Stability Pass-through to Shadow Banking:
How Did Public Liquidity Flow Along the Interbank Networks?

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Abstract

During the 1920-1921 recession, the Richmond Fed provided liquidity to its member banks to prevent a banking crisis. Using newly digitized data on interbank borrowing and deposits for Virginia state banks, we analyze how the Richmond Fed's liquidity provision affected the interactions between the funding role and the payment role of the interbank system and financial stability. We show that the Richmond Fed's liquidity provision enabled members to lend discount window liquidity to nonmembers that experienced large deposit outflows and prevented the mass withdrawal of interbank deposits. Interestingly, the banks with interbank borrowing reduced interbank deposits placed in lending banks, implying that these correspondents provided liquidity to nonmembers through both interbank loans and deposits. Our study shows that understanding the interaction between different types of networks is important to promote the stability of the banking system.

Keyword: Federal Reserve liquidity provision, funding and payment networks, shadow banking, banking stability, interbank networks

1. JEL code: E58, G21, G28, N2

1. Introduction

The global financial crisis has highlighted the importance of understanding contagion and its effect on systemic risk. One source of risk is the financial networks generated though the interactions of financial institutions in various markets with different types of exposures. Understanding systemic risk in networks is critical to establish rules that will effectively manage it. Following the financial crisis of 2007-2009, economists and policymakers have been analyzing how the structure of financial networks affect systemic risk. However, previous studies have been theoretical, focusing on single-layer financial networks with one type of exposures (Eisenberg and Noe (2001), Elliott et al. (2014), Acemoglu et al. (2015)). Some studies attempt to quantify systemic risk arising after accounting for multiple financial networks with different exposures (Poledna et al. (2015), Cao et al. (2021), Gao (2022)). Nonetheless, little has been done to understand how different types of financial networks interact with each other and affect the stability of financial system.

An empirical study understanding the interactions of different types of financial networks and their effect on financial stability confronts several difficulties. The lack of detailed data on financial linkages makes it challenging to examine how different types of networks interact and affect financial stability. Even though there is information on different types of networks, the complexity of the networks makes it difficult to determine counterparty exposures across financial institutions and examine the interactions of these networks.

In this paper, we tackle the challenges by exploiting the Richmond Fed's liquidity provision and its effect on the interbank system during the recession of 1920-1921. When the Federal Reserve Bank of Richmond injected liquidity to its member banks to prevent bank failures and mitigate the impact of the recession, it was concerned not only about the Federal Reserve member banks, but also downstream beneficiaries such as their nonmember respondents that relied on their member correspondents for liquidity (White, 2017; White and Tallman, 2019; Rieder, 2022; Carlson, 2023).[4] The Federal Reserve Act of 1913 made membership compulsory for national banks but voluntary for state banks, and most state banks in Virginia did not join the Federal Reserve System. Since they did not have direct access to the discount window, they

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[4] In 1921, the Federal Reserve Board gave general authority to Reserve Banks to discount for member banks any eligible paper acquired from nonmember banks (Hackley, 1973, p. 119). This policy supported nonmember banks further by facilitating the pass through of Federal Reserve liquidity, as a member bank could discount paper for a non-member bank and then rediscount that same paper at the Federal Reserve. This authority was withdrawn in 1923 when the perceived emergency had passed.

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relied on the interbank system to manage liquidity (Anderson, Calomiris, Jaremski, Richardson, 2018). When nonmember banks faced liquidity problems, they would withdraw interbank deposits placed in their member correspondents (payments relationships) or borrow short-term loans (funding relationships) from them for the indirect access to the discount window liquidity. While Federal Reserve liquidity provision had an impact on nonmember banks as well as member banks, previous research examining the effect of Federal Reserve liquidity provision focused on the banks that were members of the Federal Reserve System (national banks). In addition, these studies focus on the impact of discount window liquidity on interbank deposits. Limited research has been done to link the relationship between discount window liquidity and the funding role of the interbank system.

While the interbank system helped banks smooth liquidity pressures and stabilize the banking system, nonmember banks' reliance on member banks had the effect of threatening the stability of the financial system (Anderson, Erol, and Ordonez, 2022). First, interbank deposits could create funding problems for member banks. Nonmember banks became an important funding source for some of the banks in the money centers. This means that withdrawals by non-member banks drained liquidity from the member banks and force them to ask the Fed for liquidity assistance. Second, interbank borrowing could create liquidity problems for nonmember banks if member banks refuse to lend short-term funds. Nonmember banks would have to suspend convertibility or withdraw interbank deposits. Hence, it is important to understand the interaction between the two roles of the interbank system.

We construct various datasets to study the effect of the Richmond Fed's liquidity provision on the response and stability of the interbank system.[5] First, we construct a dataset on Virginia national banks using national bank examination reports. These examination reports provide detailed information on "rediscounts and borrowed money" including the amount of discount window borrowing from the Federal Reserve Bank. To the best of our knowledge, this is the first piece of data that allows us to quantify the amount of discount window loans national banks borrowed from the Federal Reserve System and provide direct evidence of discount window use. Our data contrasted to existing studies that rely on a sample of national banks and assume that these banks borrowed from the discount window. Second, we create a dataset on

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[5] Richardson and Troost (2009), Carlson, Mitchener and Richardson (2011), and Jalil (2014) have shown that the Reserve banks had enough discretionary authority to prevent a panic and mitigate the effects of bank runs during the Great Depression.

Virginia state banks using state bank examination reports. The state bank examiners reported detailed information on the interbank system. The reports provide detailed information on the payment (interbank deposits) and funding (short-term borrowing) networks: the amounts due from other banks by individual debtor banks on the asset side of the balance sheet and the amounts of borrowed money and the provider of these short-term loans on the liability side of the balance sheet. Such detailed information allows us to identify different types of interbank networks, examine the intensity of these relationships. More importantly, unlike previous studies that focus on the relationship between Federal Reserve liquidity provision and its effect on member (national) banks, it enables us to investigate how Federal Reserve liquidity assistance affected nonmember banks through funding networks. In addition, unlike previous studies that focus on payment network, we can examine both types of networks. Lastly, we collect the state call report, which contains information on the banks' balance sheets. While it provided less detailed information on balance sheets, it provides data for all the banks at the same point in time, which reduces concerns about spurious differences due to seasonal or other time-related factors.

We document two key features of the funding network of Virginia state banks. First, the short-term funding market was concentrated, with the top 10 banks making 47% of the total short-term loans. While New York City banks supplied a large amount of short-term loans, short-term funding providers in local financial centers such as Richmond and Norfolk also played an important role. Moreover, short-term loans made by lending banks in 10 cities constituted 90% of all loans. Second, banks' exposure to New York City banks through interbank borrowing was small. This is because a small number of Virginia banks borrowed a large amount of short-term loans from New York City banks, and the size of loans from New York banks was small relative to the size of balance sheets.

In addition, we present important features of the payment network; the structure of the payment network differs from that of the funding network. First, interbank balances were concentrated as well, with top 10 banks holding 46% of the total interbank deposits. More importantly a few national banks in Richmond held the most of interbank deposits. This is likely due to the regulation that allowed state banks to meet reserve requirements by holding interbank balances in reserve city banks. Second, the major depository banks were not the same as the major short-term funding providing banks.

It is important to note that banks in rural areas played an important role as well, providing more than half of short-term funds and held more than half of total interbank deposits. While Richmond functioned as a major regional financial center due to its status as a reserve city and a host of the Federal Reserve Bank of Richmond, other smaller cities, such as Norfolk and Roanoke, functioned as local financial centers.

We begin by examining which nonmember bank chose to borrow from their member correspondents. We find that nonmember banks with deposit outflows and low levels of liquid assets were more likely to borrow from their member correspondents in 1920. Among cash reserves and interbank balances, a low level of cash reserves was highly associated with interbank borrowing. Our study implies that interbank borrowing from member banks would have helped nonmember banks to offset deposit withdrawals. In other words, by providing liquidity to member banks, the Richmond Fed was able to indirectly provide liquidity to the nonmember banks that faced large deposit outflows and support the stability of the banking system.

To quantify the extent of the indirect provision of liquidity by the Richmond Fed, we compute the pass-through ratio, which measures the percentage of the discount window loans passed through from members to nonmembers. We use data on national banks' borrowing from the Federal Reserve and nonmember banks' borrowing from member banks and calculate the ratio of the amount of loans member banks to nonmember banks against the amount of loans these correspondents borrowed from the Federal Reserve. On average, short-term funding providers lent 20% of the discount window loans to their nonmember respondents during this period. Our findings suggest that the pass-through of discount window borrowing played an important role in the stability of nonmember banks.

We examine how the ability of state banks to borrow from their member correspondents affected interbank deposits and financial stability. We study whether interbank borrowing affected the withdrawal of interbank deposits. We do not find that the level of interbank borrowing in 1920 was associated with the degree of interbank deposits in the previous year (1919-1920). In other words, the magnitude of interbank deposit withdrawals did not lead nonmember banks to borrow from their correspondents. However, we find that the level of interbank borrowing in 1920 was associated with the intensity of the withdrawals of interbank deposits afterwards. More specifically, we find that the banks with high levels of borrowing

withdrew interbank deposits from the correspondents that lent them short-term loans. However, we do not find evidence that they withdrew interbank deposits from the correspondent with whom they only placed interbank deposits. Our findings suggest that the ability to borrow affected the intensity of interbank deposit withdrawals. These results imply that a group of correspondents played an important role in providing liquidity to their respondents, both through interbank deposits and short-term loans. This means that providing liquidity to these member banks was crucial for financial stability.

Our paper makes contributions to several strands of literature. First, this paper adds to the literature on interbank networks and financial stability. While the financial crisis of 2007-2009 spurred a large interest in financial contagion, there are relatively few empirical studies due to limited data on financial networks and the difficulties in identifying shocks. Cingano, Manaresi, and Sette (2016) show that banks with large exposures to the Italian interbank market reduced lending during the financial crisis of 2007-2009, while Iyer and Peydro (2011) document the effect of financial contagion in the Indian interbank market following the failure of a large bank. In addition, Hale, Kapan, and Minoiu (2019) document global financial contagion using data on cross-border (long-term) interbank loans between 1997 and 2012. Other studies examine historical interbank networks and their effects on financial stability. They study how interbank deposit networks contributed to financial crises (Calomiris and Carlson, 2017; Mitchener and Richardson, 2019; Anderson, Paddrik, and Wang, 2019). We contribute to this literature by examining how funding networks affect payment networks and financial stability.

Second, our study adds to the literature on Federal Reserve liquidity provision and its impact on financial stability during the 1920s and 1930s. One strand of literature examines the divergence in monetary policies across Federal Reserve districts and its effect on the banking sector during the 1920s (White, 2015; Tallman and White, 2019; Roberds and White, 2020; Rieder, 2021). In particular, Rieder (2022) compares the lending behavior of national banks in states that are split between different Federal Reserve districts and show that banks in districts with contractionary policy contracted lending more than banks in districts with expansionary policy. Another strand of literature examines how the independence of the regional Federal Reserve banks affected the borrowing of member banks and stability of the banking sector during the Great Depression (Richardson and Troost, 2009; Jalil, 2014; Carlson, Mitchener, and Richardson, 2011). We contrast these studies by investigating how Federal Reserve liquidity

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provision affected the borrowing of nonmember banks, focusing on the interactions between funding and payments roles of the interbank system.

Our work is closely related to Carlson, Michener, and Richardson (2011) who study how the intervention by the Atlanta Fed stabilized the banking sector during the Florida banking panic. They use correspondent relationships and argue that the Atlanta Fed's liquidity support to its member banks enabled them to meet withdrawals by rural banks that faced bank runs and prevented a banking panic. While Carlson, Michener, and Richardson (2011) examine how the Federal Reserve liquidity provision affected the banking sector through payment relationships, we examine both the funding and payments relationships. In addition, they focus on the impact of Federal Reserve liquidity provision on bank failures, but we focus more on the impact of Federal Reserve liquidity provision on the functioning of the interbank system.

Our work has important implications for policy today. The banking crisis in 2023 has underscored the importance of liquidity risk management and contingency funding planning. The level and speed of deposit outflows at Silicon Valley Bank (SVB) was unprecedented, and this contributed to liquidity and funding problems. In an environment where liquidity stress manifests quickly, the discount window is an important tool that depository institutions can utilize in managing liquidity risk. Hence, the agencies are preparing to introduce new rules regarding the pre-positioning of collateral to access the discount window as a matter of prudent contingency liquidity planning. Our study shows that improving the Federal Reserve's lender of the last resort function would increase the ability of banks to manage deposit outflows.

The paper proceeds as follows: section 2 presents some historical background on the Recession of 1920-1921, section 3 provides data and summary statistics on the sample of Virginia state banks, section 4 outlines our econometric approach and presents the results, and section 5 concludes.

2. Historical Background

This section delves into two key aspects of the U.S. banking system in the 1920s: (1) the interbank borrowing arrangements, which enabled nonmember banks to access the discount window indirectly through the intermediation of member banks and (2) the provision of liquidity by the Richmond Fed during the recession of 1920-1921.

2.1. Development of Interbank Borrowing and Its Relationship with Interbank Deposits

The interbank system played an important role in managing seasonal demands for money and credit due to agricultural payment procedures favoring cash (Barsky and Miron, 1989; Davis, Hanes, and Rhode, 2009). The seasonal demand for money and credit peaked in spring and autumn because farmers borrowed to finance the planting and harvesting of the crops (Kemmerer, 1910). In the South, seasonal variations were larger than other regions due to its reliance on cotton production. Farmers steadily accumulated short-term debts from February through June using their credit lines, but they could only repay their mounting obligations after the cotton harvest in late August through early November. As a result, the total outstanding loans peaked in July and August.

Rural banks relied on correspondents in financial centers to fill their seasonal funding gaps: interbank deposits and interbank borrowing. First, they held deposits in correspondent banks in financial centers for 2% interest. When rural banks faced deposit outflows and strong credit demand, they attempted to meet heightened demands for money by drawing down their deposits in correspondents. Second, rural banks also borrowed short-term funds from their correspondents. To borrow from their correspondents, respondents were required to place compensating balances in lending correspondents equal to 20% to 25% of their seasonal borrowing levels. The rates paid on money borrowed from other banks were typically around 6 percent. Banks borrowed because the liquidation of loans or the sale of securities would incur a loss (Rodenius and Weiman, 2020).

Banks met their local funding gap in two steps. They first used their cash reserves and correspondent balances, mainly from late February to late July. Then, they increased their short-term borrowing from correspondents from late July through September. After the harvesting seasons, they repaid their loans and restored their correspondent balances. After repaying loans and restoring interbank balances in December, they slowly replenished cash reserves (Rodenius and Weiman, 2020).

Interbank borrowing arrangements were made between rural banks and their city correspondents. Rural banks often borrowed for short periods from their correspondents, particularly at times of the year when local demands for currency and loans were at their highest. While they were most exposed to seasonal swings, their ability to meet these demands were constrained. Rural banks made interbank borrowing arrangements when they established their

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correspondents. Interbank borrowing took place commonly in the form of "notes and bills rediscounted" and "bills payable." Banks could obtain short-term funding by obtaining a short-term loan from another bank while posting a loan or other security as collateral (bills payable) or by selling one of its loans to another bank (rediscounts).

Interbank borrowing was less common before the creation of the Federal Reserve System. Short-term borrowing was not large in the aggregate, even for country banks during the National Banking Era; borrowing approached 2% of country bank assets only during banking panics. High levels of stigma were attached to borrowing because it was seen as a signal of insolvency or potential funding problems, particularly if its use was accompanied by the withdrawal of retail deposits (Calomiris and Mason, 1997, 2003; Calomiris and Carlson, 2014). Less stigma was attached for banks in the West and South (Lockhart 1921). The lower stigma there may have reflected the fact that such borrowing was seen to accommodate a seasonal peak in loan demand. However, the correspondents reportedly did not have much stigma to borrowing and some report that regular borrowing was viewed positively as it allowed the lending bank to monitor the types and quality of the loans made by the borrowing banks (Lockhart, 1921). In addition, correspondents typically were only willing to provide loans or rediscounts equal to four or five times the balances held with them (Conway and Patterson, 1914). This means that preferences regarding potential borrowing could have affected banks' choice of correspondents.

Interbank borrowing became more common after the founding of the Federal Reserve System. Member banks borrowed from a Federal Reserve Bank that discounted their paper. However, most state banks did not join the system. The greater number of state non-member banks that had not joined the system borrowed indirectly through the intermediation of member banks. During the WWI, the Board allowed the Reserve Banks to discount for nonmember banks if government securities were used as collateral and were endorsed by a member bank. In 1921, the Federal Reserve Board allowed member banks to discount for member banks on behalf of nonmember banks to prevent a banking crisis. This policy allowed a large amount of the discount window liquidity to pass on to nonmember banks since it allowed member banks to discount paper for nonmember banks and then rediscount the same paper at the discount window. This authority was withdrawn in 1923 when the recession was over. However, nonmember banks continued to borrow from member banks. Bank regulators began monitoring their borrowing

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patterns due to concerns that borrowing had become habitual rather than seasonal (Virginia Bank Examination Reports).

Although the founding of the Federal Reserve increased the importance of interbank borrowing for nonmember banks in managing liquidity, many banks continued to use interbank deposits. Prior to the founding of the Federal Reserve System, rural banks withdrew interbank deposits from financial centers where they faced liquidity pressures. The banks' reliance on interbank deposits was also supported by the regulation that allowed the use of interbank deposits to meet the reserve requirements. The founders of the Federal Reserve System hoped to eliminate the banks' reliance on interbank deposits to meet liquidity demands by offering liquidity through the discount window. In addition, they disallowed member banks to use interbank deposits to meet reserve requirements. They reduced the banks' use of interbank deposits to meet liquidity needs, but they could not eliminate it. The banks continued to place interbank deposits because most state regulators allowed state banks to satisfy reserve requirements by holding interbank deposits. In addition, nonmember banks depended on interbank deposits as a source of liquidity because they did not have direct access to the discount window.

While the interbank system was intended to help banks smooth liquidity pressures and stabilize the banking system, nonmember banks' reliance on member banks to manage liquidity had the effect of threatening the stability of the financial system. First, interbank deposits could create funding problems for member banks. Nonmember banks became an important funding source for some of the banks in the money centers. This means that withdrawals by non-member banks drained liquidity from the member banks and force them to ask the Fed for liquidity assistance. Mitchener and Richardson (2019) show that this pattern exacerbated banking crises during the Great Depression. Second, interbank borrowing could create funding issues for nonmember banks. Interbank borrowing accounted for 10% of total liabilities for borrowing banks. If member banks did not extend short-term lending to these nonmember banks, they would face liquidity issues and would have to start withdrawing interbank deposits and liquidating investments (Anderson, Erol, and Ordonez, 2022).

2.2. Federal Reserve Liquidity Provision during the Recession of 1920-1921

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The Federal Reserve was created to provide an elastic currency and prevent banking panics in 1913 (Meltzer, 2003). During the early years of 1914 through 1921, the discount window lending was the primary tool used to address emergency liquidity situations. The discount window loans were provided at the initiatives of individual member banks when they applied the loan. In contrast to later years, during the early years of the Federal Reserve, the discount window borrowing did not carry stigma (Gorton and Metrick, 2013).

Only banks that were members of the Federal Reserve System were eligible to borrow at the discount window in the 1920s. While all national banks had been required to become members of their respective Federal Reserve banks, it was optional for state-chartered banks. Despite considerable efforts by the Federal Reserve System, few state banks did so, in part as they would have been subject to tighter regulations and supervision.

In addition to the burdens of stricter federal regulation and supervision, there were two main reasons for state-charter banks to not join the Federal Reserve System. First, state-charter banks were allowed by their state banking regulators to meet reserve requirements with interbank deposits placed at commercial banks. The Federal Reserve Act, however, prohibited its members from using interbank reserves to meet reserve requirements. Rather, member banks were required to meet reserve requirements by holding reserves at their local Federal Reserve Bank. Whereas the Federal Reserve Banks did not pay interest on reserves held on their balance sheet, interbank deposits placed at commercial banks earned 2 percent interest. Becoming a member of the Federal Reserve then, meant a loss of interest earning on required reserves.

Second, banks that were not Federal Reserve members could still enjoy the benefit of the Federal Reserve's discount window by establishing a correspondent relationship with a bank that was a member. Despite efforts to limit the pass-through of discount window benefits to banks that were not members of the Federal Reserve, the Federal Reserve was not able to prevent correspondent banks from making advances to their respondents (Congressional Quarterly, 1923).[6]

In the 1920s, the economic difficulties and associated strains on the banking system were concentrated in the agricultural and rural areas. When prices soared after World War I, central banks responded by quickly raising interest rates, leading to the severe recession of 1920-1921.

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[6] For more information on the decision by state-charter banks to join the Federal Reserve System between 1915 and 1920, see Anderson, Calomiris, Jaremski, and Richardson (2018).

Banks in agricultural and rural districts faced a large economic shock due to the commodity price collapse following the WWI boom. Reserve Banks in these districts provided liquidity to their member banks to offset conditions that might have ignited a banking panic (Tallman and White, 2020; White and Roberds, 2020; Carlson, 2022).

Southern states served by the Federal Reserve Bank of Richmond faced a large shock because of a 70% drop in cotton prices that followed a wartime commodities boom. Many loans were collateralized by cotton or assets tied to cotton production. If these banks faced liquidity problems, they would have been forced into fire sales of collateral and perhaps bankruptcy as a result.

To make matters worse, a large fraction of banks in the Richmond Fed districts were nonmember banks. They borrowed from member correspondents because they did not have access to the discount window. This extensive interbank borrowing network connected the fate of the entire banking system. The whole system, even those institutions not directly lending to cotton producers and the cotton industry, was thus endangered by the collapse of the price of cotton.

The Richmond Fed was one of eight districts that used expansionary policies to their member banks in the early stage of recession and prevent widespread bank runs within their Districts (Tallman and White, 2019). Figure C1 in the appendix, which plots the amount of borrowing by national and state banks, shows both national and nonmember banks borrowed extensively during this period. To enable the banks to roll over the loans and prevent fire sales of cotton-related assets at depressed prices, the Richmond Fed provided discount window loans to its member banks.[7] We show that the decision to provide liquidity to member banks was crucial in preventing a panic because interbank borrowing was local and a large number of nonmember banks depended on member banks for liquidity (Anderson, Erol, and Ordonez, 2022).

3. Data and Summary Statistics

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[7] In 1921, the Federal Reserve Board adopted a temporary emergency measure and gave general authority to Reserve Banks to discount for member banks any eligible paper acquired from nonmember banks in 1921 to relieve liquidity strains in the banking system (Federal Reserve Bulletin, August 1921, p. 963). This policy allowed Federal Reserve liquidity to pass through to nonmember banks, as a member bank could discount paper for a non-member bank and then rediscount that same paper at the Federal Reserve. This authority was revoked in 1923 when the perceived emergency had passed. Discount window liquidity enabled all the cotton intermediaries to hold their inventories and avoid fire sales of cotton collateral. In 1932, Federal Reserve Act was amended to incorporate Section 13(3), which allows the Federal Reserve broad discretionary authority to lend in "unusual and exigent circumstances," the power to act as a lender of last resort.

3.1. Data Sources

We collect information on Virginia state and national banks from various sources. We collect information on Virginia state banks from two sources. The first source is the state bank Call Report that was submitted to the State Banking Department. The state regulators asked state banks to submit call reports four times a year and published the latest call in the Annual Report. We collect the Call Report from 1917 to 1925. The regulators changed the reporting balance sheet categories in the Call Report in 1920. They began to report liquid assets without separating cash versus interbank deposits and investments without separating loans versus bonds. While the call report does not provide detailed balance sheet information, it does have the advantage of providing balance sheets for all banks at the same point in time. The use of the call report reduces concerns arising from seasonal or other time-related factors.

The second source is Virginia state bank examiners' reports for the years 1920 and 1922. The state bank examination reports were prepared by state bank examiners in Virginia. The examiners filed two reports a year: the first one between January and June and the second one between July and December. The examination report allows us to better analyze bank balance sheets. As mentioned earlier, after 1920, the call report adopted a new reporting form which combined several balance sheet categories. Importantly, the call report stopped providing information on the composition of liquid assets and that of investments. In contrast, the examiners' report allows us to examine the behavior of cash versus interbank deposits and that of loans versus securities during the recession of 1920-1921.

In addition, the examination reports provide detailed information about interbank relationships. The reports provide detailed information on the payment (interbank deposits) and funding (short-term borrowing) networks: the amounts due from other banks by individual debtor banks on the asset side of the balance sheet and the amounts of short-term loans (borrowed money) and the provider of these short-term loans on the liability side of the balance sheet. Deposits due from other banks are deposits, which a respondent bank places in a correspondent bank and are assets of the bank. Short-term borrowing is a loan a bank receives from a correspondent, and thus a liability of the bank.

The examiners reported the information on interbank deposits for regulatory purposes. While the Federal Reserve Act (FRA thereafter) prohibited member banks from using interbank deposits to meet reserve requirements, state regulators allowed banks to use them to satisfy

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reserve requirements. In Virginia, nonmember banks could hold up to 7/12 of required reserves in the form of interbank deposits with approved reserve agents. This meant that the examiner would verify these amounts by sending postcards to the institutions listed as reserve agents; any discrepancies, of which there were very few, were then noted and an explanation provided. There is another element that was unique to Virginia state bank examination reports. Before the passage of the FRA, national bank examiners also reported interbank balances, but they only reported balances which could be used to satisfy legal reserve requirements; these balances were also required to be listed. In contrast, Virginia state bank examiners reported all the balances due from other banks even though some balances could not be used to meet reserve requirements.[8]

The examination reports also provide information on interbank borrowing arrangements, such as the type of instruments and collateral used for borrowing, the amounts of the loan, and the identity of the lender. Bank examiners paid close attention to interbank borrowing because they regarded such borrowing as a signal of potential funding problems and bank insolvency, particularly if its use was accompanied by the withdrawal of retail deposits (Calomiris and Carlson, 2016; Gruchy, 1937).

Lastly, we collect information on national banks from national bank examiners' reports as well. Following the creation of the Federal Reserve System, national banks and state member banks used the discount window to mitigate seasonal liquidity needs. For the purposes of our analysis, the most valuable material is related to the relationships with the Federal Reserve. In particular, the examiner listed outstanding amounts for money borrowed, the characteristics of the borrowed money, the duration of loans, interest rates, and the type of securities used as collateral. We collect information on the amount of discount window loans from the Federal Reserve System for each national bank in Virginia that provided short-term loans to nonmember banks.

We use state and national bank examination reports to quantify the pass-through of discount window liquidity from member to nonmember banks. By using the information on the amount of loans made by the Federal Reserve and short-term funding providers in state and national bank examination reports, we calculate the amount of discount window loans that were

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[8] While national bank examiners reported interbank balances during the National Banking Era, they only reported balances that could be used to satisfy legal reserve requirements (deposits held by national banks in reserve and central reserve cities).

passed through from member banks to nonmember banks. With balance sheet information from examination reports (1920-1922), we study how borrowing from member banks affected the lending and the withdrawal of interbank deposits in the subsequent period during the recession. We dropped all banks that were members of the Federal Reserve System between 1917 and 1921. We also dropped all the banks that became national banks and drop those banks that failed because there were less than 10 banks in total. We list all the banks that disappeared from our sample because they changed charters or failed in Appendix Section E. In addition, we report the summary of the data using call report in Appendix Section C to examine the consistency of the balance sheet information from call reports and examination reports.

3.2. Funding and Payment Roles of the Interbank System

In this section, we examine the importance of interbank borrowing and funding networks. We begin by providing information on payments and funding relationships. Then, we calculate the percentage of borrowing banks in each year to access the size of interbank borrowing activity between member and nonmember banks. In addition, we calculate the ratio of borrowing against total liabilities to assess the importance of borrowing as a funding source. Lastly, we show the borrowing behavior of member banks.

Figure 1 plots Virginia State banks in 1920. Banks in blue placed deposits with their correspondents but did not borrow from them. Banks in Red placed deposits with correspondents and borrowed short-term Funds from them. While the previous studies emphasize the importance of interbank deposits, these plots show that banks relied heavily on the interbank system for borrowing as well.

In Table 1, we provide information on payments and funding relationships. We present the number of links and correspondents the banks had on average in 1920. Due to the law that allowed the banks to meet their reserve requirements by holding interbank deposits, all Virginia state nonmember banks placed interbank deposits, but not all of them borrowed short-term funds. "Banks" indicates the number of banks in our sample, and "Respondents" those that either placed deposit and/or borrowed short-term funds. In 1920, there were 274 respondents that placed deposits, and 156 respondents that placed deposits and borrowed from one of their correspondents. In addition, respondents placed deposits in multiple correspondents, whereas

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they borrowed from one or two correspondents; the average number of depository counterparties was 3.9, while that of borrowing relationships is 2.

In Table 2, we provide the information on short-term funding markets. Panel A lists major short-term funding providers and their market share. We list 10 correspondents with the largest amounts of short-term loans. We provide information on the percent of short-term loans against the total amount of loans made to all state banks, the percent of borrowing relationships against the total number of borrowing banks, the percent of interbank deposits against the total amount of interbank deposits held by state banks, and the percent of deposit relationships against the total number of deposit relationships.

Table 2 shows that short-term funding markets were concentrated. Panel A shows that a large quantity of short-term loans was provided by a small number of correspondents. The amount of short-term loans provided by the ten largest short-term funding providers accounted for more than 40 percent of total short-term loans. In addition, we find that these institutions played a less important role in the interbank deposit markets, holding less than 40% of total interbank deposits. These patterns imply that the major correspondent banks used for interbank borrowing and interbank deposits were not always the same. Lastly, some correspondents made large loans to fewer banks. While the National Bank of Commerce (Norfolk) had more loans than First National Bank (Richmond), it had a smaller number of borrowing banks. Most correspondents located in New York City provided a large amount of short-term loans to a small number of respondent banks in Virginia.

In Panel B, we examine the concentration of the provision of short-term loans at the city level. We find the provision of short-term loans was local. This is because the founding of the Fed enabled these rural banks to access the discount window directly and provide liquidity to nonmember banks in proximity. National and state member banks in New York and Richmond provided the most short-term loans to Virginia state banks. However, member banks in outside financial cities acted as important funding providers as well. For instance, member banks in Norfolk provided 17% of total loans.

Table 3 presents information on the payment networks of the interbank system. Much like the funding network, the payments network was concentrated as well. Panel A shows that a large amount of interbank deposits were held by a small number of correspondents, mostly in Richmond. For instance, First National Bank of Richmond held 10% of total interbank deposits

place by state banks. Unlike the funding network, major depository institutes were more local, mostly located in Virginia. This is likely due to the state regulation that allowed state banks to meet reserve requirements by holding interbank deposits in financial center banks.

In Panel B, we examine the concentration of the provision of interbank deposits at the city level. First, interbank deposits were highly concentrated in Richmond. Second, the payments network was less concentrated geographically. Interestingly, financial centers outside Virginia, such and New York and Baltimore, held a large proportion of interbank deposits. These patterns indicate that many state banks held a small portion of interbank deposits in various correspondents in financial centers outside Virginia. As a result, we do not observe a single bank that received large interbank deposits from respondents in Virginia, but a large share of interbank deposits located in these places.

Figure 2, which plots the interbank network at the bank and city levels in 1920, reveals interesting patterns. Panel A plots the interbank relationships between the First National Bank in Richmond and its respondents, and Panel B shows the interbank networks between the National Bank of Commerce in Norfolk and its respondents. Panels C and D also plot the payments and funding relationships for banks in Richmond, banks in Norfolk and their respondents in other towns. While both Richmond and Norfolk served as financial centers for rural banks in Virginia, Richmond banks had much more extensive networks than Norfolk banks. Richmond banks maintained respondent banks all over Virginia, whereas Norfolk banks served banks in surrounding areas. These patterns may have been driven by the law that allowed state nonmember banks to meet reserve requirements by placing interbank deposits in national banks in reserve cities.

Using the information on the amount of short-term loans from each correspondent and the amount of the discount loans member banks in Richmond borrowed from the Federal Reserve Bank of Richmond, we construct a "pass-through rate." For this analysis, we focus on short-term funding providers in Virginia. First, correspondents in Virginia supplied a large proportion of short-term funds, accounting for over 65% of total short-term loans. Second, interbank lending was local in Virginia. Unlike other correspondents in New York, Richmond banks supplied short-term loans mostly to other banks in Virginia. Since New York City banks lent short-term loans to the banks in other regions and we do not know the amount of these loans provided to nonmember banks in other areas, we cannot calculate pass-through rates from New

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York City member banks to nonmember banks. We construct the amount of loans a member bank provided to nonmember banks by aggregating the total loans provided by each correspondent. Then, we divide the total amount of short-term loans each correspondent provided by the amount of discount window loans that the correspondent borrowed from the Federal Reserve Bank of Richmond.

In Figure 3, we plot the percentage of loans provided to respondents against the total amount of borrowing from the Richmond Fed. Most banks that were providing short-term funds to their respondents were borrowing from the Federal Reserve Bank of Richmond. While previous studies emphasized the importance of the banks in financial centers (central reserve and reserve cities) for their ability to provide liquidity to their respondents, we find that local correspondents played an important role in the pass-through of discount window liquidity as well. In addition, we find a large degree of variation in the pass-through rate. Some banks provided less than 10% of the discount window loans, while others provided more than 50% of the discount window loans.

Table 4 displays pass-through rates for correspondents in Virginia in 1920. On average, the correspondents lent 20% of the discount window loans to their respondents. We calculate the rates separately for the correspondents both in and out of Richmond. The average rates for the correspondents in Richmond and in rural areas are 15% and 20%, respectively. These results are consistent with Figure 3 that showed that state banks relied on local correspondents to indirectly access the discount window loans.

3.3. Summary Statistics

Figure 4 plots the aggregate movement of deposits and borrowed money for state banks. The plots show that deposits fell sharply from 1919 to 1920 and continued to decline slowly from 1920 to 1922. In contrast, borrowed money increased from 1919 to 1920 and remained at a high level until 1921. These patterns suggest that banks borrowed to offset deposit outflows. State banks played an important role in the banking system. As shown in Appendix Table C1, they held 40% of loans and deposits. Given that most state banks in Virginia were nonmember banks that relied on their member correspondents for liquidity, the ability of member banks to provide discount window liquidity provided by the Richmond Fed to nonmember banks was important to ensure the stability of nonmember banks.

To provide some insight into the effect of borrowing from member banks on the banking system, we use balance sheet data from examiners' reports from 1920 to 1921. In Table 5, we present balance sheet ratios for borrowing and no borrowing banks separately. During this period, the banks held a large amount of loans against deposits (116 %). In addition, they borrowed heavily from member banks as shown by the ratio of borrowed money against deposits of 17 %. The banks that borrowed in 1920 were less liquid than the banks that did not borrow from their correspondents. Those that borrowed in 1920 held less interbank deposits and more loans than the ones that did not borrow.

As mentioned earlier, rural banks relied upon the interbank system to manage liquidity. They placed interbank deposits with correspondents, which they withdrew during the time of liquidity shortages. In addition, they borrowed funds from them as well, mostly in the form of bills payable. Banks placed deposits in multiple banks but borrowed from one or two main banks. In other words, there were two types of correspondents: (1) the correspondents that only received deposits and (2) the correspondents that received deposits and lent short-term loans. These correspondents were in financial centers, such as New York and Richmond, as well as rural areas in Virginia outside Richmond.[9] Interbank deposits and borrowed money from correspondents in these locations accounted for 90 % of all interbank deposits and short-term loans.

In Table 6, we investigate whether the distance between correspondents and respondents differed for different types of banks. Distance was important because it could create liquidity problems for a bank that had placed its cash in a distant correspondent bank, but faced a large immediate demand for cash by its local depositors. In columns (1)-(3), we use the sample of all banks and compare the distance for borrowing versus non-borrowing banks. We do not find a difference in the distance between the two types of banks. In columns (4)-(6), we focus on 149 banks that borrowed from their lending correspondents in 1920, and examine the difference between the respondent-depository correspondent distance and the respondent-lending correspondent distance. We find that the respondent-lending correspondent distance was shorter than the respondent-depository correspondent distance. Given that distance was an important factor for banks for liquidity management purposes, these results suggest that interbank

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[9] See Anderson, Erol, and Ordonez (2020) for more information on the location of correspondent and respondent banks.

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borrowing was a more important tool to manage liquidity than interbank deposits for borrowing respondents.

In Tables 7 and 8, we examine the distribution of short-term loans and interbank deposits. For short-term loans, we provide the information based on the location of short-term funding providers. Since state banks had multiple correspondents, it is possible that the correspondents are located outside Virginia. Table 7 shows that most banks borrowed from member correspondents in Virginia. Interbank borrowing was local, with more than 50 percent of rural banks borrowing from other member banks in proximity. Table 8 provides information on the distribution of interbank deposits across these two types of correspondents. Much like short-term loans, most interbank deposits were placed in local banks. More importantly, borrowing banks placed over 60 % of the total interbank deposits in correspondents that provided short-term loans.

Lastly, we examine how interbank borrowing redistributed counterparty risk by computing the ratio of interbank deposits against borrowed money at the lending correspondents. As mentioned earlier, lending correspondents required respondent banks to place interbank deposits in their banks reduce counterparty risk. Figure 5 shows the distribution of interbank deposits against borrowing levels at lending correspondents. While contemporaries report that the correspondents required 20 to 25% of interbank balances against borrowed money during the National Banking Era, we find that respondents placed interbank balances in lending correspondents 70% of their borrowing levels on average.

4. Empirical Analysis

Our empirical analysis aims to understand effect of the ability of the nonmember banks to indirectly access discount window liquidity during and after the recession of 1920-1921. First, we examine the determinants of interbank borrowing. Second, we investigate the effect of the pass through of discount window liquidity on nonmember banks during the recession of 1920-1921. Then, we examine how interbank borrowing (funding system) affected the stability of the interbank deposits (payment system). Lastly, we examine how the Federal Reserve liquidity provision affected nonmember banks during the 1920s following the recession.

4.1. Why did Banks Borrow from their Correspondents?

While all banks placed deposits with their correspondents, only some banks borrowed short-term funds from them. In this section, we predict the banks' decision to borrow in 1920 using their balance sheet characteristics in 1919 and deposit growth from 1919 to 1920. Formally, we estimate a probabilistic model of an interbank borrowing event in bank *i*, in year *t*, as a function of bank characteristics at year *t*, in one of two forms,

OLS Linear Probability:	$p_{i,1920} = \beta_1 X_{i,1919} + \varepsilon_{i,t}$
Logit:	$logit(p_{i,1920}) = \beta_1 X_{i,1919}$

where $logit(p_{i,1920}) = ln(p/(1-p))$ is the log of the odds ratio. We use balance sheet information to examine whether these bank characteristics were good predictors of interbank borrowing during this period. The vector $X_{i,1919}$ indicates the one-year lagged value of bank characteristics that are used as predictors for interbank borrowing. We use the lagged value of balance sheet characteristics to control for potential reverse causality and endogeneity. These predictors are (log) total assets, cash assets as a share of total assets, deposits due from other banks as a share of total assets, bonds and securities' share of interest-earning assets, net worth to total assets, and liquid deposits.

Table 9 presents results. Columns (1) and (2) presents results from an OLS Linear Probability model, and Columns (3) and (4) presents results using a logit model. We present results with all banks and banks outside Richmond because Richmond was a reserve city where the Federal Reserve Bank of Richmond was located. These results show that, all else equal, banks were less likely to borrow when they held more bonds relative to loans (bonds tended to be less risky and more liquid), held more liquid assets (cash and interbank deposits with correspondents) and experienced less deposit outflows. In both regressions, the amount of liquid assets on the asset side and deposit growth on the liability side help predict interbank borrowing. In other words, the liquidity of banks was correlated with interbank borrowing. More specifically, the size of cash reserves and deposit outflows are indicative of a bank's use of short-term funds. These results do not change after excluding banks in Richmond. This is consistent with analogues that banks would borrow when they did not have enough liquid funds to meet deposit withdrawals.

4.2. How did the Interbank Networks Interact and Affect Financial Stability?

The Interbank system affected banking instability due to counterparty risk. Member banks provided liquidity to nonmember banks through the interbank system by allowing nonmember banks to withdraw interbank deposits and/or lending them short-term funds. When nonmember banks borrowed, they tended to borrow from one correspondent even though they placed deposits in multiple correspondent banks. Interbank deposits could pose a threat to both member and nonmember banks. Interbank deposits could create funding problems for member banks. Nonmember banks became an important funding source for some of the banks in the money centers. This means that withdrawals by non-member banks drained liquidity from the member banks and force them to ask the Fed for liquidity assistance. They could create problems for nonmember banks as well since they could no longer access their deposits if their member correspondent suspended convertibility or failed. Interbank borrowing also carried counterparty risk. Interbank borrowing could pose a threat to nonmember banks if their member correspondent could not lend them short-term funds. They could create problems for member banks as well if nonmember banks could not return their short-term loans. Since both interbank borrowing and deposits could affect the liquidity conditions of member and nonmember banks and the stability of the banking system, it is important to understand how they interact with each other.

Policymakers considered interbank deposits a source of banking instability. The reserve structure during the National Banking Era involved national and state banks and was described as an inverted pyramid: rural banks (country banks in agricultural regions) held their reserves in the form of correspondent balances (mostly, but not exclusively) in banks in central reserve cities, especially New York City. The concentration of interbank deposits in reserve and central reserve cities was considered as a source of instability of the banking system because rural banks withdrew interbank deposits from their correspondents when they experienced liquidity pressures and caused the liquidity problems of their member banks. The Federal Reserve Act disallowed national banks (and state member banks) to meet reserve requirements by holding interbank deposits. However, state regulators allowed nonmember banks to do so.

In this section, we analyze how interbank borrowing affected interbank deposits. We exploit the variation in the degree of borrowing from members in 1920 and examine the effect of

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the indirect borrowing from the discount window on bank balance sheets in the subsequent period between 1920 and 1921. To measure the degree of borrowing from members, we compute the ratio of borrowed money against deposits in 1920. Specifically, the baseline linear regression specification is:

$$\Delta y_{i,1921} = \alpha + \beta x_i + Z'_{i,1920}\gamma + \varepsilon_i,$$

where Δy represents the change in dependent variable of interest; x indicates the ratio of borrowed money over total deposits in 1920. Z is a column vector of lagged bank-level characteristics for which we wish to control and includes the lagged ratio of the sum of cash to total assets, the ratio of interbank deposits to total assets, the ratio of securities to the sum of securities and loans, the sum of capital and surplus to total liabilities, and log of asset size. We use the lagged value of balance sheet characteristics to control for potential reverse causality and endogeneity. We include these valuables to control for liquidity, quality of investment, equity, and bank size, respectively. We also include bank age, as new banks were often risker. Lastly, we include the log value of town population and county fixed effects to control for local economic conditions and credit demand. ε is a mean- zero, heteroskedastic error term. β is the key parameter of interest, as it represents the effect of using borrowed funds from correspondents.

In Table 10, we study whether a difference in the level of interbank borrowing affected the withdrawal of interbank deposits in different locations. Columns (1) and (5) present results with total interbank deposits, whereas Columns (2)-(4) and (6)-(8) present results using interbank deposits in New York, Richmond, and rural areas in VA. We do not find evidence that banks with interbank borrowing withdrew their interbank deposits. In addition, we do not see that interbank borrowing is associated with the withdrawal of deposits from different locations.

In Table 11, we investigate whether a variation in the withdrawal of interbank deposits is associated with the types of correspondents. We study whether interbank borrowing was associating with a reduction in interbank deposits in correspondents that only held interbank deposits and those that held interbank deposits and provided loans. We regress the variation in the amount of borrowing in 1920 on interbank deposit withdrawals from 1919 to 1920 to rule out the reverse causality issue that the magnitude of interbank deposit withdrawals led banks to borrow from their correspondents. Columns (1) and (2) present results for the years 1919-1920, and columns (4) and (5) present results for the years 1920-1921. We do not find that the level of interbank borrowing in 1920 was associated with the degree of the withdrawals of interbank

deposits in the previous year (1919-1920), but we find that the level of interbank borrowing in 1920 was associated with the intensity of the withdrawals of interbank deposits after borrowing. In addition, we find that the banks with high levels of borrowing withdrew interbank deposits from the correspondents that lent them short-term loans. However, we do not find evidence that they withdrew interbank deposits from the correspondent with whom they only placed interbank deposits. Our findings suggests that the ability to borrow determined the intensity of interbank deposit withdrawals. These results imply that a group of correspondents played an important role in providing liquidity to their respondents, both through interbank deposits and short-term loans. This means that providing liquidity to these member banks was crucial for financial stability. These patterns also have implications for counterparty risk as well. Nonmembers were reducing their exposures to a member correspondent through interbank deposits while they were increasing their exposure through interbank loans.

Our study shows that interbank borrowing played a key role in financial stability and suggests that Federal Reserve liquidity would have affected the availability of short-term funds and the nonmember banks' decision to withdraw interbank balances from their correspondents. Large withdrawals of interbank balances by nonmember banks could drain liquidity of member banks, as shown in Mitchener and Richardson (2019). Carlson, Michener, and Richardson (2011) document that the Atlanta Fed's liquidity support helped stabilize the banking sector because it provided member banks cash reserves to meet the withdrawals by rural banks. Our analysis adds another layer by showing that the Federal Reserve liquidity provision affected the stability of the banking sector because it altered the *intensity* of deposit withdrawals by the amount of funds banks could borrow from their member correspondents.

4.3. Stability of Interbank Correspondent Relationships following the Recession

In this section, we examine the stability of correspondence relationships by investigating the relationship between nonmember banks and the member banks that provided indirect access to discount window liquidity after the recession of 1920-1921. Given that borrowing from the member bank intended to be short-term measure, many nonmember banks were not borrowing from these banks in 1922. Hence, we assess the changes in the correspondent relationships through the evolution of payments relationships and the size of the interbank deposits between nonmember and member banks.

Table 12 provides information on the payment relationships of nonmember banks that borrowed in 1920. We focus on 267 banks that are in our samples of 1920 and 1922. There are 131 banks that borrowed from their correspondent in 1920. Among 131 banks, 118 banks still maintained the correspondent relationship with their lending correspondent in 1922.

We find that the correspondent relationship between nonmember banks and the member banks that provided short-term loans was stable. Balance sheet ratios indicate that there was not much change in the payment relationships of nonmember banks and their correspondents between 1920 and 1922. On average, these respondents held 9-10 % of interbank deposits against total deposits. These nonmember banks held 4% of total deposits in the form of interbank deposits placed in these lending banks. In other words, about 44% of interbank deposits were placed in the member banks that provided short-term funds in 1920.

5. Conclusion

The global financial crisis has shown the importance of financial networks and its effect on systemic risk. Following the financial crisis of 2007-2009, economists and policymakers have been analyzing the relationship between financial networks and their effects on systemic risk. However, these studied focused on the structure of the network mostly with one type of exposures. Little studies have examined multi-layered networks with different exposures or the interactions between different types of financial networks and their effect on systemic risk.

In this paper, we tackle the challenges by exploiting the Richmond Fed's liquidity provision and its effect on the funding versus payment roles of the interbank system during the recession of 1920-1921. When the Federal Reserve Bank of Richmond injected liquidity directly to its member banks to prevent bank failures and mitigate the impact of the recession, it was concerned not only about the Federal Reserve member banks, but also downstream beneficiaries such as their nonmember respondents that relied on their member correspondents for liquidity (White and Tallman, 2019; Rieder, 2022; Carlson, 2023, White, 2015). When nonmember banks faced liquidity problems, they would withdraw interbank deposits placed in their member correspondents or borrow short-term loans from them for the indirect access to the discount window liquidity.

The ability of the nonmember banks to directly access the provision of liquidity by the Richmond Fed helped stabilize the banking system because it enabled member banks to extend

short-term funds to nonmember banks that experienced heavy deposit withdrawals. More nonmember banks borrowed from member banks to meet with deposit outflows. In addition, we find that the ability to borrow affected the intensity of the withdrawals of interbank deposits; the banks with interbank borrowing withdrew interbank deposits from the members that provided short-term loans. These patterns indicate that some member banks functioned as major liquidity providers in the banking system, injecting liquidity to nonmember banks through both the interbank loans and interbank deposits. In the meant time, nonmember banks were able to balance their exposures to a single counterparty. They were increasing their exposure to member banks through the liability side of the balance sheets while reducing their exposures to members through the asset side of the balance sheets.

Our research highlights the importance of understanding how different networks interact with each other. In addition, it sheds a new light on the relationship between Federal Reserve liquidity assistance and the severity of banking panics during the Great Depression. Previous research argues that the failure of the Fed to provide liquidity contributed to the severity of the banking panics during the Depression. The nonmember banks that experienced heavy retail deposit withdrawals had to withdraw interbank balances in member banks to meet these demands, draining the liquidity of member banks. However, our study highlights the importance of interbank borrowing and suggest that the Fed's failure to provide liquidity to member banks could have drained the liquidity of nonmember banks if member banks refused to extend short-term loans to nonmember banks. The banks that relied on interbank borrowing would have been forced to withdraw interbank balances to offset a reduction in interbank borrowing. More research should be conducted to understand the relationship between monetary policy, the interbank system, and the stability of the banking system during the Great Depression.

References

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. "Systemic risk and stability in financial networks." *American Economic Review* 105.2 (2015): 564-608.

Anderson, H., Calomiris, C. W., Jaremski, M., & Richardson, G. (2018). Liquidity Risk, Bank Networks, and the Value of Joining the Federal Reserve System. *Journal of Money, Credit and Banking*, *50*(1), 173-201.

Anderson, H., Paddrik, M., & Wang, J. J. (2019). Bank Networks and Systemic risk: Evidence from the national banking acts. *American Economic Review*, *109*(9), 3125-61.

Anderson, H., Erol, S., & Ordoñez, G. (2022). Interbank networks in the shadows of the federal reserve act (No. w27721). National Bureau of Economic Research.

Barsky, R. B., & Miron, J. A. (1989). The seasonal cycle and the business cycle. *Journal of Political Economy*, *97*(3), 503-534.

Calomiris, C. W., & Mason, J. R. (1997). Contagion and Bank Failures During the Great Depression: The June 1932 Chicago Banking Panic. *The American Economic Review*, 863-883.

Calomiris, C. W., & Mason, J. R. (2003). Fundamentals, panics, and bank distress during the depression. *American Economic Review*, *93*(5), 1615-1647.

Calomiris, C. W., & Carlson, M. A. (2014). National Bank Examinations and Operations in the Early 1890s.

Calomiris, C. W., & Carlson, M. (2016). Corporate governance and risk management at unprotected banks: National banks in the 1890s. *Journal of Financial Economics*, *119*(3), 512-532.

Calomiris, C. W., & Carlson, M. (2017). Interbank networks in the national banking era: their purpose and their role in the panic of 1893. *Journal of Financial Economics*, *125*(3), 434-453.

Cao, Jie, et al. "Multilayer financial networks and systemic importance: Evidence from China." *International Review of Financial Analysis* 78 (2021): 101882.

Carlson, M., Mitchener, K. J., & Richardson, G. (2011). Arresting banking panics: Federal Reserve liquidity provision and the forgotten panic of 1929. *Journal of Political Economy*, *119*(5), 889-924.

Carlson, M. (2023). Learning to Be a Lender of Last Resort: A History of the Federal Reserve's Approach to Emergency Liquidity Provision in the 1920s, Working Paper.

Cingano, F., Manaresi, F., & Sette, E. (2016). Does credit crunch investment down? New evidence on the real effects of the bank-lending channel. *The Review of Financial Studies*, *29*(10), 2737-2773.

Conway, T., & Patterson, E. M. (1914). *The Operation of the New Bank Act*. JB Lippincott.

Davis, J. H., Hanes, C., & Rhode, P. W. (2009). Harvests and business cycles in nineteenth-century America. *The Quarterly Journal of Economics*, *124*(4), 1675-1727.

Eisenberg, Larry, and Thomas H. Noe. "Systemic risk in financial systems." *Management Science* 47.2 (2001): 236-249.

Elliott, Matthew, Benjamin Golub, and Matthew O. Jackson. "Financial networks and contagion." *American Economic Review* 104.10 (2014): 3115-3153.

Financial Stability Board (2021). Global monitoring report on non-bank financial intermediation 2018. *Financial Stability Board*.

Gao, Qianqian. "Systemic risk analysis of multi-layer financial network system based on multiple interconnections between banks, firms, and assets." *Entropy* 24.9 (2022): 1252.

Gorton, G., & Metrick, A. (2013). The federal reserve and panic prevention: The roles of financial regulation and lender of last resort. *Journal of Economic Perspectives*, *27*(4), 45-64.

Gruchy, A. G. (1937). *Supervision and Control of Virginia State Banks* (No. 24). D. Appleton-Century Company, incorporated, for the Institute for research in the social sciences, University of Virginia.

Hackley, H. (1973). *Lending Functions of the Federal Reserve Banks: A History,* Washington, DC: Board of Governors of the Federal Reserve System.

Hale, G., Kapan, T., & Minoiu, C. (2020). Shock transmission through cross-border bank lending: Credit and real effects. *The Review of Financial Studies*, *33*(10), 4839-4882.

Iyer, R., & Peydro, J. L. (2011). Interbank contagion at work: Evidence from a natural experiment. *The Review of Financial Studies*, *24*(4), 1337-1377.

Jalil, Andrew J. (2014). Monetary intervention really did mitigate banking panics during the Great Depression: Evidence along the Atlanta Federal Reserve District border. *The Journal of Economic History*, *74*(1), 259-273.

Kemmerer, E. W. (1910). *Seasonal variations in the relative demand for money and capital in the United States: A statistical study* (No. 588). US Government Printing Office.

Li, L., Li, Y., Macchiavelli, M., & Zhou, X. (2021). Liquidity restrictions, runs, and central bank interventions: Evidence from money market funds. *The Review of Financial Studies*, *34*(11), 5402-5437.

Lockhart, O. C. (1921). The Development of Interbank Borrowing in the National System, 1869-1914. *Journal of Political Economy*, *29*(2), 138-160.

Meltzer, A. H. (2010). *A history of the Federal Reserve, Volume 1: 1913-1951*. University of Chicago Press.

Mitchener, K. J., & Richardson, G. (2019). Network contagion and interbank amplification during the Great Depression. *Journal of Political Economy*, *127*(2), 465-507.

Poledna, Sebastian, et al. "The multi-layer network nature of systemic risk and its implications for the costs of financial crises." *Journal of Financial Stability* 20 (2015): 70-81.

Redenius, S. A., & Weiman, D. F. (2020). Banking on the Periphery: The Cotton South, Systemic Seasonality, and the Limits of National Banking Reform. In *Economic evolution and revolution in historical time* (pp. 214-242). Stanford University Press.

Richardson, G., & Troost, W. (2009). Monetary intervention mitigated banking panics during the great depression: quasi-experimental evidence from a federal reserve district border, 1929–1933. *Journal of Political Economy*, *117*(6), 1031-1073.

Rieder, K. (2021). Financial Stability Policies and Bank Lending: Quasi-experimental Evidence from Federal Reserve Interventions in 1920-1921.

Roberds, W., & White, E. (2020). *Central Banks, Global Shocks, and Local Crises: Lessons from the Atlanta Fed's Response to the 1920–21 Recession* (No. 2020-15). Federal Reserve Bank of Atlanta.

Tallman, E., & White, E. N. (2019). Monetary Policy When One Size Does Not Fit All: the Federal Reserve Banks and the Recession of 1920–1921.

Virginia State Banking Division (1922): State Bank Examination Report, State Corporation Commission.

White, E. (2017). Protecting Financial Stability in the Aftermath of World War I: The Federal Reserve Bank of Atlanta's Dissenting Policy. In P. Rousseau & P. Wachtel (Eds.), Financial Systems and Economic Growth: Credit, Crises, and Regulation from the 19th Century to the Present (Studies in Macroeconomic History, pp. 201-231). Cambridge: Cambridge University Press.

Wicker, E. R. (1966). A reconsideration of Federal Reserve policy during the 1920–1921 depression. *The Journal of Economic History*, *26*(2), 223-238.

Figure 1. Interbank Relationships, Virginia State Nonmember Banks, 1920.

- ● depositing
- ● depositing/borrowing
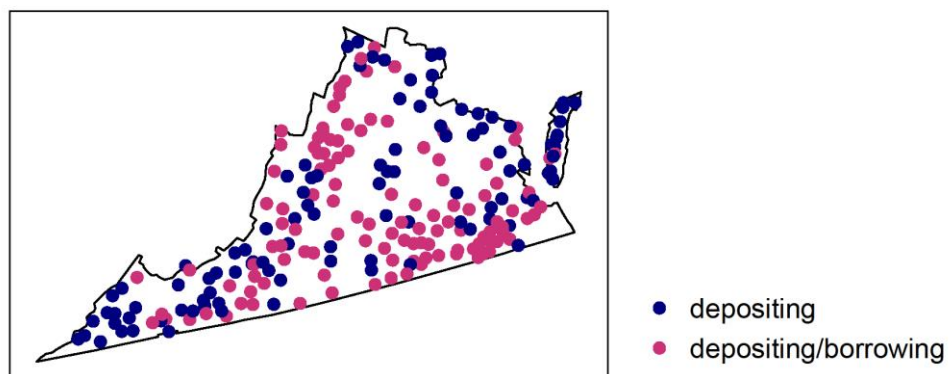
Source: Virginia State Bank Examination Reports.

Figure 2. Interbank Networks, by City and Bank, 1920.
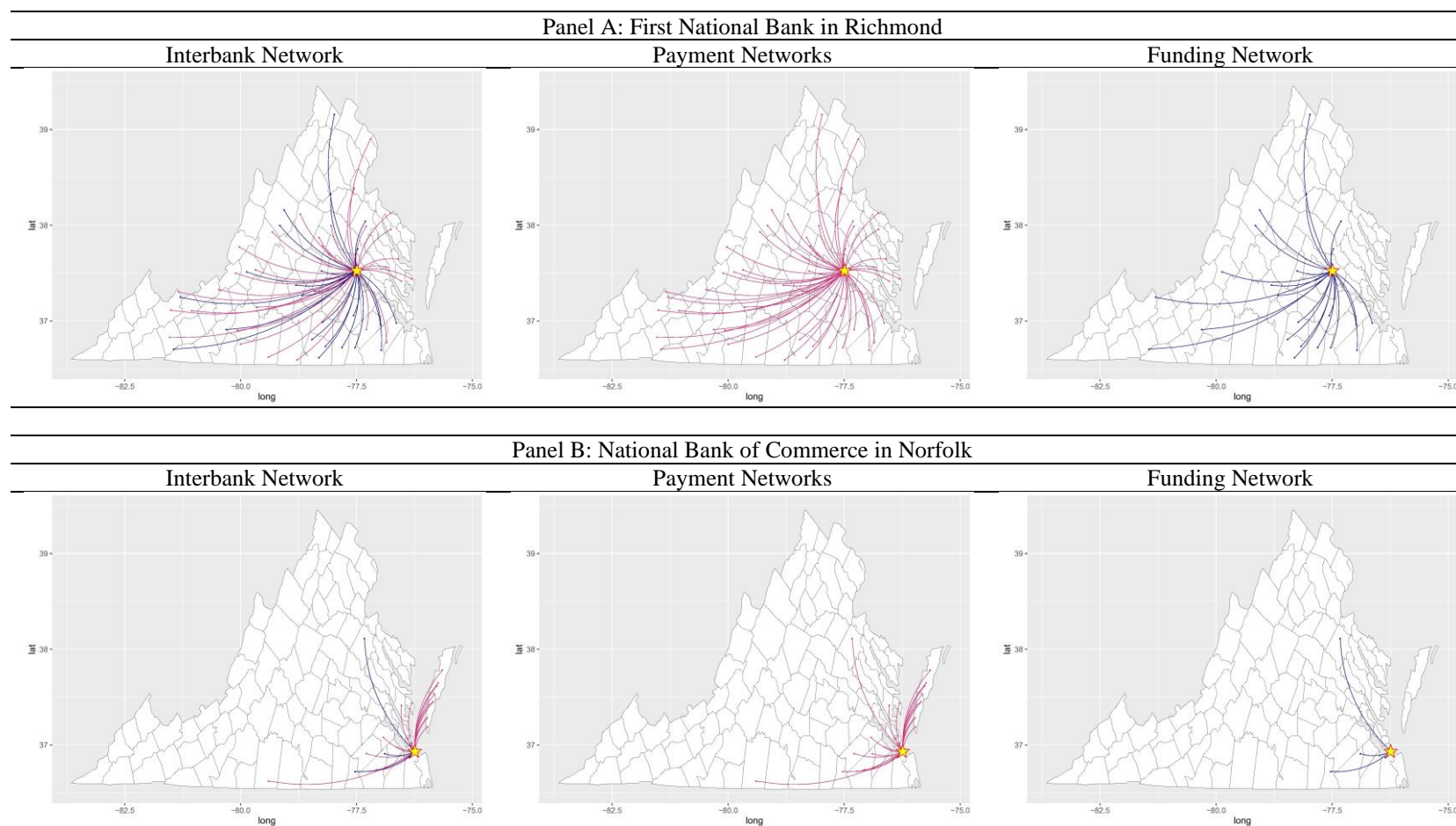
	Panel A: First National Bank in Richmond	
Interbank Network	Payment Networks	Funding Network

	Panel B: National Bank of Commerce in Norfolk	
Interbank Network	Payment Networks	Funding Network

Notes: This figure maps respondent banks (Virginia state banks) and correspondent banks. Panels A and B plot the interbank relationships for the First National Bank in Richmond and the National Bank of Commerce in Norfolk. Panels C and D plot the payments and funding relationships for banks in Richmond and their respondents, and for banks in Norfolk and their respondents, respectively. The respondent (corresponding) banks that only placed (received) deposits are in blue, while banks that both placed (received) deposits and borrowed (lent) short-term funds are in red. Source: Virginia State Bank Examination Reports (1920).

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Figure 2. Interbank Networks, by City and Bank, 1920.

Notes: This figure maps respondent banks (Virginia state banks) and correspondent banks. Panels A and B plot the interbank relationships for the First National Bank in Richmond and the National Bank of Commerce in Norfolk. Panels C and D plot the payments and funding relationships for banks in Richmond and their respondents, and for banks in Norfolk and their respondents, respectively. The respondent (corresponding) banks that only placed (received) deposits are in blue, while banks that both placed (received) deposits and borrowed (lent) short-term funds are in red. Source: Virginia State Bank Examination Reports (1920).

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Figure 3. Share Discount Window Loans Lent to Respondent Banks, 1920.
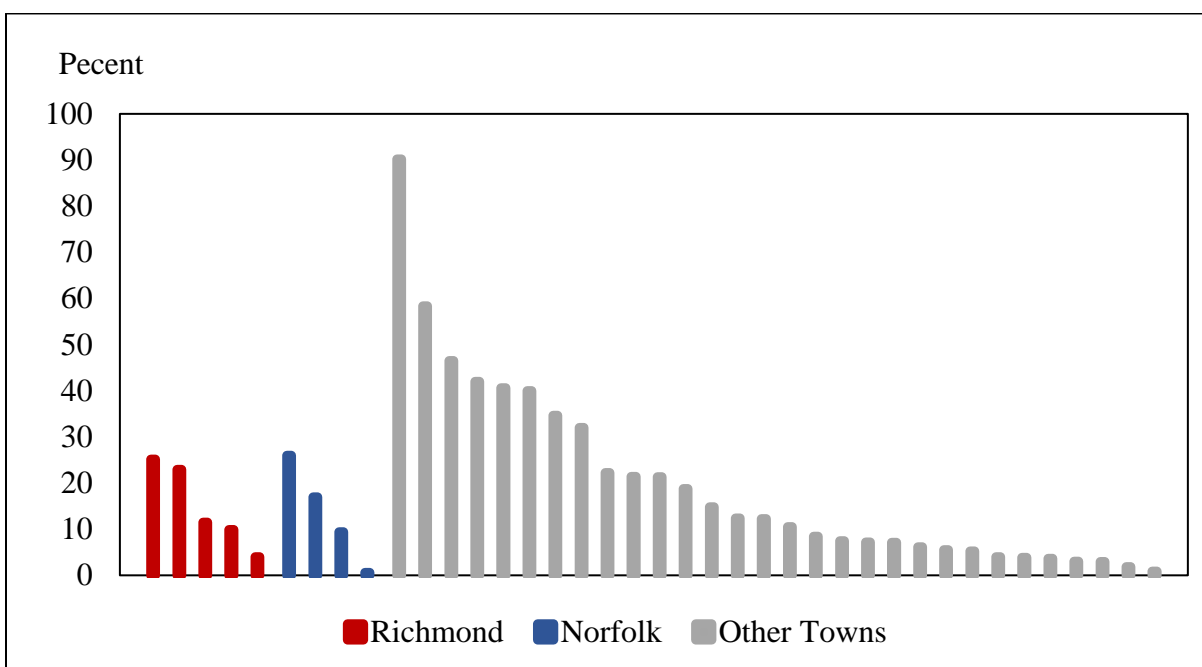
Notes: This figure plots the ratio of loans lent to respondents against total borrowing from the Federal Reserve Bank of Richmond for each bank. Banks in Richmond, Norfolk, and other towns are plotted in Red, Blue, and Grey, respectively.
Source: National Bank Examination Reports and Virginia State Bank Examination Reports.

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Figure 4. Deposits and Borrowed Money, Virginia State Nonmember Banks, 1919-1922.

Source: Virginia State Bank Examination Reports.

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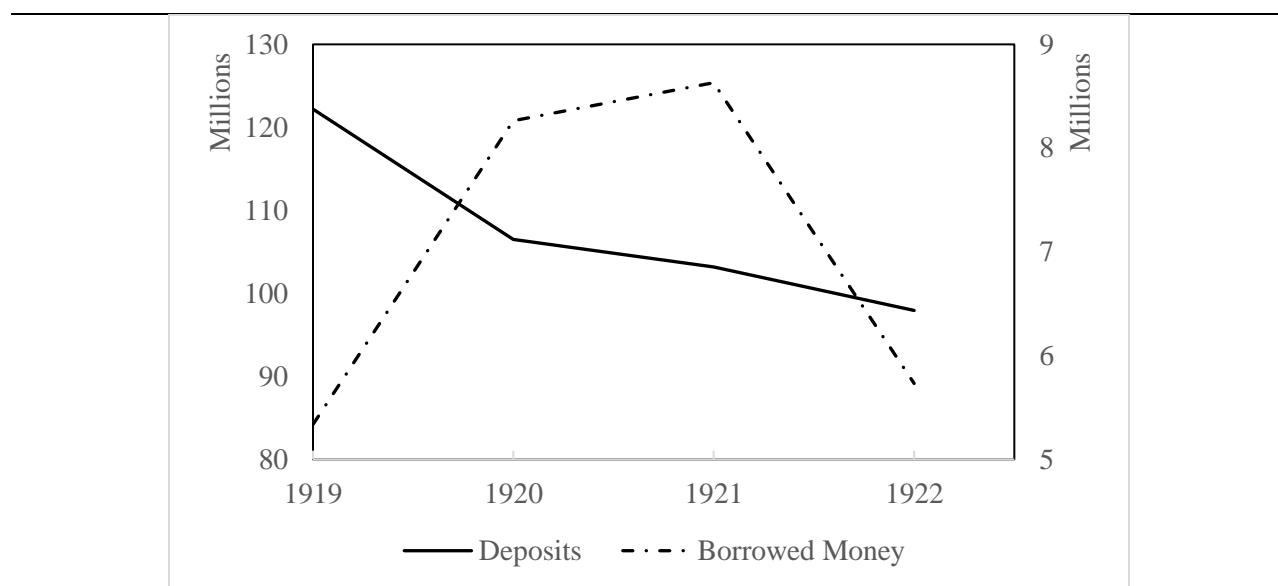
Figure 5. Interbank Deposits against Borrowed Money at Leading Correspondents, Borrowing Banks.
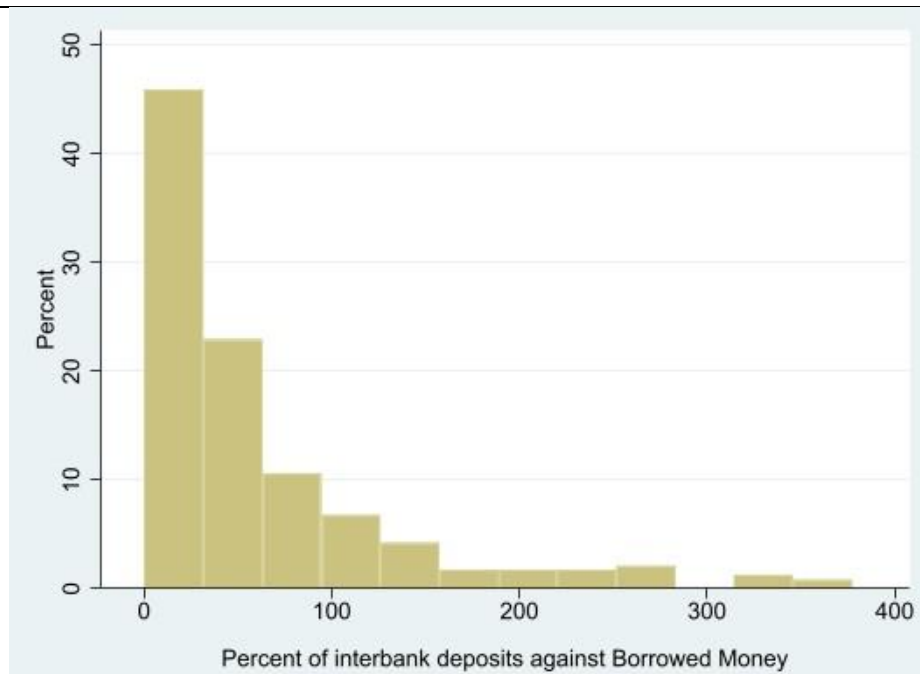
Notes: Figure 4 shows the distribution of interbank deposits against borrowing levels at lending correspondents for borrowing banks in 1920. Borrowing respondents placed, on average, 70 percent of deposits against total borrowing amounts in their lending correspondents.

Table 1. Payments and Funding Relationships, 1920.

	Banks	Respondents	Total Links	Mean	SD
Due-from	274	263	1071	3.90	2.84
Borrowing	156	98	310	2.01	1.46

Notes: "Due-from" indicates deposits in other banks. "Borrowing" indicates short-term borrowing from other banks. "Banks" indicate the total number of Virginia banks in the sample. "Respondent" indicates banks that either deposit or borrow. "Total links" indicate the total number of linkages of a respondent bank.
Source: Virginia State Bank Examination Reports.

Table 2. Distribution of Short-Term Loans by Correspondents and Locations in 1920, Market Share (%).

Panel A: Share of Short-Term Loans Provided by Top 10 Short-term Funding Providers, Market Share (%)

	Correspondents	Location	Lending (amount)	Lending (links)	Deposits (amount)	Deposits (links)
1	National Bank of Commerce	Norfolk	6.29	3.33	3.86	3.30
2	First National Bank	Richmond	5.63	8.00	10.54	5.92
3	Merchants National Bank	Richmond	5.43	6.33	3.13	4.07
4	National Bank of Commerce	New York	5.35	1.00	1.02	0.78
5	State and City Bank and Trust Co.	Richmond	5.29	4.00	5.35	3.20
6	Citizens Bank	Norfolk	4.67	1.67	0.54	1.07
7	National Bank of Petersburg	Petersburg	4.34	3.67	0.99	1.55
8	Equitable Trust Co.	New York	3.87	0.67	0.61	0.19
9	Mechanics and Metals National	New York	3.61	1.00	0.92	0.87
10	Planters National	Richmond	3.01	3.33	6.40	1.94
	Total Amount / Links		$ 8783460	300	$ 12804341	1031

Panel B: Share of Short-Term Loans Provided by Top 10 Correspondent Cities by Year, Market Share (%)

	State	Location	Lending (amount)	Lending (links)	Deposits (amount)	Deposits (links)
1	NY	New York	26.53	14.33	12.50	15.39
2	VA	Richmond	21.28	26.33	31.04	19.55
3	VA	Norfolk	16.66	10.33	11.20	8.81
4	VA	Petersburg	7.22	7.67	3.00	4.26
5	VA	Roanoke	3.77	5.00	4.58	3.97
6	MD	Baltimore	3.76	5.33	8.37	8.33
7	VA	Lynchburg	2.61	4.00	5.72	3.58
8	VA	Staunton	2.02	5.00	0.57	1.55
9	VA	Suffolk	1.67	3.00	0.54	2.23
10	PA	Philadelphia	1.51	1.67	2.98	2.13
	Total		8783460	300	12804341	1031

Notes: Panel A displays information about major short-term funding providers. The first column shows the percentage of short-term loans the top 10 correspondent banks provided to state nonmember banks in Virginia in each year. Column (3) displays the percentage of interbank balances these top 10 short-term funding providers received from state banks. Columns (2) and (4) display the precent of banks that were connected to at least one of the top 10 correspondents through borrowing or due-from links. Some banks were connected to more than one of the top 10 correspondent banks and, thus, it is not a simple sum of the individual percentages. Panel B displays information about the percentage of short-term loans the top 10 correspondent cities provided to state nonmember banks in Virginia in each year. Column (3) displays the percentage of interbank balances these top 10 cities received from state banks. Columns (2) and (4) display the precent of banks that were connected to at least one of the top 10 cities through borrowing or due-from links. Some banks were connected to more than one of the top 10 cities and, thus, it is not a simple sum of the individual percentages.
Source: Virginia State Bank Examination Reports.

Table 3. Distribution of Interbank Deposits Held by Correspondents and Locations in 1920, Market Share (%).

Panel A: Share of Interbank Deposits Held by Top 10 Short-term Funding Providers, Market Share (%)

	Correspondents	Location	Deposits (amount)	Deposits (links)	Lending (amount)	Lending (links)
1	First National Bank	Richmond	10.54	5.92	5.63	8.00
2	Planters National Bank	Richmond	6.40	1.94	3.01	3.33
3	State and City Bank and Trust Co.	Richmond	5.35	3.20	5.29	4.00
4	Norfolk National Bank	Norfolk	4.55	2.04	2.63	2.33
5	National Bank of Commerce	Norfolk	3.86	3.30	6.29	3.33
6	Lynchburg National Bank	Lynchburg	3.57	1.45	0.73	1.00
7	American National Bank	Richmond	3.24	2.72	1.03	2.33
8	Merchants National Bank	Richmond	3.13	4.07	5.43	6.33
9	National Exchange Bank	Roanoke	2.98	2.72	1.86	2.67
10	Hanover National Bank	New York	2.35	4.46	2.76	3.67
	Total Amount / Links		$ 8783460	300	$ 12804341	1031

Panel B: Share of Interbank Deposits Held by Top 10 Correspondent Cities by Year, Market Share (%)

	State	Location	Deposits (amount)	Deposits (links)	Lending (amount)	Lending (links)
1	VA	Richmond	31.04	19.55	21.28	26.33
2	NY	New York	12.50	15.39	26.53	14.33
3	VA	Norfolk	11.20	8.81	16.66	10.33
4	MD	Baltimore	8.37	8.33	3.76	5.33
5	VA	Lynchburg	5.72	3.58	2.61	4.00
6	VA	Roanoke	4.58	3.97	3.77	5.00
7	VA	Petersburg	3.00	4.26	7.22	7.67
8	PA	Philadelphia	2.98	2.13	1.51	1.67
9	OH	Cincinnati	2.41	1.06	0.85	0.33
10	DC	Washington	1.01	2.42	0.38	0.67
	Total Amount / Links		$ 8783460	300	$ 12804341	1031

Notes: Panel A displays the percentage of interbank deposits held the top 10 correspondent banks in Virginia in each year. Table also displays the percentage of short-term loans these top 10 correspondents provided to nonmember banks. Table displays the precent of banks that were connected to at least one of the top 10 correspondents through borrowing or due-from links. Some banks were connected to more than one of the top 10 correspondent banks and, thus, it is not a simple sum of the individual percentages. Panel B displays the percentage of interbank deposits placed in top 10 correspondent cities in 1920. Table also displays the percentage of interbank balances these top 10 cities received from state banks. Table also displays the precent of banks that were connected to at least one of the top 10 cities through borrowing or due-from links. Some banks were connected to more than one of the top 10 cities and, thus, it is not a simple sum of the individual percentages.
Source: Virginia State Bank Examination Reports.

Table 4. Percentage of Discount Window Loans Passed through to Nonmember Banks.

	1920			
	All	Richmond	Norfolk	Rural Banks
Mean	18.248	14.676	13.225	19.513
SD	(18.629)	(9.004)	(10.807)	(20.595)
Median	11.480	11.480	13.184	11.401
Min	0.580	3.980	0.580	0.872
Max	90.164	25.123	25.952	90.164
Obs.	39	5	34	30

Notes: Table 4 displays the percentage of short-term loans to nonmember Banks from short-term funding providers against the amount of short-term funding providers borrowing from the Federal Reserve.
Source: Virginia State Bank Examiners' Reports and National Bank Examiners' Reports.

Table 5. Balance Sheet Ratios, 1920-21.

	(1)	(2)	(3)	(4)
	All	No Borrowing	Borrowing	Difference
Cash to deposits	4.096	4.314	3.882	0.432**
	(2.784)	(2.836)	(2.718)	(0.197)
Duefroms to deposits	11.18	12.92	9.476	3.448***
	(8.020)	(8.943)	(6.576)	(0.555)
Bonds to deposits	12.24	13.03	11.46	1.578
	(15.89)	(15.82)	(15.95)	(1.125)
Loans to deposits	106.3	95.62	116.8	-21.17***
	(36.70)	(34.72)	(35.59)	(2.490)
Equity to deposits	27.46	25.75	29.13	-3.377*
	(25.76)	(25.78)	(25.67)	(1.821)
Borrowing to deposits	10.47	3.827	16.98	-13.15***
	(16.20)	(9.502)	(18.61)	(1.049)
Cash growth	-0.124	-0.081	-0.166	0.093
	(1.691)	(2.331)	(0.586)	(0.120)
Due from growth	-0.292	-0.296	-0.287	-0.009
	(2.967)	(3.506)	(2.325)	(0.210)
Deposit Growth	-0.036	-0.003	-0.068	0.066***
	(0.244)	(0.264)	(0.219)	(0.017)
Obs.	577	290	287	

Notes: This table reports summary statistics from 1920 to 1921. We define borrowing banks as those that borrowed in 1920. Cash is composed of specie and legal tender notes. Duefroms are interbank deposits due from correspondent banks. Equity is composed of paid in capital and surplus. Borrowing is short-term borrowing from correspondent banks. Growth rates are first logged difference from 1920 to 1921. Standard deviations in parentheses. Source: Virginia State Bank Examination Reports (1920-1921).

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Table 6. Distance between Respondent and Correspondent Banks, 1920.

	All Banks			Borrowing Banks		
	(1)	(2)	(3)	(4)	(5)	(6)
	No Borrowing	Borrowing	Difference	Depository	Depository/Funding Provider	Difference
Longest Distance	213.7	232.1	-18.37	199.7	122.8	76.94***
	(161.5)	(137.1)	(18.14)	(139.4)	(132.3)	(16.64)
Shortest Distance	29.71	25.78	3.935	59.21	64.93	-5.723
	(38.15)	(38.55)	(4.682)	(94.29)	(88.51)	(11.19)
Mean Distance	96.86	101.2	-4.361	117.6	90.04	27.60**
	(64.24)	(59.06)	(7.500)	(92.69)	(96.36)	(11.61)
Median Distance	72.96	68.19	4.774	101.6	83.94	17.69
	(58.72)	(59.33)	(7.205)	(96.79)	(95.56)	(11.79)
Total Distance	378.3	418.6	-37.56	1410.1	491.8	935.1***
	(409.2)	(375.1)	(47.64)	(3537.6)	(1200.3)	(310.3)
Obs.				337	278	615
No of banks	123	149	272			149

Notes: Table 6 provides information on geographical distance between respondent and correspondent banks in miles. In columns (1)-(3), we use the sample of all banks and compare the distance for borrowing versus non-borrowing banks. In columns (4)-(6), we focus on 149 banks that borrowed from their lending correspondents in 1920, and examine the difference between the respondent-depository correspondent distance and the respondent-lending correspondent distance.
Source: Virginia State Bank Examiners' Reports (1920).

Table 7. Distribution of Borrowed Money, Borrowing Banks.

Against Total Liabilities	All	1920	1921
Borrowed Money	11.07	11.79	10.30
	(8.781)	(8.560)	(8.978)
Borrowing from New York	1.156	1.297	1.006
	(2.599)	(2.754)	(2.425)
Borrowing from Richmond	2.649	3.185	2.078
	(4.452)	(5.072)	(3.611)
Borrowing from Rural Areas in VA	7.218	7.375	7.050
	(8.704)	(8.762)	(8.670)
Obs.	289	149	140

Notes: This table reports the share of borrowed money against total liabilities for the banks that borrowed from member banks in 1920. Borrowed Money indicates the total amount of borrowed money. Borrowing from New York indicates the total amount of borrowed money from New York. Borrowing from Richmond indicates the total amount of borrowed money from Richmond. Lastly, Borrowing from Rural Areas in VA indicates the total amount of borrowing from areas outside Richmond. Heteroskedasticity-robust standard errors are in parentheses.
Source: Virginia State Bank Examiners' Reports (1920-1921).

Table 8. Distribution of Interbank Deposits by Borrowing Status, 1920-1921.

	(1)	(2)	(3)	
	All	No Borrowing	Borrowing	Difference
Duefrom to total assets	8.277	10.39	6.159	4.229***
	(6.441)	(7.498)	(4.226)	(0.506)
Duefrom to total assets (Deposits only)	5.989	9.524	2.441	7.083***
	(7.114)	(7.954)	(3.586)	(0.513)
Duefrom to total assets (Deposits & Loans)	2.310	0.861	3.763	-2.902***
	(3.208)	(2.312)	(3.324)	(0.238)
Duefrom to total assets (New York)	0.518	0.534	0.502	0.032
	(1.112)	(1.349)	(0.810)	(0.0925)
Duefrom to total assets (Richmond)	2.166	2.413	1.918	0.494
	(3.781)	(4.251)	(3.231)	(0.314)
Duefrom to total assets (Rural Banks)	5.058	6.423	3.688	2.734***
	(5.235)	(6.204)	(3.553)	(0.420)
Obs.	579	290	289	

Notes: Respondent banks placed interbank balances in multiple correspondents but borrowed short-term loans from one or two banks. We define borrowing banks as those that borrowed in 1920. 'Deposits only' indicates the correspondent bank that only received interbank deposits. 'Deposit and loans' indicate the correspondent bank that received deposits and provided short-term loans. We calculate the ratio of interbank deposits in these banks against total interbank deposit and total assets. Standard deviations in parentheses.
Source: Virginia State Bank Examination Reports.

Table 9. Interbank Borrowing Prediction, OLS and Logit Estimates.

	All Banks		Rural Banks	
	(1)	(2)	(3)	(4)
Estimation Method	OLS	Logit	OLS	Logit
Log assets	-0.022	-0.052	-0.126	-0.273
	(0.048)	(0.048)	(0.232)	(0.246)
Bonds to interest earning assets	-0.527*	-0.594**	-2.474*	-2.857**
	(0.212)	(0.208)	(1.055)	(1.090)
Net worth to assets	0.002	0.000	0.014	0.005
	(0.003)	(0.003)	(0.017)	(0.019)
Cash to assets	-0.017**	-0.017**	-0.086**	-0.086**
	(0.005)	(0.005)	(0.030)	(0.029)
Due-froms to assets	-0.008*	-0.008*	-0.038*	-0.038*
	(0.003)	(0.003)	(0.017)	(0.016)
Deposit Growth	-0.708***	-0.689***	-3.626***	-3.535***
	(0.112)	(0.111)	(0.804)	(0.786)
Obs.	249	239	249	239

Notes: Equation estimated using a linear probability model and a logit model. Negative coefficients indicate that the variable increases the odds of survival. Rural banks are state nonmember banks outside Richmond. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Logit standard errors are robust.

Table 10. Behavior of Interbank Deposits, by Location, Borrowing Banks, 1919-1921.

	1919-1920				1920-1921			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Deposits (All)	Deposits (New York)	Deposits (Richmond)	Deposits (Rural Areas)	Deposits (All)	Deposits (New York)	Deposits (Richmond)	Deposits (Rural Areas)
Borrowing to deposits $_{1920}$	-0.042	-0.098	-0.044	0.073	-0.088	-0.052	-0.137	-0.010
	(0.032)	(0.184)	(0.147)	(0.194)	(0.065)	(0.051)	(0.097)	(0.059)
Log assets $_{t-1}$	-1.037**	5.990***	4.720**	3.355	0.647	-0.812	1.339	1.099
	(0.424)	(2.027)	(1.882)	(2.206)	(0.658)	(0.818)	(1.423)	(1.119)
Bonds to interest earning assets $_{t-1}$	4.382	-4.606	9.089	16.594	-8.275	6.259	-6.660	-7.436
	(3.889)	(11.880)	(12.527)	(11.520)	(6.735)	(5.616)	(7.427)	(8.750)
Net worth to deposits $_{t-1}$	0.013**	-0.000	0.001	0.020	0.017**	0.003	0.058**	0.001
	(0.007)	(0.030)	(0.029)	(0.030)	(0.008)	(0.014)	(0.029)	(0.012)
Liquid assets to deposits $_{t-1}$	-0.037**	0.093	-0.058	0.008	-0.147*	0.028	0.063	0.002
	(0.017)	(0.094)	(0.081)	(0.079)	(0.081)	(0.077)	(0.085)	(0.087)
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	257	257	257	257	245	245	245	245
R-squared	0.267	0.428	0.541	0.537	0.291	0.345	0.418	0.451

Notes: This table presents the effect of interbank borrowing on interbank deposits between 1919 and 1921. We examine the banks that borrowed in 1920. "Borrowing to deposits $_{1920}$" is the ratio of borrowed money against deposits in 1920. Column (1) and (5) indicate total interbank deposits, and Columns (2)-(4) and (6)-(8) indicate deposits in New York, Richmond, and rural areas, respectively. Heteroskedasticity-robust standard errors are in parentheses. R-squared is within r-squared. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectfully.

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Table 11. Behavior of Interbank Deposits, by Types of Correspondents, Borrowing Banks, 1919-1921.

	1919-1920		1920-1921	
	(1)	(2)	(3)	(4)
	Deposits (Deposit)	Deposits (Dep/Loans)	Deposits (Deposit)	Deposits (Dep/Loans)
Borrowing to deposits $_{1920}$	0.037	-0.032	0.079	-0.536***
	(0.138)	(0.111)	(0.091)	(0.178)
Log assets $_{t-1}$	1.888	1.164	-1.747	5.754
	(4.287)	(3.871)	(1.570)	(3.752)
Bonds to interest earning assets $_{t-1}$	-10.389	34.736	3.893	-2.919
	(21.348)	(23.255)	(9.409)	(21.641)
Net worth to deposits $_{t-1}$	0.032	-0.023	-0.001	-0.003
	(0.056)	(0.036)	(0.024)	(0.041)
Liquid assets to deposits $_{t-1}$	-0.012	0.135	-0.031	0.312
	(0.148)	(0.097)	(0.186)	(0.236)
County FE	Yes	Yes	Yes	Yes
Obs.	140	140	154	154
R-squared	0.564	0.482	0.538	0.584

Notes: This table presents the effect of interbank borrowing on interbank deposits between 1919 and 1921. We examine the banks that borrowed in 1920. "Borrowing to deposits $_{1920}$" is the ratio of borrowed money against deposits in 1920. Deposits (deposit) indicate the amount of deposits in the correspondents that only received interbank balances, whereas deposits(deposit/loans) indicates the amount of interbank deposits in the correspondents that received deposits and provided short-term funds. Heteroskedasticity-robust standard errors are in parentheses. R-squared is within r-squared. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectfully.

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Table 12: Stability of Correspondent Relationships, Borrowing Banks, 1920 and 1922.

	1920	1922	Difference
Due-froms to assets	9.966	9.494	0.472
	(6.409)	(5.766)	(0.634)
Deposits in lending bank to assets	4.375	4.152	0.223
	(4.691)	(4.370)	(0.470)
Deposits in lending bank to total due-froms	44.96	44.06	0.898
	(31.13)	(32.21)	(3.264)
Total Links	214	167	
Correspondents	71	63	
Respondents	131	118	

Notes: This table examines the stability of correspondent relationships in 1920 and 1922. We examine 267 banks that are in both 1920 and 1922 datasets. There were 131 bans that borrowed from their correspondents. Among 131 banks, 118 banks continued to maintain correspondent relationship the member banks that provided short-term funds. "Due-froms to assets" indicates the ratio of total interbank deposits against total assets. "Deposits in lending bank to assets" represents the ratio of deposits in the lending correspondent against total assets, and "Deposits in lending bank to total due-froms" represents the ratio of deposits in the lending correspondent against total interbank deposits.

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Appendices

A. Virginia State Bank Examination Reports

In Figure A1 we present images of representative pages in the state bank examination reports used for this study. The reports provide information on three types of interbank relationships: (1) the amounts due from other banks by individual debtor banks on the asset side of the balance sheet, (2) the amounts due to other banks by individual creditor banks on the liability side of the balance sheet, and (3) the amounts of borrowed money and the provider of these short-term loans on the liability side of the balance sheet. In some cases, the reports provide information on collateral used for securing short-term funds.

Figure A1. Virginia State Bank Examination Reports

Interbank Deposits	Interbank Borrowing

B. National Bank Examination Reports

In Figure A1 shows the present the image of page in the national bank examination reports used for this study. The reports provide information on the amount of borrowing from the Federal Reserve Banks. In addition, it provides information on date of borrowing, date of maturity, interest rate, security pledged, form of borrowing (rediscounts vs bills payable).

Figure B1. National Bank Examination Reports

C. Borrowing by National and State Banks in Virginia

Both national and state banks borrowed. National banks and state banks that were members of the Federal Reserve System borrowed from the discount window, while state banks that were not members of the Federal Reserve System borrowed from their member correspondents. In Virginia, most state banks operated as nonmember banks.

Table C1 provides aggregate balance sheet information for national and state banks in 1920. There were twice as many state banks as there were national banks. While fewer in number, they held over 60 percent of total deposits in Virginia. Nonetheless, state banks played an important role in the banking system, holding almost 40% of loans and deposits.

Table C1. Aggregate Balance Sheets for National and State Banks (in thousands of dollars).

	National	State
Loans	242,297.00	145,890.77
Securities	66,506.00	25,576.81
Real Estate, Furniture and Fixtures	7,415.00	5,061.42
Cash	45,922.00	5,884.75
Due from	20,884.00	16,004.78
Other	12,267.00	3,141.40
Capital	23,987.00	21,577.37
Surplus and Undivided Profits	22,694.00	15,282.55
Deposits	237,872.00	143,762.46
Due to	57,171.00	3,288.12
Borrowed Money	21,259.00	12,006.51
Other	32,308.00	5,642.84
Total Assets and Liabilities	395,291.00	201,559.84
Number of Richmond Banks	7	18
Number of Country Banks	153	298

Notes: Aggregate balance sheets for national and state banks in 2/28/1920. The figures are in thousands of dollars.
Source: *Annual Report of the Comptroller of the Currency* (1917-1923) and *Virginia State Bank Call Reports* (1917-1923).

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Figure C1 plots the amount of borrowed money for national and state banks in Virginia. In February 1920, there were 160 national banks (153 in rural areas and 7 in Richmond) and 316 state banks (298 in rural areas and 18 in Richmond). While fewer in number, national banks borrowed more than state banks, especially during WWI when the Federal Reserve encouraged member banks to borrow using government bonds as collateral to support the war. Interestingly, national banks reduced borrowing when the discount rates were increased, but state banks increased borrowing.

Figure C1. Borrowing by National and State Banks in Virginia, 1917 to 1923.
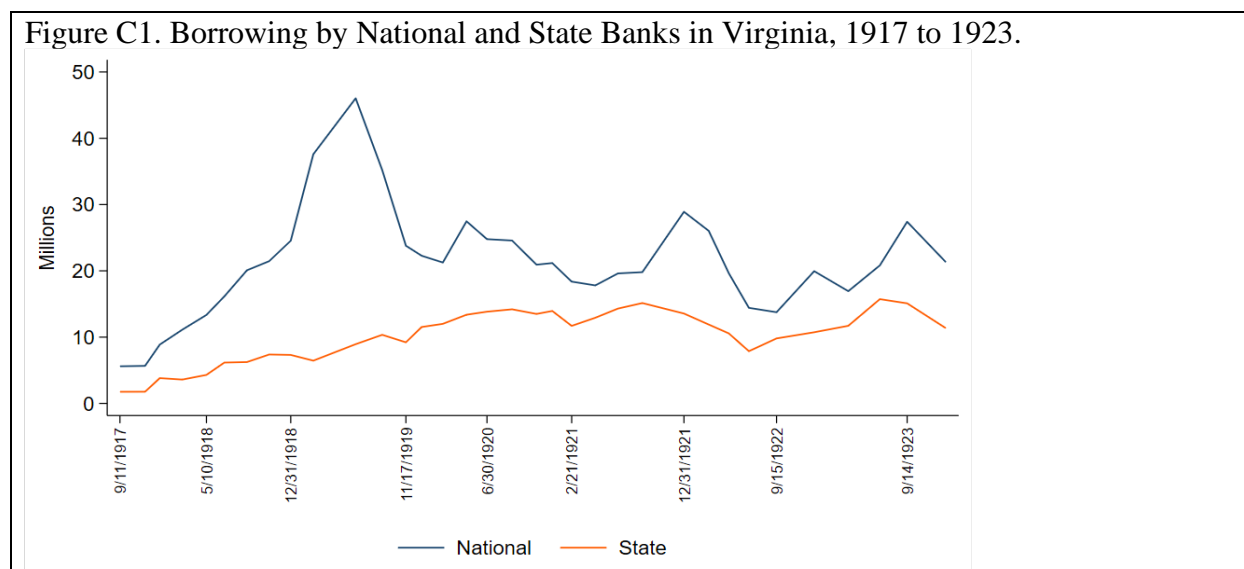
Notes: There were 160 national banks (153 in rural areas and 7 in Richmond) and 316 state banks (298 in rural areas and 18 in Richmond) in February 1920. State banks include both fed member and nonmember banks.
Source: Annual Report of the Comptroller of the Currency (1917-1923) and Virginia State Bank Call Reports (1917-1923).

Figure C2 provides information on the extent of interbank borrowing by Virginia state banks from 1917 to 1928. Panel A shows the percentage of state banks that borrowed from their member correspondents from 1917 to 1928. It shows that more banks borrowed during the recession of 1920-1921. About 30% of banks borrowed between 1917 and 1919, but more banks borrowed during the recession. The percentage of borrowing banks rose to over 50 % in 1920. Panel B shows that borrowing constituted a large portion of bank liabilities and played an important role during the recession. The borrowing to liabilities ratio was 8.2% between 1917 and 1919, but it rose to 11.33% during the recession.

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Figure C2. Interbank Borrowing by Virginia State Banks, 1917-1928.

Panel A: Share of Borrowing Banks against Total Banks, 1917-1928.
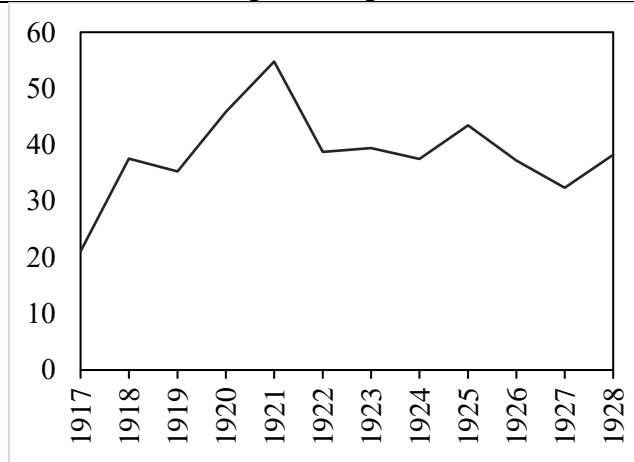
Panel B: Ratio of Borrowed Money against Total Liabilities, Borrowing Banks, 1917-1928
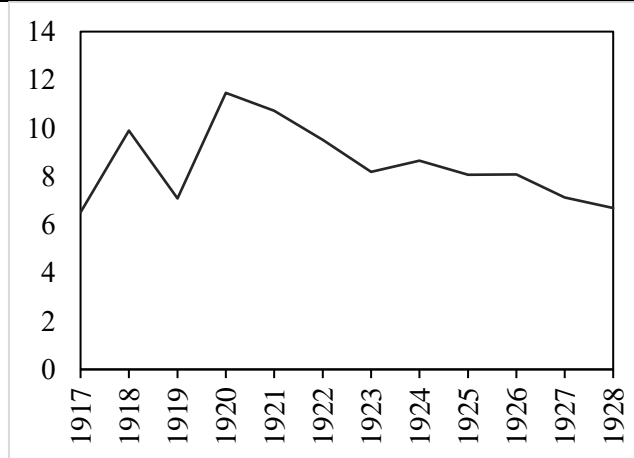
Notes: Panel B plots the share of nonmember banks borrowing from their correspondents against all nonmember banks. Panel C plots the ratio of borrowed money against total liabilities for banks that are borrowing in each year. Source: Virginia State Bank Call Reports (1917-1928) and Virginia State Bank Examination Reports (1920-1922).

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D. State Bank Balance Sheet Data from Call Reports

In the main text, we provide summary statistics of the balance sheet data from state bank examination reports. Some might be concerned about the consistency of these balance sheets since examination reports were not recorded at the same time. To alleviate this concern, we are reporting summary statistics from call reports. We provide more information on state banks and report the results of the empirical analysis using call reports.

Table D1. Balance Sheet Ratios, 1920-1921, Call Reports.

	(1)	(2)	(3)	(4)
	All	No Borrowing	Borrowing	Difference
Liquid Assets to deposits	16.57	18.37	14.65	3.714***
	(9.348)	(10.27)	(7.827)	(0.775)
Investments to deposits	114.4	101.6	128.0	-26.35***
	(32.13)	(16.80)	(38.39)	(2.477)
Equity to deposits	26.09	22.06	30.36	-8.300***
	(23.52)	(12.08)	(30.87)	(1.958)
Borrowing to deposits	10.14	2.583	18.17	-15.59***
	(15.64)	(6.409)	(18.33)	(1.146)
Liquid asset growth	-0.286	-0.246	-0.328	0.0825
	(0.704)	(0.659)	(0.748)	(0.0595)
Investment growth	0.144	0.213	0.0700	0.143*
	(0.873)	(1.141)	(0.424)	(0.074)
Deposit growth	-0.0128	0.0293	-0.057	0.087***
	(0.376)	(0.395)	(0.350)	(0.032)
Obs.	561	289	272	

Source: Statements Showing the Condition of the Incorporated State Banks operating in Virginia.

Table D2. Balance Sheet Ratios, 1922-28, Call Reports.

	(1)	(2)	(3)	(4)
	All	No Borrowing	Borrowing	Difference
Liquid assets to deposits	22.72	25.91	18.75	7.181
	(181.4)	(239.3)	(49.78)	(8.463)
Investments to deposits	151.2	145.5	158.3	-12.91
	(885.0)	(1043.1)	(635.0)	(41.29)
Equity to deosits	49.17	30.41	72.61	-42.22**
	(442.1)	(181.8)	(630.6)	(20.60)
Borrowing to deposits	6.163	5.262	7.290	-2.038
	(52.63)	(69.48)	(14.13)	(2.455)
Liquid asset growth	0.0340	0.0323	0.0362	0.000128
	(0.933)	(0.820)	(1.058)	(0.0437)
Investment growth	0.0389	0.0457	0.0305	0.0159**
	(0.163)	(0.150)	(0.178)	(0.00761)
Deposit growth	0.0597	0.0504	0.0713	0.0352
	(0.569)	(0.366)	(0.748)	(0.0396)
Obs.	1863	1034	829	

Source: Statements Showing the Condition of the Incorporated State Banks operating in Virginia.

E. Appendix: List of Failed Banks in 1920 and 1921.

E1. The following banks have ceased to operate as State banks since January 1, 1920.

Big Stone Gap	Interstate Finance and Trust Company	Nationalized
East Radford	Farmers and Merchants Bank	Nationalized
Harrisonburg	Peoples Bank	Nationalized
Newport News	Colonial State Bank	Receivership
Norfolk	Peoples Bank and Trust Company	Consolidated with Savings Bank of Norfolk under the corporate title of Continental Trust Company
Monroe	First State Bank	Voluntary Liquidation
Roanoke	Colonial Bank and Trust Company	Nationalized
Stuart	Bank of Stuart	Consolidated with Patrick County Bank

E2. The following banks have ceased to operate as State banks since January 1, 1921.

Ashland	Peoples Bank	Nationalized
Bassett	Bank of Bassett	Nationalized
Charlottesville	Commerce Bank and Trust Company	Nationalized
Hopewell	Virginia State Bank	Receivership
Houston	Peoples Bank	Consolidated with Bank of Halifax
Lovingston	Bank of Nelson	Nationalized
Lynchburg	United Loan and Trust Company	Consolidated with First National Bank
Norfolk	Marine Bank	Consolidated with National Bank of Commerce
Ocean View	Ocean View Day and Night Bank	Receivership
Portsmouth	Mutual Savings Bank	Receivership
Sugar Grove	Bank of Sugar Grove	Voluntary liquidation
Troutdale	Bank of Troutdale	Receivership
Woodstock	Valley Savings Bank	Nationalized

F. Additional Regressions

Table F1. Behavior of Interbank Deposits by Location, 1920-1921.

	(1)	(2)	(3)
	Deposits in New York	Deposits in Richmond	Deposits in Rural Banks
Borrowing to deposits $_{t-1}$	-0.052	-0.137	-0.010
	(0.051)	(0.097)	(0.059)
Log assets $_{t-1}$	-0.812	1.339	1.099
	(0.818)	(1.423)	(1.119)
Bonds to interest earning assets $_{t-1}$	6.259	-6.660	-7.436
	(5.616)	(7.427)	(8.750)
Net worth to deposits $_{t-1}$	0.003	0.058**	0.001
	(0.014)	(0.029)	(0.012)
Liquid assets to deposits $_{t-1}$	0.028	0.063	0.002
	(0.077)	(0.085)	(0.087)
Constant	6.329	-5.911	-20.340
	(8.366)	(12.857)	(12.770)
County FE	Yes	Yes	Yes
Obs.	245	245	245
R-squared	0.345	0.418	0.451

Notes: This table presents effect of interbank borrowing on interbank deposits during the recession of 1920-1921. We define borrowing banks as the banks that borrowed in 1920 and 1921. Heteroskedasticity-robust standard errors are in parentheses. R-squared is within r-squared. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectfully.

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