. Column (9) reports estimates for the aggregate sample, using pair-specific weights such that each pair has equal weight. The estimates in Column (9) are therefore the average of those in Columns (1) to (8). Standard errors clustered at the individual bank level are in parentheses. In Column (9), p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table 7: Type of distress

	(1) Permanent Suspensions	(2) Acquired	(3) Temporary Suspensions	(4) Troubled raising	(5) Perm. Susp. or Acquired
Panel A: Single difference					
SL	0.031	0.059	-0.009	0.007	0.090
	(0.015)	(0.014)	(0.007)	(0.007)	(0.018)
	[0.331]	[0.101]	[0.448]	[0.547]	[0.042]
Cons.	0.155	0.085	0.033	0.021	0.240
	(0.010)	(0.007)	(0.005)	(0.004)	(0.012)
N	4,222	4,222	4,222	4,045	4,222
Adj. R^2	0.001	0.008	0.000	0.000	0.010
Panel B: Double difference					
SL x	0.030	0.067	-0.011	0.021	0.097
State bank	(0.027)	(0.025)	(0.010)	(0.011)	(0.034)
	[0.375]	[0.158]	[0.407]	[0.054]	[0.145]
SL	-0.004	-0.016	-0.001	-0.010	-0.020
	(0.022)	(0.020)	(0.007)	(0.008)	(0.028)
State bank	0.035	-0.001	0.025	-0.009	0.033
	(0.021)	(0.016)	(0.009)	(0.007)	(0.025)
Cons.	0.118	0.086	0.010	0.029	0.204
	(0.018)	(0.014)	(0.006)	(0.006)	(0.022)
N	5,633	5,633	5,633	5,499	5,633
Adj. R^2	0.005	0.007	0.005	0.001	0.013

Note: The dependent variables are the constituent parts of *total trouble* and are indicated at the top of each column. Since banks could experience multiple forms of trouble, the coefficients do not add up to the ones in Table 6 (Column 9). Column (5) combines *permanent suspensions* and being *acquired*. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table 8: Causes of permanent suspensions

	(1) All suspensions	(2) Slow paper	(3) Failure of correspondent	(4) Failure of large debtor	(5) Defalcation	(6) Heavy withdrawals	(7) Other
Panel A: Single difference							
SL	0.031	0.018	-0.003	-0.001	-0.001	0.006	0.004
	(0.015)	(0.011)	(0.002)	(0.001)	(0.004)	(0.010)	(0.008)
	[0.331]	[0.517]	[0.315]	[0.338]	[0.810]	[0.828]	[0.826]
Cons.	0.155	0.073	0.005	0.002	0.012	0.057	0.025
	(0.010)	(0.008)	(0.002)	(0.001)	(0.003)	(0.006)	(0.005)
N	4,222	4,207	4, 207	4, 207	4, 207	4, 207	4, 207
Adj. R^2	0.001	0.001	0.000	0.000	-0.000	-0.000	-0.000
Panel B: Double difference							
SL x	0.030	0.020	-0.005	-0.001	-0.006	0.004	0.014
State bank	(0.027)	(0.022)	(0.003)	(0.001)	(0.005)	(0.016)	(0.009)
	[0.375]	[0.516]	[0.127]	[0.553]	[0.216]	[0.882]	[0.452]
SL	-0.004	-0.003	0.001	-0.000	-0.000	0.008	-0.010
	(0.022)	(0.018)	(0.001)	(0.000)	(0.002)	(0.012)	(0.005)
State bank	0.035	-0.003	0.006	0.002	0.012	0.025	0.008
	(0.021)	(0.017)	(0.003)	(0.001)	(0.004)	(0.012)	(0.007)
Cons.	0.118	0.072	0.000	0.000	0.002	0.030	0.016
	(0.018)	(0.015)	(0.000)	(0.000)	(0.002)	(0.010)	(0.005)
N	5,633	5,620	5,620	5, 620	5, 620	5, 620	5, 620
Adj. R^2	0.005	0.000	0.002	0.000	0.003	0.004	0.003

Note: The dependent variables are indicators for permanent suspensions with different reported causes. Column (1) presents results for all permanent suspensions, and replicates Column (1) of Table 7. Columns (2) to (7) distinguish by the primary reason(s) for the suspension reported on form St. 6386. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table 9: Robustness: results for subsets of State banks

	(1)	(2)	(3)	(4)	(5)	(6)
	Total trouble	Permanent Suspensions	Acquired	Temporary Suspensions	Troubled raising	Permanent Susp. or Acquired
Panel A: Non-Fed members						
SL	0.093	0.025	0.073	-0.007	0.008	0.097
	(0.020)	(0.016)	(0.015)	(0.007)	(0.007)	(0.020)
	[0.023]	[0.441]	[0.060]	[0.555]	[0.504]	[0.035]
Cons.	0.286	0.161	0.079	0033	0.020	0.240
	(0.013)	(0.011)	(0.008)	(0.006)	(0.004)	(0.013)
N	3,809	3,809	3,809	3,809	3,646	3,809
Adj. R^2	0.009	0.001	0.013	0.000	0.000	0.011
Panel B: State banks with limited capital						
SL	0.093	0.045	0.049	-0.014	0.020	0.093
	(0.037)	(0.033)	(0.019)	(0.013)	(0.007)	(0.036)
	[0.063]	[0.328]	[0.000]	[0.367]	[0.047]	[0.078]
Cons.	0.275	0.204	0.045	0.037	-0.000	0.248
	(0.029)	(0.026)	(0.013)	(0.012)	(0.000)	(0.028)
N	1,292	1,292	1,292	1,292	1,206	1,292
Adj. R^2	0.009	0.002	0.009	0.001	0.009	0.010
Panel C: State banks not located in (central) reserve cities						
SL	0.103	0.041	0.069	-0.010	0.006	0.110
	(0.020)	(0.015)	(0.014)	(0.007)	(0.007)	(0.019)
	[0.010]	[0.208]	[0.050]	[0.414]	[0.570]	[0.017]
Cons.	0.268	0.146	0.075	0.035	0.021	0.220
	(0.013)	(0.010)	(0.007)	(0.006)	(0.004)	(0.012)
N	3,937	3,937	3,937	3,937	3,776	3,937
Adj. R^2	0.012	0.003	0.012	0.001	0.000	0.015

Note: Column (1) presents results for *total trouble*. Columns (2) through (5) use its four constituent components (*permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*). Column (6) combines *permanent suspensions* and being *acquired.* Panel A includes only State banks that were not Fed members. Requiring at least 50 banks per state-Fed district retains all pairs. Panel B includes only State banks that could not easily convert into National banks because of insufficient paid-in capital. Requiring at least 50 banks per state-Fed district drops pairs (1) through (4) of Figure 1. Panel C includes only State banks that were not located in reserve or central reserve cities. Requiring at least 50 banks per state-Fed district retains all pairs. *SL* is an indicator variable that equals one for states with single liability State banks. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) in Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

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A. Regulatory differences

A.1. Fed membership

First, we examine Fed membership. Some State banks were members of the Federal Reserve system, which gave them access to the Fed's discount window. This may have *reduced* their probability of failure (Richardson and Troost 2009, Carlson, Mitchener, and Richardson 2011). On the other hand, Fed policies during the Great Depression were not as liberal as expected, which might have led member banks to hold too little liquidity (Carlson and Wheelock 2016, 2018). Thus, Fed membership could have *increased* the probability of bank failure.

Averaging across the state-Fed district pairs, Table A.1 shows that Fed membership rates were 8% for SL State banks and 12% for DL State banks. In Panel A of Table 9, we redo our analysis of bank distress but exclude all State banks that were Fed members. The SL effects on bank distress are close to the full sample results, which suggests that Fed membership is not driving our results.

Table A.1: State banks and Fed membership by state-Fed district

Pair	State-Fed district	Single liability	Number of State banks	Fed members (%)
1	CT (1)	1	69	5.8%
	MA	0	95	22.1%
2	NJ (2)	1	160	33.8%
	NY	0	350	26.3%
3	NJ (3)	1	64	9.4%
	PA (3)	0	397	17.1%
4	VA	1	307	3.6%
	MD	0	124	1.6%
5	TN (6)	1	254	0%
	GA	0	326	12.0%
6	AL (6)	1	236	5.1%
	GA	0	327	11.9%
7	MO (8)	1	860	5.3%
	KY (8)	0	267	1.5%
8	TN (8)	1	128	3.9%
	KY (8)	0	258	0.8%
All	Average	1	2,078	8.4%
	Average	0	2,144	11.7%

Note: The number of State banks and the percentage that were Fed members in each state-Fed district in 1928 for the single difference common support sample. The last two rows (labeled "All") report the total number of single and double liability State banks in the sample and the average of the Fed membership percentages across the state-Fed district pairs.

A.2. Reserve and capital requirements

Next, we examine minimum reserve and capital requirements. Higher reserve requirements mean more cash is available in case depositors run. Higher capital requirements imply lower leverage for banks at the constraint and higher barriers to entry, especially for smaller (potentially weaker) banks.

For each bank in our sample, we determine its reserve and capital requirements (as of 1928) based on the town it was located in.[45] Reserve requirements are for demand deposits only. Table A.2 presents the 20th, 50th, and 80th percentiles of the bank-level distributions of the two requirements for each state-Fed district. Although there are differences within pairs, there are no systematic differences between SL and DL states. Reserve and capital requirements were stricter for SL banks in three pairs, less strict in three pairs, and equally strict (or mixed depending on banks size) in the remaining two pairs. Aggregating across pairs, SL banks on average faced slightly stricter requirements, which means that, if anything, we underestimate the effect of SL.

[45] Capital and reserve requirements were functions of the status and population of the town or city the bank was located in. Capital requirements are hand-collected from state statutes and session laws; reserve requirements are from Federal Reserve Bulletin (1928).

Table A.2: Reserve and capital requirements (for State banks)

Pair	State-Fed district	Single liability	Reserve Requirements			Capital Requirements		
			20th	50th	80th	20th	50th	80th
1	CT (1)	1	12%	12%	12%	50,000	50,000	100,000
	MA	0	15%	15%	15%	50,000	100,000	200,000
2	NJ (2)	1	15%	15%	15%	100,000	100,000	100,000
	NY	0	10%	12%	12%	25,000	50,000	100,000
3	NJ (3)	1	15%	15%	15%	100,000	100,000	100,000
	PA (3)	0	15%	15%	15%	25,000	125,000	125,000
4	VA	1	10%	10%	10%	25,000	25,000	50,000
	MD	0	15%	15%	15%	25,000	25,000	100,000
5	TN (6)	1	10%	10%	10%	20,000	20,000	100,000
	GA	0	15%	15%	15%	25,000	25,000	25,000
6	AL (6)	1	15%	15%	15%	10,000	15,000	25,000
	GA	0	15%	15%	15%	25,000	25,000	25,000
7	MO (8)	1	15%	15%	15%	15,000	15,000	25,000
	KY (8)	0	7%	7%	7%	15,000	15,000	15,000
8	TN (8)	1	10%	10%	10%	20,000	20,000	50,000
	KY (8)	0	7%	7%	7%	15,000	15,000	15,000
All	All	1	10%	15%	15%	20,000	50,000	100,000
	All	0	7%	15%	15%	15,000	25,000	100,000

Note: Percentiles of the bank level distribution of reserve and capital requirements for each state-Fed district. We determine the two requirements for each State bank in the single difference common support sample based on the town or city it was located in. Reserve requirements are for demand deposits only. The last two rows (labeled "All") report percentiles for the full sample using pair-specific weights such that each state-Fed district pair has equal weight. Sources: Federal Reserve Bulletin (1928) for reserve requirements; state statutes and session laws for capital requirements, supplemented with information from Polk's Bankers Encyclopedia (various issues) where needed.

A.3. Restrictions on bank risk taking and regulatory quality

We use state statutes and session laws to construct a measure of other state-level restrictions on bank risk taking in 1929. Federal Reserve (1932) emphasizes that there was significant variation in this dimension. From a careful reading of the national and state banking laws, we identify eight relevant categories. These include restrictions on making real estate loans, discounting activities, and holding corporate securities. Details are in Table A.3. As baseline we use the regulations of National banks in the National Banking Act. For each category, we determine whether the law in a particular state was laxer, equally strict, or stricter than the national law. We score strictness from -1 (most lax) over 0 (equal to the national law) to +1 (most strict). For loans to officers and directors, which the national law did not constrain, we code states as either equally lax (0) or stricter (+1). For each state, we take the simple unweighted sum of the eight categories. Results are in Table A.5, Column (1). A higher score indicates tighter restrictions. Although there is substantial heterogeneity, there are no systematic differences between SL and DL states. The laws were more restrictive for SL banks in four pairs and less restrictive in the other four. On average, SL and DL banks faced similar restrictions.

Next, we assess the quality of the state regulator. Federal Reserve (1932) documents considerable variation across states (see also Mitchener 2005, 2007). Based on a 1929 American Bankers Association survey of state regulators (amended with state statutes), Federal Reserve (1932) discusses nine categories of regulator quality, some of which have multiple sub-categories. These cover the regulator's general authority, the tenure and salary of its head, the frequency of bank examinations, and related topics. Details are in Table A.4. For each (sub)category we score states between 0 and 1, where 0 is the lowest quality in our sample and 1 the highest. Table A.5, Column (2), presents the sum of these scores, giving equal weight to each of the nine main categories. Again, although there is considerable variation within pairs, there are no systematic differences between SL and DL states. Regulator quality was higher for SL banks in two pairs, lower in four pairs, and roughly the same in the remaining two. On average, regulator quality was similar for SL and DL banks.

Finally, we examine branching restrictions. Banks subject to more restrictive branching might have been less diversified and therefore riskier. Constraints on branching created pressure to open independent banks in small, rural communities. Such banks were at a high risk of failure due to

their lack of size and dependence on local economic conditions (Federal Reserve 1932, Wheelock 1995). There is also evidence that branching restrictions reduced competition, leaving weak banks in the system (Carlson 2004, Mitchener 2005, Carlson and Mitchener 2006, 2009). Using data from Federal Reserve (1931), Table A.5, Column (3) compares branching restrictions within our pairs. "Prohibited" indicates that no branches were allowed (although banks could typically open local agencies to receive deposits and pay checks), "Limited" indicates branching was allowed within the same town, city, or municipality, and "Allowed" indicates branching was allowed within the same state. Branching restrictions were the same within most of our pairs. Geographical diversification and opening branches in smaller communities was only possible in states where branching was "Allowed". There are only two such states in our sample, Maryland (DL) and Virginia (SL), which are in the same pair. In the other seven pairs, branching was less restricted for SL banks in one pair, more restricted in two pairs, and equally restricted in the remaining four pairs.

Table A.3: Restrictions on bank risk taking

	Category	National Banking Act
1	Holding corporate securities	Cannot hold corporate stock
2	Insurance	Cannot guarantee any loans or bonds
3	Limits on discounting bills of exchange	Limits on maturities (less than 6 months for domestic bills, less than 3 months for foreign ones) and total amounts (max. 50% of equity capital for each)
4	Loans on the collateral of real estate	Max. 25% of equity capital or 50% of time deposits, max. loan-to-value ratio of 50%
5	Loans to individual borrowers	Max. 10% of equity capital, except for some forms of safe commercial paper
6	Loans to officers and directors	Not regulated
7	Owning (lending on the security of) shares in the bank itself	Restricted, only to secure existing debts
8	Usury limit on loans	7%, unless stipulated otherwise by local state laws

Source: National Banking Act of 1927

Table A.4: Different categories of regulatory quality

	Category	Subcategory	Description	Score
1	Status of supervisory agency		Under other department	0
			Separate	1
2	Type of supervisory agency		Single official under control of / appointed by banking board	0
			Single official + banking board	0.5
			Single official	1
3	Method of selecting commissioner or supervisor		Selected by banks	0
			Selected by (political) commission	0.5
			Appointed by governor	1
4	Term of office of supervisor		3 years or less	0
			4 years	0.333
			5 or 6 years	0.666
			Indefinite	1
5	Salaries of supervisors		< $5,000	0
			$5,000-$10,000	0.5
			>$10,000	1

6	Method of selecting examiners		Supervisory agency + governor or board Supervisory agency Civil service	0 0.5 1
7	Powers in the organization of new banks	Principal discretionary powers in passing on applications for new charters	Commissioner Banking board No	1 1 0
		Must be assured of legitimate purpose and/or integrity of applicant	No/Yes	0/1
		Must take into consideration the public need for and convenience of banking facilities	No/Yes	0/1
8	Powers relevant to banking operations	Examinations – frequency	Not stipulated Annual More than annual	0 0.5 1
		Examinations – discretionary powers	No/Yes	0/1
		Stockholders required to make good impairment of capital	No/Yes	0/1
		May limit borrowing by banks	No/Yes	0/1
		May require removal of undesirable and/or illegal assets	No/Yes	0/1
		May *order* removal of officers or employees	No/Yes	0/1
		May *recommend* removal of officers or employees	No/Yes	0/0.5
		May *order* removal of directors	No/Yes	0/1
		May *recommend* removal of directors	No/Yes	0/0.5
9	Powers relevant to insolvent banks	May liquidate the bank	No/Yes	0/1
		May appoint a receiver	No/Yes	0/1
		May *apply* for the appointment of a receiver	No/Yes	0/0.5

Source: Federal Reserve (1932).

Table A.5: Restrictions on bank risk taking and regulatory quality

Pair	State-Fed district	Single liability	(1) Restrictions on bank risk taking	(2) Regulator quality	(3) Branch banking
1	CT (1)	1	-0.33	5.4	Prohibited
	MA	0	-2.83	5.4	Limited
2	NJ (2)	1	-3.00	5.6	Limited
	NY	0	-2.33	6.3	Limited
3	NJ (3)	1	-3.00	5.6	Limited
	PA (3)	0	-1.50	5.3	Limited
4	VA	1	-5.67	4.6	Allowed
	MD	0	-2.67	6.0	Allowed
5	TN (6)	1	-1.33	5.2	Limited
	GA	0	-1.83	6.1	Limited
6	AL (6)	1	-0.83	5.8	Prohibited
	GA	0	-1.83	6.1	Limited
7	MO (8)	1	-2.67	6.4	Prohibited
	KY (8)	0	-1.67	5.3	Prohibited
8	TN (8)	1	-1.33	5.2	Limited
	KY (8)	0	-1.67	5.3	Prohibited
All	Average	1	-2.27	5.5	
	Average	0	-2.04	5.7	

Note: Restrictions on bank risk taking: We identify eight restrictions on banks' assets in state laws. For each restriction we use the National Banking Act as baseline and code state laws as laxer (up to -1), equally strict (0), or stricter (up to +1). For categories not in the National Banking Act, we code states as equally lax (0) or stricter (+1). To capture differences in strictness across states, we use fractions, e.g., -1/3 or +1/2. See Internet Appendix A.3 for details. The table reports the unweighted sum of the eight category scores as of 1929. *Regulator quality*: Federal Reserve (1932, Appendix Table II) describes nine dimensions of state regulator quality, such as its powers to intervene in banks' operations and the term and salary of the bank commissioner (based on a 1929 American Bankers Association survey of bank regulators and state statutes). We score each dimension between 0 and 1. Some dimensions have subcategories, each of which we score between 0 and 1 and average. See Internet Appendix A.3 for details. The table reports the unweighted sum of the scores over the nine dimensions. *Branch banking*: "Prohibited" means no branches allowed, although banks could typically open local agencies to receive deposits and pay checks. "Limited" means branches allowed within the same town, city, or municipality. "Allowed" means branches allowed in other locations in the home state. The last two rows (labeled "All") report equal-weighted averages of the results across the state-Fed district pairs. Sources: State statutes and session laws, Federal Reserve (1931, 1932), Federal Reserve Bulletin (1929).

B. Data sources

We hand collect data from a variety of sources.

Bank-level annual balance sheet data for 1928 to 1933 comes from OCC annual reports (for National banks) and from reports by the various state banking departments (for State banks). The state reports are not available for Connecticut, Massachusetts, Maryland, Pennsylvania, and Tennessee, so we use Rand McNally's *Bankers' Directory* instead.[46] If available, we prefer the state reports, as we believe them to be more accurate. The reported balance sheet categories are coarse, especially on the asset side. The exception are State bank reports for New Jersey and New York for 1928, which provide more detailed information about bank assets.

To calculate bank profits (return on equity) between 1923 and 1929, we collect 6-monthly bank balance sheet and dividend data for National and State banks between 1922 and 1929 from RandMcNally. We do this for Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania (Fed district 3). The data includes detailed information on name changes, acquisitions, and bank exits.

Information on deposit rates paid by New Jersey banks in 1928 comes from OCC call reports for National banks and from New Jersey State bank reports for State banks.

The information on individual bank failures was recorded on forms St. 6386 by the Fed Board of Governors' Division of Bank Operations.[47] In the 1920s, a nationwide reporting network had been established to collect uniform and comprehensive information about bank suspensions, mergers and acquisitions, and other changes. The data covers all banks, including National and State banks, trust companies, and banks that were not members of the Federal Reserve.[48] We collect this data for all state-Fed districts in our sample. In case of acquisitions, these forms also provide bank balance sheet information before and after an acquisition, which we also collect if available.

Information about differences in state-level regulations comes from several sources. Mitchener and Richardson (2013) carefully reconstruct which states imposed single or double liability on bank shareholders. Federal Reserve (1932) provides information on State bank regulators, and Fed bulletins from 1929 report reserve requirements and restrictions on branching for State banks. We

[46] For Missouri the state banking department only published data every other year.
[47] The forms are currently located in the National Archives: record group 82, file number 434.-1.
[48] See Richardson (2007b, 2007c) and references therein for a detailed description of this source.

study original state statutes and session laws (available through *Heinonline.org*) to determine minimum capital requirements, restrictions on banks' asset portfolios, and other state-level regulatory differences.

C. State selection, pre-trends, common size support, and summary statistics

C.1. State selection

We attempt to match each single liability (SL) state (with a sufficient number of State banks) to one neighboring double liability (DL) state that is the closest match. We only consider matches in the same Federal Reserve District because different Federal Reserve banks had different policies during the Great Depression, with large effects on bank outcomes (Richardson and Troost 2009, Jalil 2014). For states that are split into two different Fed Districts, we consider each state-Fed district separately. We then collect individual bank level data for the selected state-Fed districts.

To determine the best match we use aggregate data from Federal Reserve (1956). In particular, we compare the failure rates of National banks in 1929 – 1932 and the average size of State banks at the end of 1928. As this data is not broken down by state-Fed district, we use state-level information. We use the failure rates of National banks to select states that faced similar financial and economic shocks during the Great Depression.[49] We use average bank sizes to match states with similar types of banks.

We drop eight DL states that provided state-level deposit insurance at any time during the 1920s (none of the SL states had deposit insurance). Deposit insurance might have had long-lasting effects on the structure of the banking system by, for example, increasing the number of small banks (Aldunate 2019, Calomiris and Jaremski 2019). Consistent with this concern, Wheelock (1995) shows that, even for states where deposit insurance ended before 1929, its effects lingered on, causing more bank failures in the early 1930s.

The sequence of the matching process is as follows:

1. We start with all nine SL states in 1928. We consider all their DL neighbors within the same Fed district as potential matches.
2. We require each state-Fed district to have at least 50 State banks.
    - ⇨ Three SL state-Fed districts (Connecticut (district 2), Delaware, and Rhode Island) are dropped. No DL neighbors are dropped.
3. We drop all states with state deposit insurance at any time during the 1920s.

[49] We use these annual state-level failure rates up to 1932 to match the observation period of the bank-level data, which ends in February 1933.

- ⇨ SL states Louisiana (districts 6 & 11) and Missouri (district 10) are dropped because all potential DL matches had deposit insurance during the 1920s.

4. We eliminate DL states for which the failure rate of National banks differs by more than 15 percentage points from the SL state. This cutoff is motivated by the distribution of state-level National bank failure rates, which has a standard deviation of 13%, and the desire to retain at least one potential match per SL state-Fed district.
    - ⇨ DL states Arkansas (potential match for Tennessee (district 8)), North Carolina, and West Virginia (both potential matches for Virginia) are dropped.
5. If there are multiple potential matches left, we pick the DL state for which the average State bank size (measured by book assets) is closest to the SL state.

Table C.1 shows the results of this matching process, as well as the state-level National bank failure rates and average State bank sizes used in the process.

To assess our matching procedure, Table C.1 also reports urbanization rates, which capture economic structure and development (Table 1, Panel D in the main text shows that urbanization lines up well with agricultural and manufacturing output for our final set of state-Fed districts). Because urbanization data is available at the county level, we can calculate it at the state-Fed district level rather than at the state level. Specifically, we calculate state-Fed district urbanization rates as the weighted average of county-level urbanization rates across counties in the relevant Fed-district, with weights proportional to the number of State banks per county as reported by RandMcNally.

Even though we did not match on urbanization, our sample is mostly well-balanced in this dimension, and there are no closer matches available based on it (with the exception of Virginia, more on this below).

C.2. Selection of additional states

For robustness tests in Section E.4, we collect individual bank-level data for two additional DL state-Fed district candidates that were close runners-up in our selection procedure.

For Missouri (district 8), we add Illinois (district 8) as an additional DL match. Our preferred match, Kentucky, has a similar average bank size and urbanization rate to Missouri, but its National bank failure rate is lower (24% vs 35%). Illinois is geographically close to Missouri, and its

National bank failure rate is similar. However, its average bank size is much larger than Missouri's, and Illinois (district 8) is more urbanized. Arkansas is another candidate but differs from Missouri on all dimensions. Its average bank size and urbanization rate are substantially lower, and its National bank failure rate is higher (47%). This is driven by the collapse of the Caldwell banking network in 1930, which caused many more bank failures in Arkansas than in Missouri (Mitchener and Richardson 2020, Figure 1), making Arkansas a poor match.

For Virginia, we add West Virginia (district 5) as additional DL match. Our preferred match, Maryland, has a National bank failure rate that is very close to Virginia's. However, its average bank size and urbanization rate are higher. West Virginia's average bank size and urbanization rate are similar to Virginia's. However, its National bank failure rate is much higher (37% vs 17%), signaling more systemic stress, likely due to the collapse of its coal mining industry.[50] To account for systemic differences in economic distress, we focus on the double difference estimates when we include West Virginia (district 5). North Carolina is another candidate. However, its National bank failure rate is much higher (55% vs 17%). This is again due to the collapse of the Caldwell network, which caused widespread bank failures in North Carolina but had almost no impact in Virginia (Mitchener and Richardson 2020, Figure 1).

For Alabama and Tennessee (district 8), we did not find suitable additional DL states. For Alabama, the only other potential match without deposit insurance in the 1920s is Florida, which had a very different economic structure, with much larger banks, a much higher urbanization rate, and a very different agricultural crop mix (citrus vs cotton). For Tennessee (district 8), the only other potential match without deposit insurance in the 1920s is Arkansas, which had a much higher National bank failure rate (47% vs 28%), again due to the failure of the Caldwell network, which affected Tennessee less, even though it originated there (Mitchener and Richardson 2020, Figure 1).

Additional references

Thomas, Jerry Bruce. "An Appalachian New Deal: West Virginia in the Great Depression." University Press of Kentucky (2010).

[50] According to Thomas (2010, p. 27), "as the Depression deepened in West Virginia, it produced conditions that were among the worst in the country. Coal production fell from 146 million tons in 1927 to 83.3 million in 1932, and some 33 thousand coal industry jobs disappeared. (…) From 1929 to 1932, one hundred banks collapsed, accelerating the rate of bank failure that had already been high in the 1920s. Deposits dwindled from $328 million to $213 million."

Table C.1: State selection

Single liability (SL) states in the sample and their same Fed-district double liability (DL) neighbors. Final matches are in bold.

SL State	Neighboring DL States	Fed district	Deposit insurance in 1920s	National bank failure rate 1929-32	Diff.	Average State bank size in 1928 ($000)	Diff.	Urbanization*	Diff.
Alabama		6	N	32%		533		18%	
	Florida	6	N	37%	5%	951	418	45%	27%
	Georgia	**6**	**N**	**35%**	**3%**	**523**	**-10**	**18%**	**0%**
	Mississippi	6&8	Y						
Connecticut		1	N	11%		3,745		69%	
	Massachusetts	**1**	**N**	**14%**	**3%**	**9,226**	**5,481**	**89%**	**20%**
Missouri		8		35%		772		22%	
	Arkansas	8	N	47%	12%	467	-305	15%	-7%
	Illinois	7&8	N	38%	3%	2,148	1,376	32%	10%
	Kentucky	**4&8**	**N**	**24%**	**-11%**	**724**	**-48**	**18%**	**-4%**
New Jersey		2		16%		6,165		88%	
	New York	**2**	**N**	**18%**	**2%**	**19,011**	**12,845**	**64%**	**-24%**
New Jersey		3		16%		6,165		61%	
	Pennsylvania	**3**	**N**	**16%**	**0%**	**4,207**	**-1,958**	**65%**	**4%**
Tennessee		6		28%		673		19%	
	Georgia	**6**	**N**	**35%**	**6%**	**523**	**-149**	**18%**	**-1%**
Tennessee		8		28%		673		17%	
	Arkansas	8	N	47%	19%	467	-206	15%	-2%
	Kentucky	**4&8**	**N**	**24%**	**-4%**	**724**	**51**	**18%**	**1%**
	Mississippi	6&8	Y						
Virginia		5		17%		868		24%	
	Maryland	**5**	**N**	**18%**	**1%**	**3,159**	**2,291**	**33%**	**9%**
	North Carolina	5	N	55%	38%	808	-60	22%	-2%
	West Virginia	4&5	N	37%	20%	1,144	276	22%	-2%

Note: The table omits the SL states (Fed districts) Connecticut (2), Delaware, and Rhode Island because they had fewer than 50 State banks in 1928, as well as Louisiana (6 & 11) and Missouri (7) because all neighboring DL states in the same Fed district had state-level deposit insurance during the 1920s. *Weighted average of county-level urbanization rate across counties in the relevant Fed-district, with weights proportional to the number of State banks per county as reported by RandMcNally. These numbers are slightly different from Table 1, Panel D, where we restrict the sample to counties with banks that fall in the common size support sample. Here, we consider all banks because we have bank balance sheet data, including total bank assets, only for the state-Fed districts in our final sample.

C.3. Pre-trends

In order to validate our selection algorithm, we look at pre-trends in state banking systems. Specifically, we look at the development of the number of State banks and the number of failures (suspensions and acquisitions), both relative to those of National banks. Subtracting National banks in the same state accounts for state-specific trends or shocks that affect both types of banks. This makes parallel trends more likely, and it corresponds to the difference-in-differences specifications in our main analysis.

The detailed bank failure data that we use in the main paper only starts in 1929 and is therefore unavailable for this exercise. Instead, we use the next-best available source. In 1937, the Fed published a detailed annual state-level overview, separated by National and State banks, of bank additions and exits, also detailing the number of permanent suspensions and acquisitions (Federal Reserve 1937). There are three important limitations to this data: (1) it only covers states, not the state-Fed districts that we use in the main analysis, (2) its 1933 data includes failures during and after the National Banking Holiday of March 1933, which we exclude in the main analysis,[51] and (3) as aggregate data, it does not allow for a careful comparison of banks of similar size (cf. Section C.4).

Figure C.1 documents the importance of having parallel pre-trends. It shows a strong positive correlation between the growth (decline) in the number of State banks during 1920-28 and 1929-33 (t = 2.69). This indicates that trouble in the 1920s may have made state banking systems more vulnerable to the Great Depression.

Figure C.2 illustrates the difference in the development of the number of State and National banks for single and multiple liability (ML) states.[52] In particular, we calculate an index of the number of State and National banks in a given state and year, $I^b_{s,t}$, with 1928 normalized to 1, and then take the difference:

[51] As is the case in much of the literature (see, for example, Wheelock 1995), our sample runs up to February 1933. It therefore excludes bank closures caused by the banking holidays. During the national banking holiday, all banks were closed and only those permitted by regulators could reopen. These decisions might have, at least in part, been driven by broader economic or political considerations rather than the health of each bank. In addition, the bank failure data we use in this paper is based on a Federal Reserve reporting system that did not track bank closures during state or national banking holidays (Richardson 2007c)

[52] In the full sample of 48 states, some states had triple or even unlimited liability for bank shareholders. We therefore refer to "multiple liability" in the full sample and to "double liability" in our matched sample of 12 states.

$$I_{s,t}^{SB} - I_{s,t}^{NB} = \frac{N_{s,t}^{SB}}{N_{s,t=1928}^{SB}} - \frac{N_{s,t}^{NB}}{N_{s,t=1928}^{NB}}, \tag{C1}$$

where $N_{s,t}^{b}$ is the number of State or National banks in a given state and year. We then regress this difference on year dummies θ_t, with the coefficients β_t capturing the cumulative difference in growth rates between State and National banks:

$$I_{s,t}^{SB} - I_{s,t}^{NB} = \sum_{t} \beta_t \, \theta_t + \varepsilon_{s,t} \tag{C2}$$

We run this regression separately for SL and ML states.

Panel A reports results for all 48 contiguous states and shows that the state banking sectors evolved differently (compared to National banks) in single and multiple liability states during the 1920s. In ML states, the number of State banks saw a strong relative decline from 1920 to 1928. This is likely because agricultural states were more likely to have multiple liability in the 1920s (Grossman 2001) and because State banks were more exposed to agriculture than National banks (Jaremski and Wheelock 2020). The boom and bust in commodity prices during and after WWI likely weakened their banking sectors and made them more susceptible to shocks (e.g., Federal Reserve 1932, p. 125; Wheelock 1995; Rajan and Ramcharan 2015; Jaremski and Wheelock 2020; see Internet Appendix F for more details). In contrast, in SL states, the number of State banks saw a relative increase, especially during 1923-28. Given the evidence in Figure C.1, we expect both of these trends to have persisted into the Great Depression. This makes it difficult to compare the performance of State banks in SL and ML states during the Great Depression. Their relative performance is likely affected by both the liability regime and by differences in the economic shocks suffered during the 1920s.

In Panel B, we redo the same exercise for our matched sample of 12 states. Even though we do not consider pre-trends in our matching, the relative growth of State banks in single and double liability states looks parallel, especially after 1925. There is a slightly larger downward trend in the relative number of DL State banks between 1920 and 1925. If anything, this would predict that DL State banks would continue to perform relatively poorly in the Great Depression, which would attenuate our main results. However, consistent with the findings in the main text, Panel B shows a relative decline in the number of SL State banks during the Great Depression.

Figure C.3 plots cumulative bank failures. In particular, we calculate:

$$F^{SB}_{s,1920\to t} - F^{NB}_{s,1920\to t} = \sum_{\tau=1920}^{t} F^{SB}_{s,\tau} - \sum_{\tau=1920}^{t} F^{NB}_{s,\tau}, \tag{C3}$$

where $F^{SB/NB}_{s,\tau}$ is the fraction of State or National banks in state s present in year $\tau - 1$ that failed in year τ due to a suspension or acquisition. We then regress this difference on year dummies θ_t, with coefficients β_t capturing the cumulative difference in failure rates between State and National banks:

$$F^{SB}_{s,1920\to t} - F^{NB}_{s,1920\to t} = \sum_{t} \beta_t \, \theta_t + \varepsilon_{s,t} \tag{C4}$$

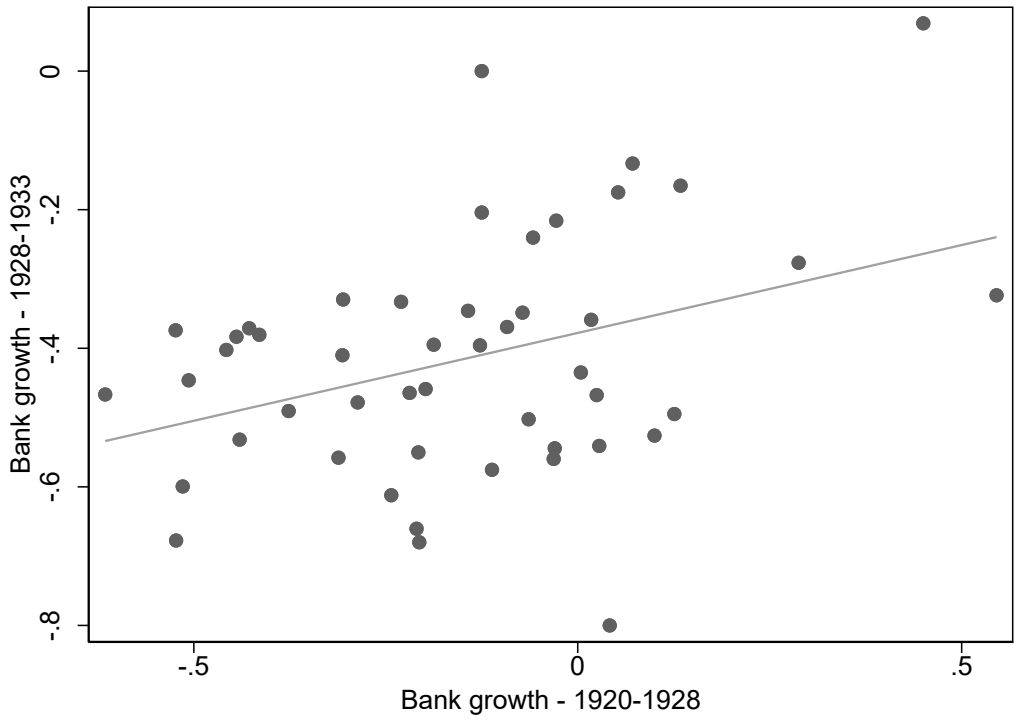
We run this regression separately for SL and ML states.

Panel A confirms that in the full sample of 48 states, single and multiple liability states were on different trajectories, with the latter having a substantially higher likelihood of State bank failures in the 1920s. Again, this is likely driven by the fact that ML states were much more agricultural in the full sample.

Panel B shows that when we restrict the sample to our 12 matched states, there were no large differences during the 1920s. Double and single liability states saw (temporary) elevated State banks failure rates in 1925 and 1929, respectively. However, by the end of 1929, the accumulated failure rates were similar for both groups. Consistent with the results in our main analysis, State banks in SL states had a substantially higher failure rate during the Great Depression.

In sum, our state selection algorithm produces largely parallel trends across SL and DL states during the 1920s in terms of the development of the number of State banks and State bank failures, which is not the case in the full sample of 48 states.

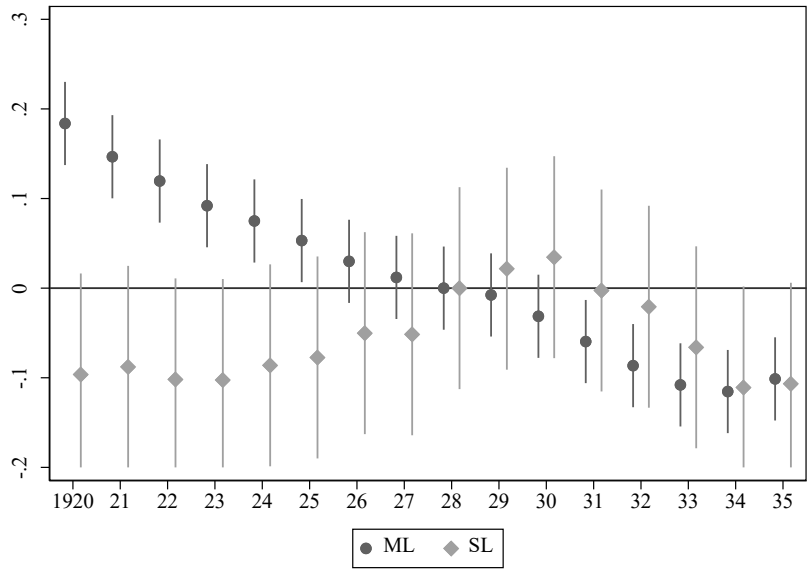
Figure C.1. State bank growth (decline): 1920-1928 vs 1928-1933



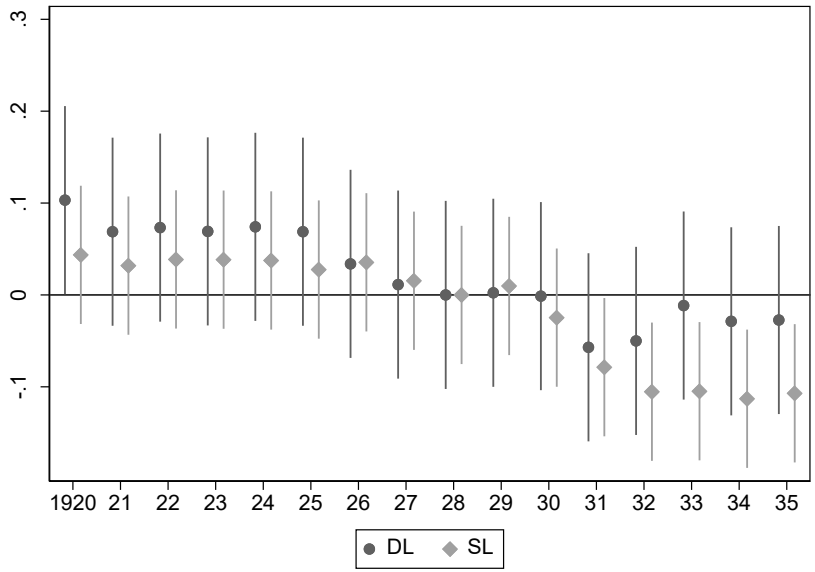
This figure shows that the rate of growth (decline) of the number of State banks between 1920 and 1928 positively predicts the growth (decline) of State banks between 1928 and 1933. Unit of observation: state-period. Coefficient (t-stat) of the fitted OLS line: 0.254 (2.69). Source: Federal Reserve Bulletin, November 1937.

Figure C.2: Difference in the development of the number of State and National banks (1928=0), 1920-1935

Panel A: Full sample of 48 states



Panel B: Matched sample of 12 states



This figure explores whether the development of the number of State banks (compared to the number of National banks) in multiple (double) and single liability states was parallel before the Great Depression. We calculate an index of the number of State and National banks in a given state and year, $I^{b}_{s,t}$, with 1928 normalized to 1, and then take the difference:

$$I^{SB}_{s,t} - I^{NB}_{s,t} = \frac{N^{SB}_{s,t}}{N^{SB}_{s,t=1928}} - \frac{N^{NB}_{s,t}}{N^{NB}_{s,t=1928}}$$

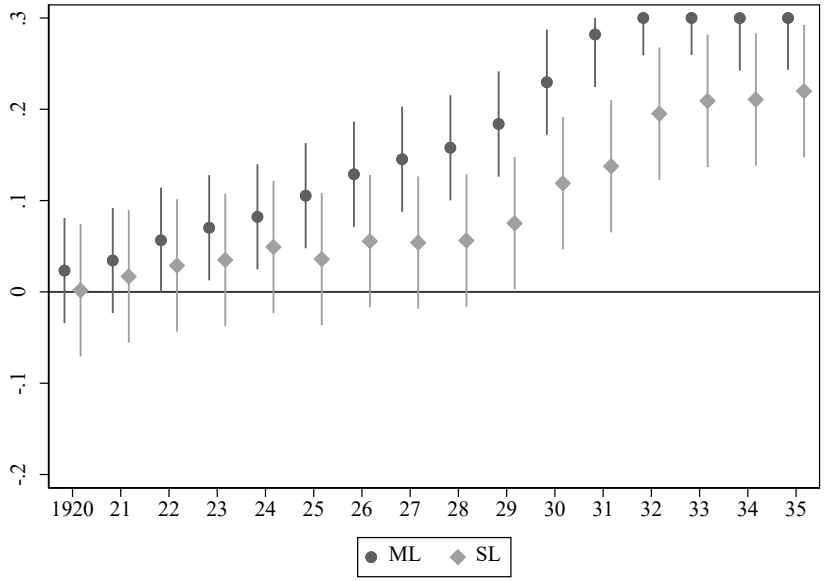
$N^{b}_{s,t}$ is the number of State or National banks in a given state and year. We then regress this difference on year dummies θ_t, with the β_t coefficients capturing the cumulative difference in growth rates between State and National banks:

$$I^{SB}_{s,t} - I^{NB}_{s,t} = \sum_{t} \beta_t \, \theta_t + \varepsilon_t$$

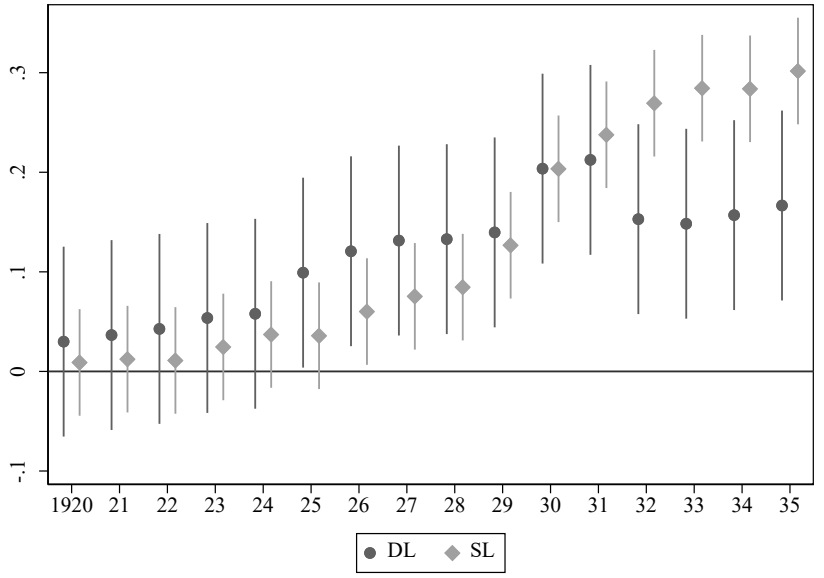
We run this regression separately for SL and ML (DL) states, plotting the β_t coefficients and their 95% confidence intervals. Source: Federal Reserve Bulletin, November 1937.

Figure C.3: Difference in the cumulative failure rates of State and National banks, 1920-1935

Panel A: Full sample of 48 states



Panel B: Matched sample of 12 states



This figure explores whether the failure rates of State banks (compared to the number of National banks) in multiple (double) and single liability states were parallel before the Great Depression. We calculate:

$$F^{SB}_{s,1920\to t} - F^{NB}_{s,1920\to t} = \sum_{\tau=1920}^{t} F^{SB}_{s,\tau} - \sum_{\tau=1920}^{t} F^{NB}_{s,\tau},$$

where $F^{SB/NB}_{s,\tau}$ is the fraction of State or National banks in state s present in year $\tau - 1$ that failed in year τ. We then regress this difference on year dummies θ_t, with the β_t coefficients capturing the cumulative difference in failure rates between State and National banks:

$$F^{SB}_{s,1920\to t} - F^{NB}_{s,1920\to t} = \sum_{t} \beta_t \, \theta_t + \varepsilon_{s,t}$$

We run this regression separately for SL and ML (DL) states, plotting the β_t coefficients and their 95% confidence intervals. Source: Federal Reserve Bulletin, November 1937.

C.4. Common support of bank size

The majority of banks that failed during the Great Depression were small (Wheelock 1995). On the other hand, Figure C.4 shows that larger banks had substantially higher leverage, which might have affected their probability of failure. In our analyses, we therefore restrict the sample to banks that, within each state-Fed district pair, are on the common support in terms of bank size (measured by book assets). We construct the single and double difference common support samples as follows:

Single difference sample

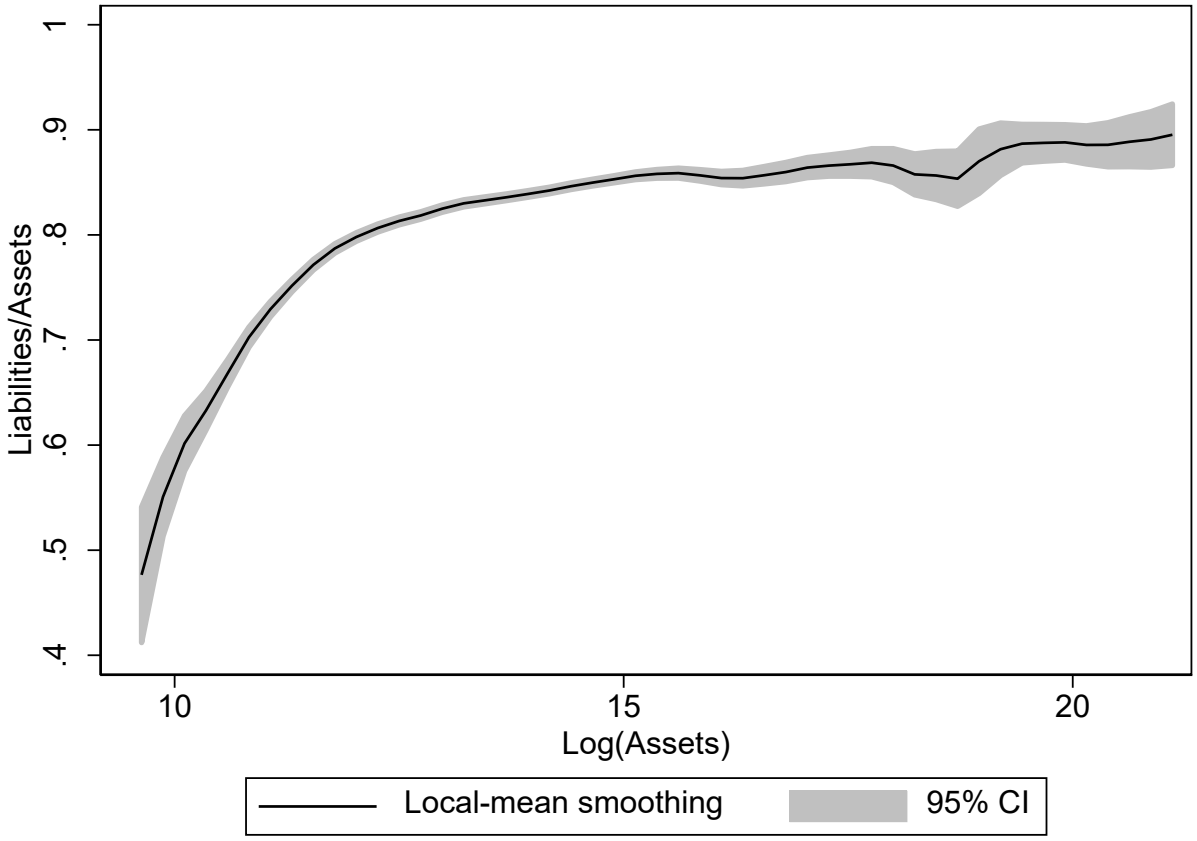
1. Start with each SL State bank in a given state-Fed district.
2. Select all DL State banks in the paired state-Fed district with total assets between 75% and 125% of the SL bank's assets. For SL banks with less than $100,000 in assets, select all DL banks for which the difference is at most $25,000.
3. Retain all SL State banks for which at least one DL State bank satisfies the size criterion.
4. If an SL State bank is retained, retain all selected DL State banks. Each DL bank is included once, even if selected multiple times, except for Georgia and Kentucky (8), which are used twice as control states.

Double difference sample

1. Start with each SL State bank in a given state-Fed district.
2. Select all DL State banks in the paired state-Fed district with total assets between 75% and 125% of the SL bank's assets. For SL banks with less than $100,000 in assets, select all DL banks for which the difference is at most $25,000.
3. Repeat Step 2 for National banks in the same state-Fed district, and again for National banks in the paired state-Fed district.
4. Retain all SL State banks for which at least one bank satisfying the size criterion is in each of the three control groups (DL State banks in paired state-Fed district, National banks in own state-Fed district, and National banks in paired state-Fed district).
5. If an SL State bank is retained, retain all DL banks selected in Steps 2 and 3. Each DL bank is included once, even if selected multiple times, except for Georgia and Kentucky (8), which are used twice as control states.

Summary statistics on average bank size in the various samples are reported in Table 1 in the main text.

Figure C.4: Leverage as a function of bank size, 1928 (State and National banks)



Note: Kernel-weighted local polynomial regression of bank leverage on bank size in 1928 for all State and National banks in the complete sample (corresponding to Table 1, Panel A). Leverage is defined as total liabilities divided by total assets, and bank size is defined as log(total assets). The figure is produced using Stata's *lpoly* command with a polynomial of degree zero (local mean smoothing). We use the default kernel (Epanechnikov) with the default rule-of-thumb bandwidth (0.3) and pilot bandwidth (0.46) for the standard error calculation.

C.5. Summary statistics

Table C.3 provides descriptive statistics for 1928 balance sheets and for the outcome variables, which are measured from the end of 1928 to the end of 1932 (February 1933 for suspensions and acquisitions). The table includes separate statistics for State and National banks, and for the single and double difference common support samples. Observations are weighted such that all pairs receive equal weight, independently of the number of banks, as described in the main text.

Table C.3: Summary statistics

	Single difference sample					Double difference sample				
	Mean	**25th**	**Median**	**75th**	**N**	**Mean**	**25th**	**Median**	**75th**	**N**
Panel A: State banks										
Total assets, 1928 ($000s)	2,655	209	532	1,872	4,222	2,118	279	618	1,834	3,375
Leverage, 1928	0.815	0.780	0.837	0.878	4,222	0.828	0.791	0.843	0.881	3,375
Cash/deposits, 1928	0.196	0.097	0.147	0.246	4,186	0.186	0.096	0.141	0.233	3,351
Total trouble	0.328				4,222	0.321				3,375
Permanent suspensions	0.171				4,222	0.166				3,375
Acquired	0.115				4,222	0.111				3,375
Temporary suspensions	0.028				4,222	0.030				3,375
Troubled raising	0.025				4,045	0.026				3,273
Capital write-downs (%)	-3.972	-12.50	-1.264	6.295	4,044	-4.553	-13.52	-1.747	6.443	3,272
Log change in deposits (%)	-29.80	-50.29	-25.85	-5.871	4,003	-29.56	-49.67	-25.31	-6.283	3,244
Log change in total assets (%)	-17.95	-35.06	-17.47	-1.668	4,045	-18.33	-35.45	-17.49	-1.827	3,273
Panel B: National Banks										
Total assets, 1928 (000s)						2,254	564	1,066	2,125	2,258
Leverage, 1928						0.843	0.813	0.856	0.892	2,258
Cash/deposits, 1928						0.192	0.120	0.172	0.238	2,258
Total trouble						0.223				2,258
Permanent suspensions						0.116				2,258
Acquired						0.078				2,258
Temporary suspensions						0.010				2,258
Troubled raising						0.025				2,226
Capital write-downs (%)						-9.701	-18.85	-5.170	2.523	2,225
Log change in deposits (%)						-29.54	-47.92	-26.65	-11.46	2,226
Log change in total assets (%)						-18.52	-32.06	-18.51	-7.020	2,226

Note: Summary statistics for the common support samples. Panel A: State banks in the single difference (left) and double difference (right) common support samples. Panel B: National banks in the double difference common support sample. Observations are weighted such that each state-Fed district pair has equal weight. Except where stated otherwise, variables are calculated between the end of 1928 and the end of 1932 (February 1933 in case of suspensions and acquisitions). *Leverage* is total liabilities divided by total assets. *Cash/deposits* is all cash items (including deposits due from other banks) divided by total deposits. *Total trouble* combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *Capital write-downs* are the log-change in total equity, subtracting any increase in paid-in capital over the period; a 10% reduction in total equity is coded as -10. For permanently suspended or acquired banks, *capital write-downs*, *log changes in deposits*, and *log changes in total assets* are calculated using data from the last available year.

D. Bank Risk taking before the Great Depression – additional results

D.1. Cash/Deposits

Table D.1 replicates the leverage analysis in Table 2 in the main text for cash/deposits. The aggregate estimate in Column (9) has different signs in the single and double difference. In both, the effect is small and insignificant. Hence, there is no evidence that SL banks held less cash before the Great Depression. This is perhaps not surprising given the strict reserve requirements banks had to adhere to (see Internet Appendix A.2).

Table D.1: Cash/Deposits, 1928

	(1) CT(1)-MA	(2) NJ(2)-NY	(3) NJ(3)-PA(3)	(4) VA-MD	(5) TN(6)-GA	(6) AL-GA	(7) MO(8)-KY(8)	(8) TN(8)-KY(8)	(9) All-Weighted
Panel A: Single difference									
SL	0.022	-0.002	-0.010	0.058	-0.123	-0.057	0.031	0.156	0.009
	(0.014)	(0.008)	(0.006)	(0.008)	(0.012)	(0.014)	(0.008)	(0.015)	(0.006)
									[0.843]
Cons.	0.103	0.126	0.127	0.101	0.352	0.351	0.186	0.185	0.192
	(0.006)	(0.005)	(0.002)	(0.005)	(0.010)	(0.010)	(0.007)	(0.007)	(0.004)
N	160	507	455	430	570	562	1,120	382	4,186
Adj. R^2	0.010	-0.002	0.011	0.091	0.140	0.025	0.016	0.251	0.001
Panel B: Double difference									
SL x	-0.036	-0.001	-0.035	0.001	-0.061	-0.051	-0.016	0.014	-0.023
State bank	(0.021)	(0.008)	(0.009)	(0.012)	(0.020)	(0.021)	(0.017)	(0.032)	(0.010)
									[0.237]
SL	0.058	0.002	0.024	0.042	-0.055	-0.004	0.032	0.130	0.029
	(0.016)	(0.004)	(0.007)	(0.008)	(0.016)	(0.015)	(0.015)	(0.026)	(0.008)
State bank	-0.053	-0.002	0.010	-0.013	0.069	0.071	-0.020	-0.022	0.005
	(0.008)	(0.005)	(0.003)	(0.008)	(0.015)	(0.015)	(0.011)	(0.011)	(0.006)
Cons.	0.154	0.122	0.118	0.114	0.262	0.261	0.195	0.197	0.178
	(0.006)	(0.003)	(0.002)	(0.006)	(0.012)	(0.011)	(0.008)	(0.009)	(0.005)
N	338	1,213	1,051	531	591	637	895	353	5,609
Adj. R^2	0.199	-0.002	0.037	0.088	0.153	0.049	0.036	0.310	0.008

Note: The dependent variable is all cash items (including deposits due from other banks) divided by total deposits in 1928. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. Columns (1) through (8) present estimates for individual state-Fed district pairs. Column (9) reports estimates for the aggregate sample, using pair-specific weights such that each pair has equal weight. The estimates in Column (9) are therefore the average of those in Columns (1) to (8). Standard errors clustered at the individual bank level are in parentheses. In Column (9), p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

D.2. Asset safety

Table D.2 shows how we aggregate the different balance sheet items from the New Jersey and New York state bank reports into uniform asset categories.

Table D.3 verifies that asset safety in 1928 predicts lower rates of failure during the Great Depression. This is true within both NJ (Fed district 2) and NY separately (columns 1 and 2), and when taking NJ(2) and NY together (column 3). The coefficients on asset safety in NJ(2) and NY are similar and the t-statistic on their difference is only around -0.6. We control for whether banks were in a Reserve city (specifically, NY banks in New York City and Buffalo). These banks specialized in providing liquidity to the national financial system and had a relatively high likelihood of failure in the Great Depression (e.g., Richardson and Van Horn 2009).

Table D.4 uses mediation analysis to determine to what extent the difference in failure rates between NJ(2) and NY banks is driven by observable differences in asset composition. The analysis indicates that, one we control for banks in Reserve cities, SL banks had failure rates that were about 11 percentage points higher. About 20% of this difference is explained by observed asset risk.

Table D.2: Balance sheet items reported for State banks in New Jersey and New York

Aggregate categories	NJ items	NY items
Cash items	• checks and other cash items	• cash items
Cash on hand	• cash on hand	• specie • other currency authorized by the laws of the United States
Due from banks	• due from banks	• due from the Federal Reserve Bank of New York, less offsets • due from approved reserve depositaries, less offsets • due from other banks, trust companies and bankers
Collateralized loans	• demand loans upon collateral • time loans upon collateral	• loans and discounts secured by other collateral
Real estate loans	• mortgages guaranteed and certificates • bonds and mortgages	• loans and discounts secured by bond and mortgage, deed or other real estate collateral • bonds and mortgages owned
Securities	• stocks and bonds • united states bonds	• stock and bond investments
Uncollateralized loans	• notes and bills rediscounted	• loans, discounts and bills purchased not secured by collateral
Overdrafts	• overdrafts	• overdrafts
Real estate	• banking house • furniture and fixtures • other real estate	• real estate
Other	• loans to counties, etc. • interest accrued • acceptances • letters of credit • other assets	• own acceptances purchased • others assets

Note: This table shows the aggregation of balance sheet items from 1928 State bank reports for New York and New Jersey to the smallest common denominator.

Table D.3: Asset safety and bank failure

Panel A: Total Trouble

	(1)	(2)	(3)
	NJ(2)	NY	NJ(2) & NY
(Collateralized & Real estate loans + Securities)/	-0.513**	-0.391**	-0.475***
Non-cash assets in 1928	(0.234)	(0.156)	(0.128)
t-test col. (1) vs (2).		(-0.64)	
Reserve city		0.301***	0.288***
		(0.068)	(0.066)
N	158	348	506
Adj. R^2	0.0368	0.0880	0.0642

Panel B: Exits (due to permanent suspensions and acquisitions)

(Collateralized & Real estate loans + Securities)/	-0.426**	-0.383***	-0.445***
Non-cash assets in 1928	(0.214)	(0.136)	(0.114)
t-test col. (1) vs (2).		(-0.50)	
Reserve city		0.316***	0.307***
		(0.059)	(0.058)
Common size support	Y	Y	Y
Controls	ln(Assets)	ln(Assets)	ln(Assets)
N	158	348	506
Adj. R^2	0.0559	0.110	0.0767

Note: This table tests whether individual State banks in New Jersey Fed district (2) and in New York were less at risk of failure if their non-cash assets as of 1928 were safer. Panel A: total trouble (permanent and temporary suspensions, exits due to acquisitions, and troubled raising). Panel B: Exits due to permanent suspensions and acquisitions. Reserve city: a bank is located in New York City or Buffalo. Common size support: see details in the text. Assets: total balance sheet value as of 1928. Standard errors are in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table D.4: Mediation analysis – asset safety, the liability regime, and bank failure

Panel A: Total Trouble			
	(1)	(2)	(3)
SL	0.052	0.107**	0.081*
	(0.042)	(0.042)	(0.043)
(Collateralized & Real estate loans + Securities)/ Non-cash assets in 1928			-0.429***
			(0.130)
Reserve city		0.325***	0.323***
		(0.069)	(0.068)
N	506	506	506
Adj. R^2	0.008	0.051	0.071
Panel B: Exits (due to permanent suspensions and acquisitions)			
SL	0.060	0.119***	0.095**
	(0.037)	(0.038)	(0.038)
(Collateralized & Real estate loans + Securities)/ Non-cash assets in 1928			-0.391***
			(0.115)
Reserve city		0.350***	0.348***
		(0.061)	(0.060)
Common size support	Y	Y	Y
Controls	ln(Assets)	ln(Assets)	ln(Assets)
N	506	506	506
Adj. R^2	0.006	0.067	0.088

Note: This table tests to what extent the effect of the liability regime on bank failure is mediated through safer asset holdings as of 1928 for State banks in New Jersey (district 2) and New York. Panel A: total trouble (permanent and temporary suspensions, exits due to acquisitions, and troubled raising). Panel B: Exits due to permanent suspensions and acquisitions. Reserve city: a bank is located in New York City or Buffalo. Common size support: see details in the text. Assets: total balance sheet value as of 1928. Standard errors are in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

D.3. Deposit interest rates

Table D.5 reports balance sheet characteristics and Fed membership for all New Jersey banks and the subs-sample of banks with deposit rate information. In terms of balance sheet characteristics, the sub-sample with deposit rates looks similar to the full sample. Banks are of similar size and have similar ratios of cash to deposits and liabilities to assets. State banks' Fed membership rate is slightly higher in the sub-sample with deposit rates (National banks were Fed members by default). Overall, these summary statistics suggest that the sub-sample of banks with deposit rates is broadly representative of all New Jersey banks. We also compare balance sheet characteristics of State and National banks. Again, these look similar, both in the full sample and in the sub-sample with deposit rates. This suggests that State and National banks in New Jersey are broadly comparable.

Table D.5: Summary statistics and interest rates for New Jersey banks, December 1927

Panel A: All banks with balance sheet data					
	State Banks		National Banks		t-statistic on
	Mean	Std. Dev.	Mean	Std. Dev.	difference
Cash/Deposits	13.30	10.91	13.87	9.65	-0.38
Liabilities/Assets	84.07	9.65	84.61	9.54	-0.39
Log(Assets)	1,516	122	1,519	104	-0.17
Fed Membership (%)	39.10				
Observations	131		77		
Panel B: Banks with balance sheet and deposit rate data					
Maximum Deposit Rate	3.89	0.45	2.41	0.58	14.82
Minimum Deposit Rate	2.25	0.64	2.02	0.09	1.93
Cash/Deposits	13.76	11.44	11.24	6.26	1.14
Liabilities/Assets	83.81	9.86	85.41	8.58	-0.80
Log(Assets)	1,515	124	1,504	845	0.43
Fed Membership (%)	46.15				
Observations	115		29		

Note: Panel A reports summary statistics for New Jersey State and National banks with balance sheet data as of December 1927. Panel B reports summary statistics for the sub-sample of banks with matched deposit rate data.

D.4. Profit adjustments for capital raisings, write-downs, acquisitions, and failures

Capital raisings: We identify capital issuances by identifying increases in paid-in capital unrelated to acquisitions. When a bank issues new capital, its paid-in capital increases, as well as its surplus. For example, if the bank issues new equity with a paid-in or par value of $100,000 at a price of 150% of par, we should see increases in paid-in capital of $100,000 and surplus of $50,000. To approximate the equity issuance price (as a percentage of par), we use the last period's ratio of the book value of paid-in capital and surplus to paid-in capital (on average, this lines up well with the last listed share price that is sometimes provided in RandMcNally). To calculate profits, we take the change in the book value of equity that is not attributed to the capital raising.

An increase in paid-in capital can also signal a conversion of surplus into paid-in capital, in which case no adjustment to our profit calculations needs to be made. We identify such cases as increases in paid-capital that correspond to proportional declines in surplus (at least 75% of the increase in paid-in capital), with a small change in total assets (at most an increase of 25% of the change in paid-in capital) to exclude cases in which equity was issued below par.

Acquisitions: We identify acquisitions from RandMcNally, which reports the reason why a bank disappears. It also reports the identity of the acquiring bank for acquisitions. Two adjustments need to be made. First, the acquirer's equity will increase by the target's equity. Second, the target's equity might be written down during the acquisition to reflect the realization of losses. We apply the following approximation. We assume that during an acquisition period, the acquirer's change in its own equity is zero. We then compute the write-down as the difference between the acquirer's actual change in equity and the target's last reported equity. We assign this difference to the target. For example, if the target's last reported book value of equity was $100,000, and the acquirer's equity increases by $80,000 in the same period, we assign a loss (capital write-down) of $20,000 to the target for the last period of its existence.

Failures: We identify failures from RandMcNally, which reports the reason why a bank exits the sample: voluntary liquidation or suspension. In case of the former, we would expect that the remaining equity in the bank was somewhere between zero and the reported book value of equity in the last period. A zero lower bound is sensible because the regulator would not allow management to liquidate the bank, instead appointing a receiver, if the bank's losses exceeded its equity. The rationale for the upper bound is that if equity had not declined, there would have been

little reason for a voluntary liquidation. To fix a number within this range, as an approximation, we assume that paid-in capital retained its value while we write down surplus to zero. In case of suspensions, we expect that liabilities exceeded assets, implying negative equity. As a conservative approximation, we write down both paid-in capital and surplus to zero.

E. Bank outcomes during the Great Depression - additional results

E.1. Total trouble: additional controls

Bank-level controls: Table E.1 controls for bank characteristics. For brevity we only report aggregate results for all pairs combined. For comparison, Column (1) replicates Column (9) of Table 6 in the main text. Column (2) controls for 1928 leverage (the ratio of liabilities to assets) and the ratio of cash (including deposits at other banks) to deposits. Since SL and DL banks were similar on these dimensions in 1928, we do not expect the effect of SL to change much. The estimates confirm this. Columns (3) and (4) add controls for 1928 bank size using log(total assets) and indicators for total asset quintiles, respectively. Because the sample was already restricted to banks on the common support of bank size, we do not expect size controls to matter much. The results again confirm this. Altogether, Table E.1 suggests that neither observable ex-ante balance sheet conditions nor bank size can explain the much higher distress rate of SL banks.

Controls for the regulatory regime: A key concern is that SL and DL states might have had other banking regulations that were correlated with the liability regime. We investigate these concerns by hand-collecting and comparing banking regulations across our state-Fed district pairs. Details are in Internet Appendices A.2 and A.3, where we show that there are no systematic differences between SL and DL states in their minimum reserve and capital requirements, other restrictions on bank risk taking, the quality of the state regulator, and branching restrictions.

To further verify that regulatory differences between states other than the liability regime do not explain our results, we add controls for regulatory differences to our baseline regression for total trouble. Table E.2 shows that the inclusion of each regulatory dimension on its own does not change the effect of SL on total trouble. If anything, the effect becomes marginally stronger. When all regulatory differences are included together, the effect of SL does decrease from 8.4 to 6.3 percentage points. In this specification, there are five additional variables to capture differences between 12 states; this overfitting likely attenuates the effect of the liability regime.

Controls for county characteristics: The Great Depression proved especially harsh for small rural banks (Wheelock 1995). Table 1 Panel D shows that the single and double liability State banks in our sample were located in counties with similar characteristics. To verify that our results are not affected by county characteristics, we add controls for them to our baseline total trouble regression.

The results in Table E.3 show that the coefficient on the SL indicator becomes, if anything, slightly larger.

State-pair fixed effects: Throughout our analyses, we have weighted observations such that each state-Fed district pair receives equal weight, independently of the number of banks. This creates a straightforward correspondence between the within-pair and the aggregate results. Alternatively, we can estimate regressions with pair fixed effects, which absorb differences in average outcomes across pairs but allow pairs with more banks to have greater influence.

For the single difference estimates, we run the following regression

$$Y_{i,s,p} = \beta SL_s + \eta_p + \varepsilon_{i,s,p} \tag{E.1}$$

for all eight pairs combined, where $p \in [1,8]$ identifies state-Fed district pairs and η_p are pair fixed effects. For the double difference we run

$$Y_{i,s,p} = \delta SL_s SB_{i,s,p} + \eta_p + \eta_p \times SL_s + \eta_p \times SB_{i,s,p} + \varepsilon_{i,s,p} \tag{E.2}$$

where, to saturate the difference-in-differences specification, we include interactions between the pair fixed effects and the State bank (SB) and SL indicators.

Table E.4 reports regression results for total trouble. Column (1), for comparison, uses the pair-specific weights used elsewhere in the paper and replicates Table 6 Column (9), while Column (2) includes pair fixed effects. As expected, weights and fixed effects produce similar results. In the single difference, the effect of SL on total trouble is 9.2 percentage points when using fixed effects, slightly larger than the 8.4 percentage points when using weights. In the double difference, the effect with fixed effects is 8.8 percentage points, slightly smaller than the 10.0 percentage points with weights.

Table E.1: Total trouble, controlling for bank characteristics

	(1) No controls	(2) Controls	(3) log(Assets) + Controls	(4) Size quintiles + Controls
Panel A: Single difference				
SL	0.084	0.089	0.088	0.088
	(0.019)	(0.019)	(0.020)	(0.020)
	[0.030]	[0.027]	[0.031]	[0.033]
Cons.	0.286	0.281	0.316	0.318
	(0.013)	(0.013)	(0.101)	(0.026)
N	4,222	4,186	4,186	4,186
Adj. R^2	0.008	0.019	0.019	0.020
Panel B: Double difference				
SL x	0.100	0.095	0.094	0.098
State bank	(0.036)	(0.035)	(0.035)	(0.035)
	[0.105]	[0.107]	[0.118]	[0.119]
SL	-0.027	-0.0320	-0.020	-0.020
	(0.029)	(0.029)	(0.029)	(0.029)
State bank	0.048	0.052	0.049	0.039
	(0.026)	(0.026)	(0.026)	(0.027)
Cons.	0.237	0.237	0.388	0.282
	(0.022)	(0.022)	(0.119)	(0.035)
N	5,633	5,609	5,609	5,609
Adj. R^2	0.015	0.021	0.021	0.023

Note: The dependent variable is *total trouble*, which combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Column (1) replicates Column (9) of Table 6. Columns (2) through (4) include 1928 leverage (liabilities/assets) and cash/deposits as control variables, where cash includes deposits at other banks. Both controls are winsorized at the 1st and 99th percentile. Columns (3) and (4) add log(total assets) and dummies for size quintiles, respectively, as additional controls. Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table E.2: Total trouble, controlling for other regulatory differences

	(1) Reserves	(2) Capital	(3) (1)+(2)	(4) Risk taking	(5) Regulator	(6) Branching	(7) (4)+(5)+(6)	(8) All
SL	0.085	0.095	0.094	0.087	0.086	0.081	0.081	0.063
	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.021)	(0.022)
	[0.023]	[0.017]	[0.014]	[0.023]	[0.050]	[0.033]	[0.075]	[0.132]
Reserve requirements (%)	1.158		1.072					2.151
	(0.314)		(0.323)					(0.409)
Minimum capital requirements ($000)		0.468	0.305					0.291
		(0.150)	(0.146)					(0.142)
Restrictions on bank risk taking (score)				0.011			0.001	-0.001
				(0.008)			(0.010)	(0.010)
Regulator quality (score)					0.009		0.000	-0.090
					(0.016)		(0.018)	(0.023)
Branching restrictions (score)						0.058	0.055	0.136
						(0.029)	(0.036)	(0.041)
Cons.	0.137	0.250	0.123	0.307	0.236	0.253	0.255	0.420
	(0.042)	(0.016)	(0.043)	(0.020)	(0.094)	(0.020)	(0.102)	(0.103)
N	4,222	4,091	4,091	4,222	4,222	4,222	4,222	4,091
Adj. R^2	0.013	0.013	0.017	0.008	0.008	0.009	0.009	0.024

Note: Single difference regressions for *total trouble* with controls for regulatory differences across states. *Total trouble* combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *Reserve requirements*: reserve requirements on demand deposits for each bank, in percent of deposits. *Minimum capital requirements*: minimum capital requirements for each bank, in $000. See Internet Appendix A.2 for more details on reserve and capital requirements. *Restrictions on bank risk taking*: regulatory restrictions on bank risk taking, scored relative to the National Banking Act. A positive number means a stricter state regulator. *Regulator quality*: score based on Federal Reserve (1932). *Branching restrictions*: restrictions on branching (1 = prohibited, 0.5 = restricted, 0 = allowed). See Internet Appendix A.3 for more details on the previous three variables. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table E.3: Total trouble, controlling for county characteristics

	(1) County controls 1920	(2) County controls 1930	(3) County controls 1920 and 1930
SL	0.095	0.089	0.095
	(0.024)	(0.024)	(0.025)
	[0.023]	[0.036]	[0.038]
Manufacturing output (per capita) in 1920 ($000)	-0.077		-0.114
	(0.045)		(0.092)
Manufacturing output (per capita) in 1930 ($000)		-0.049	0.045
		(0.046)	(0.086)
Crop value (per capita) in 1920 ($000)	0.070		0.067
	(0.132)		(0.195)
Crop value (per capita) in 1930 ($000)		0.134	-0.029
		(0.269)	(0.385)
Urban population in 1920 (fraction)	0.070		-0.030
	(0.092)		(0.261)
Urban population in 1930 (fraction)		0.038	0.093
		(0.084)	(0.224)
Population in cities over 25k in 1920 (fraction)	0.182		0.132
	(0.082)		(0.215)
Population in cities over 25k in 1930 (fraction)		0.173	0.050
		(0.076)	(0.217)
Cons.	0.241	0.241	0.243
	(0.037)	(0.037)	(0.041)
N	4,138	3,944	3,893
Adj. R^2	0.021	0.019	0.021

Note: Single difference regressions for *total trouble* with controls for county characteristics. *Total trouble* combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *Manufacturing output (per capita)*: manufacturing output (in $000) divided by total population. *Crop value (per capita):* value of crops (in $000) divided by total population. *Urban population:* urban population divided by total population. Urban areas are defined as cities and other incorporated places with at least 2,500 inhabitants and include other political subdivisions with at least 10,000 inhabitants and a population density of at least 1,000 per square mile. *Population in cities over 25k:* population in cities with more than 25,000 inhabitants divided by total population. Column (1) uses county characteristics from the 1920 census; Column (2) uses the 1930 census. To improve readability, unlike in Table 1, m*anufacturing output (per capita)* and *crop value (per capita*) are in thousands*,* while *urban population* and *population in cities over 25k* are fractions*.* All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

Table E.4: Total trouble, pair fixed effects vs weights

	(1) Weights	(2) Pair f.e.
Panel A: Single difference		
SL	0.084	0.092
	(0.019)	(0.018)
	[0.030]	[0.000]
Cons.	0.286	0.297
	(0.013)	(0.037)
N	4,222	4,222
Adj. R^2	0.008	0.022
Panel B: Double difference		
SL x	0.100	0.088
State bank	(0.036)	(0.031)
	[0.105]	[0.001]
SL	-0.027	
	(0.029)	
State bank	0.048	
	(0.026)	
Cons.	0.237	0.167
	(0.022)	(0.031)
N	5,633	5,633
Adj. R^2	0.015	0.041

Note: The dependent variable is *total trouble*, which combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. The table shows two sets of estimates for the aggregate sample. Column (1), which replicates Column (9) of Table 6, uses pair-specific weights such that each state-Fed district pair receives equal weight. Column (2) instead includes pair fixed effects, interacted in the double difference (Panel B) with the *SL* and *State bank* indicators. Coefficients on the pair fixed effects and their interactions are omitted for brevity. Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

E.2. Data construction for acquisition analysis

Table E.5 shows the source, timing, and content of the information we use to calculate changes in equity and estimated liabilities.

Table E.5: Timing with respect to acquisition and available information

$t-2$	$\boldsymbol{t-1}$	$\boldsymbol{t}$	$t+1$
RandMcNally	**Acquisition form**		RandMcNally
0-6 months before	**Right before**	**Right after**	0-6 months later
Acquirer (*A*) & target (*T*) individually		Merged entity (*M*)	
Equity	Equity		Equity
Deposits			Deposits
Other liabilities			Other liabilities
Loans and discounts & bonds	Loans and discounts & bonds		Loans and discounts & bonds
Cash & other resources			Cash & other resources

In some cases, data on the acquisition forms, especially for period t, is missing.

We calculate proportional changes in the equity of acquirer and target before the acquisition between $t-2$ and $t-1$:

$$\Delta E_{i,t-2\to t-1} = \frac{E_{i,t-1} - E_{i,t-2}}{E_{i,t-2}} \tag{E.3}$$

with $i \in \{A, T\}$ indicating the acquirer or target, and with E denoting equity (paid-in capital and surplus). Further, we calculate the proportional change in equity for the consolidated entity M during the acquisition between $t-1$ and t (or $t+1$):

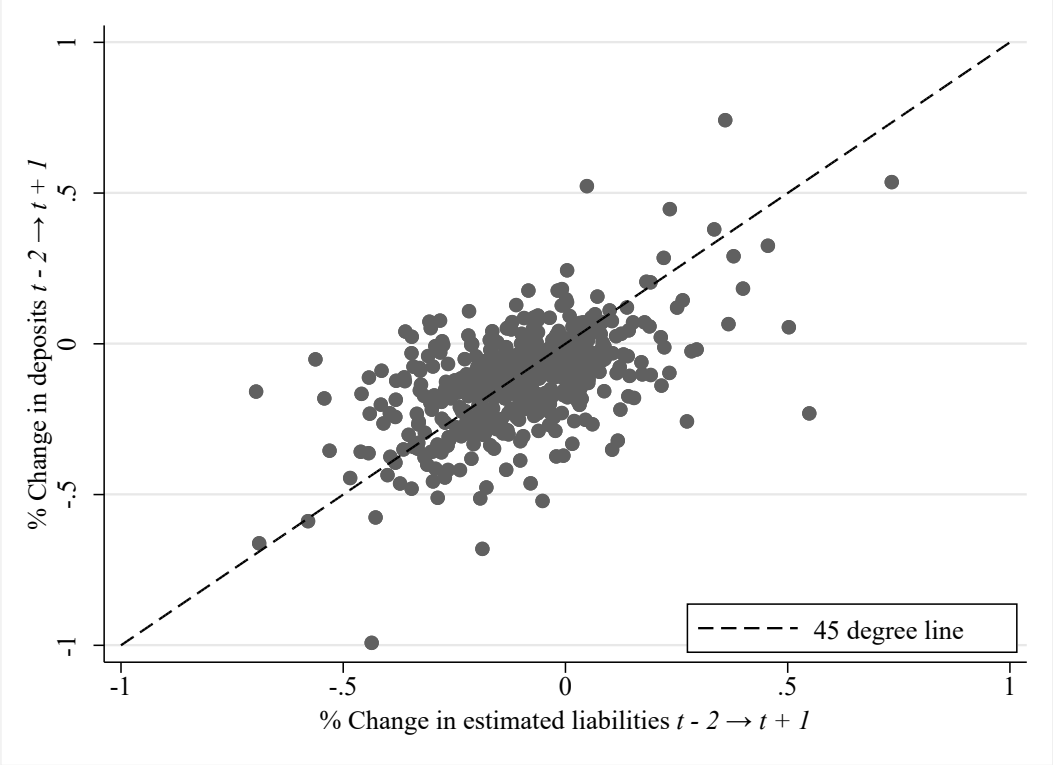
$$\Delta E_{M,t-1\to t} = \frac{E_{M,t} - E_{A,t-1} - E_{T,t-1}}{E_{A,t-1} + E_{T,t-1}};\ \Delta E_{M,t-1\to t+1} = \frac{E_{M,t+1} - E_{A,t-1} - E_{T,t-1}}{E_{A,t-1} + E_{T,t-1}} \tag{E.4}$$

The acquisition forms do not report deposits, but we can use the difference between *Loans and discounts & bonds* and *Equity* as an approximation for total liabilities. From the balance sheet identity:

$$Deposits = \underbrace{Loans\ and\ discounts\ \&\ bonds - Equity}_{\tilde{L}} + \varepsilon \tag{E.5}$$

with $\varepsilon = Cash\ and\ other\ resources - Other\ liabilities$. On average, deposits make up around 80% of a bank's entire balance sheet. As long as changes in ε are relatively small in size, changes in estimated liabilities $\tilde{L}$ should closely follow changes in deposits. Figure E.1 shows that $\Delta\tilde{L}$ is strongly correlated with changes in deposits between $t-2$ and $t+1$ (when data on both is available) with an F-statistic of 216 and R^2 of 0.30, indicating that changes in estimated liabilities are primarily driven by changes in deposits. Similar to equity, we calculate changes in estimated liabilities between $t-2$ and $t-1$: $\Delta\tilde{L}_{i,t-2\to t-1}$ for $i \in \{A, T\}$; and between $t-1$ and t or $t+1$ for the consolidated entity: $\Delta\tilde{L}_{M,t-1\to t}$ or $\Delta\tilde{L}_{M,t-1\to t+1}$.

Figure E.1: Predicting changes in deposits with changes in estimated liabilities



Acquisitions, 1930-1933. Changes in estimated liabilities: changes in loans and discounts & bonds minus changes in equity. Acquirer and target in $t-2$, consolidated entities in $t+1$, where t is the time of the acquisition. Data from RandMcNally. Internet Appendix E.2 has details on the data construction.

E.3. Capital write-downs, changes in deposits, and changes in bank size, 1929-1932

Tables 6 and 7 in the main text show that SL banks were more likely to experience distress and fail during the Depression. Here, we examine whether this was also reflected in the balance sheets of banks that had not (yet) failed. We examine capital write-downs, changes in deposits, and changes in total assets, all in terms of percentages of their 1928 values. For capital write-downs we take the log-difference between total equity at the end of 1932 and 1928, subtracting the (approximate) amount of capital raised. Specifically, if paid-in capital increased during any fiscal year, we subtract that increase from total equity at the end of 1932 before computing the log-difference.[53] For changes in total assets we simply use log-changes from 1928 to 1932.

Results are in Table E.6. For brevity, we only present the aggregate results for all state-Fed district pairs combined. Columns (1a), (2a), and (3a) report estimates for all banks, using the last available data before failure for those that failed. The corresponding "b"-columns restrict the analysis to banks that survived until February 1933. Column (1) examines capital write-downs. Despite the severity of the Depression, DL State banks wrote down on average only around 3% of capital, suggesting that banks were slow to recognize losses. Nevertheless, based on the single difference estimates, SL banks wrote down an additional 3.6 percentage points. In the double difference, the SL effect increases to more than 9 percentage points and becomes statistically significant. Column (2) analyzes the loss of deposits. Here the baseline is larger. Focusing on surviving banks, DL banks lost around 33% of deposits, and SL banks an additional 4.5 percentage points.[54] The double difference shows an SL effect of similar magnitude, but neither estimate is statistically significant. Column (3) examines changes in total assets, with similar results: the assets of surviving DL banks fell by 19% on average, those of SL banks by an insignificant additional 4.6 percentage points. The double-difference estimates are similar in magnitude.

In sum, balance sheets provide some evidence that SL had negative consequences for bank outcomes, but with limited statistical significance. None of the estimates reflect any actual bank *failures*, as we either use the last observed data before failure or drop failing banks altogether. Given banks' apparent unwillingness to recognize losses, it is difficult to detect bank distress using

[53] This is an approximation for two reasons. First, if equity was sold above par, it increased both paid-in and surplus capital. Second, if a bank both wrote down and raised equity in the same year, we underestimate the amount raised.
[54] This does not imply that SL banks suffered more bank runs, as these deposit declines predate bank failure. It is, however, consistent with a gradual loss of trust and with banks trying to unlever.

balance sheets. This underscores the advantage of using information on actual suspensions and acquisitions from forms St. 6386 in our main analysis.

Table E.6: Capital, deposits and assets conditional on survival

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	Capital write-downs (%)		Log-change in deposits (%)		Log-change in assets (%)	
Panel A: Single difference						
SL	-3.604	-3.635	-2.533	-4.468	-2.877	-4.603
	(0.877)	(1.063)	(1.611)	(1.968)	(1.196)	(1.450)
	[0.217]	[0.236]	[0.742]	[0.593]	[0.636]	[0.432]
Cons.	-2.203	-2.945	-28.625	-32.629	-16.662	-19.363
	(0.635)	(0.749)	(1.068)	(1.225)	(0.811)	(0.928)
N	4,044	2,826	4,003	2,796	4,045	2,826
Adj. R^2	0.007	0.007	0.001	0.003	0.002	0.006
Panel B: Double difference						
SL x	-9.004	-9.558	0.233	-3.799	-1.066	-3.443
State bank	(1.629)	(1.907)	(3.063)	(3.575)	(2.201)	(2.520)
	[0.026]	[0.019]	[0.954]	[0.360]	[0.809]	[0.388]
SL	5.044	5.570	-1.703	0.050	-1.693	-0.663
	(1.301)	(1.507)	(2.551)	(2.945)	(1.788)	(2.006)
State bank	9.588	9.465	0.205	0.522	0.714	0.966
	(1.222)	(1.436)	(2.124)	(2.516)	(1.549)	(1.769)
Cons.	-12.202	-12.872	-28.836	-33.132	-17.785	-20.714
	(1.010)	(1.186)	(1.822)	(2.187)	(1.292)	(1.480)
N	5,497	4,198	5,470	4,177	5,499	4,198
Adj. R^2	0.025	0.023	0.000	0.001	0.001	0.003
Survivors	N	Y	N	Y	N	Y

Note: The dependent variables are *capital write-downs* in Column (1), the *log-change in deposits* in Column (2), and the *log-change in assets* in Column (3), all in percentages. Columns with an "a" include all banks. Columns with a "b" include only banks that survived until February 1933. *Capital write-downs* are the log-difference between total equity at the end of 1928 and 1932 (or the last observed year if the bank does not survive), subtracting any increase in paid-in capital over this period, multiplied by 100. *Log-change in deposits* and *log-change in assets* are similarly defined from the end of 1928 to the end of 1932 (or the last observed year if the bank does not survive). *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. All estimates are for the aggregate sample and use pair-specific weights such that each state-Fed district pair has equal weight (cf. Column (9) of Table 6). Standard errors clustered at the individual bank level are in parentheses; p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

E.4. Bank outcomes with additional states

To test whether our results are robust to including additional DL state-Fed districts, we add West Virginia (district 5) and Illinois (district 8) as matches for Virginia and Missouri (district 8), respectively. Section C.2 shows that these state-Fed districts are close runners-up to our preferred matches, Maryland and Kentucky (8). In Table E.7, we reproduce the total trouble analysis from Table 6 for Virginia, Missouri (8), and the full sample. Next to it, we report estimates including the two additional DL state-Fed districts. The column numbering follows Table 6.

Including West Virginia (5) in column (4b) as additional match for Virginia reverses the difference in total trouble in the single difference (Panel A) and reduces it in the double difference (Panel B). West Virginia experienced an especially severe banking crisis because of the collapse of its coal mining industry (Thomas 2010, p. 27), which is visible in its much higher National bank failure rate (37% vs. 17%). Because of this systematic difference in economic circumstances, the single difference estimate is arguably misleading. The double difference estimate in Panel B, which accounts for the higher National bank failure rate in West Virginia, changes less and remains positive at 6.4 percentage points.

Including Illinois (8) in Column (7b) as additional match for Missouri (8) reduces the estimate in the single difference, but turns it positive in the double difference, bringing the estimates from the two specifications closer together. Looking at the full sample estimates in Columns (9a) and (9b), the inclusion of the two additional matches reduces the single difference estimate (mostly because of the inclusion of West Virginia), while the double difference estimate is unchanged.

In sum, our results are robust to the inclusion of additional DL state-Fed districts that look similar to their matched SL counterparts.

Table E.7: Robustness – total trouble with additional DL states

	(4a) VA – MD	(4b) VA – MD+WV(5)	(7a) MO(8) – KY(8)	(7b) MO(8) – KY(8)+IL(8)	(9a) Total **excl.** WV(5) and IL(8)	(9b) Total **incl.** WV(5) and IL(8)
Panel A: Single Difference						
SL	0.108	-0.030	0.149	0.102	0.084	0.061
	(0.046)	(0.039)	(0.032)	(0.026)	(0.019)	(0.019)
					[0.030]	[0.111]
Cons.	0.218	0.356	0.266	0.313	0.286	0.309
	(0.037)	(0.0286)	(0.027)	(0.019)	(0.013)	(0.012)
N	431	588	1,127	1,444	4,222	4,696
Adj. R^2	0.012	-0.001	0.024	0.010	0.008	0.004
Panel B: Double Difference						
SL x	0.112	0.064	-0.038	0.011	0.100	0.100
State bank	(0.076)	(0.061)	(0.086)	(0.068)	(0.036)	(0.033)
					[0.105]	[0.105]
SL	-0.072	-0.126	0.151	0.055	-0.027	-0.046
	(0.056)	(0.045)	(0.078)	(0.062)	(0.029)	(0.027)
State bank	0.014	0.089	0.035	-0.009	0.048	0.052
	(0.063)	(0.045)	(0.064)	(0.037)	(0.026)	(0.022)
Cons.	0.219	0.274	0.232	0.323	0.237	0.255
	(0.049)	(0.034)	(0.057)	(0.032)	(0.022)	(0.019)
N	532	840	897	1,552	5,633	6,596
Adj. R^2	0.006	0.027	0.017	0.002	0.015	0.016

Note: The dependent variable is *total trouble*, which combines *permanent suspensions*, being *acquired*, *temporary suspensions*, and *troubled raising*. *SL* is an indicator variable that equals one for states with single liability State banks. *State bank* is an indicator that equals one for State banks. The column numbering follows Table 6 in the main text. Columns (4a) through (7b) present estimates for individual state-Fed district pairs. Columns (9a) and (9b) report estimates for the aggregate sample, using pair-specific weights such that each pair has equal weight. Standard errors clustered at the individual bank level are in parentheses. In Columns (9a) and (9b), p-values from a wild cluster bootstrap of coefficients with double-clustering at the state and state-Fed-district-pair level, using default Rademacher weights, are in square brackets.

F. Comparison with Grossman (2001)

Grossman (2001) finds that in 1930, the failure rate of State banks relative to National banks was lower, not higher, in states with single liability. In this appendix, we examine the reasons for the difference with our findings. We first review Grossman's empirical approach, selection of states, and data. Next, we propose changes to bring Grossman's analysis more in line with the latest econometric techniques and data. After implementing these changes in the full sample of 48 states, there is no material difference in the State bank failure rates between single and multiple liability states during the Great Depression.[55] However, using the same data and empirical approach on our paper's matched sample of 12 states, State bank failure rates are significantly higher in states with single liability. Finally, we show that the single and multiple liability states in the full sample are not comparable to each other in terms of their economic fundamentals. In particular, multiple liability states were more rural and agricultural on average, which made them more susceptible to bank distress. In contrast, the single and double liability states in our matched sample are comparable. Thus, the identifying assumptions underlying the difference-in-differences estimation are unlikely to hold in the full sample, but they are likely to hold in our matched sample.

This appendix is structured as follows. Section F.1 reviews Grossman's empirical approach. Section F.2 implements his approach with the latest econometric techniques and data. Finally, Section F.3 examines whether single and multiple liability states have similar economic fundamentals.

F.1. Review of Grossman's (2001) approach, selection of states, and data

Empirical approach

Grossman's main results are in his Tables 1 and 2. In Table 1 (reproduced in Panel A of Table F.1 below), Grossman calculates ratios-of-ratios. Most important is column 2, which considers bank failure rates. The results suggest that in 1930, the failure rate of banks with single liability was lower (not higher) than that of banks with multiple liability. How does he arrive at these numbers?

Grossman first calculates the failure rates ($FR_{s,t}^{b}$) of State and National banks in a given state *s* and year *t*:

[55] In the full sample of 48 states, some states had triple or even unlimited liability for bank shareholders. We therefore refer to "multiple liability" in the full sample and to "double liability" in our matched sample of 12 states.

$$FR_{s,t}^{b} = \frac{F_{s,t}^{b}}{n_{s,t-1}^{b}} \tag{F1}$$

with $b \in \{SB, NB\}$ for State and National banks, $F_{s,t}^{b}$ the number of State or National bank failures in state *s* and year *t*, and $n_{s,t-1}^{b}$ the number of State or National banks in state *s* at the end of year $t-1$.

He then averages these failure rates over the set of states that either have single (SL) or multiple liability (ML):

$$AFR_{t}^{b,l} = \frac{\sum_{s \in l} FR_{s,t}^{b}}{N_{t}^{l}} \tag{F2}$$

with $l \in \{SL, ML\}$ and N_{t}^{l} the number of states in year *t* with single or multiple liability.

Next, he takes the ratio of the average failure rates of State and National banks in SL and ML states:

$$RAFR_{t}^{l} = \frac{AFR_{t}^{SB,l}}{AFR_{t}^{NB,l}} \tag{F3}$$

This is the number Grossman reports in column 2 of Table 1 for the year 1930, separately for single and multiple liability states.[56]

This strikes us as an unnatural approach. Ratios balloon if the denominator is small, which often happens when taking the ratio of two ratios. In particular, if the failure rate of National banks in single or multiple liability states in a given year is small, which is the case in 1930 in Grossman's data, this ratio-of-ratios becomes inflated and dramatically overstates differences. A more robust approach would take the difference of the two average failure rates, as in a standard difference-in-differences analysis.

Grossman's description of his data, choice of states, and calculations lacks essential details. For replication, we hand-collected the data from the original source he uses (which is not digitally

[56] When reporting the ratio of average failure rates over periods of multiple years, he takes the simple average across years: $\overline{RAFR}_{t'-t}^{l} = (\sum_{t}^{t'} RAFR_{t}^{l})/(t'-t+1)$.

available) and experimented with the calculations to reverse-engineer his approach. Table F.1 Panel B shows that we were largely successful in replicating his estimates, though some small discrepancies remain. The lack of information in Grossman (2001) makes it hard to pinpoint exactly where the remaining differences come from.

In his Table 2, Grossman uses regressions to implement a quasi-difference-in-differences approach. The unit of observation is the failure rate of State banks in a given state and year. He transforms the left-hand side variables as

$$\widetilde{FR}_{s,t}^{SB} = ln\frac{FR_{s,t}^{SB} + 0.001}{1 - FR_{s,t}^{SB} + 0.001} \tag{F4}$$

and runs the following regression:

$$\widetilde{FR}_{s,t}^{SB} = \alpha + \beta FR_{s,t-1}^{SB} + \gamma FR_{s,t}^{NB} + \delta ML_{s,t} + \varepsilon_{s,t} \tag{F5}$$

Again, this strikes us as an unnatural approach to implementing a difference-in-differences estimation. First, the log transformation is non-standard and produces skewed values for failure rates close to zero. For example, moving from a failure rate of 0 to 0.01 leads to a transformed shift of 2.40, while moving from 0.15 to 0.16 leads to a transformed shift of 0.08 (see Mitchener and Richardson 2013, Section 4.3, for a detailed criticism). For relatively low failure rates, this approach again overstates differences. Second, adding a small number to the log transformation to avoid taking the log of zero can lead to substantial bias (Cohn, Liu and Wardlaw 2022, Chen and Roth 2024). Third, including the lagged dependent variable can lead to biased coefficients. Further, after some experimentation, we realized that Grossman must have included the raw, rather than the transformed lagged failure rate. We see no economic justification for doing so. Finally, including the failure rate of National banks as a control variable, rather than implementing a more standard difference-in-differences estimation, seems unnatural and difficult to interpret.

In sum, Grossman's approach deviates substantially from a standard difference-in-differences estimation. His approach can lead to biased estimates, especially for relatively low failure rates.

Source of bank failure data

Grossman's state-level bank failure data comes from annual reports by the Office of the Comptroller of the Currency (OCC). This has two problems. First, the OCC stopped reporting

bank failure data after 1930. Closer inspection shows that the OCC reports failures for July-June fiscal years. Thus, Grossman misses all bank failures after June 1930, which constitute the bulk of failures during the Great Depression. Second, the OCC data only covers outright suspensions and misses bank exits through acquisitions, which more recent literature (Richardson 2007b, Carlson 2010) and our own results show to be important. In our paper, we use micro data from Federal Reserve forms St. 6386 for all types of bank exits until the 1933 Federal bank holidays, which circumvents both problems.

To alleviate the problems with Grossman's OCC data, we use the best available state-level data on bank exits, which was published by the Fed in 1937 and runs from 1920 to 1936, covering the entire Great Depression (Federal Reserve 1937). This state-level data is derived from the micro-data we use in our paper and covers all 48 U.S. states of the period. Further, it has information about both bank suspensions and exits through acquisitions.

The Fed data reveals several problems with the OCC data used by Grossman. First, the average state-level bank suspension rate in 1930 in the OCC data is only 2.2%, less than half of the rate in the Fed data. The most likely reason is that the OCC data ends in June 1930, while most suspensions occurred later that year. Second, in the Fed data, the average state-level suspension rate is 4.5% in 1930 but 8.2% from 1929 to 1933 (including 1929 when few banks failed). Thus, focusing on only 1930 misses most of the bank failures during the Great Depression.

In sum, Grossman's data captures only a small part of the bank failures in the Great Depression, both in terms of time period and types of failures. This is easily remedied by using Federal Reserve (1937) as source of state-level bank failure data.

Selection and classification of states

Grossman only includes 36 out of the 48 U.S. states in existence at the time. This stems from data issues he encountered.

First, Grossman omits 10 states (California, Connecticut, Delaware, Massachusetts, Minnesota, New Jersey, Rhode Island, Tennessee, Vermont, and Virginia) because, according to him, state liability rules were either voluntary, ambiguous, or absent (Grossman 2007, Figure 3). This appears to be incorrect. Mitchener and Richardson (2013) carefully examined state statutes to figure out the exact liability rules in each state. All states had laws, and no laws were ambiguous or voluntary.

We double-checked this before starting our project. As a result, all 10 states can be assigned to either multiple or single liability.

Second, Grossman omits Maine and New Hampshire, arguing that these states did not have chartered banks. This also does not reflect the current view of the literature. Both states did have State banks, but they were formally organized as trust companies. Other states, such as New York or New Jersey, also had trust companies that functioned as State banks. Based on the literature (Federal Reserve 1932, p. 54, 58, White 1983, p. 40) and our own reading of state statutes, there were few practical differences between trust companies and State banks in the 1920s. Other recent literature also treats trust companies as State banks (Carlson 2004, Jaremski and Wheelock 2020). Thus, there is no reason to omit Maine and New Hampshire.

In sum, Grossman considers an unnecessarily restricted set of states. These restrictions eliminate six out of ten single liability states, leaving only four in his sample (Alabama, Idaho, Louisiana, and Missouri), one of which (Idaho) changed from double to single liability only in 1923.

Comparability of single and multiple liability states

Grossman (2001) uses all 36 states for which he could classify the liability regime, making no effort to focus on comparable SL and DL states. He himself indicates that this is a potential problem:

> "During periods of heightened financial distress, double liability was associated with greater levels of instability. This result may be a consequence of the fact that financial distress during this period was concentrated in the agricultural regions of the midwest and west—areas which were frequently already governed by double-liability laws."[57] (p. 145)

The issue is that State bank failures were most frequent in the heavily agricultural states of the West and Midwest, which happened to be states that had historically decided to implement multiple liability. Many of these states saw explosive growth in their state banking sectors on the back of a commodity price boom during WWI. After the war ended, and commodity prices fell precipitously, many of their State banks got into trouble (Rajan and Ramcharan 2015, Jaremski and Wheelock 2020). As a result, their state banking systems became fragile and potentially more vulnerable to the Great Depression. This might hold even in comparison with National banks in

[57] The "double liability" in this sentence should read "multiple liability."

the same states, which did less agricultural lending and were therefore less exposed to commodity prices. Figure C.2 shows evidence consistent with this hypothesis: State banks in the full set of multiple liability states (including those in in the West and Midwest) had disproportionately high failure rates during the 1920s compared to those of National banks.

In sum, Grossman's comparison of single and multiple liability states is not apples-to-apples (as he himself notes). Many multiple liability states are in the West and Midwest and were heavily exposed to the commodity boom and bust during WWI, while most single liability states are east of the Mississippi and more urban. As we show in Section F.3 below, this leads to large differences between the single and multiple liability states in his sample. In contrast, in our paper, we focus on neighboring single and double liability states, we match states based on several characteristics, and we verify that the matched states are comparable on a much wider set of characteristics.

Additional references

Chen, Jiafeng, and Jonathan Roth. "Logs with Zeros? Some Problems and Solutions." The Quarterly Journal of Economics 139, no. 2 (2024): 891-936.

Cohn, Jonathan B., Zack Liu, and Malcolm I. Wardlaw. "Count (and Count-like) Data in Finance." Journal of Financial Economics 146, no. 2 (2022): 529-551.

F.2. Improving on Grossman's analysis

We attempt to improve on Grossman's analysis in several ways. We use the full set of 48 U.S states, classifying them into SL and ML based on Mitchener and Richardson (2013). Later, we will also make an effort to focus on comparable SL and ML states. We measure bank failures from 1929 to 1933, instead of 1930 only, to capture the entire Great Depression. We use state-level bank failure data from Federal Reserve (1937), which includes both suspensions and exits through acquisition.

Finally, we run a standard diff-in-diff analysis. The outcome variable is the state-specific failure rate of State (SB) or National banks (NB) for each year. We stack the failure rates by bank type for each state s and year t and use the following specification:

$$FR_{b,s,t} = \alpha SB_b + \beta\, SL_s + \gamma\, SB_b \times\, SL_s + \theta_t + \sigma_s + \varepsilon_{b,s,t} \qquad \text{(F7)}$$

for $b \in \{SB, NB\}$, s all 48 U.S. states, and $t \in \{1929, \ldots, 1933\}$. $FR_{b,s,t}$ is the number of State or National bank exits due to suspensions or acquisitions in state s in year t, divided by the number of State or National banks in state s at the end of year $t-1$. SB_b is a dummy identifying State banks, SL_s is a dummy identifying states with single liability, and θ_t and σ_s are year and state fixed effects. Of main interest is the interaction coefficient γ, which measures the differential failure rate of single liability State banks per year. Since the panel is fully balanced and there are no additional control variables, the inclusion of year and state fixed effects does not affect this coefficient, though it affects standard errors. We also run a purely cross-sectional specification with state-level failure rates cumulated over 1929-1933 as dependent variable, for which we drop the year fixed effects.

Results are in Table F.2. There is no support for Grossman's conclusion that State banks in single liability states were significantly less likely to fail during the Great Depression. The interaction coefficient on single liability and State bank, even though negative, is close to zero (-0.5 percentage points in total for 1929-33, compared to a baseline State bank failure rate of >50%).

Table F.2 does not show a *higher* failure rate for single liability State banks, which is what we find in our main analysis. One potential reason is the selection of states. Table F.2 uses all 48 states, while our main analysis focuses on 12 carefully matched single and double liability states.

To assess whether the state selection matters, we re-estimate the Table F.2 regressions for our matched states, using the same data source as before. This is not exactly what we do in the main text, where we match State-Fed districts rather than states, restrict the sample to the common bank size support, and end before the National Banking Holiday of March 1933. Nevertheless, the two analyses are close. Results are in Table F.3. The interaction effect is positive, economically large, and statistically significant. When considering the full 1929-1933 period, SL State banks were 12.6 percentage points more likely to fail, with a t-statistic of 2.39.

In sum, we have shown that Grossman's result that banks with single liability failed less during the Great Depression is an artifact of his methodology and the limitations of his data. Using the most authoritative source on bank failures for the entire Great Depression and a standard difference-in-differences approach using all 48 U.S. states, there is little difference in failure rates between single and multiple liability banks. When we use our matched sample of states, we find

that banks with single liability failed substantially more. This raises the key question: which of the two provides the better estimate of the effect of enhanced liability on failures, the full sample of 48 states or the matched sample of 12? We attempt to answer this question in the next section.

F.3. Comparability of single and double liability states

The identifying assumption underlying the difference-in-differences approach is that, without different liability regimes, the difference in failure rates between State and National banks would be the same in single and multiple liability states. This assumption is untestable. However, it becomes much less credible if SL and ML states have different economic fundamentals. This would make it unlikely that the Great Depression affects the two sets of states similarly, and that any differences in bank failure rates are due only to the different liability regimes.

In Table F.4, we compare the manufacturing and agricultural intensity and the urbanization of SL and ML states in the full set of 48 states in census years 1920 and 1930. ML states had lower manufacturing output per capita than SL states: $453 vs $591 in the 1920 census and $444 vs $536 in 1930. The opposite holds for agricultural crop value per capita: $179 vs $114 in 1920 and $95 vs $68 vs in 1930. ML states were also much less urbanized. The fact that multiple liability states were more rural and agricultural means that the bust in commodity prices after WWI may have weakened their banking sectors and made them more susceptible to further shocks.

Table F.4 also reports these statistics for our matched sample of 12 states. Single and double liability states look far more similar in terms of manufacturing and agricultural production.

Next, Table F.4 weights observations by the number of banks in each county, similar to our main analysis. This reduces the differences between SL and DL states further, rendering them economically and statistically insignificant. This makes it likely that the two sets of states started the Great Depression with similar economic conditions.

We obtain consistent results in Internet Appendix C.3, where we compare pre-trends in state banking systems between SL and ML states. Specifically, we compare the development of the number of State banks and bank failures. For the full sample of 48 states, single and multiple liability states were on different trajectories in the 1920s, with ML states seeing larger declines in the number of banks and more failures. Moreover, Figure C.1 shows that a decline in the number of State banks in the 1920s predicts additional declines during the Great Depression. We would

therefore expect ML states to underperform during the Great Depression, undermining the identifying assumption behind the difference-in-differences analysis. In contrast, in the matched sample of 12 states, SL and DL states were on parallel trends during the 1920s. Thus, the matched sample is more likely to deliver the correct estimate of the effect of enhanced liability on bank failures than the full sample of 48 states.

Table F.1: Replication of Table 1 of Grossman (2001)

Panel A: Grossman (2001)

TABLE 1

RATIO OF STATE TO NATIONAL BANK FAILURES, 1892–1930

	Failures	Failure Rates	Assets of Failures	Asset Failure Rates
Liability Status (ratio of number of state banks to national banks in cohort)				
			1921–1930	
Single (6.20)	14.44	2.11	10.50	4.31
Multiple (2.23)	5.27	1.94	2.95	3.23
			1930	
Single (5.41)	6.40	1.23	4.50	4.74
Multiple (2.19)	6.33	2.48	4.22	6.63

NOTES: Only states with three consecutive years of single or multiple (that is, double, triple, or unlimited) liability included. Voluntary or ambiguous liability excluded. Total observations = 1419 (81.6% multiple liability). Sources: see text.

Panel B: Our replication

(1) & (2) Liability status (Ratio no. of banks)	(3) Ratio no. of failures	(4) Ratio of failure rates
	1921-1930	
Single (5.84)	14.78	2.68
Multiple (2.48)	6.26	2.36
	1930	
Single (5.43)	6.40	1.22
Multiple (2.19)	6.33	2.46

Note: Panel A reproduces Table 1 from Grossman (2001) for 1921-1930 and 1930. Panel B presents our replication of Grossman's estimates. Column (2) reports the "ratio of number of State banks to National banks in cohort," Column (3) the "ratio of number of failures of State banks to number of failures of National banks in cohort," and Column (4) the "ratio of failure rate of State banks to failure rate of National banks in cohort."

Table F.2: Bank failure rates, 48 states, 1929-1933

	(1) $FR_{b,s,t}$	(2) $FR_{b,s,t}$	(3) $FR_{b,s,t}$	(4) $FR_{b,s,1929-1933}$
$SB_b \times SL_s$	-0.00603	-0.00603	-0.00603	-0.00469
	(-0.27)	(-0.36)	(-0.55)	(-0.10)
SL_s	-0.0289*			
	(-1.81)			
SB_b	0.0343***	0.0343***	0.0343***	0.118***
	(3.33)	(4.46)	(6.84)	(5.60)
Mean dep. var.	0.111	0.111	0.111	0.454
Year FE	N	Y		
State FE	N	Y		Y
Year x State FE	N	N	Y	
N	480	480	480	96
Adj. R^2	0.042	0.521	0.886	0.871

Note: The dependent variable is the failure rates of State and National banks for each state and year in Columns (1) through (3) and the cumulative failure rates of State and National banks for 1929-1933 in Column (4). Bank failures include suspensions and being acquired. SL is an indicator variable that equals one for states with single liability State banks. SB is an indicator that equals one for State banks. Since the panel is fully balanced and there are no additional control variables, the inclusion of year and state fixed effects does not affect the coefficients, though it affects standard errors. *t* statistics based on robust standard errors are in parentheses: * p<0.10, ** p<0.05, *** p<0.010.

Table F.3. Bank failure rates, 12 matched states, 1929-1933

	(1) $FR_{b,s,t}$	(2) $FR_{b,s,t}$	(3) $FR_{b,s,t}$	(4) $FR_{b,s,1929-1933}$
$SB_b \times SL_s$	0.0345	0.0345*	0.0345**	0.126**
	(1.40)	(1.98)	(2.34)	(2.39)
SL_s	-0.00875			
	(-0.50)			
SB_b	0.00430	0.00430	0.00430	0.0213
	(0.25)	(0.35)	(0.41)	(0.57)
Constant	0.0826***	0.0783***	0.0783***	0.344***
	(6.70)	(12.69)	(15.01)	(18.42)
Mean dep. var.	0.089	0.089	0.089	0.386
Year FE	N	Y		
State FE	N	Y		Y
Year x State FE	N	N	Y	
N	120	120	120	24
Adj. R^2	0.045	0.580	0.829	0.825

Note: The dependent variable is the failure rates of State and National banks for each state and year in Columns (1) through (3) and the cumulative failure rates of State and National banks for 1929-1933 in Column (4). Bank failures include suspensions and being acquired. SL is an indicator variable that equals one for states with single liability State banks. SB is an indicator that equals one for State banks. Since the panel is fully balanced and there are no additional control variables, the inclusion of year and state fixed effects does not affect the coefficients, though it affects standard errors. *t* statistics based on robust standard errors are in parentheses: * p<0.10, ** p<0.05, *** p<0.010.

Table F.4: State characteristics

Census		Manuf. output (per capita)	Crop value (per capita)	Urban pop. (%)	Pop. cities over 25k (%)
			Full Sample		
1920	SL	636	94	51%	37%
	ML	446	182	40%	23%
	Diff.	*189*	*-88*	*10%*	*15%*
	p-val	*0.097*	*0.025*	*0.192*	*0.051*
			Matched sample - Aggregate data		
	SL	561	103	45%	33%
	DL	623	85	59%	44%
	Diff.	*-62*	*18*	*-14%*	*-11%*
	p-val	*0.787*	*0.625*	*0.381*	*0.401*
			Matched sample - Weighted by bank count		
	SL	449	131	36%	22%
	DL	426	142	39%	23%
	Diff.	*23*	*-11*	*-3%*	*-1%*
	p-val	*0.911*	*0.766*	*0.842*	*0.929*
			Full Sample		
1930	SL	536	68	51%	36%
	ML	444	95	45%	27%
	Diff.	*92*	*-27*	*7%*	*9%*
	p-val	*0.336*	*0.223*	*0.000*	*0.000*
			Matched sample - Aggregate data		
	SL	536	51	50%	35%
	DL	582	38	60%	45%
	Diff.	*-45*	*12*	*-11%*	*-11%*
	p-val	*0.804*	*0.477*	*0.462*	*0.392*
			Matched sample - Weighted by bank count		
	SL	417	71	39%	22%
	DL	402	70	40%	23%
	Diff.	*14*	*1*	*-1%*	*-1%*
	p-val	*0.929*	*0.981*	*0.970*	*0.914*

Note: Averages of state characteristics for single and multiple (double) liability states. Data are from the 1920 and the 1930 censuses. *Manufacturing output (p.c.)*: manufacturing output (in U.S. dollars) divided by total population. *Crop value (p.c.):* value of crops (in U.S. dollars) divided by total population. *Urban population (%):* urban population divided by total population, times 100. Urban areas are cities and other incorporated places with at least 2,500 inhabitants and include other political subdivisions with at least 10,000 inhabitants and a density of at least 1,000 per square mile. *Population in cities over 25k (%):* population in cities with over 25,000 inhabitants divided by total population, times 100. Full sample: all 48 U.S. states. Matched sample: the matched sample of 12 states. Aggregate data: state level values. Weighted by bank count: county level values, weighted by the number of banks in each county.

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