Extended Liability, Bank Regulation, and Bank Risk-Taking: Evidence from the Great Depression

Haelim Anderson,[1,2] Daniel Barth[3] Dong Beom Choi[4]

September 13, 2017

Abstract

In this paper, we study how bank regulation affected bank risk-taking behavior during the Great Depression. We examine the relationship between extended liability, (minimum) capital requirements, and risk-taking by comparing national, state fed-member, and state non-member banks. We find that banks under a double liability regime held more liquid assets compared to banks under a single liability regime. However, federal reserve member single-liability state banks were the most risky during the boom years of 1926 and 1928; such banks had lower liquidity than double-liability national banks, and higher leverage than single-liability, non-member state banks. This may suggest that access to the discount window, when paired with capital regulations under the Federal Reserve System, provided incentives for increased risk-taking. We also show that during the crisis years of 1930 and 1932, state fed-member banks had similar liquidity to national banks, whereas non-member banks remained considerably less liquid. This suggests that the discount window improved bank liquidity for member banks compared to non-member banks.

JEL Classifications: G21, N22

Keywords: Extended Liability, Bank Regulation, Bank Risk, Great Depression

[1] Views and opinions expressed are those of the authors and do not necessarily represent official positions or policy of the OFR, the U.S. Department of the Treasury, the Federal Reserve Bank of New York, or the Federal Reserve System.

[2] Office of Financial Research, U.S. Department of Treasury, 717 14th St. NW, Washington, DC, 20005, USA. Phone: (202) 927-8419. Email: Haelim.Anderson@ofr.treasury.gov

[3] Office of Financial Research, U.S. Department of Treasury, 717 14th St. NW, Washington, DC, 20005, USA. Phone: (202) 927-8235. Email: Daniel.Barth@ofr.treasury.gov

[4] Federal Reserve Bank of New York, 33 Liberty Street, New York, NY 10045, USA. Phone: (212) 720-6485. Email: dongbeom.choi@@ny.frb.org

1 Introduction

In the years leading up to the global financial crisis, the financial sector was marked by excessive risk taking. The banking sector maintained an inadequate and deteriorated capital base and held insufficient liquidity buffers. Under the current limited liability environment, shareholders are incentivized to take risks because they receive the full benefit of profitable investments but bear none of the costs if these risky projects fail. Further, bank shareholders fail to internalize the negative economic externalities that result from bank distress. In the aftermath of the crisis, bank regulators strengthened regulation by adopting Basel III standards, which required banks to hold more capital and liquid assets.[5] In order to promote financial stability, understanding how different types of bank regulation can interact to affect bank risk-taking behavior is important.

Prior to the Great Depression, extended shareholder liability served as an institutional architecture for financial stability in the U.S. By imposing contingent liability on shareholders, regulators wanted to reduce bank risk-taking incentives. Under extended liability, when a bank is declared insolvent and closed with negative net worth, shareholders are responsible for their initial investment plus some or all of the unpaid debts in proportion to their shareholdings. Regulators believed that banks with extended liability would choose less risk, since shareholders would be liable for a greater payment if the bank went bankrupt and therefore bore more exposure to downside risks. (Macey and Miller (1992); Esty (1998); Grossman (2001)).

In addition to extended shareholder liability, bank regulators imposed reserve and capital requirements. During this period, depositor withdrawal risk was high due to the absence of deposit insurance, so bank regulation was keenly focused on reserve requirements. Regulators stipulated the amount of liquid assets required to be held based on demand and time deposits. Regulators also imposed minimum capital requirements in the form of absolute dollars (rather than ratios). Reserve and capital requirements varied depending on the choice of the charter and differed by state (Mitchener (2005)).

In this paper, we examine how bank regulation affected bank risk-taking behavior during the Great Depression. We do this by comparing national, state federal reserve member banks, and state non-fed member banks in states where national and state banks operated under different liability regimes. By comparing national banks to state fed-member banks, we aim to identify the *ceteris paribus* effect of extended liability on bank risk taking, as fed-member banks operated under the same capital and reserve requirements as national banks, but under different liability regimes. We then compare state fed-member to non-member banks estimate the partial effect of capital and reserve requirements on bank risk, as these banks operated under the

[5] Specifically, the Liquidity Coverage Ratio (LCR) has been introduced to ensure liquidity in banks in the short term, and a Net Stable Funding Ratio (NSFR) is proposed to promote medium- and long-term resilience against liquidity shocks.

same liability structure but faced different capital and reserve requirements.

In order to support our study, we construct a micro-level dataset on banks in states where state banks operated under limited liability: Alabama, Idaho, New Jersey, Louisiana, Virginia, and Missouri. By contrast, all national banks regardless of the state of operation were governed by double-liability. The dataset includes information on balance sheets as well as information on Federal Reserve membership. Using this newly constructed dataset, our identification strategy allows us to conduct both within and between state comparisons.

Examining the U.S. banking system during the 1920's and 1930's provides us a unique opportunity to understand how bank regulation affects bank risk-taking behavior and financial stability. During the 1920's, banks tended to be healthy and the probability of bank failures fell due to strong economic growth. In contrast, the Great Depression during the early 1930's accompanied the most severe banking crisis in the U.S. history. Studying heterogeneous bank risk-taking behavior under different regulatory regimes, both in aggregate and separately during the boom and bust cycles, may help policy-makers to design effective regulations that better ensure financial stability.

We find that state fed-member banks were the riskiest. Banks that operated under double liability were more liquid than banks that operated under single liability. The observed difference in liquidity remains when we compare national and state fed-member state banks, which effectively controls for differences in capital and reserve regulations. We find no difference in the level of capital buffers between single- and double-liability banks, regardless of state bank federal reserve membership. However, we do find that state fed-member banks were riskier than non-fed member banks during the boom; while both state fed and non-fed members held less liquid assets compared to national banks, non-member banks held more capital buffers. Thus, state fed-member banks held the same capital as double-liability national banks, but less liquidity, and held the same liquidity as non-member banks, but less capital. These results suggest a nuanced and important interaction between bank risk and multiple dimensions of bank regulation.

This paper makes contributions to several literatures. First, it adds to the literature on extended liability and its effect on bank risk. While regulators intended for extended liability to rein in bank risk-taking behavior, previous studies have shown mixed results. While some studies show that banks operating with extended liability exhibited less risky behavior than banks with single liability (Esty (1998); Grossman (2001); Mitchener and Richardson (2013)), others find that double liability encouraged bankers to take more risk (Macey and Miller (1992); Bodenhorn (2016)). We contribute to this literature by comparing banks that faced the same capital and reserve regulations, but operated under different extended liability rules.

Second, it adds to the literature on how bank regulation affects financial stability. Many studies find that

capital requirements are an effective macro prudential tool to curb excessive bank lending (Bernanke, Lown, and Friedman (1991); Peek and Rosengren (1995a); Peek and Rosengren (1995b); Gambacorta and Mistrulli (2004); Francis and Osborne (2012); Aiyar, Calomiris, and Wieladek (2014); Uluc and Wieladek (2016)).[6] Other studies that focus on reserve requirements find them to be effective as well (Roldos and Guzman (2014); Federico, Vegh, and Vuletin (2012); Montoro and Moreno (2011); Tovar Mora, Garcia-Escribano, and Vera Martin (2012); Mora (2014)). During our sample period, regulators put a large emphasis on reserve requirements since the banking system was vulnerable to deposit withdrawal risk (Calomiris, Heider, and Hoerova (2015)). Yet, Mitchener (2005) finds that capital requirements served as a more effective policy tool to lower suspension rates during the Great Depression. We contribute to this literature by examining the impact of capital and reserve requirements on bank risk during the boom-bust cycles of the 1920's and 30's.

The remainder of the paper is organized as follows. In Section 2, we review the details of extended shareholder liability, of federal reserve membership and the dual-banking system, and of the regulatory environment during the 1920's and 1930's. Section 3 describes our data sample. Section 4 outlines our identification strategy and empirical specification. Section 5 presents our findings. Section 6 concludes.

2 Historical Background

2.1 Dual-Banking System and Federal Reserve Membership

During the 1920's and 1930's, the U.S. banking system operated under a dual banking system where banks could choose either a national or state charter. All national banks had to become members of the Federal Reserve System. In contrast, state banks could choose to become members of the Federal Reserve System or not. There were differences in regulatory requirements depending on a charter choice and federal reserve membership status. As this is central to our control and treatment groups, we provide a brief review of the development of that banking system and the regulations during the period under study.

Until 1863, bank regulation was left to states, and the level of regulation varied from state to state. Federal regulation was first introduced when the National Banking Acts of 1863 and 1864 were passed. The new legislation intended to create a market for government bonds to finance the Civil War by establishing a system of nationally chartered banks and a uniform banking and currency system. In addition, it created the Office of the Comptroller of the Currency (OCC) to regulate nationally chartered banks.

However, the National Banking Acts of 1863 and 1864 failed to create a unified banking system. Under the National Banking Act, commercial banks could choose to organize as either national banks with a federal

[6] While these studies find that capital requirements reduce bank lending, they are divided on whether a reduction in bank lending is welfare-improving or not.

charter or as state banks with a charter issued by state governments. The choice of charter dictated the law under which the bank would operate and the agency that would act as the bank's supervisor. The decision to choose a federal or a state charter determined a bank's powers, reserve requirements, capital requirements, and lending opportunities. Most banks chose to be regulated by the state because the standards required for a federal charter were generally stricter than for state charters (Bordo, Rockoff, and Redish (1994)).

In June of 1864, a revision of the act was passed to encourage more state banks to apply for a national bank charter. The revision imposed a tax on all bank notes issued by state banks of 2 percent, which was raised to 10 percent in March of 1865. After the revision, many state banks converted to national charters because the tax made state banking unprofitable. In 1870, the number of state banks decreased from 1,466 in 1863 to 349, while the number of national banks increased from 66 to 1,612. However, state banks revived in the 1880's due to the growing popularity of checking accounts which replaced banknotes. Combined with lower capital and reserve requirements, as well as the ease with which states issued banking charters, state banks again became the dominant banking structure by the late 1880's. By 1913, there were 16,841 state banks and 7,467 national banks in operation (Committee on Branch and Baking (1932)).

When the Federal Reserve Act was passed in 1913 to create a lender of last resort, the Federal Reserve Board expressed its hope of establishing a unified banking system. Under the Act, national banks were required to join, whereas state banks could choose to join. Becoming a member bank meant becoming subject to both state and federal supervision. Many state banks found membership too costly and chose not to join. In order to encourage state banks to join the Federal Reserve System, Congress passed a revision in 1917 to make capital and reserve requirements less strict. Many banks joined in 1917 and 1918. By 1926, there were 7,972 national banks, 1,403 state banks with Federal Reserve membership, and 17,591 state banks without Federal Reserve membership. In total, roughly 30 percent of banks in the U.S. were supervised under the regulatory requirements of the Federal Reserve System, and 64 percent were governed by the regulatory requirements of the state (Committee on Branch and Baking (1932)).

The top panel of Figure 2 shows the total number of banks in each state, along with the proportion of national, state fed-member, and state non-member banks in 1926. Membership in the Federal Reserve System was not popular in many states; state banks in the Northeast and Midwest regions were much more likely to participate.[7]

[7] Anderson, Calomiris, Jaremski, and Richardson (2017) find that participation in the Federal Reserve System was highly correlated with banks' desire to use the discount window.

2.2 Regulatory Framework

2.2.1 Extended Liability

In the United States, extended liability was a key feature of bank regulation between 1863 and 1933. Double liability was most common. Under double liability, bank shareholders could lose the value of their equity as well *in additional to* an amount not to exceed the value of their equity at par in the event of bank liquidation. During this period equity was sold at par, which implied stockholders effectively stood to lose double their equity in the event of bank failure. Triple and unlimited liability regimes were implemented by Colorado and California state laws, respectively.

Extended liability was adopted to discourage bank risk-taking behavior. Since extended liability imposes post-closure losses on bank stockholders, it should increase incentives for banks to hold additional capital and more effectively align the incentives of equity holders and depositors. In addition, under extended liability, insolvent banks may choose to close before their liabilities exceeded their assets to prevent shareholders from being assessed the extra liability, which would allow depositors to avoid potential losses. Early closures in the form of voluntary liquidations minimized depositor and shareholder losses (Macey and Miller (1992)).

In addition, extended liability was used to increase depositors' confidence in the banking system (Marquis and Smith, 1937). Extended liability sought to pay creditors even if the liquidated value of assets could not cover liabilities. Stockholders would be assessed by state officials "equitably and ratably" to the extent of the state limitations of liability. Extended-liability banks could therefore, in theory, offer lower interest rates on deposits as the risk associated with deposits would be reduced. Conversely, depositors who chose limited liability banks chose to expose themselves to a higher degree of insolvency risk in exchange for the better rates offered by limited liability banks (White, 2014).

After the Great Depression, political pressure forced the repeal of many contingent liability provisions. Bank stockholders, especially those with very little stock, felt it impossible for them to monitor bank behavior and did not want to be liable for their debt. In addition, large depositor withdrawals showed that shareholders' wealth was not credible enough to prevent bank runs. As a result, many questioned whether extended liability was able to stabilize the banking system (Macey and Miller (1992)).

2.2.2 Capital and Reserve Requirements

The regulatory environment varied by the choice of state or national charters and by federal reserve membership. Minimum capital, reserves, and branching restrictions also varied considerably from state to state. Additionally, states differed in reserve requirements on deposits and in the type of deposit that required

reserves to be held. Table 1 shows the state bank regulatory environment in force as of 1926 and which continued through the mid-1930's.

Perhaps most importantly, states implemented different liability rules. Most states adopted double liability for bank shareholders, but ten states operated under single liability: Alabama, Connecticut, Delaware, Idaho, Missouri, Louisiana, New Jersey, Rhode Island, Tennessee, and Virginia.

Figure 1 shows the bank regulatory environment for national banks and state banking institutions that were members of the Federal Reserve System as of 1926. These banks tended to face higher capital and reserve requirements than state banks that were not members of the Federal Reserve System. This was because national banks and fed-member state banks had access to the federal reserve discount window. However, non-member trust companies often had more stringent capital requirements than non-member state commercial banks, and in some cases depending on town population, had more stringent controls than even national and state fed-member banks.

3 Data and Summary Statistics

3.1 Data Sources

In order to examine how extended shareholder liability affected bank risk, we construct a data set containing the biannual balance sheet items of national, state commercial banks, and trust companies. Our data comprise only single-liability states, and include: Alabama, Idaho, Louisiana, Missouri, New Jersey, and Virginia, for the years 1926, 1928, 1930, and 1932. Our data for Missouri currently comprises only 1926. We collect balance sheets from the Rand McNally Bankers' Directory, which published semi-annual balance sheets for all financial institutions every January and July. We focus our data collection on banks in towns where at least one fed-member banks existed.

We consult the Annual Report of the Federal Reserve Board and the Annual Report of the Commissioner of Banking and Insurance to determine whether a bank was a member of the Federal Reserve. The report lists all state member banks by district each year. Because the report does not contain the exact date of membership, we match these lists to the balance sheet data, creating a dummy variable for whether the bank was a member or not as of 1926. It is worth noting that all the banks in our sample that became Federal Reserve members remained members for the rest of our sample period.

Our identification strategy relies on separating national banks, state commercial fed-member and non-member banks, and fed-member and non-member trust companies. Table 1 reports the number of observations in our data for each bank type, further delineated by state and year. There is considerable heterogeneity in the number of each bank type between different states. Louisiana, for example, has zero state commercial

banks.

4 Estimation Strategy and Identification

4.1 Identification of Bank Risk Choices

Our goal is to determine the extent to which liability structure and reserve and capital requirements affect bank risk-taking, both independently and through their interactions. Previous attempts to measure the effect of liability structure on bank risk have exploited the variation between national banks and state banks within the same state. National banks were governed by double liability, whereas state banks were governed by liability structures set by state regulators. By comparing national and state banks within the same state (or town or county), one may in principle control for local variation in economic and cultural conditions, and infer that differences in observed risk-taking arise from differences in liability structure.

However, this identification strategy does not account for important sources of heterogeneity that result from additional regulations, such as capital and reserve requirements. Fed-member state banks that joined the federal reserve system had access to borrowing from the discount window. As a consequence, membership also imposed the same capital and reserve requirements faced by national banks, whereas state non-member banks had capital and reserve requirements set by the states. Further, state trust companies, which are often lumped together with state commercial banks in the existing literature, may also join the federal reserve system. But non-member trust companies often face different reserve and capital requirements than even non-member state commercial banks.

By combining state fed-member commercial banks, non-member commercial banks, and non-member trust companies, previous empirical evidence of an effect of liability structure and bank risk becomes difficult to interpret. If state banks, treated as one homogeneous group, are observed to take higher leverage than national banks, it is impossible to know whether that results from heterogeneity in risk choices incentivized by limited-liability, or mechanically from heterogeneity in capital requirements. Additionally, one cannot separate the liquidity choices of banks from their leverage choices, which are likely affected by capital controls. One cannot know, for example, if an empirical relationship between bank risk and liability structure is found, whether limited-liability state banks take more risk than double-liability national banks because double-liability helps to mitigate the agency problem inherent in deposit-financed lending, or whether limited-liability state banks face higher capital controls (and therefore tighter constraints on leverage), and counteract this restriction on leverage by holding less liquidity.

Further, previous studies of liability structure on ex-ante bank risk and ex-post bank failures study periods prior to the boom and bust cycles of the great depression. This makes it impossible to know whether

liability structure has the intended effect on bank risk-taking during periods when such an effect is most valuable — during or just prior to episodes of financial stress.

Instead, our identification strategy seeks to exploit variation along these multiple dimensions of bank risk-taking and across the boom-bust cycle to estimate whether certain risk-management regulations are important for particular measures of bank risk, and whether the combination of these multi-faceted regulations produce important interactions for observed bank risk choices. In particular, we divide banking institutions into five groups: national banks, state commercial fed-member banks, state commercial non-member banks, state fed-member trust companies, and state non-member trust companies. Each group differs from the others either in liability structure or in capital and reserve requirements. This allows us to estimate the partial and total effects of bank regulations on bank risk choices in a way that is not possible when banking institutions in the latter four groups are lumped into one homogeneous "state banks" category.

In particular, state fed-member commercial banks differ from national banks in liability structure, but share the same capital and reserve requirements. State non-member commercial banks differ from state fed-member commercial banks in capital and reserve requirements, but share the same liability structure. Of course, this implies that state non-member banks differ from national banks in both liability structure and capital and reserve requirements. Finally, state non-member trust companies differ from state non-member commercial banks in capital and reserve requirements, but share the same liability structure and neither has access to the discount window. This heterogeneity across multiple dimensions of bank regulations allow us to credibly estimate the *ceteris paribus* effect of each regulation mechanism separately, and to estimate whether important interactions between different mechanisms also exist. Further, we separate our analysis into boom (1926 and 1928) and bust (1930 and 1932) periods, to test whether these regulations, either separately or jointly, have differential effects during different parts of the boom-bust cycle.

4.1.1 Estimation

We follow previous studies on bank risk and liability structure by developing various measures of risk-taking which may be broadly described as relating to leverage and liquidity. Our measures are: the ratio of cash reserves to total assets, which is a measure of bank liquidity, and the ratio of bank equity to total assets, which is an inverse measure of bank leverage. In each case, higher values of our measures suggest less bank risk-taking or higher bank liquidity. As discussed in the last section, our aim is to empirically estimate the effects of liability structure and capital requirements on bank's choices of liquidity and leverage by separating banking institutions into national, state commercial, and state trust, with the latter two further decomposed into federal reserve members and non-members.

We begin by estimating a model that is similar to those estimated previously in the literature. We do this largely to establish facts, and to obtain the estimates that result from combining all state banking institutions into one group, irrespective of their capital requirements. This will serve as our baseline specification. The specification in equation (1) below is analogous those used in previous studies of liability structure on ex-ante bank risk-taking (Esty, 1998) and ex-post bank failures (Grossman, 2001). We include in the estimation: national banks, which are governed by double-liability structure, state banks, and trust companies. The latter two have liability structures and capital requirements set by the states themselves, and we include only those states that are governed by limited-liability. We estimate:

$$y_i = \beta_0 + \beta_1 SB_i + \beta_2 X_i + \varepsilon_i \tag{1}$$

where y_i is either the cash-to-assets ratio (liquidity) or equity-to-assets ratio (inverse of leverage), and SB_i is an indicator variable equal to one if the bank is a state bank. In this specification, all state banking institutions — state fed-member, non-member, trust fed-member, and trust non-member — are treated as a state bank. The excluded group is national banks. X_i is a vector of controls, which may include state fixed effects, town controls such as population, and bank controls such as total bank assets and age. We estimate equation (1) for three separate samples: the "boom" period, which includes 1926 and 1928, the "bust" period, which includes 1930 and 1932, and the full sample, which includes all four years. In the literature, β_1 in this specification would be interpreted as the *ceteris paribus* effect of liability structure on bank risk. However, as discussed in the previous section, heterogeneity in capital and reserve requirements make this interpretation problematic.

Next, we re-estimate equation (1) but decompose state banks into federal reserve members or non-members. Each is assigned a separate indicator variable. Formally, we estimate:

$$y_i = \beta_0 + \beta_1 SB_i^F + \beta_2 SB_i^N + \beta_3 X_i + \varepsilon_i \tag{2}$$

where SB_i^F is an indicator equal to one if the state bank is a member of the federal reserve system (superscript F for *fed*-member), and SB_i^N is an indicator equal to one if the state bank is not a member (superscript N for *non*-member). In this specification, trust companies are once again considered state banks. Because state fed-member banks have the same capital and reserve requirements as national banks, the coefficient β_1 in this specification represents the *ceteris paribus* effect of liability structure on bank liquidity or leverage, holding other regulatory restrictions such as capital and reserve requirements fixed. Because state non-member banks have the same liability structure as state fed-member banks, but differ in their capital and reserve requirements, $\beta_2 - \beta_1$ has the interpretation of the effect of capital and reserve requirements on bank

liquidity and leverage, holding liability structure fixed.

In order to more precisely estimate the effect of capital requirements on bank risk, we next exploit the additional capital requirements placed on trust companies in some states. Whereas trust companies that belong to the federal reserve system comply with national requirements, non-member trust companies had different capital requirements than non-member state banks in the same state. In many cases, these capital requirements were more stringent. In two states in particular, Missouri and New Jersey, these capital requirements on non-member trust companies were much stricter (see Table 1). With this in mind, we estimate one final specification:

$$y_i = \beta_0 + \beta_1 TC_i^F + \beta_2 TC_i^N + \beta_3 X_i + \varepsilon_i \tag{3}$$

where, unlike equation (2) we now restrict our sample to include only national banks and trust companies. TC_i^F is an indicator equal to one if the trust company is a member of the federal reserve system, and TC_i^N is an indicator equal to one if the trust company is not a member. The coefficients in equation (3) have the same interpretation as those in equation (2), but due to the larger difference in capital requirements between fed-member and non-member trust companies (as compared to state commercial banks), we expect β_2 to be more precisely estimated in this specification. Finally, to utilize the stringent capital requirements imposed on trust companies in Missouri and New Jersey, we estimate equation (3) for only those two states. We expect this to be the most powerful specification for accurately estimating β_2.

Table 3 provides summary statistics of our liquidity and leverage measures and additional controls for the full sample and individually by state.

5 Empirical Results

5.1 Plots of Bank Risk

We begin by plotting cross-sectional values for our two measures of bank risk and liquidity for the six states in our data. We restrict our data to 1926, the only year for which we have complete data for each state. This is shown in Figure 4. Two results are immediately apparent from Figure 4: firstly, there is considerable heterogeneity in risk-taking and liquidity between state fed-member and non-member banks across different states, which suggests that local economic conditions may play an important role; secondly, there is no discernible pattern for the difference in bank risk or liquidity between state fed-member banks, state non-fed member banks, and national banks *within a particular state*. For example, in Alabama state fed-member banks have much higher average cash-to-asset ratios that non-member banks, and each has a

higher average ratio than Alabama national banks. In Missouri, however, while state non-member banks have slightly higher cash-to-asset ratios (although statistically insignificant), each has a much higher ratio that state fed-member banks.

Figures 5-9 plot the time-series of our measures of bank risk and liquidity separately for each state (with Missouri excluded since we only have data for 1926). Not only is the relationship between bank risk and liquidity and liability structure difficult to discern in the cross-section, but also across time *within* a particular state. In Alabama, Idaho, Virginia, and California, for example, the time-series of each of our risk measures for state fed-member and national banks cross on multiple occasions. While figures 4-9 are only instructive, they do suggest that the relationship between bank risk-taking and liability structure is more subtle than the existing literature may suggest.

5.2 Estimation Results

Table 4 shows the results obtained by estimating equation (1) by OLS. Bank leverage, measured as the ratio of bank equity to total assets, is the dependent variable. We separate our data into boom (1926 and 1928) and bust (1930 and 1932) periods in addition to the full sample. Columns (1)-(3) show that (inverse) leverage is much higher for state banks than for national banks. This is puzzling. If liability structure is the sole — or even most important — determinant of bank risk during this era, we should expect the state bank indicator coefficient to be *negative*, as limited-liability state banks would be taking more risk and hence more leverage than their double-liability national bank counterparts.

Table 5 shines light on this apparent contradiction, which shows results from estimating equation (2) and which splits state banks into fed-member and non-member groups, with a separate indicator variable for each. This is the crux of our identification argument. Because state fed-member banks faced the same capital and reserve requirements as national banks, the differences in leverage between national and state fed-member banks is likely to come only from differences in liability structure (limited vs. double). However, differences in leverage between state fed-member and non-member banks would suggest that liability structure is not the operative risk-management tool constraining leverage, but rather capital and reserve requirements.

As seen from Table 5, nearly all of the difference in leverage between state banks and national banks comes from the non-member state banks. In the boom period, state fed-member banks used statistically and economically similar levels of leverage as national banks, but non-member state banks used considerably less leverage than fed-member state banks and, by transitivity, national banks as well. The strongest effect comes from the boom period, and the difference in leverage between fed-member and non-member state

banks shrinks slightly in the bust period — during which state fed-member banks may have used slightly less leverage than national banks as well — but non-fed members nonetheless continued to use much less leverage than state fed-member or national banks.

Of course, the empirical finding that state non-member banks used considerably less leverage may be somewhat mechanical. Even though state banks had capital requirements based on population levels in their towns, rather than as a proportion of bank assets, if local banking competition was such that excessively large state banks were unlikely, then enhanced requirements on the total amount of capital and reserves required for state banks could practically constrain the total leverage a state bank was able to take.

In Table 6, we exclude state commercial banks, and re-estimate the specifications in Table 5 for only state-chartered trust companies and national banks. This is done in columns (1)-(3). It is clear that in both boom and bust periods that non-member trust companies held considerably higher equity relative to total assets than fed-member trust companies and national banks. In the full panel, which includes state-by-year fixed effects, there is weak evidence fed-member trust companies may have also used less leverage than national banks (although still considerably more than non-member trust companies). However, because trust companies are not necessarily required to hold more capital or reserves than national banks (see Alabama in Table 1), the results in columns (1)-(3) may be misleading. In columns (4)-(6), we restrict our sample even further to include only Missouri and New Jersey national banks and trust companies. In these states, the capital and reserve requirements imposed on trust companies were considerably higher than those imposed on state-charted commercial banks or national banks. If capital and reserve requirements are indeed constraining bank leverage, it should be most apparent in these states. Columns (4)-(6) show that, consistent with our hypothesis, non-member trust companies held substantially lower levels of leverage than fed-member trust companies, a result which is consistent across both boom and bust periods and over the entirety of the sample.

The results in Tables 4-6 demonstrate consistent evidence that double-liability national banks used considerably more leverage than single-liability state banks, but that this difference is likely driven primarily by heterogeneity in capital and reserve requirements faced by state-chartered banking institutions outside the federal reserve system. One immediate takeaway from this analysis is that evaluating the effect of liability structure on bank risk can be difficult if heterogeneity in other risk-management regulations are not appropriately accounted for. A second confounding effect is that significant constraints on bank leverage may lead to *increased* risk-taking in other dimensions, such as the amount of cash held. To investigate further the possibility of substitution effects in bank risk due to regulations that span multiple dimensions of risk, we turn next to the liquidity choices of national, state fed-member, and non-member banking institutions.

In Tables 7-9, we repeat the specifications estimated in Tables 4-6 (equations (1)-(3), but include as the dependent variable our measure of liquidity — the ratio of cash to total assets — rather than leverage. Column (1) of Table 7 shows that during the boom period, limited liability state banks held considerably less liquidity that double-liability national banks. This result is both economically large and highly statistically significant. This result is consistent with Esty (1998), who also finds that limited-liability state banks took on more risk than national banks within the same state. However, during the bust period, state banks had liquidity ratios that were statistically indistinguishable from national banks. This is shown in column (2). In this specification, the coefficient on the state-bank indicator is roughly 70% smaller than the coefficient estimated in column (1), and is statistically insignificant. Column (3) shows results for the full data sample. In this case, the coefficient on the state bank indicator is once again negative and statistically significant, but this obscures the important distinction between bank risk choices prior to and during the great depression.

In Table 8, we re-estimate the specifications in Table 7 but separate state banks into fed-member and non-members, with an indicator variable for each. The results offer a more nuanced view of state-bank liquidity choices than would be inferred from Table 7 alone. Whereas, similarly to Table 7, both fed-member and non-member state banks held significantly less liquidity than national banks during the boom period, during the bust period state non-member banks *continued* to hold significantly less liquidity than either double-liability national banks or single-liability state fed-member banks during the bust period. This highlights the importance of our identification strategy that exploits variation in both liability structure and in capital and reserve requirements (or possibly access to the discount window). Once again, column (3) of Table 7 shows that over the full sample limited-liability state banks held less liquidity than national banks, but this result also misses the important differences in risk-taking during different phases of the boom-bust cycle.

One way to rationalize the results in Table 8 is through the interactions between liquidity and leverage regulations. Whereas both state fed-member and non-member banks operated under limited-liability, they faced potentially different capital and reserve requirements. If limitations are imposed on banks' optimal risk choices through regulation of capital and reserves, this may lead to increased risk-taking through the liquidity channel, which (in the case of our data) is less constrained. To test this hypothesis, we limit our analysis to only national banks and state trust companies. Trust companies faced different capital and reserve requirements than state commercial banks, with these requirements often being more stringent. If capital and reserve requirements create risk spillovers into bank liquidity choices, evidence of such risk-shifting should be most apparent when comparing national banks to trust companies specifically.

In Table 9, we re-estimate the specifications in Table 8 but restrict the sample to include only national

banks and state trust companies. This is done in columns (1)-(3). However, because reserve requirements for trust companies are not necessarily stricter state banks in every state, in columns (4)-(6) we further restrict our sample to include only Missouri and New Jersey — two states which have the clearest distinction between trust company and state bank capital and reserve requirements.

The patterns in Table 9 are consistent with those in Table 8, and in the case of the bust period offer an even stronger distinction between liquidity choices of fed-member and non-member institutions. Whereas the estimated coefficients in columns (2) and (5) differ to some degree, the *difference* in the estimated fed-member and non-member coefficients are nearly identical (2.444 vs. 2.342), and are both larger than the difference found in column (2) of Table 8.

To summarize, Tables 4-9 highlight at least two important considerations for empirical analyses of the effectiveness of bank risk regulations, each of which has been previously unexplored in the literature. Firstly, studying the effect of liability structure on various dimensions of bank risk by exploiting variation between state-chartered and nationally-chartered banking institutions may lead to incorrect interpretations of the evidence if heterogeneity in other dimensions of bank regulation, such as in capital and reserve requirements, is not appropriately accounted for. Tables 4-6 offer support for this conclusion, as the simple comparison between limited-liability state banks and double-liability national banks would suggest that state-chartered institutions used considerably *less* leverage. However, this difference becomes economically and statistically insignificant in most specifications when comparing state fed-member banks and national banks, which had identical capital and reserve requirements.

Secondly, the imposition of bank risk-management regulations that span multiple dimensions of bank risk decisions, such as liquidity and leverage, may lead to spillovers that render particular regulations less-effective than they may otherwise be, particularly during times when the effectiveness of such regulations may be the most valuable. Tables 7-9 offer evidence of this effect as well. Whereas the liquidity choices of state fed-member and non-member institutions were largely similar during the boom period (despite the differences in capital and reserve requirements), during the stress of 1930 and 1932, when state fed-member banks increased their liquidity ratios to be statistically equivalent to national banks, state non fed-member banking institutions did not, and ended up holding considerably less cash than their fed-member counterparts. One interpretation of this result is that during the stress times of 1930 and 1932, the additional controls on bank leverage were more costly than during the boom period, and forced non-member institutions to shift risk and search for yield by lowering their cash ratios relative to both state fed-member and national banks.

6 Conclusion

We demonstrate that previous studies of liability structure on bank risk may be confounded by additional bank regulations such as capital and reserve requirements. We show that it is possible to estimate the effects of liability structure and capital requirements on bank risk separately by sorting state banking institutions into federal reserve member and non-member banks.

We find that if all state banking institutions are treated as one homogeneous group, single-liability banks actually choose *less* leverage than double-liability national banks. However, this effect is driven entirely by state non-member banks, who faced different capital requirements as well as different liability structures than national banks.

Further, we demonstrate that during the boom years of 1926 and 1928, bank liquidity as measured by cash-to-asset ratios was highly similar between state fed-member and non-member banks, each of which held less liquidity than double liability national banks. However, during the bust years of 1930 and 1932, state fed-member banks increased their cash ratios to be statistically equivalent to national banks, whereas state non-member banks continued holding considerably less cash.

Our interpretation of these results is that the additional restrictions on leverage for state non-member banks led to additional risk taking through decreased liquidity during the bust period, but did not decrease liquidity during the boom period. One possibility is that the cost of constrained leverage was higher during bust years than boom years.

Together, our results demonstrate that estimating the effect of liability structure on bank risk is problematic if one does not appropriately control for additional dimensions of bank risk regulations. We further demonstrate that the interaction of these regulations, combined with banks setting leverage and liquidity levels both endogenously and simultaneously, may reduce the effectiveness of some regulations during periods when such effectiveness is most valuable.

7 Tables and Figures

7.1 Tables

Table 1: State Commercial Bank and Trust Company Regulatory Environment

		Min. Capital (000's)			Reserve
		Commercial	Trust		Requirement
State	Failure Rate	Banks	Companies	Branching	(%)
Missouri	45.38	10	50	Prohibited	15
Louisiana	41.88	10	100	Limited	20
Idaho	40.43	10	50	Prohibited	15
Alabama	38.59	15	25	Prohibited*	15
Virginia	27.33	10	100	Statewide	10
New Jersey	18.64	50	100	Limited	15

Table 1 reports information on bank failures and the regulatory environment by state as of 1926.

Table 2: Data Observations by State, Year, and Bank Type

		# Obs.			
State	**Bank Type**	1926	1928	1930	1932
Alabama	National Bank	6	6	6	6
	State Commercial Fed-Member	7	7	6	3
	State Commercial Non-Member	2	2	2	2
	Trust Company Fed Member	3	2	1	1
	Trust Company Non-Member	1	1	1	1
Idaho	National Bank	10	6	6	3
	State Commercial Fed-Member	11	10	10	9
	State Commercial Non-Member	0	0	0	1
	Trust Company Fed Member	2	2	2	1
	Trust Company Non-Member	0	0	0	0
Louisiana	National Bank	5	5	4	3
	State Commercial Fed-Member	0	0	0	0
	State Commercial Non-Member	0	0	0	0
	Trust Company Fed Member	4	4	3	2
	Trust Company Non-Member	5	5	5	4
Missouri	National Bank	26	0	0	0
	State Commercial Fed-Member	27	0	0	0
	State Commercial Non-Member	46	0	0	0
	Trust Company Fed Member	24	0	0	0
	Trust Company Non-Member	18	0	0	0
New Jersey	National Bank	47	41	49	47
	State Commercial Fed-Member	8	3	4	4
	State Commercial Non-Member	5	6	5	4
	Trust Company Fed Member	47	49	60	54
	Trust Company Non-Member	44	41	42	36
Virginia	National Bank	11	9	9	4
	State Commercial Fed-Member	4	3	3	3
	State Commercial Non-Member	3	3	2	1
	Trust Company Fed Member	3	4	4	5
	Trust Company Non-Member	4	2	1	1

Table 2 reports the number of observations by state, bank-type, and year for our sample.

Table 3: Summary Statistics

All States	**Mean**	**Median**	**Std.Dev.**	**Min**	**Max**	**Obs.**
Cash /Total Assets	12.25	10.19	7.32	0.52	88.00	1,362
Equity /Assets	14.94	13.02	9.29	4.37	100.00	1,356
Bank Age	26.11	22.00	19.78	5.00	120.00	1,361
Total Assets (per $ Million)	7.33	2.98	14.42	0.05	164.74	1,362
Town Population (per 1,000)	112.18	43.52	180.33	0.03	821.54	1,355
Alabama						
Cash /Total Assets	17.42	15.07	9.69	2.54	69.00	84
Equity /Assets	22.36	20.05	8.27	10.75	59.00	84
Bank Age	28.68	24.00	17.62	5.00	83.00	84
Total Assets (per $ Million)	1.02	0.74	0.83	0.05	3.03	84
Town Population (per 1,000)	6.19	2.48	6.58	0.34	18.01	84
Idaho						
Cash /Total Assets	20.00	19.41	7.78	6.22	46.00	91
Equity /Assets	12.86	12.19	4.89	5.53	27.00	88
Bank Age	23.35	23.00	13.38	5.00	67.00	91
Total Assets (per $ Million)	0.97	0.48	1.00	0.12	3.80	91
Town Population (per 1,000)	5.01	1.36	5.84	0.03	18.34	91
Louisiana						
Cash /Total Assets	16.52	15.86	7.44	7.06	57.00	62
Equity /Assets	12.01	11.50	3.49	6.97	29.00	62
Bank Age	22.53	18.00	13.02	6.00	55.00	62
Total Assets (per $ Million)	4.83	2.37	5.67	0.23	20.55	62
Town Population (per 1,000)	34.25	7.20	34.64	1.36	81.30	55
Missouri						
Cash /Total Assets	17.51	16.60	7.69	1.41	44.00	141
Equity /Assets	13.22	11.54	10.61	5.02	92.00	141
Bank Age	24.26	20.00	16.77	5.00	79.00	141
Total Assets (per $ Million)	8.55	2.30	21.09	0.08	162.66	141
Town Population (per 1,000)	382.38	324.41	334.49	0.12	821.54	141
New Jersey						
Cash /Total Assets	9.17	8.24	5.33	0.52	88.00	749
Equity /Assets	13.98	12.54	7.43	4.37	100.00	746
Bank Age	27.02	22.00	22.38	5.00	120.00	749
Total Assets (per $ Million)	9.87	5.08	16.19	0.07	164.74	749
Town Population (per 1,000)	110.80	59.26	136.69	1.84	473.60	749
Virginia						
Cash /Total Assets	11.07	10.22	4.26	0.54	23.00	99
Equity /Assets	20.18	20.40	6.01	6.09	40.00	99
Bank Age	30.82	23.00	18.66	5.00	72.00	98
Total Assets (per $ Million)	4.28	0.87	7.20	0.14	37.48	99
Town Population (per 1,000)	63.51	18.49	74.39	0.44	184.20	99

Table 3 reports summary statistics for our main sample

Table 4: Regressions of (Inverse) Leverage on Liability Structure

	(1) Equity /Assets (1926 & 1928)	(2) Equity /Assets (1930 & 1932)	(3) Equity /Assets (Full Panel)
State Bank	2.024***	2.035***	1.695**
	(0.624)	(0.699)	(0.704)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.111	0.275	0.150
Observations	573	418	1212

Table 4 reports regression results of the ratio of equity-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5: Regressions of (Inverse) Leverage on Liability Structure: State Fed-Member vs. Non-Member

	(1) Equity /Assets (1926 & 1928)	(2) Equity /Assets (1930 & 1932)	(3) Equity /Assets (Full Panel)
State /Fed Member	0.678	1.515**	0.777
	(0.501)	(0.698)	(0.645)
State /Non-Fed Member	3.937***	2.915***	3.163***
	(1.102)	(0.983)	(1.099)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.132	0.280	0.164
Observations	573	418	1212

Table 5 reports regression results of the ratio of equity-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6: Regressions of (Inverse) Leverage on Liability Structure: Trust Companies vs. National Banks Only

	(1) Equity /Assets (1926 & 1928)	(2) Equity /Assets (1930 & 1932)	(3) Equity /Assets (Full Panel)	(4) Equity /Assets 1926 & 1928 MO & NJ	(5) Equity /Assets 1930 & 1932 MO & NJ	(6) Equity /Assets Full Panel MO & NJ
State /Fed Member	0.725	1.023	0.643	0.369	0.806	0.290
	(0.558)	(0.725)	(0.690)	(0.610)	(0.848)	(0.784)
State /Non-Fed Member	4.952***	2.764***	3.426**	5.312***	3.277***	3.934**
	(1.609)	(0.994)	(1.337)	(1.866)	(1.122)	(1.536)
State FE	Yes	Yes	No	Yes	Yes	No
Year x Bank FE	No	No	Yes	No	No	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.106	0.247	0.124	0.064	0.229	0.105
Observations	430	361	976	337	288	766

Table 5 reports regression results of the ratio of equity-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7: Regressions of Cash-to-Assets on Liability Structure

	(1) Cash /Assets (1926 & 1928)	(2) Cash /Assets (1930 & 1932)	(3) Cash /Assets (Full Panel)
State Bank	-2.027***	-0.575	-1.319**
	(0.679)	(0.538)	(0.529)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.292	0.280	0.303
Observations	576	420	1218

Table 7 reports regression results of the ratio of cash-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 8: Regressions of Cash-to-Assets on Liability Structure: State Fed-Member vs. Non-Member

	(1) Cash /Assets (1926 & 1928)	(2) Cash /Assets (1930 & 1932)	(3) Cash /Assets (Full Panel)
State /Fed Member	-2.232***	0.015	-1.219**
	(0.652)	(0.633)	(0.520)
State /Non-Fed Member	-1.734*	-1.546**	-1.478*
	(0.957)	(0.640)	(0.765)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.293	0.289	0.303
Observations	576	420	1218

Table 8 reports regression results of the ratio of cash-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 9: Regressions of Cash-to-Assets on Liability Structure: Trust Companies vs. National Banks Only

	(1) Cash /Assets (1926 & 1928)	(2) Cash /Assets (1930 & 1932)	(3) Cash /Assets (Full Panel)	(4) Cash /Assets 1926 & 1928 MO & NJ	(5) Cash /Assets 1930 & 1932 MO & NJ	(6) Cash /Assets Full Panel MO & NJ
State /Fed Member	-2.244***	0.126	-1.093**	-1.092*	0.742	-0.249
	(0.639)	(0.506)	(0.485)	(0.556)	(0.527)	(0.431)
State /Non-Fed Member	-2.528**	-2.318***	-2.285***	-1.095	-1.600***	-1.295*
	(1.141)	(0.539)	(0.762)	(1.214)	(0.560)	(0.760)
State FE	Yes	Yes	No	Yes	Yes	No
Year x Bank FE	No	No	Yes	No	No	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.304	0.342	0.321	0.220	0.099	0.223
Observations	430	361	976	337	288	766

Table 9 reports regression results of the ratio of cash-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 10: Regressions of (Inverse) Leverage on Liability Structure

	(1) Dep. Growth (1926 & 1928)	(2) Dep. Growth (1930 & 1932)	(3) Dep. Growth (Full Panel)
State Bank	3.448	-3.067	-0.318
	(3.497)	(2.912)	(1.557)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.038	0.040	0.013
Observations	200	418	837

Table 10 reports regression results of the ratio of cash-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 11: Regressions of (Inverse) Leverage on Liability Structure: State Fed-Member vs. Non-Member

	(1) Dep. Growth (1926 & 1928)	(2) Dep. Growth (1930 & 1932)	(3) Dep. Growth (Full Panel)
State /Fed Member	1.962	-1.168	0.417
	(4.066)	(3.250)	(1.747)
State /Non-Fed Member	6.030	-6.247	-1.585
	(6.042)	(3.907)	(2.167)
State FE	Yes	Yes	No
Year x Bank FE	No	No	Yes
Bank Controls	Yes	Yes	Yes
Town Controls	Yes	Yes	Yes
R^2	0.041	0.044	0.013
Observations	200	418	837

Table 11 reports regression results of the ratio of cash-to-assets on a state-bank indicator and other controls. State FE indicates state fixed-effects, Year x Bank FE indicates year-by-bank fixed effects, Bank Controls comprise bank age and total assets, and Town Controls comprise town population. Standard errors are clustered at the bank level. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

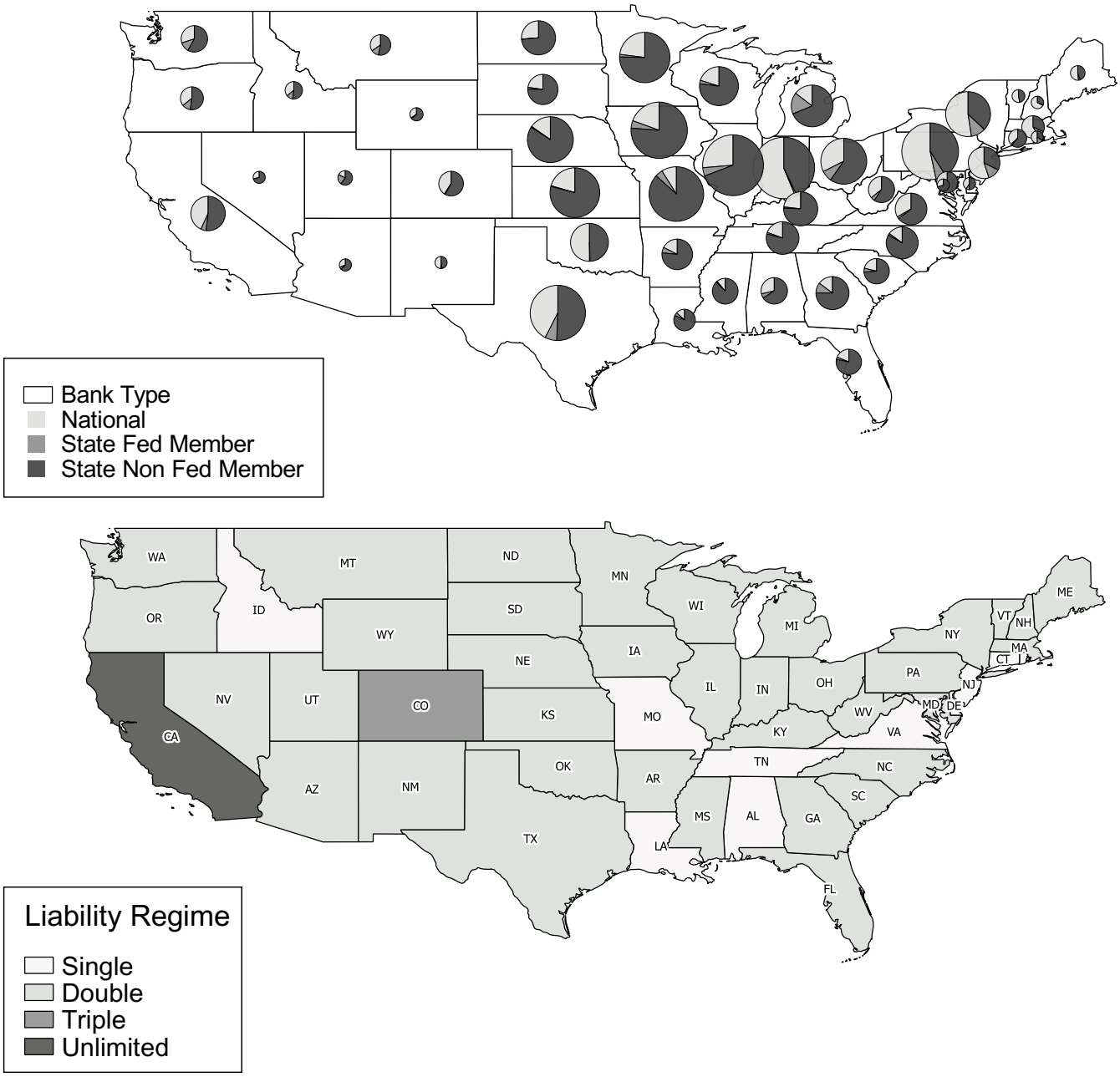
7.2 Figures

Figure 1: Capital and Reserve Requirements for Fed-Member Banks

	National / State Members
Capital Stock	Population of town less than 3,000 : $25,000 Population of town greater than 3,000 but less than 6,000 : $50,000 Population of town greater than 6,000 but less than 50,000 : $100,000 Population of town more than 50,000 : $200,000 In an outlying district of a town with a population more than 50,000 : $100,000
Reserves against Deposits	If not in a reserve or central reserve city: 7% demand deposits and 3 percent time deposits If in a reserve city: 10 % demand deposits and 3 % time deposits If in a central reserve city: 13 % demand deposits and 3 % time deposits (Banks were allowed to count interbank balances as part of their reserves.)

Figure 1 shows the regulatory environment for national banks and federal reserve member state banks as of 1926.

Figure 2: Bank Type and Liability Structure by State



The top panel of Figure 2 shows the relative distribution of the number of banks within each state by bank type: national bank, federal reserve member state banks, and non-member state banks. The bottom panel shows bank shareholder liability structure by state in 1926.

Figure 3: Number of Banks in Each State

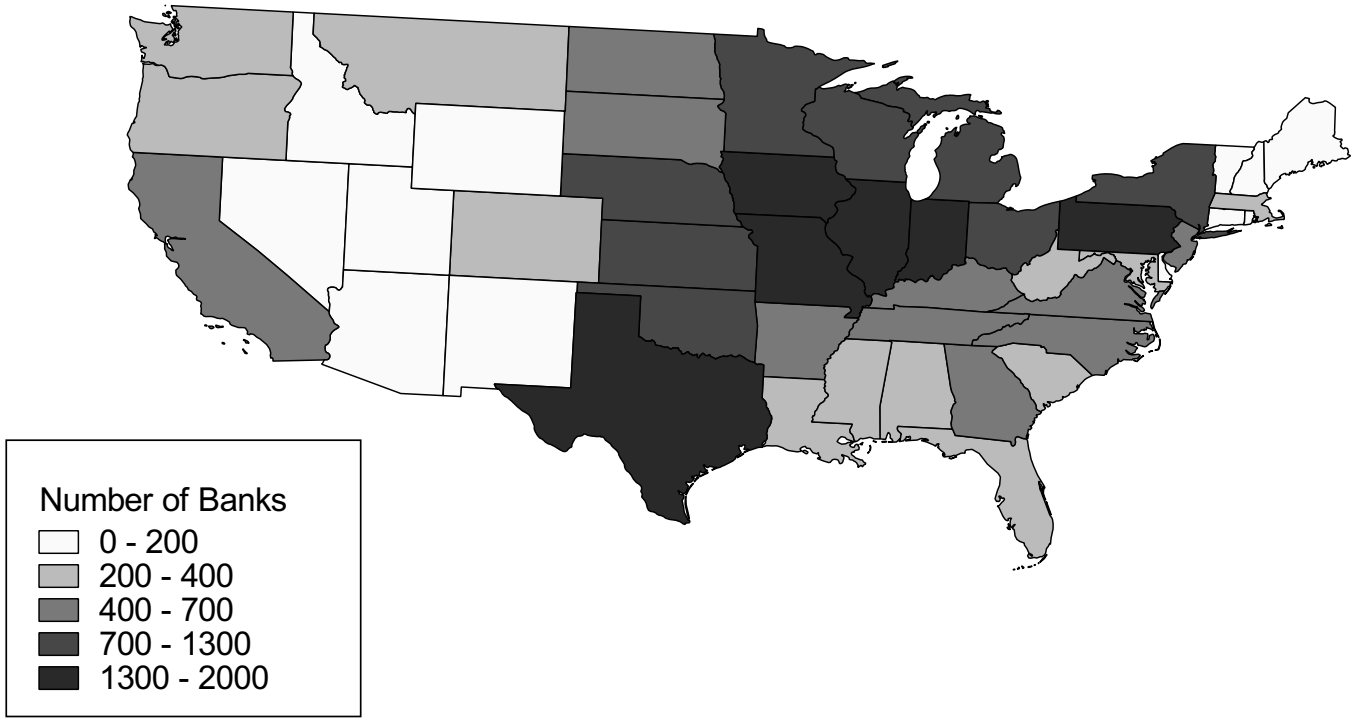


Figure 3 shows the distribution of the number of banks by state in 1926.

Figure 4: Cross-Sectional Plots: 1926

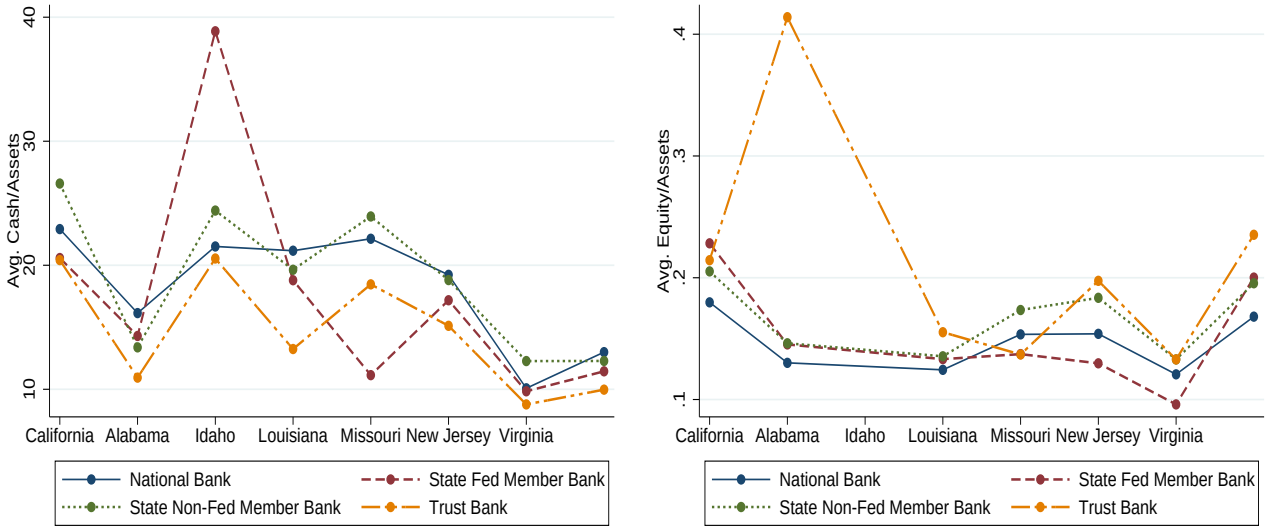


Figure 4 shows cross-sectional plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies.

Figure 5: Alabama Plots

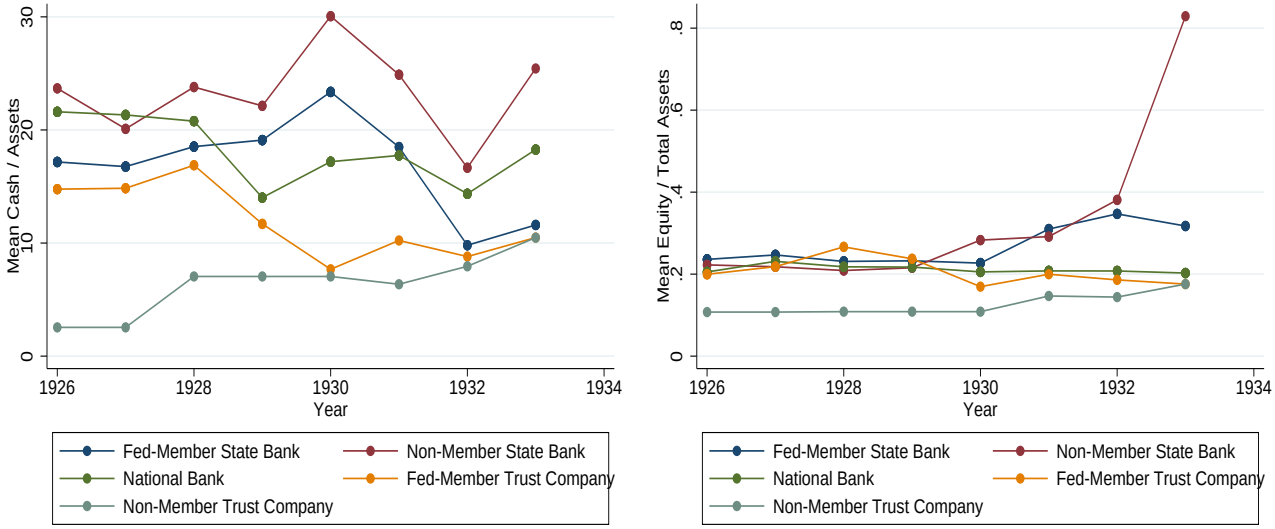


Figure 5 shows plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies, for the state of Alabama.

Figure 6: Idaho Plots

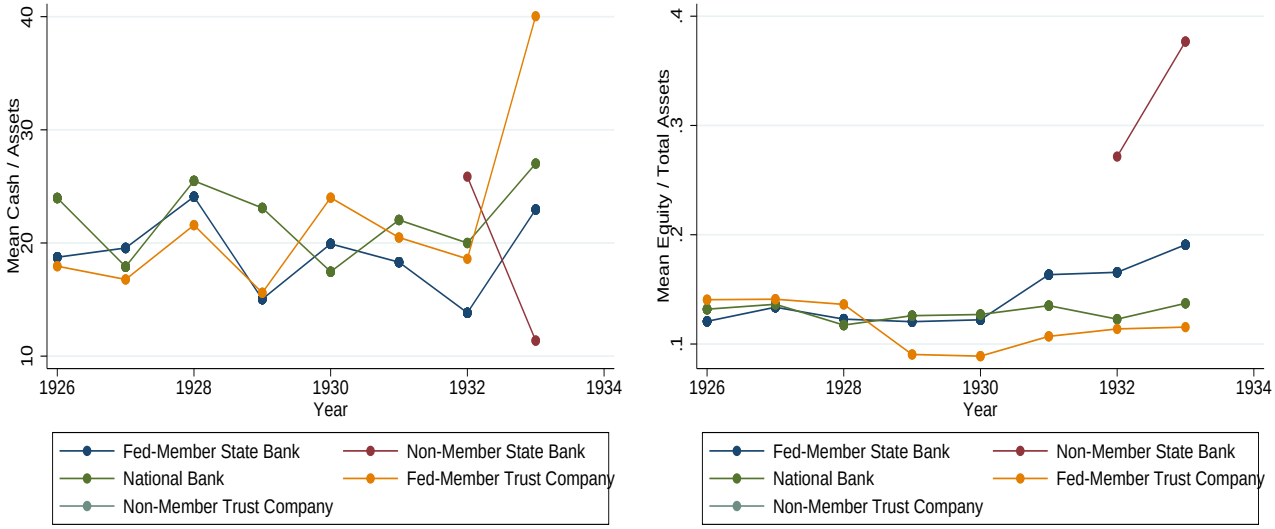


Figure 6 shows plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies, for the state of Idaho.

Figure 7: Louisiana Plots

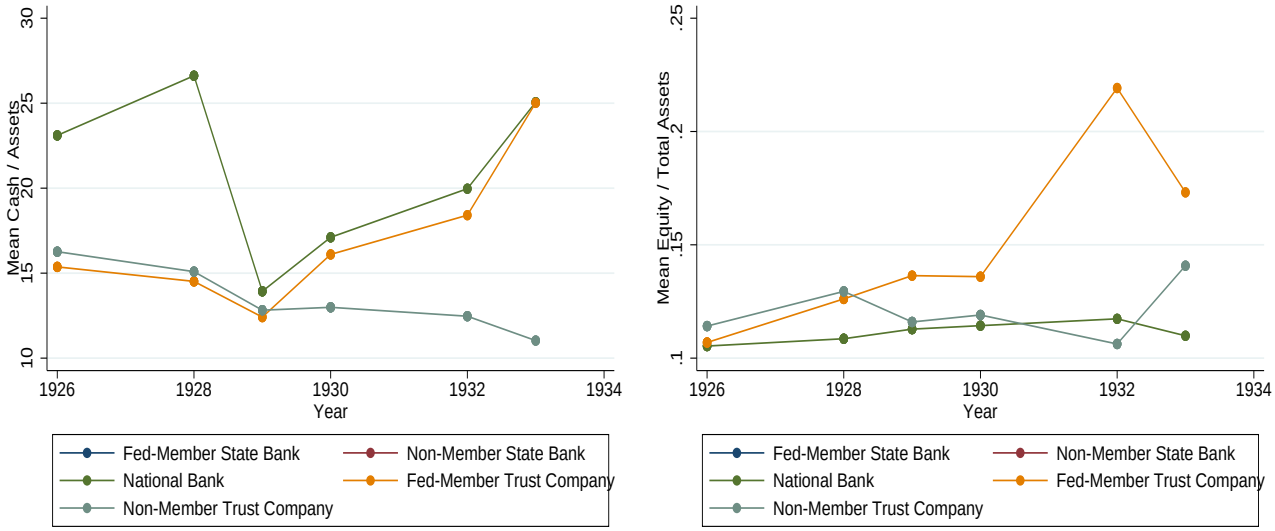


Figure 7 shows plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies, for the state of Louisiana.

Figure 8: New Jersey Plots

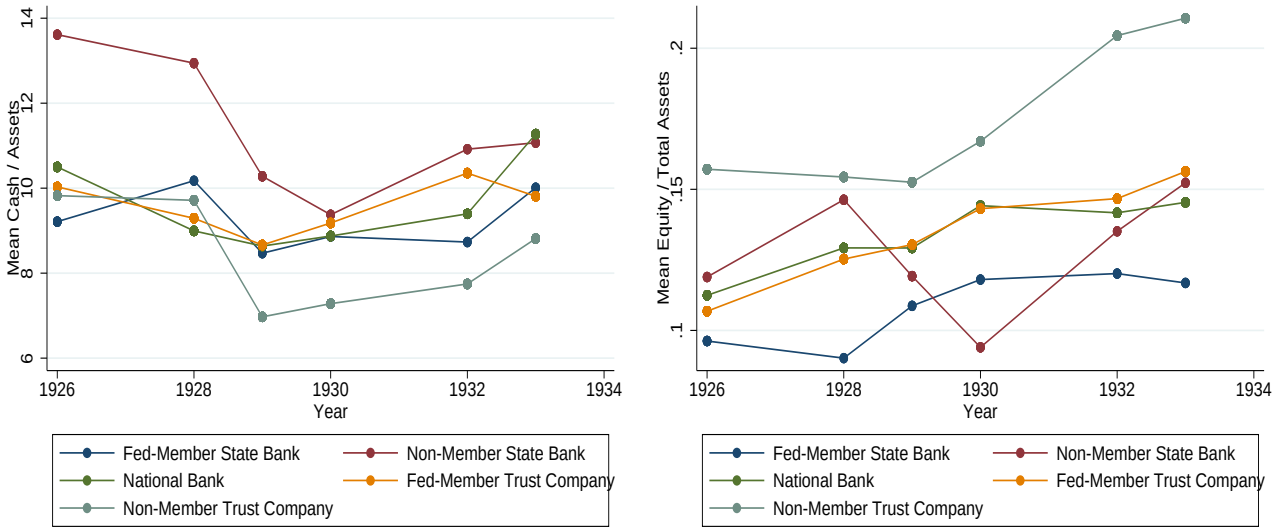


Figure 8 shows plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies, for the state of New Jersey.

Figure 9: Virginia Plots

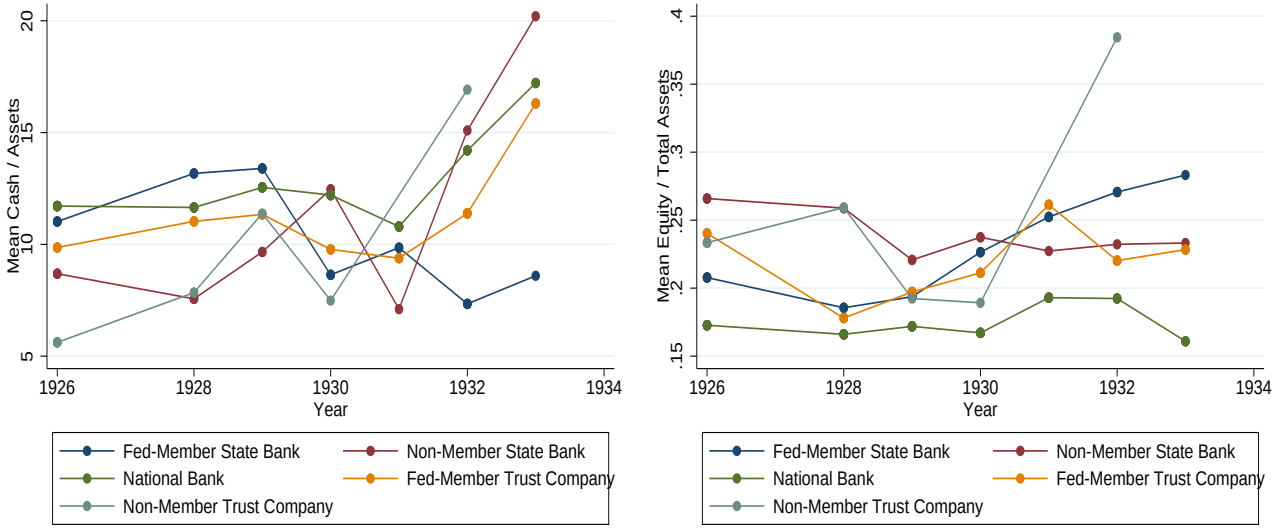


Figure 9 shows plots of average cash-to-asset and equity-to-asset ratios for national banks, state fed-member banks, state non-member banks, and trust companies, for the state of Virginia.

References

AIYAR, S., C. W. CALOMIRIS, AND T. WIELADEK (2014): "Does Macro-Prudential Regulation Leak? Evidence from a UK Policy Experiment," *Journal of Money, Credit and Banking*, 46(s1), 181–214.

ANDERSON, H., C. W. CALOMIRIS, M. JAREMSKI, AND G. RICHARDSON (2017): "Liquidity Risk, Bank Networks, and the Value of Joining the Federal Reserve System," Discussion paper, National Bureau of Economic Research.

BERNANKE, B. S., C. S. LOWN, AND B. M. FRIEDMAN (1991): "The credit crunch," *Brookings papers on economic activity*, 1991(2), 205–247.

BODENHORN, H. (2016): "Double liability at early American banks," *Clemson University, unpublished working paper*.

BORDO, M. D., H. ROCKOFF, AND A. REDISH (1994): "The US banking system from a northern exposure: Stability versus efficiency," *The Journal of Economic History*, 54(2), 325–341.

CALOMIRIS, C. W., F. HEIDER, AND M. HOEROVA (2015): "A theory of bank liquidity requirements," .

COMMITTEE ON BRANCH, G., AND C. BAKING (1932): "The Dual Banking System in the United States," .

ESTY, B. C. (1998): "The impact of contingent liability on commercial bank risk taking," *Journal of Financial Economics*, 47(2), 189 – 218.

FEDERICO, P., C. VEGH, AND G. VULETIN (2012): "Effects and role of macroprudential policy: Evidence from reserve requirements based on a narrative approach," *Unpublished manuscript*.

FRANCIS, W. B., AND M. OSBORNE (2012): "Capital requirements and bank behavior in the UK: Are there lessons for international capital standards?," *Journal of Banking & Finance*, 36(3), 803–816.

GAMBACORTA, L., AND P. E. MISTRULLI (2004): "Does bank capital affect lending behavior?," *Journal of Financial intermediation*, 13(4), 436–457.

GROSSMAN, R. S. (2001): "Double Liability and Bank Risk Taking," *Journal of Money, Credit and Banking*, 33(2), 143 – 159.

MACEY, J. R., AND G. P. MILLER (1992): "Double liability of bank shareholders: history and implications," *Wake Forest L. Rev.*, 27, 31.

MARQUIS, R. W., AND F. P. SMITH (1937): "Double Liability for Bank Stock," *The American Economic Review*, 27(3), 490–502.

MITCHENER, K. J. (2005): "Bank supervision, regulation, and instability during the Great Depression," *The Journal of Economic History*, 65(1), 152–185.

MITCHENER, K. J., AND G. RICHARDSON (2013): "Does skin in the game reduce risk taking? Leverage, liability and the long-run consequences of new deal banking reforms," *Explorations in Economic History*, 50(4), 508 – 525.

MONTORO, C., AND R. MORENO (2011): "The use of reserve requirements as a policy instrument in Latin America," .

MORA, N. (2014): "Reason for reserve? Reserve requirements and credit," *Journal of Money, Credit and Banking*, 46(2-3), 469–501.

PEEK, J., AND E. ROSENGREN (1995a): "Bank regulation and the credit crunch," *Journal of Banking & Finance*, 19(3), 679–692.

——— (1995b): "The capital crunch: Neither a borrower nor a lender be," *Journal of Money, Credit and Banking*, 27(3), 625–638.

ROLDOS, M. J., AND J. P. M. GUZMAN (2014): *Monetary and Macroprudential Policies to Manage Capital Flows*. International Monetary Fund.

TOVAR MORA, C. E., M. GARCIA-ESCRIBANO, AND M. VERA MARTIN (2012): "Credit growth and the effectiveness of reserve requirements and other macroprudential instruments in Latin America," .

ULUC, A., AND T. WIELADEK (2016): "Capital requirements, risk shifting and the mortgage market," .

WHITE, E. N. (2014): *The regulation and reform of the American banking system, 1900-1929*. Princeton University Press.