Interbank Connections, Contagion and Bank Distress in the Great Depression

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October 7, 2019

Abstract

Liquidity shocks transmitted through interbank connections contributed to bank distress during the Great Depression. New data on interbank connections reveal that banks were more likely to close when either their correspondents or their respondents closed. Further, banks' management of cash and capital buffers was less responsive to network liquidity risk after the Federal Reserve was established, suggesting that banks expected the Fed to reduce that risk. The Fed's presence weakened incentives for the most systemically important banks to maintain capital and cash buffers against liquidity risk, and thereby likely contributed to the banking system's vulnerability to contagion during the Depression.

JEL Codes: G21, L14, N22

Keywords: Bank Contagion, Great Depression, Interbank Networks, Liquidity Risk, Federal Reserve System

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1. Introduction

The financial crisis of 2008-09 heightened interest in how relationships within the financial system can amplify shocks. Amplification can occur through multiple channels. Distress in one firm can signal potential problems in other firms with correlated positions and trigger withdrawals of short-term debt whether or not the firms are contractually connected. For example, during the 2008-09 financial crisis, the inability of Reserve Primary Fund, a money market mutual fund with a large exposure to Lehman Brothers, to maintain a constant $1 per share price triggered runs on other mutual funds, including many that had little or no counterparty exposure to Lehman or direct connections to Reserve Primary Fund.

Counterparty contagion can also occur through direct contractual relationships between firms. A default by one firm can impose distress on other firms that hold significant liabilities of the defaulting firm. For example, some observers believe that because of its exposure to AIG, Goldman Sachs might have failed if AIG had been permitted to fail in 2008.[1] As the interbank lending market collapsed in September 2008, banks scrambled to hoard reserves as a means of self-insurance against prospective liquidity needs, which aggravated declines in risky asset prices and bank lending (e.g., Iyer et al. 2014; Heider, Hoerova, and Holthausen 2015).

This paper investigates the role of contagion on bank distress during the Great Depression. Specifically, we examine the effects of i) direct contractual obligations between banks and ii) geographic proximity to distressed banks on increasing the closure probability of individual banks. Despite a large amount of research on the causes and consequences of bank distress during the Depression, previous studies have not examined comprehensively whether bilateral bank network connections contributed to bank failure risk during the Depression or the

[1] However, Scott (2012) argues that contractual contagion was not as important as the effect of correlated positions during the recent financial crisis.

extent that the direction of the network connection mattered. We do so by mapping the interbank network in detail and examining how network connections affected the risk of bank failure and other closure events.

Using interbank network and balance sheet data for the decades prior to the Depression, we also investigate how the founding of the Federal Reserve System (Fed) affected network risk. Existing literature criticizes the Fed for failing to offset major liquidity shocks during the Depression. Here we consider a new channel: Did the Fed's establishment lead banks to become complacent about liquidity risk and, therefore, more vulnerable to liquidity shocks?

In the early 20th century, contractual exposures between banks occurred mainly through correspondent relationships, which from a research perspective have the advantage of being readily observable and without the complexity of many types of modern contractual exposures.[2] Furthermore, because banks and their correspondents were typically located in different cities for regulatory reasons, we can isolate the effects of the contractual relationship from local shocks hitting the markets of the bank and its correspondents.[3] For these reasons, it can be easier to identify the role of contractual exposures on interbank liquidity risk in the historical banking system than it is in the modern system.

Most banks maintained deposits with other banks (i.e., their correspondents) for payments and other services, as well as to invest surplus funds or obtain credit. The interbank

[2] As discussed below, most banks deposited funds in other banks, i.e., their correspondents, in exchange for various services and as a source of liquidity. The banks that were the customers of a correspondent bank are commonly referred to as the respondents of the correspondent bank. The correspondent system continues to exist today. However, international banking relationships, and relationships between different types of financial intermediaries, which are not always transparent, have become more important and complex. The relatively straightforward and transparent nature of interbank relationships in the historical period facilitates study of network risk and contagion during the Great Depression.

[3] Legal restrictions on branching (including a total prohibition in most states) encouraged banks to contract with banks in other cities because most banks were restricted to a single office location. The structure of reserve requirements on deposits before 1914 also promoted expansion of the interbank system by permitting banks to use deposits placed in national banks in designated reserve cities to satisfy a portion of their reserve requirements.

system had a “core-periphery” structure, with large banks in New York City, Chicago and other major cities at the core of a system comprised of local, regional and national nodes connecting banks across the country (James and Weiman 2010). Most banks had at least one correspondent in New York or Chicago, and often one or more correspondents in other cities.

Correspondent relationships were both a source of liquidity risk and a means of mitigating liquidity risk. Ordinarily, funds deposited in correspondent banks were a liquid asset that banks could tap as needed. Banks with established connections could also borrow in the interbank market when their own depositors withdrew funds. For example, when faced with deposit withdrawals in 1931-32, Chicago banks borrowed from other banks to replace lost deposits, thus mitigating the need to liquidate assets (Calomiris and Mason 2003). Banks that were better known and had a larger network profile were better able to borrow funds when needed.

However, the interbank market was also a source of liquidity risk, especially for banks that relied heavily on interbank deposits as a funding source. Funds that a bank deposited in a correspondent were an asset of the depositing bank but a liability of the correspondent. Those deposits could be withdrawn suddenly, and often were withdrawn during panics, putting the correspondent bank in an illiquid position.

The interbank network dissipated seasonal needs and minor liquidity disturbances across the system, but large shocks that overwhelmed the ability of correspondent banks to provide liquidity resulted in nation-wide banking panics.[4] Several major panics occurred in the 19th and early 20th centuries, and the liquidity risk associated with interbank deposit withdrawals was an

[4] Acemoglu, et al. (2015) provide a theoretical framework for studying the network’s role as a shock propagation and amplification mechanism, and show that a densely connected network enhances financial stability when shocks are small, but beyond a certain point, dense interconnections amplify shocks and increase instability. Other papers that discuss the “robust-yet-fragile” aspects of interconnectedness include Allen and Gale (2007) and Gai, Haldane and Kapadia (2011).

important magnifier of distress during those panics (Calomiris and Carlson 2016, 2017; Calomiris and Gorton 1991; Wicker 2006). Congress sought to eliminate panics by establishing the Federal Reserve System in 1913. The System's founders expected that the Fed would greatly reduce the size and importance of the interbank network, which they saw as a conduit for instability. However, interbank deposit exposures remained large in the aggregate, making up almost $4 billion, or 6.5 percent of total banking system assets in 1929, and thus were potentially a major source of risk to the banking system.

Studies of local panics at the beginning of the Great Depression find that correspondent relationships contributed to contagion, as did close geographic proximity to distressed institutions (Heitfield, Richardson and Wang 2017; Wicker 1996). However, in a broader study of bank failures during the Depression, Calomiris and Mason (2003) found no evidence that the volume of a bank's interbank deposit liabilities affected its failure risk, though the authors did not explore the impact of bilateral network connections. More recently, Mitchener and Richardson (2019) find that withdrawals of interbank deposits caused banks in major cities to contract their loans and other assets, and that those withdrawals were often correlated with bank suspensions in the surrounding Federal Reserve district. Further, Das, Mitchener and Vossmeyer (2018) find that greater connectedness to the interbank network (reflected in eigenvalue centrality) increased the odds that a bank would close during the Depression, but that a larger contribution to network systemic risk lowered the likelihood of closing. However, neither Das, Mitchener and Vossmeyer (2018) nor other studies examine whether or how contagion among related banks (either geographically or through explicit connections) affected survival probability over the course of the Depression. One of the main contributions of our paper is in showing that contagion occurred through contractual relationships in the interbank network, and did so in both directions (i.e., from distressed correspondents to their respondents, and from distressed respondents to their correspondents), as well as through geographical proximity to distressed banks.[5]

Given the severity of liquidity risk in magnifying failures during the Depression, we also consider how the establishment of the Federal Reserve System might have altered banks' incentives to manage liquidity risk associated with their position in the interbank network. Based on aggregated data, Carlson and Wheelock (2018) find that national banks generally were less liquid during the 1920s than they had been in the 20 years before the Fed was established. Here, we probe the cross-sectional variation in individual banks' liquidity holdings to see how the Fed's presence affected management of network liquidity risk by correspondent banks.

Our study relies on newly digitized data on the entire U.S. interbank network on key dates before the establishment of the Fed (1910), soon after the Fed was founded (1919) and on the eve of the Great Depression (1929). Most banks had multiple correspondents located in major cities outside their local market (very few banks had any correspondents in their local market). Using information about the identities and performance of each bank's correspondents, as well as the bank's own balance sheet and local market, we study the impact of interbank contagion on bank closure risk and the effect of the founding of the Fed on bank management of network liquidity risks.

Our results indicate that contagion through network ties was a significant source of banking instability during the Great Depression. Controlling for various balance sheet characteristics that are commonly associated with the probability of failure as well as location-specific closure risks, we find that a bank's probability of closing during the Depression was

[5] For interested readers, the Appendix provides a detailed review of the literature on bank distress during the Depression and its potential relationship to liquidity risk through interbank contagion.

higher when a higher percentage of its correspondents closed. A bank would lose access, at least temporarily, to funds it had on deposit in correspondents that closed, and the outright failure of a correspondent could permanently impair a bank's assets, leading to the bank's own downfall. We also find that closures of respondent banks increased a correspondent bank's closure risk. Although having multiple respondents probably mitigated liquidity risk in normal times, it likely had the opposite effect when a major banking panic or other adverse shock caused all of a correspondent bank's depositors to withdraw their funds simultaneously. We find persistence in these effects: respondent bank closures in one year had a significant negative effect on the stability of their correspondent banks in the subsequent year.

To examine how the founding of the Fed affected banks' management of network liquidity risks, we identify two separable aspects of network relationships that affected liquidity risk in the pre-Fed era, consistent with the fact that network relationships could be either a source of liquidity risk or a means of mitigating liquidity risk. One aspect (the amount of deposits due to respondents) created liquidity risk, and the other (the total number of respondents, which we interpret as a measure of the bank's reputation and creditworthiness within the network, and thus its ability to access resources) ordinarily mitigated liquidity risk. After controlling for the amount of deposits due to respondents, which would tend to increase risk, the size of a bank's respondent network should usually mitigate liquidity risk. We find that before the Fed was established, both aspects affected how correspondent banks managed their portfolio risk and leverage. Greater exposure to interbank deposits encouraged banks to increase their capital ratios, while more network relationships (holding constant the amount of interbank deposits) led them to hold lower cash and capital ratios.

By contrast, shortly after the founding of the Fed, correspondent banks appear less sensitive to network liquidity risk. We find that both aspects of network connections had much less impact on banks' risk management decisions in the years after the Fed's founding, suggesting that expected access to liquidity from the Fed reduced cross-sectional differences in perceived liquidity risk for correspondent banks, which likely heightened contagion risk through the interbank network. In essence, the founding of the Fed provided a perception of liquidity risk insurance against the sorts of shocks associated with banking panics in the National Banking era, and in so doing weakened the incentives for correspondent banks to guard against interbank liquidity risks by holding more capital or liquid assets. Ultimately, the Fed failed to provide sufficient liquidity to prevent contagion during the Great Depression, and thus did not fulfill the promise of the System's founders or the expectations of banks that the Fed would insure them against liquidity shocks.[6] Our findings thus contribute new information about how the interbank network contributed to banking system instability during the Great Depression.

The paper proceeds as follows: Section 2 describes the data that we use to measure closure and bank contagion. Section 3 provides the results of the empirical analysis of bank closure. Section 4 examines ex ante perceptions of liquidity risk related to the network prior to the Depression and shows the risk-creating consequences of the Fed's founding on banks' portfolio and leverage decisions. Section 5 concludes.

[6] On the Fed's failure to provide adequate liquidity during the Depression, see Friedman and Schwartz (1963), Richardson and Troost (2009), or Bordo and Wheelock (2013).

2. Data

Our study examines closures of national banks during the Great Depression.[7] Although national banks represented just 30 percent of all U.S. commercial banks in 1929, they held nearly 44 percent of all U.S. bank assets (Board of Governors 1959). We focus on national banks because they faced a common regulatory regime throughout the United States and because *Annual Reports of the Comptroller of the Currency* provide comprehensive end-of-year balance sheets for every national bank. State-chartered banks were subject to various state-specific regulations, and many states did not report consistent or comprehensive balance sheets for individual banks.[8] We digitized year-end balance sheets for all national banks from 1929 through 1934.[9]

We identified the interbank connections of every national bank as reported in the January 1929 edition of *Rand McNally Bankers' Directory.* The *Directory* provides a complete list of banks in the United States as well as each bank's "principal correspondents."[10] Although the *Directory* does not define "principal correspondents," the evidence suggests that it lists each

[7] National banks are banks with federal charters (as opposed to banks with charters issued by individual states). We define a closure as any event that extinguishes a bank charter, including a failure that results in a bank being placed into receivership and liquidated or merged with another bank, a voluntary liquidation, or a charter conversion, e.g., a conversion from a state-chartered to a federally-chartered (national) bank. During the Depression, almost all closures were associated with financial distress, whether they were failures, mergers or voluntary liquidations. Importantly, however, we do not treat temporary bank suspensions as closures.

[8] Das, Mitchener and Vossmeyer (2018) use balance sheet data as reported in *Rand McNally Bankers' Directory* for both national and state banks in their study of bank survivorship during the Great Depression. However, the balance sheet data reported in Rand McNally for earlier years are more highly aggregated than the data in the *Annual Reports of the Comptroller of the Currency*. In particular, *Rand McNally* does not report information on interbank deposits, which is required for our analysis of how the founding of the Fed changed banks' management of network liquidity risk. Hence, we focus on national banks throughout our study and use balance sheet information as reported by the Comptroller.

[9] We drop a few banks that had extreme values as they were likely to be typos in the original document or new banks that had not started business.

[10] Directories include listings of private (i.e., unchartered) banks, and bank branches as well as commercial banks, mutual savings banks and institutions, and trust companies. We focus on chartered depository institutions and as such omit (1) private banks (i.e., financial institutions with no charters or regulation) because they typically were small and did not always take deposits, and (2) bank branches because they either mimicked their head office's correspondents or did not list any. We also omit the few banks (i.e., generally less than 1 percent of banks) that did not list any correspondents as we are unsure whether the data are missing or that they had no correspondents.

bank's largest and most important correspondents.[11] By identifying the correspondents of every bank, the information allows us to identify every correspondent bank's respondents and thus observe both sides of the interbank network. For our analysis of pre-Depression changes in bank risk management in Section 4, we use similar data on network structure and balance sheets for 1910 and 1919 from the same sources.

We use the list of "Discontinued Banks" in the January 1935 edition of *Rand McNally Bankers' Directory* to determine if and when each state and national bank closed. The list describes every change in a bank's status and the year of occurrence from 1929 through 1935. This allows us to avoid conflating temporary closures, location changes, or changes in name with terminal bank closures, and provides a consistent source of information for all banks.

3. Interbank Connections and Closure Risk During the Great Depression

We estimate limited dependent variable models to examine the role of contagion on bank closure risk during the Great Depression. The models include balance sheet and other bank-specific information, as well as information about the market in which the bank operated. To capture possible contagion, we include the fractions of a bank's correspondents and respondents that closed, as well as the fraction of other national banks in the bank's local market (i.e., county) that closed. If contractual contagion was important, we expect that a bank was more likely to close, the larger the fractions of its correspondents or respondents that closed. Banks lost access, at least temporarily, to their deposits in a correspondent that closed. Although a bank might eventually regain access to some or all of those funds, the abrupt closure of a correspondent could impair a bank's assets and threaten its own survival. Similarly, a correspondent bank

[11] From the few surviving archival records that contain full correspondent information for comparison, we determined that by 1900 the correspondent lists in *Rand McNally* cover the vast majority of funds placed in correspondents.

would lose the deposits of any of its respondents that closed and entered liquidation, and could experience substantial outflows of respondent deposits before closure as the respondents withdrew funds to meet their own deposit outflows. We expect the effect of respondent closures to be immediate and long lasting because banks would likely never regain deposits lost with the closure of respondents, whereas the effect of correspondent closures should be immediate but not permanent because respondent banks would eventually recover at least some of the funds they had on deposit with correspondents that closed.

Because the vast majority of correspondents and respondents of national banks were located in cities outside the bank's local market (i.e., county), the estimated effect of interbank closures reflects contractual connections between banks rather than a spurious correlation caused by exposure of related banks to common local shocks. We show below that the network contagion results remain when we drop from the sample the few within-market interbank network connections that existed.

Contagion might also occur from closures of nearby, but otherwise unrelated, banks. We include the percentage of other national banks in a bank's local market that closed as an additional independent variable. We expect that a bank was more likely to close when a higher percentage of other within-market banks failed. Obviously, a correlation between local bank closures might reflect common local shocks, though it could also reflect local panics or other manifestations of contagion. However, including this variable in our regressions provides further assurance that the effects of correspondent and respondent closures do not simply reflect common local shocks.

We also include logarithms of the numbers of the bank's respondents and correspondents (in 1929) as independent variables. Having more correspondents might provide a bank with more potential sources of funds if needed. The likely effect of having more respondents is less clear, and likely depended on the size of shocks hitting the banking system. Ordinarily, having more respondents could mitigate risk for a correspondent bank because the seasonal and other demands for funds from the bank's respondents were typically not highly correlated (Carlson and Wheelock 2018). However, a large common shock – like the massive, nationwide liquidity shocks that struck during the Great Depression – could put a great deal of pressure on correspondent banks with a large number of respondents all clamoring for funds at the same time. Thus, while a larger number of respondents might have mitigated liquidity risk arising from correspondent deposits in the pre-Depression era, it might not have done so during the Depression.

Making use of the detailed interbank data, we also control for the composition of a bank's interbank connections. Because the failure rate of national banks was lower than that of state-chartered banks, we hypothesize that banks fared better when more of their correspondents were national banks; hence, we include the fraction of a bank's correspondents that were national banks. Similarly, banks with correspondents in Federal Reserve cities might have had better access to liquidity provided by the Fed. To test this, we include the fraction of a bank's correspondents in cities with a Federal Reserve Bank or branch office.[12]

In addition to variables meant to capture aspects of interbank connections, we include various balance sheet measures that have often been found to be correlated with the probability of a bank's failing or being acquired. These include the logarithm of a bank's assets, its loans-to-assets ratio, capital-to-assets ratio (i.e., the sum of paid in capital, surplus, and undivided

[12] In unreported regressions, we decompose the Fed effect into cities within the bank's Fed district, central reserve cities (i.e., New York, Chicago, and St Louis) as distinct from other Fed cities, and looked at the geographic diversity of correspondents. The results in each case are statistically insignificant when the other controls are included.

profit/total assets), and cash-like-assets-to-total-deposits (i.e., cash in vault, due from banks, and due from the Fed)/(individual deposits and due to banks).[13] We also include the logarithm of bank age. Consistent with previous studies across many different periods including the Great Depression, we expect that older and larger banks, those with a lower ratio of loans-to-assets, and those with higher capital-to-assets or higher cash-like assets-to-total deposits, were less likely to close.[14]

Finally, we include variables that control for aspects of the bank's location and market. Using the Census of Population data from Haines (2004), we include the 1930 population and urbanization rate of the bank's county as controls for the local demand for deposits and loans. We control for other aspects of a bank's market by including the logarithms of the number of other national banks and state banks in the bank's county in 1929, and indicator variables for whether the bank was located in a city with a Federal Reserve Bank or branch office, and denoting its Fed district. These types of factors were likely important over the course of the Great Depression when many local waves of bank closures occurred.

We first estimate a cross-sectional probit model where the dependent variable is an indicator variable that takes the value 1 if the bank closed between January 1, 1930 and December 31, 1934.[15] The model takes the form:

[13] Individual deposits refer to deposits of firms, households and state and local governments, i.e., deposits other than those of other banks.
[14] Historical studies include White (1984), Calomiris and Mason (1997, 2003), Heitfield, Richardson and Wang (2017), and Wheelock and Wilson (2000), the latter of which examines the determinants of closing via merger as well as by failure.
[15] We find qualitatively similar results when using a linear probability or Cox proportional hazard model. Only the effect of correspondent closures losses its statistical significance if we exclude bank closures in 1933 or 1934.

$$Closure_{i,c,1929-34} = a + \beta_1 CorrClosures_{i,1929-34} + \beta_2 RespClosures_{i,1929-34} + \beta_3 Interbank_{i,1929} + \beta_4 NBClosures_{c,1929-34} + \beta_5 BalSheet_{i,1929} + \beta_6 X_{c,1930} + FedDist_c + s_s + e_{i,c} \quad (1)$$

$Closure_{i,c,1929-34}$ is an indicator variable for whether bank *i* in county *c* closed between 1929 and 1934. $CorrClosures_{i,1929-34}$ is the fraction of bank i's correspondents that closed by 1934. $RespClosures_{i,1929-34}$ is the fraction of bank i's respondents that closed by 1934, $Interbank_{i,1929}$ is a vector of interbank variables (observed in 1929) including the logarithm of the number of respondents, the logarithm of the number of correspondents, the fraction of correspondents that were in a Federal Reserve Bank or branch office city, and the fraction of correspondents that were national banks.[16] $NBClosures_{c,1929-34}$ is the fraction of other national banks in county *c* that closed by 1934. $BalSheet_{i,1929}$ is a vector of balance sheet characteristics (observed in 1929), which includes the logarithms of assets and bank age, as well as loans-to-assets, capital-to-assets, and cash-like assets-to-total-deposits. $X_{c,1930}$ is a vector of county and city controls (observed in 1930) that includes the logarithm of county population, the fraction of county population located in cities with more than 2,500 persons, the logarithms of other national banks and state banks in the county, and dummies for whether the bank was located in a Federal Reserve Bank or branch office city. $FedDist_c$ is a vector of Fed District-fixed effects. s_s is a vector of state-fixed effects. $e_{i,c}$ is the error term clustered by county.

Table 1 presents summary statistics for the variables used in the regression broken down by the bank's outcome. The data indicate that the means of all of the variables included in the model are significantly different between surviving and closing banks. On average, banks that

[16] We add 1 to the numbers of respondents and correspondents before taking logs because many banks had no respondents. The results are similar if we were to use the levels or drop the variables from the model.

survived the Depression were larger and older than banks that closed. Survivors also tended to have higher ratios of capital-to-assets and cash-like-assets-to-total-deposits, and lower ratios of loans-to-assets in 1929 than banks that closed. Thus, as White (1984), Calomiris and Mason (2003), and Das, Mitchener and Vossmeyer (2018) show, banks that had more balance sheet risk *ex ante* were more likely to fail (or otherwise close) during the Great Depression.

The summary statistics also show that on average, banks that survived the Depression had substantially smaller fractions of correspondents and respondents that closed. Although survivors also had more total respondents and correspondents, the differences in the mean values of those totals between survivors and closing banks are quantitatively small. In other words, network connections *per se* were not a differentiating attribute of troubled banks, but connections to *distressed* banks increased closure risk for connected banks. Survivors also tended to have higher percentages of national banks among their correspondents, and more of their correspondents were located in Fed cities.

Table 2 presents estimation results (i.e., marginal effects) for equation (1). The coefficients on the balance sheet variables have the expected signs. As suggested by the comparison of mean values, larger banks and those with smaller ratios of loans-to-assets and higher ratios of cash-like-assets-to-total-deposits and of capital-to-assets were more likely to survive the Great Depression.

In addition, banks were more likely to close when larger fractions of their correspondents or respondents closed, and when a larger fraction of other national banks in their local market closed. Quantitatively, the effects of local bank closures and respondent closures are somewhat larger than the effect of correspondent closures. We estimate that a one standard deviation increase in the fraction of local closed national banks (i.e., 0.321) increased the probability of closure by 4.9 percent, and a one standard deviation increase in the fraction of closed respondents (i.e., 0.238) increased closure probability by 3.5 percent. A one standard deviation increase in the fraction of closed correspondents (i.e., 0.235) increased the probability of closure by 2.2 percent.

The ordering of the size of effects is as expected. Closures within a county pick up local fundamental shocks and panics that occurred throughout the period and eliminated large numbers of banks in particular locations. Respondent closures would have almost immediately and likely permanently stripped banks of deposits as their respondents were liquidated. By contrast, the closure of a correspondent would tie up a bank's asset temporarily but most banks ultimately received much of their funds in closed banks back after the liquidation process was completed.

The possibility of assortative matching in the risk profiles of respondents and correspondents might raise concerns about our results. Is it possible that riskier respondents tended to pair with riskier correspondents? If so, then covariation in closure rates between respondents and correspondents might reflect unobserved heterogeneity that is not captured by our control variables, rather than the transmission of shocks through the network. However, previous studies do not indicate any motivation for assortative matching among connected banks. Studies such as Paddrik, Anderson, and Wang (2019) and Jaremski and Wheelock (2018) show that the network connections between respondents and correspondents were driven by common legal requirements imposed by state and federal regulations and the structure of the Federal Reserve System rather than idiosyncratic bank-specific choices. Interbank connections tended to be long-established and tied to financial centers, and their main purpose was to transfer deposits (seasonally) from peripheral banks to financial center banks. Second, interest rates on interbank deposits were quite similar across banks (typically 2%) and fixed by local clearinghouses (see

Turner 1931), suggesting that there was no assortative matching according to risk in the deposit market.

Our empirical analysis of network contributors to closure risk controls for observable characteristics of banks, and the control variables can be used to investigate whether the closure risks of respondents and correspondents (as predicted by our control variables) are correlated. Using the full set of variables in column (2), the correlation between predicted closure of banks and their correspondents is 0.2318. However, much of that correlation is due to matching on size (total assets) rather than on portfolio risk as reflected in the balance sheet ratios chosen by banks as part of their risk management decisions. Using just the three balance sheet ratios to predict closure, the correlation in predicted closure of banks and their correspondents is –0.01. In other words, there is no evidence that risk management choices of correspondents and respondents are correlated. That finding indicates further that assortative matching is not likely to be a significant factor in our sample.

The results reported in Table 2 suggest a role for local and interbank contagion, but do not address the timing of closures. Therefore, we next take advantage of the time-series variation in the data to estimate a panel probit model of the form:

$$\begin{aligned} Closure_{i,c,t} = {} & a + \beta_1 CorrClosures_{i,t} \\ & + \beta_2 RespClosures_{i,t} + \beta_3 Interbank_{i,1929} + \beta_4 NBClosures_{c,t} \\ & + \beta_5 BalSheet_{i,t-1} + \beta_6 X_{c,1930} + FedDist_c + FedDist_c * t_t + s_s + t_t \\ & + e_{i,c,t} \quad (2) \end{aligned}$$

where $Closure_{i,c,t}$ is an indicator variable for whether bank *i* in county *c* closed in year *t*, $CorrClosures_{i,t}$ is the fraction of bank *i*'s correspondents present in 1929 that closed in year *t*, $RespClosures_{i,t}$ is the fraction of bank *i*'s respondents present in 1929 that closed in year *t*,

$NBClosures_{c,t}$ is the fraction of other national banks in county *c* in 1929 that closed in year *t*, $BalSheet_{i,t-1}$ is the vector of balance sheet statistics for bank *i* at the end of the previous year (*t-1*), t_t is a vector of year fixed effects, and the other variables retain their previous definitions. We add the interaction between the Fed District dummies and the time fixed effects to control for potential differences in discount window policies of the Reserve Banks as documented by Richardson and Troost (2009) as well as the regional shocks that could have affected different parts of the country.

Table 3 presents results of the panel probit regression in equation (2). The pattern of coefficients is similar to those in Table 2. Closure probability is significantly and negatively influenced by bank size and the ratio of cash-like-assets-to-total-deposits, and is significantly and positively influenced by the ratio of loans-to-assets.

Focusing on our measures of contagion risk, the coefficient on the fraction of other national banks in the market that closed as well as those on the fractions of correspondent and respondent closures remain positive and statistically significant. The panel aspect of our sample allows us to capture the timing of events and make use of closures that occurred well before a subject bank's closure. As would be expected, the effects of closures are always largest within the same year, but the coefficients on within-county and respondent closures in the previous year are also statistically and economically significant. This shows that banks not only suffered from the immediate hardship of connected closures, but they also continued to be negatively influenced a full year later. The lack of a similar lagged effect on correspondents also makes sense; banks that survived the initial shock of a correspondent bank's closure usually would eventually gain much of their funds back as their correspondent was liquidated. This asymmetry in persistence is helpful for confirming that interbank closures mattered *per se* rather than spuriously as the result of some other influence that is correlated with network connections (such as assortative matching).

Having shown that correspondent closures and local bank panics contributed to bank closures during the Great Depression, we next examine, in Table 4, local contagion that could flow through interbank connections. Specifically, we test whether panics were transmitted between markets through the interbank network. We do this by calculating the fraction of national banks that closed in the counties where a given bank's correspondents and respondents were located.[17] Because the year fixed effects should control for any nation-wide panics that affected all banks and the Fed district-by-year interactions capture broader regional panics, including the fraction of banks that closed in the correspondent's or respondent's location captures any impact of distress in the counties of a bank's correspondents and respondents. The results indicate that a high rate of closures in the counties of a bank's correspondents and respondents increased a bank's closure risk. The evidence thus indicates that interbank network connections transmitted local shocks to other areas.

Although most banks used correspondents in distant cities for check clearing and indirect access to the Fed's discount window, a handful of banks had more local correspondent or respondent connections. In these few cases, the closures among correspondents and respondents might reflect local common influences, including local banking panics. Thus, we reestimated equation (2) after dropping out any correspondent or respondent links within the same county as the observed bank. The results in Table 5 are very similar to those previously reported. When we exclude connections between banks located in the same county, both correspondent and respondent closures still have a positive and significant effect on a bank's closure probability.

[17] The variable is labeled "Correspondents' Fraction of Other National Banks in County that Closed in Year."

Hence, local shocks are not responsible for our finding that formal interbank relationships transmitted shocks between banks.

While correspondent and respondent closures increased a bank's probability of closing, they could have also affected bank balance sheets. Consequently, the closure regressions could underestimate the total effect of interbank closures on bank closure risk due to the inclusion of balance sheet controls. Therefore, we examine the impacts of correspondent and respondent closures on the balance sheets of surviving banks to gauge further the effects of contagion spread through the interbank system. We also include within-county bank closures in our model, which captures some combination of time-varying location-specific loan risks and location-specific closure contagion. Focusing on the set of banks that survived from 1929 through 1934, we have sufficient observations to include bank-fixed effects to capture characteristics of the bank that are constant over time. We estimate the following regressions:

$$\Delta Y_{i,c,t} = a + \beta_1 CorrClosures_{i,t} + \beta_2 RespClosures_{i,t} + \beta_3 NBClosures_{c,t} + u_i + FedDist_c * t_t + t_t + e_{i,c,t} \quad (3)$$

where $\Delta Y_{i,c,t}$ is a vector consisting of the change in the logarithm of assets, loans, cash-like assets, capital, and total deposits, u_i is a vector of bank-fixed effects, and the rest of the variables retain their aforementioned definitions.

The estimates reported in Table 6 show that surviving national banks gained deposits and assets when neighboring banks closed, lost deposits and assets when more of their correspondents closed, and experienced no change in deposits and assets as the result of their respondents closing. Thus, while an increase in the number of local bank closures tended to increase a bank's own probability of closing, closures of other banks in the market tended to increase the size of banks that did not close. Surviving banks likely gained customers, and thus assets and deposits, from banks that closed, either by acquiring distressed banks or as customers of those banks moved their deposits to healthier banks. On the other hand, the decline in assets that banks experienced when their correspondents closed likely forced some to reduce loans to their own customers.[18]

4. Imprudence in Post-Fed Liquidity Risk Management by Correspondent Banks

The high incidence of bank distress during the Great Depression is prime evidence that the Fed did not prevent the sorts of liquidity crises that had plagued the interbank system during the National Banking era.[19] Although panics were not the principal cause of most bank failures during the Depression (Calomiris and Mason 2003), our regression evidence indicates that contagious liquidity shocks were transmitted through the interbank system and heightened bank distress. The Fed should have, and apparently did reduce risks associated with seasonal variation in reserve supply and demand, and thereby largely eliminate seasonal volatility in interest rates and stock returns (Miron 1986; Bernstein et al. 2010; Calomiris 2013; Carlson and Wheelock 2018). The successful elimination of seasonal money market pressures and the absence of significant banking crises during the Fed's first 15 years likely encouraged banks to hold less liquidity themselves and instead rely on the Fed in times of need (Carlson and Wheelock 2018). Further, the Fed's presence should have reduced perceived liquidity risk in the interbank network and thereby encouraged correspondent banks to take on more balance sheet risk as expressed, for

[18] The finding complements Mitchener and Richardson (2019), who find that withdrawals of interbank deposits led to reduced lending by correspondent banks.

[19] Numerous studies have examined why the Fed did not live up to the promise of its founders. Friedman and Schwartz (1963) argue that the Fed should have done more to prevent the Great Depression, contending that the Fed could have employed both open market operations and discount window lending to increase the money supply, reduce the contraction in nominal income and prices, and prevent the financial distress of many bank borrowers from causing bank distress. Meltzer (2003) shows that the Fed leadership failed to understand the difference between low nominal interest rates and low real interest rates, and mistook the abundance of excess reserves as a sign of monetary slack when in fact it was caused by banks' scramble to shore up their positions in the face of monetary contraction and increasing financial distress. Bordo and Wheelock (2013) point to flaws in the discount window mechanism in the Federal Reserve Act.

example, by lower ratios of capital-to-assets and liquid-assets-to-total-deposits, defined as (cash items + due from banks and Fed + bonds + stocks)/total deposits. If correspondent banks did lower their guard in response to the introduction of a lender of last resort, then the Fed's mistakes during the Depression were compounded by banks' *ex ante* belief that the Fed would be a reliable source of liquidity.

We investigate how the Fed's establishment might have altered perceptions of risk in the interbank system by focusing on the behavior of correspondent banks, which were central to managing liquidity risk in the banking system. We identify two cross-sectional characteristics of correspondent banks that affected the extent of their liquidity risk prior to the Fed, and measure the influence of those characteristics on capital-to-assets and liquid assets-to-total deposits ratios after the Fed was established.

Our first measure of liquidity risk is the ratio of deposits due to banks to total deposits. Correspondent banks with higher due to ratios should have maintained higher capital-to-assets ratios, higher liquid-assets-to-total-deposits ratios, or both, *ceteris paribus* as protection against respondent withdrawals. After the founding of the Fed, if correspondent banks believed that the Fed had reduced systemic risk, then those with higher due to ratios would have reduced their capital or liquidity ratios (or both) compared with their levels in 1910.

Whereas a bank's network liquidity risk would be positively correlated with a higher ratio of deposits due to banks relative to total deposits, having a large number of connections to other banks would generally lower liquidity risk through diversification so long as the shocks hitting the bank's respondents were not perfectly correlated. Thus prior to the large common shock experienced during the Depression, more connections should have reduced liquidity risk for a given ratio of deposits due to banks-to-total deposits. Of course, the number of connections a bank has is potentially endogenous. Banks with more connections might have been better known, more diversified in their liquidity risk, or considered more reputable (i.e., the number of respondents should reflect the reputation of the correspondent bank). Therefore, we expect that, controlling for the due-to-banks-to-total-deposits ratio, more respondent connections should be associated with less liquidity risk.

If the number of respondents reflects a stronger reputation or a more diverse network of respondents, then banks with larger respondent networks might have been able to maintain lower capital-to-assets or liquid assets-to-total deposits ratios *ceteris paribus*.[20] The founding of the Fed might have mitigated cross-sectional differences in capital and cash ratios that previously had reflected the need to respond to liquidity risk. If correspondent banks believed that the Fed's founding had reduced systemic risk, then those with lower (higher) numbers of respondents would have reduced (increased) the relative sizes of their capital-to-assets and liquid-assets-to-total deposits ratios (after removing the average year effect). Furthermore, average year effects for the capital-to-assets and liquid-assets-to-total deposits ratios would be declining over time if banks believed that the establishment of the Fed reduced systemic risk.

We carry out the analysis in two steps. First, we construct a cross-sectional dataset consisting of balance sheet and respondent data for banks in 1910 (before the founding of the Fed), in 1919 (after the Fed's founding) and at the end of 1928 (just prior to the Great Depression). This approach allows us to make use of the data we collected on interbank network information for those years. However, with the limited number and decadal spacing of

[20] Because the number of respondents is potentially endogenous (an increasing function of) lower risk, it is also possible that more respondents could be correlated with higher capital ratios or higher liquid asset ratios. In our empirical analysis, however, the opposite is true, indicating this reverse causality is not apparent. More respondents, *ceteris paribus*, is associated with lower capital and cash ratios. That negative covariance indicates that unobservable characteristics about the correspondent bank (a better reputation or a more diverse network of respondents) drive the negative association between the number of respondents and the capital and liquid asset ratios.

observations one cannot determine the exact timing of any changes within each decade. The small number of observations per bank (many banks only appear once or twice in the sample) also precludes us from including bank fixed effects in our regressions. Because of these deficiencies, we also examine an annual panel of banks from 1910 to 1920.[21] This approach allows us to identify better the timing of the shift in correspondent bank balance sheets and also to include bank-fixed effects to control for constant bank and location characteristics. Because we lack information on bank network connections for years other than 1910 and 1919, in this second analysis we hold the structure of interbank connections fixed at their 1910 values.[22]

The cross-sectional model is:

$$Z_{i,c,t} = a + \beta_1 Respondents_{i,c,t} + \beta_2 Respondents_{i,c,t} * Post - 1910_t + \beta_3 DuetoBanks_{i,c,t} + \beta_4 DuetoBanks_{i,c,t} * Post - 1910_t + \beta_5 X_{c,t} + s_i + t_t + e_{i,t} \quad (4)$$

where $Z_{i,c,t}$ is either the capital-to-assets or liquid-assets-to-deposits ratio, $Respondents_{i,c,t}$ is a vector of indicator variables for whether the bank *i* had 0 respondents (excluded group), 1-15 respondents, 16-100 respondents, or more than 100 respondents in year *t*, $Post - 1910_t$ is an indicator variable for years after 1910 (i.e., in this sample, this refers to 1919 and 1929, which cover dates after the Fed was in operation), the rest of the variables retain their previous definitions, and s_i is a vector of state-fixed effects.[23] The levels of our two interbank risk variables provide measures of the effect of each across all periods, whereas the interaction between the variables and the *Post* – 1910 indicator tests whether banks behaved differently after the Fed was established. We include state fixed effects to control for location characteristics, but

[21] We end the panel in 1920 rather than continuing through 1929 to better identify the effect of the Fed and rule out other changes that took place in the 1920s.
[22] The results are similar if we use the 1919 interbank values instead.
[23] We chose the cutoff points for numbers of respondents based on the underlying distribution of the data. The results are not sensitive to picking different bins for the number of respondents or to using the log number of respondents instead. They are also not sensitive to holding the number of respondents and due to banks fixed at their 1910 values.

allow banks to vary over time in the size of their respondent networks. Moreover, in some specifications, we include the interactions between region fixed effects and time fixed effects to capture any differential changes in risk that resulted over the period, such as WWI-related location specific risks that may have mattered for bank liquidity management (see Calomiris and Jaremski 2019, and Jaremski and Wheelock 2019).

The results for the decadal sample, reported in Table 7, support our hypotheses about liquidity risk perceptions before and after the Fed's establishment. Results in the first two columns pertain to the capital-to-assets ratio for all three decades. The coefficient on the due-to-banks-to-total-deposits ratio of 0.093 in the first column indicates a positive impact of the ratio on Capital/Assets. The effect reversed in 1919 and 1929, however, with the total effect being –0.023 (i.e., 0.093 – 0.116). The introduction of region-by-time fixed effects in the second columns reduces the coefficients but the total negative effect remains similar. Moreover, the results are similar for the panel estimates reported in the third and fourth columns, which are based on data for just 1910 and 1919.

Whereas we find a positive impact of deposits due to banks to total deposits on Capital/Assets in 1910, we find having more respondents was associated with lower Capital/Assets. The capital-to-assets ratio is lower by 0.018 for banks with 1-15 respondents, by 0.061 for banks with 16-100 respondents, and by 0.101 for banks with 101 or more respondents. After the founding of the Fed, however, the relationship between number of respondents and Capital/Assets disappears. In the first column of the table, the net effect for the 1-15 respondent group is –0.004 (i.e., –0.018 + 0.014), for example. The net effects for those with larger size networks are similarly close to zero. Results reported in other specifications are similar.

Results are also broadly similar for Liquid Assets/Total Deposits. We do not find that banks held more liquid assets as the result of a greater exposure to interbank deposits (the coefficient –0.001 is not statistically different from zero), suggesting that on average banks viewed interbank deposits and other deposits as equivalent when adjusting their liquidity positions. The absence of a relationship between due to banks/total deposits and the liquidity ratio does not necessarily mean that correspondent banks were unresponsive to network liquidity risk, however, because banks could mitigate such risk by holding either more capital or more liquidity. The use of greater equity capital as the means of managing liquidity risk likely reflects the unusually low cost of raising equity in the pre-Depression era which made the raising of additional equity the generally preferred tool for absorbing increased risk (see Calomiris and Wilson 2004; Calomiris and Oh 2018).

For the years after the founding of the Fed, we find that higher ratios of due to banks-to-total deposits are associated with lower liquid-assets-to-total-deposits ratios, again suggesting that the founding of the Fed changed how correspondent banks managed interbank liquidity risk. And, as with Capital/Assets, we observe positive reversals of the negative coefficients in the liquid-assets-to-total-deposits ratio regressions for the effects of respondent network size, as well as significant negative year effects for 1919 and 1929.

The year effects for 1919 and 1929 are negative and statistically significant in all of the regressions without the region-by-year fixed effects, indicating that banks generally held lower capital/assets and liquid assets/total deposits in the years after the Fed was established. This suggests that banks expected the Fed to reduce systemic risk. Reserve requirements on national banks were lowered when the Fed was established and again in 1917. For our broad measure of liquid assets, reserve requirements generally should not bind for banks holding positive liquid assets in addition to reserves at the Fed. In particular, a loosening of reserve requirements might lower reserves held at the Fed, but that effect likely would be somewhat offset by increased holdings of other liquid assets that could not be used to satisfy reserve requirements. However, the negative year effects on liquid assets after the founding of the Fed suggest that banks chose to hold less liquidity after the introduction of the lender of last resort.[24]

In Table 8, we examine an annual panel of banks from 1910 through 1920. This allows us to focus on the timing of the change in bank risk management, and connect it more closely to the founding of the Fed. The annual specification also allows us to control for constant locational and bank characteristics using bank-fixed effects. Specifically, we investigate whether the Fed was responsible for the changing behavior of large correspondent banks by examining whether changes in balance sheet ratios began to occur in 1915.[25] The model is:

$$Z_{i,c,t} = a + \beta_1 Respondents_{i,c,1910} * Post - 1914_t + \beta_2 DuetoBanks_{i,c,1910} * Post - 1914_t + \beta_3 X_{c,t} + u_i + t_t + e_{i,t} \quad (5)$$

where $DuetoBanks_{i,c,1910}$ and $Respondents_{i,c,1910}$ are now based on 1910 values, $Post - 1914_t$ is an indicator variable for all years after 1914 (i.e., those when the Fed was in operation), and the rest of the variables retain their previous definitions. Note that the bank-fixed effects subsume the levels of the bins for number of respondents and due to banks in 1910, and thus these variables do not enter the model separately from the interactions.

The results in Table 8 show that the balance sheet changes observed in Table 7 occurred after the Fed was established rather than in the years between 1910 and 1914. Indeed, the coefficients on the interactions between the interbank measures and the post-1914 indicator

[24] Carlson and Wheelock (2018) find that national banks generally held lower levels of liquid assets in excess of required reserves during the 1920s than they did before 1914.

[25] The Fed began to operate on November 16, 1914. Balance sheet observation for 1914 are from September 12, 1914.

variables are all statistically significant and take the same sign as in the cross-section. Thus, we are sure that our results are not being driven by changes that occurred prior to the Fed's founding. Moreover, the results remain when we include the region-by-year fixed effects, indicating that the effects were likely unrelated to the World War I agricultural price boom whose effects were felt primarily in farming regions (Jaremski and Wheelock 2019).

Overall, these findings lend support to the view that before the founding of the Fed, correspondent banks managed their capital and liquidity in response to network liquidity risks, but that they were less responsive to such risks after the Fed was established. Banks likely expected that the Fed would supply any needed additional liquidity and, hence, that systemic liquidity risk associated with interbank connections had been reduced. Correspondent banks not only reduced their average capital and liquid asset ratios, but they cut them even more if they had large due to banks/total deposits ratios and relatively small numbers of respondents. Thus, the impact of interbank contagion during the Depression was likely magnified by a pre-Depression perception that the Fed's presence had reduced systemic risk.

5. Conclusion

Using newly digitized data that identify all interbank network relationships before and during the Great Depression, we explore how contractual connections among banks affected liquidity risk. We find large effects. Banks whose correspondents closed (making it harder for them to access their own deposits) or whose respondents closed (leading to a sudden permanent loss of deposits) were also more likely to close. In addition, the interbank network transmitted shocks across locations as banks in one location suffered when either their correspondents or their respondents were located in other markets with higher numbers of bank closures.

For liquidity risk to have contributed to bank closures, the amount of risk experienced during the Depression must have exceeded the liquidity risk management precautions that banks had undertaken prior to the crisis. The Depression was an extremely adverse event that produced losses and increased risks that overwhelmed the risk management precautions that banks had undertaken in the form of capital and liquid asset buffers. Compounding the problem, systemically important banks acted as though they expected the Fed to provide liquidity risk insurance that had not existed before the Fed's founding. Before the Fed was established, bank capital and cash ratios varied with cross-sectional differences in the two network influences that we identify as important to their liquidity risk (interbank deposit exposure and number of network connections). Those correlations largely disappeared after the founding of the Fed, suggesting that correspondent banks no longer perceived a need to hold extra capital or liquidity against systemic risk in the interbank network. Thus, when the Fed failed to deliver on the promise of the System's founders that the central bank would end the problem of banking panics, banks were even more exposed to network liquidity risk than they would have been in pre-Fed days. Hence, the response of banks to the creation of a lender of last resort likely made the banking collapse worse than it otherwise would have been. An important lesson from that experience is that lender of last resort policy requires an understanding of the incentives that the policy creates as well as the actual execution of policy when a crisis occurs.

Risks associated with relationships among financial firms remain relevant today, and regulators attempt to take them into account. Banks continue to have direct contractual exposures to one another through a variety of channels, including interbank loans and deposits, commercial loan participations, and derivative contracts, and bank regulators remain concerned about the systemic risk that may result from such contractual exposures. The Dodd Frank Act of 2010 requires regulators to write rules that limit the credit exposures of banks to one another, and new liquidity regulations, such as the Liquidity Coverage Ratio, comprise part of Basel III prudential regulation.[26] The founders of the Federal Reserve System believed that they had eliminated systemic interbank risks in 1914. The Great Depression subsequently proved them wrong. Insights from studies of the Great Depression and other stress episodes can help in the design of policies to limit and contain spillovers associated with counterparty exposures among financial institutions.

[26] See “Fed Set to Cap How Much Big Banks Can Be Each Other’s Customers,” *BNA’s Banking Report* vol. 110, no. 25, June 18, 2018, p. 862.

Appendix: Literature on Interbank Contagion During the Great Depression

On the eve of the Great Depression in 1929, the United States had some 24,970 commercial banks (Board of Governors 1959). By 1934, that number had shrunk to 15,348. The decline was due mostly to failures, voluntary liquidations, mergers, and acquisitions of unhealthy banks.[27] Economists and historians have long been interested in the causes of bank distress during the Great Depression, at least since Friedman and Schwartz (1963) attributed the Depression to banking panics and collapse of the stock of money. One strand of the literature has focused on banking panics, and attempted to determine whether local or national panics caused waves of bank failures that could not otherwise be explained by fundamentals (Temin 1976; White 1984; Calomiris and Mason 1997, 2003; Richardson 2007). Another strand has focused on the causes and consequences of interbank connections in propagating contagion and contributing to the demise of banks or collapse of bank lending (e.g., Heitfield, Richardson and Wang 2017; Mitchener and Richardson 2019). Our paper brings these strands together in a bank-level analysis of how network connections mattered for failure risk, after taking other influences into account.

Temin (1976) challenged the Friedman and Schwartz (1963) interpretation of the events of the Great Depression. He argued that rather than the cause of the Depression, bank failures primarily reflected the collapsing economy. White (1984) and Calomiris and Mason (1997, 2003) provide supporting evidence, showing that fundamental influences were often at the heart of bank failures. White (1984) shows that the pattern of bank failures that occurred during 1930 was similar to the 1920s, when many small, rural banks failed due to weakness in the farm economy. White uses logit regressions to examine the microeconomic determinants of bank

[27] The vast majority of closed banks were either acquired by or merged into other banks. Because most mergers and acquisitions at the time involved distressed banks, we treat any bank whose charter ended as a result of a merger or acquisition as closed, similar to banks that failed and were placed into receivership or that voluntarily liquidated.

failures in the final quarter of 1930 based on failures of national banks and a stratified random sample of non-failing banks from the same cities or local areas. He finds that deteriorating asset values was a primary cause of bank failures, and that the failures in 1930 can be predicted a year in advance with some accuracy, suggesting that the causes of failures in that year were not fundamentally different from those of earlier years. However, he finds that regressions estimated on earlier data do not forecast bank failures in 1931-32 well, suggesting that the later failures had fundamentally different causes.

Calomiris and Mason (1997, 2003) pursue the causes of Depression-era bank failures, first by studying patterns of failures during a banking panic in Chicago in June 1932 (Calomiris and Mason 1997), and then by a detailed microeconomic study of the causes of bank failures from 1930 to 1933 (Calomiris and Mason 2003). In their study of the Chicago panic, the authors estimate logit and hazard models to test various hypotheses about the causes of failures during the panic. Similar to White's (1984) analysis of the banking panic episode of 1930, Calomiris and Mason (1997, 2003) show that both in the case of the Chicago Panic of 1932, and for the nationwide episodes identified as panics by Friedman and Schwartz (1963), bank failures were similar to those occurring outside those windows of time, and are similarly predictable from bank balance sheet and income statement information observable prior to the distress event. They reject the null hypothesis that characteristics of banks that failed during the panic differed from those of banks that failed in other months. The authors conclude that the failures that occurred during panics reflected the relative weakness of those banks in the face of a common asset value shock rather than illiquidity per se or contagion. Calomiris and Mason (2003) find no evidence that deposits due to, or due from, other banks contributed to failure risk. However, that evidence does not distinguish across banks based on their differences within the network (correspondent or respondent banks), differences in the size of their exposures, or interactions between due to and due from (i.e., the "two-sided liquidity risk" emphasized by Calomiris and Carlson 2017). We show that modeling the network and taking these factors into account reveals an important relation between interbank liquidity risk and bank failure risk.

Richardson (2007) revisits the "insolvency versus illiquidity" debate using information about the causes of bank suspensions as recorded by contemporary Fed officials. Whereas White (1984) and Calomiris and Mason (1997, 2003) focused exclusively on national banks or Fed member banks, respectively, because of a lack of balance sheet information about non-member banks, the Fed information used by Richardson reports on suspensions by all types of banks. From those reports, Richardson concludes that both illiquidity and insolvency were substantial sources of bank distress during the Depression. Moreover, the information suggests that contagion played some role in that the closure of a correspondent was the primary cause of nearly 6 percent of suspensions occurring between January 1929 and March 1933. Although this evidence is suggestive, the interpretation of the language used by examiners remains somewhat unclear, and the accuracy of their causal inferences is unknown. Our analysis shows that liquidity risk as measured by network exposures had identifiable consequences for failure risk after controlling for other fundamental influences.

Heitfield, Richardson and Wang (2017) examine further the impact of contagion on bank failures by focusing on the banking panic of 1930, triggered by the collapse of Caldwell and Company, a Nashville based financial holding company (Wicker 1996). The authors estimate hazard models of the determinants of bank failures in three states (Alabama, Mississippi, and Tennessee) during 1930-31. A key feature of their analysis is the inclusion of variables that capture geographic proximity and contractual (correspondent) connections between banks. The study finds that geographic proximity to other failed banks was an important source of contagion causing bank failures. Interbank correspondent connections also were important, though somewhat less so than geographic proximity. These findings are suggestive, but apply only to a subset of banks during a specific period. Furthermore, as Calomiris and Mason (2003) note, geographic attributes per se are easily confounded with location-specific omitted variables.

Other than Heitfield, Richardson and Wang (2017), we are unaware of any direct evidence that specific bilateral interbank connections help explain bank distress during the Great Depression. However, Mitchener and Richardson (2019) find that outflows of interbank deposits contributed significantly to the decline in aggregate commercial bank lending during the Depression. Their evidence shows that the interbank network was a conduit for transmitting economic distress, with suspensions by local banks putting pressure on their city correspondents. It seems likely that the stresses on the system they identify as important for reducing the supply of lending were also a factor in causing failures and suspensions. Until now, however, researchers have been unable to test whether network connections between respondents and correspondents contributed to failures. By digitizing the complete set of correspondent connections among U.S. banks in 1929, we have the data that enable us to test whether interbank connections help explain the disappearance of banks during the Great Depression.

Das, Mitchener and Vossmeyer (2018) construct a detailed bank-level mapping of the interbank network for the Great Depression. Their focus is on estimating the extent to which network attributes of banks, in combination with individual banks' balance sheet characteristics, contributed to systemic risk. Their study provides valuable evidence of the importance of network connections, but differs from our study in several ways. First, and most importantly, we study specific bilateral connections between the failure risks of correspondents and respondents.

In our model, we consider bilateral network influences that should have mattered from the perspective of liquidity risk. We find that having more respondents (which should be correlated with total deposits due to banks) positively affected the risk of closure. We also find that the failure of a correspondent (which should have reduced a respondent's access to liquidity) additionally affected the risk of failure. Das, Mitchener and Vossmeyer (2018) focus on the contribution of network risk to systemic risk, and do not model these sorts of specific influences in the same way. They measure instead each bank's importance in the network (e.g., captured by eigenvalue centrality which treats respondent and correspondent connections the same) and use that attribute to estimate the effect of network influences on failure rates.

Second, in our study, we control for location-specific differences in the riskiness of the loan portfolios of banks. We do so by including location characteristics and measures of local bank failure rates as controls, in addition to measures of bank balance sheet characteristics. We believe that doing so avoids the risk of over-estimating network liquidity risk influences. Das, Mitchener and Vossmeyer (2018) do not include similar local bank closure risk- and location-specific controls, which may affect their estimate of the contribution of network connections to systemic risk.

Finally, we restrict our sample to national banks using data from the official Office of the Comptroller of the Currency reports of their balance sheets. Das, Mitchener and Vossmeyer (2018) include in some of their estimates data for state-chartered banks as reported in *Rand McNally Bankers' Directory*. While Das, Mitchener and Vossmeyer (2018) focus only on the Depression and find in their robustness checks no difference in their main findings when they drop state banks, the balance sheet data for state banks reported in *Rand McNally Bankers' Directory* are less complete and less reliable for the pre-Depression years. Most importantly, *Rand McNally Bankers' Directory* only reports five balance sheet items before the mid-1920s: Paid-in Capital, Surplus, Deposits, (Loans+Discounts+Stocks+Bonds), and (Cash+Exchanges). Without total assets, deposits due to banks, or a separation of loans and discounts from stocks and bonds, we would be unable to carry out our examination of the leverage or liquid assets measures for the pre and post-Fed period. Moreover, Mitchener and Jaremski (2015) find that many states had not yet begun to report official individual balance sheets even as late as 1910, indicating that some of *Rand McNally*'s numbers for earlier years were either missing, estimated, or obtained from communication with each bank itself. As a result, we have chosen to focus on the sample of data that is consistently measured before and during the Great Depression and contains sufficient balance sheet items to estimate the necessary regressions to identify changes in interbank risk-taking after the Fed.

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Table 1: Summary Statistics for Regression Variables

	Closed Banks (N=2,548)		Surviving Banks (N=4,667)		
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Difference**
Ln(Asssets) in 1929	13.73	1.18	13.99	1.17	0.257*
Loans/Assets in 1929	53.7%	14.0%	51.1%	13.6%	-2.70%*
Capital/Assets in 1929	14.5%	5.7%	15.1%	6.0%	0.60%*
Cash-Like Assets/Total Deposits in 1929	18.3%	9.6%	19.5%	10.3%	1.10%*
Ln(Bank Age) in 1929	2.97	0.80	3.12	0.81	0.148*
Fraction of Other National Banks in County in 1929 that Closed By End of 1934	40.4%	34.0%	28.1%	30.2%	-12.3%*
Ln(# of Respondents+1) in 1929	0.41	0.92	0.44	1.01	0.038*
# of Respondents in 1929	4.63	41.35	7.28	76.05	2.65
Ln(# of Correspondents+1) in 1929	1.34	0.34	1.36	0.37	0.016*
# of Correspondent in 1929	3.05	1.57	3.18	2.01	0.13*
Fraction of Respondents in 1929 that Closed By End of 1934	11.1%	26.6%	8.2%	22.0%	-2.90%*
Fraction of Correspondents in 1929 that Closed By End of 1934	19.4%	25.5%	14.5%	22.1%	-4.90%*
Fraction of Correspondents in Fed Reserve Bank or Branch City in 1929	37.5%	30.0%	42.5%	29.1%	5.00%*
Fraction of Correspondents That Are National Banks in 1929	78.7%	26.0%	80.9%	24.5%	2.10%*

Notes: Table provides summary statistics for the variables included in regressions reported in the paper. Dollar values are deflated to 1929 using Officer (2008). The "Difference" column provides the mean difference between surviving and closing banks. * denotes mean differences that are statistically significant at the 10% or greater level

Table 2: Predicting National Bank Closure During Great Depression - Cross-Section (1929-1934)

	Closed Before Dec. 1934	
	(1)	(2)
Ln(Assets) in 1929	-0.098***	-0.099***
	[0.010]	[0.010]
Loans/Assets in 1929	0.256***	0.258***
	[0.054]	[0.054]
Capital/Assets in 1929	-0.534***	-0.524***
	[0.127]	[0.127]
Cash-Like Assets/Total Deposits in 1929	-0.452***	-0.452***
	[0.088]	[0.088]
Ln(Bank Age)	-0.010	-0.009
	[0.009]	[0.009]
Fraction of Other National Banks in County in 1929 that Closed By End of 1934	0.153***	0.154***
	[0.026]	[0.026]
Ln(# of Respondents+1) in 1929	0.012	0.013
	[0.010]	[0.010]
Ln(# of Correspondents+1) in 1929	-0.014	-0.016
	[0.021]	[0.021]
Fraction of Respondents in 1929 that Closed By End of 1934	0.148***	0.148***
	[0.028]	[0.028]
Fraction of Correspondents in 1929 that Closed By End of 1934	0.090***	0.093***
	[0.027]	[0.027]
Fraction of Correspondents in Fed Reserve Bank or Branch City in 1929		-0.048*
		[0.027]
Fraction of Correspondents that are National Banks in 1929		-0.022
		[0.026]
State-Fixed Effects?	Yes	Yes
Fed District Fixed Effects?	Yes	Yes
Location Controls?	Yes	Yes
Observations	7180	7180
R-Squared	0.095	0.095

Notes: The table presents the marginal effects from a probit regression. The dependent variable is an indicator variable equal to 1 for banks that closed by December 1934. Each observation is a national bank present in 1929. "Location Controls" includes the logarithm of county population, fraction of county population above 2,500, the logarithms of other national banks in the county and state banks in the county, and dummies for whether the bank was located in a Federal Reserve Bank or branch city. Robust standard errors clustered by county are presented in parentheses below the coefficients. Dollar values are deflated to 1929 using Officer (2008). * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 3: Predicting National Bank Closure During the Great Depression - Panel (1929-1934)

	Closed During Year			
	(1)	(2)	(3)	(4)
L.Ln(Assets)	-0.252***	-0.283***	-0.245***	-0.275***
	[0.039]	[0.052]	[0.039]	[0.051]
L.Loans/Assets	0.656***	0.748***	0.703***	0.800***
	[0.147]	[0.182]	[0.149]	[0.186]
L.Capital/Assets	-0.143	-0.172	0.017	0.004
	[0.256]	[0.285]	[0.268]	[0.296]
L.Cash-Like Assets/Total Deposits	-1.372***	-1.453***	-1.366***	-1.445***
	[0.202]	[0.225]	[0.205]	[0.227]
Ln(Bank Age)	-0.006	-0.005	-0.022	-0.021
	[0.022]	[0.025]	[0.023]	[0.025]
Fraction of Other National Banks in County in 1929 that Closed in Year	0.762***	0.818***	0.784***	0.842***
	[0.088]	[0.106]	[0.088]	[0.105]
Fraction of Other National Banks in County in 1929 that Closed in Previous Year		0.199*		0.222**
		[0.107]		[0.107]
Ln(# of Respondents+1) in 1929	0.100***	0.107***	0.121***	0.132***
	[0.026]	[0.031]	[0.027]	[0.033]
Ln(# of Correspondents+1) in 1929	0.046	0.051	0.035	0.038
	[0.047]	[0.053]	[0.048]	[0.054]
Fraction of 1929 Respondents that Closed In Year	0.690***	0.741***	0.681***	0.733***
	[0.096]	[0.110]	[0.097]	[0.111]
Fraction of 1929 Respondents that Closed In Previous Year		0.309**		0.293*
		[0.157]		[0.160]
Fraction of 1929 Correspondents that Closed In Year	0.242**	0.248**	0.251***	0.258**
	[0.095]	[0.102]	[0.097]	[0.104]
Fraction of 1929 Correspondents that Closed In Previous Year		0.026		0.035
		[0.126]		[0.129]
Fraction of Correspondents in Fed Reserve Bank or Branch City in 1929			-0.118*	-0.134*
			[0.061]	[0.069]
Fraction of Correspondents that are National Banks in 1929			-0.128**	-0.150**
			[0.059]	[0.069]
State-Fixed Effects?	Yes	Yes	Yes	Yes
Fed District Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
Fed District X Year Effects?	Yes	Yes	Yes	Yes
Location Controls?	Yes	Yes	Yes	Yes
Observations	29881	29881	29881	29881
R-Squared	0.1010	0.1015	0.0994	0.1000

Notes: The table presents the coefficients from a probit model with random effects. The dependent variable is an indicator variable equal to 1 for banks that closed in the following year. Each observation is a national bank in a specific year. "Location Controls" includes the logarithm of county population, fraction of county population above 2,500, the logarithms of other national banks in the county and state banks in the county, and dummies for whether the bank was located in a Federal Reserve Bank or branch city. Robust standard errors clustered by county are presented in parentheses below the coefficients. Dollar values are deflated to 1929 using Officer (2008). * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 4: Predicting National Bank Closure During the Great Depression - Panel (1929-1934)

	Closed During Year	
	(1)	(2)
L.Ln(Assets)	-0.251***	-0.257***
	[0.039]	[0.040]
L.Loans/Assets	0.724***	0.740***
	[0.150]	[0.155]
L.Capital/Assets	0.041	0.054
	[0.277]	[0.280]
L.Cash-Like Assets/Total Deposits	-1.332***	-1.336***
	[0.210]	[0.212]
Ln(Bank Age)	-0.040*	-0.035
	[0.024]	[0.024]
Fraction of Other National Banks in County in 1929 that Closed in Year	0.500***	0.506***
	[0.093]	[0.094]
Respondents' Fraction of National Banks in County that Closed In Year	2.510***	2.529***
	[0.207]	[0.212]
Correspondents' Fraction of National Banks in County that Closed In Year	0.472**	0.423*
	[0.213]	[0.219]
Ln(# of Respondents+1) in 1929	0.042	0.042
	[0.028]	[0.028]
Ln(# of Correspondents+1) in 1929	0.026	0.020
	[0.053]	[0.053]
Fraction of 1929 Respondents that Closed In Year	0.274**	0.278***
	[0.107]	[0.108]
Fraction of 1929 Correspondents that Closed In Year	0.272***	0.278***
	[0.099]	[0.100]
Fraction of Correspondents in Fed Reserve Bank or Branch City in 1929		-0.097
		[0.066]
Fraction of Correspondents that are National Banks in 1929		-0.124**
		[0.062]
State-Fixed Effects?	Yes	Yes
Fed District Fixed Effects?	Yes	Yes
Year Fixed Effects?	Yes	Yes
Fed District X Year Effects?	Yes	Yes
Location Controls?	Yes	Yes
Observations	29881	29881
R-Squared	0.1253	0.1258

Notes: The table presents the coefficients from a probit model with random effects. The dependent variable is an indicator variable equal to 1 for banks that closed in the following year. Each observation is a national bank in a specific year. "Location Controls" includes the logarithm of county population, fraction of county population above 2,500, the logarithms of other national banks in the county and state banks in the county, and dummies for whether the bank was located in a Federal Reserve Bank or branch city. Robust standard errors clustered by county are presented in parentheses below the coefficients. Dollar values are deflated to 1929 using Officer (2008). * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 5: Dropping Correspondent & Respondent Closures in County - Panel (1929-1934)

	Closed During Year	
	(1)	(2)
L.Ln(Assets)	-0.250***	-0.259***
	[0.043]	[0.045]
L.Loans/Assets	0.724***	0.750***
	[0.163]	[0.169]
L.Capital/Assets	-0.009	0.007
	[0.278]	[0.283]
L.Cash-Like Assets/Total Deposits	-1.413***	-1.423***
	[0.213]	[0.216]
Ln(Bank Age)	-0.028	-0.022
	[0.024]	[0.024]
Fraction of Other National Banks in County in 1929 that Closed in Year	0.815***	0.825***
	[0.092]	[0.093]
Ln(# of Respondents+1) in 1929	0.139***	0.141***
	[0.031]	[0.031]
Ln(# of Correspondents+1) in 1929	0.043	0.037
	[0.050]	[0.051]
Fraction of 1929 Respondents Outside of County that Closed In Year	0.369***	0.374***
	[0.132]	[0.134]
Fraction of 1929 Correspondents Outside of County that Closed In Year	0.231**	0.238**
	[0.106]	[0.107]
Fraction of Correspondents in Fed Reserve Bank or Branch City in 1929		-0.126*
		[0.066]
Fraction of Correspondents that are National Banks in 1929		-0.138**
		[0.064]
State-Fixed Effects?	Yes	Yes
Fed District Fixed Effects?	Yes	Yes
Year Fixed Effects?	Yes	Yes
Fed District X Year Effects?	Yes	Yes
Location Controls?	Yes	Yes
Observations	29881	29881
R-Squared	0.0958	0.0965

Notes: The table presents the coefficients from a probit model with random effects. The dependent variable is an indicator variable equal to 1 for banks that closed in the following year. Each observation is a national bank in a specific year. "Location Controls" includes the logarithm of county population, fraction of county population above 2,500, the logarithms of other national and state banks in county, and dummies for whether the bank was located in a Federal Reserve Bank or branch city. Robust standard errors clustered by county are presented in parentheses below the coefficients. Dollar values are deflated to 1929 using Officer (2008). * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 6: Effect of Correspondent or Respondent Closures on Balance Sheets of Surviving Banks (1929-1934)

	ΔLn(Assets)		ΔLn(Loans)		ΔLn(Cash-Like Assets)		ΔLn(Capital)		ΔLn(Deposits)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fraction of National Banks in County that Closed in Year	0.039***	0.036***	0.029***	0.026**	0.004	0.003	0.023**	0.022*	0.046***	0.041***
	[0.008]	[0.009]	[0.010]	[0.011]	[0.003]	[0.004]	[0.011]	[0.011]	[0.011]	[0.011]
Fraction of National Banks in County that Closed in Previous Year		-0.017**		-0.016		-0.006		-0.004		-0.023**
		[0.008]		[0.011]		[0.004]		[0.010]		[0.010]
Fraction of 1929 Respondents that Closed in Year	0.009	0.005	0.008	0.005	-0.001	-0.001	-0.020	-0.024	0.020	0.019
	[0.010]	[0.011]	[0.014]	[0.014]	[0.005]	[0.005]	[0.015]	[0.015]	[0.014]	[0.015]
Fraction of 1929 Respondents that Closed In Previous Year		-0.018*		-0.014		-0.000		-0.016		-0.009
		[0.011]		[0.016]		[0.006]		[0.017]		[0.014]
Fraction of 1929 Correspondents that Closed in Year	-0.017*	-0.018*	-0.035***	-0.036***	0.000	-0.001	0.008	0.011	-0.032***	-0.035***
	[0.010]	[0.010]	[0.013]	[0.013]	[0.005]	[0.004]	[0.014]	[0.014]	[0.012]	[0.013]
Fraction of 1929 Correspondents that Closed In Previous Year		-0.006		-0.004		-0.004		0.015		-0.012
		[0.011]		[0.013]		[0.005]		[0.014]		[0.014]
Bank Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed District X Year Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17680	17680	17680	17680	17680	17680	17680	17680	17680	17680
R-squared	0.144	0.145	0.173	0.173	0.115	0.116	0.084	0.084	0.220	0.221

Notes: The table presents the marginal effects from an ordinary least squares regression. The dependent variable is specified by the column heading. Each observation is a national bank in a specific year. Only banks that were present all years from 1929 through 1934 are included. The top and bottom 1% of banks are dropped to avoid extreme values. Robust standard errors clustered by county are presented in parentheses below the coefficients. Dollar values are deflated to 1929 using Officer (2008). * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 7: Effect of Interbank Liquidity Risk on Balance Sheet Risk Before and After the Fed (1910, 1919, and 1929)

	Capital/Assets				Liquid Assets/Total Deposits			
	1910-29		1910-19		1910-29		1910-19	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-15 Respondents	-0.018***	-0.013***	-0.016***	-0.012***	-0.019**	-0.015**	-0.013*	-0.013*
	[0.002]	[0.002]	[0.002]	[0.002]	[0.007]	[0.007]	[0.007]	[0.008]
1-15 Respondents * Post-1910	0.014***	0.008***	0.017***	0.012***	0.017**	0.015**	0.025***	0.027***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.008]	[0.008]	[0.008]	[0.008]
16-100 Respondents	-0.061***	-0.049***	-0.052***	-0.045***	-0.045***	-0.035**	-0.038**	-0.032*
	[0.006]	[0.006]	[0.006]	[0.006]	[0.017]	[0.017]	[0.017]	[0.017]
16-100 Respondents * Post-1910	0.050***	0.036***	0.051***	0.036***	0.101***	0.090***	0.124***	0.119***
	[0.006]	[0.005]	[0.006]	[0.005]	[0.018]	[0.018]	[0.017]	[0.018]
101+ Respondents	-0.101***	-0.073***	-0.085***	-0.067***	-0.081***	-0.053**	-0.078***	-0.050**
	[0.012]	[0.010]	[0.012]	[0.011]	[0.021]	[0.022]	[0.023]	[0.023]
101+ Respondents * Post-1910	0.080***	0.048***	0.075***	0.048***	0.122***	0.087***	0.137***	0.103***
	[0.010]	[0.008]	[0.010]	[0.008]	[0.022]	[0.022]	[0.022]	[0.024]
Due to Banks/Total Deposits	0.093***	0.040***	0.071***	0.039***	-0.001	-0.050	0.028	-0.015
	[0.009]	[0.009]	[0.009]	[0.009]	[0.031]	[0.032]	[0.031]	[0.032]
Due to Banks/Total Deposits	-0.116***	-0.061***	-0.117***	-0.066***	-0.289***	-0.233***	-0.346***	-0.289***
* Post-1910	[0.010]	[0.010]	[0.010]	[0.010]	[0.033]	[0.034]	[0.034]	[0.035]
Yr=1919	-0.075***	-0.085***	-0.075***	-0.085***	-0.029***	0.014	-0.024***	0.015*
	[0.001]	[0.002]	[0.001]	[0.002]	[0.005]	[0.009]	[0.005]	[0.009]
Yr=1929	-0.077***	-0.080***			-0.029***	-0.086***		
	[0.001]	[0.003]			[0.006]	[0.012]		
State Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	21136	21136	14564	14564	21136	21136	14564	14564
R-squared	0.4072	0.4232	0.4347	0.4437	0.1569	0.1745	0.2148	0.2203

Notes: Table presents the results of OLS regressions. Each observation is a national bank-year. The sample includes all national banks in either 1910, 1919, and 1929 or in 1910 and 1919. "Location Controls" includes the logarithm of county population. Robust standard errors clustered by county are presented in parentheses below the coefficients. * denotes significance at 10%; ** at 5% level and *** at 1% levels.

Table 8: Effect of Interbank Liquidity Risk on Balance Sheet Risk Before and After the Fed (1910-1920)

	Capital/Assets		Liquid Assets/Total Deposits	
	(1)	(2)	(3)	(4)
1-15 Respondents in 1910	-	-	-	-
1-15 Respondents in 1910 * Post-1914	0.008***	0.005***	0.009*	0.011**
	[0.001]	[0.001]	[0.005]	[0.005]
16-100 Respondents in 1910	-	-	-	-
16-100 Respondents * Post-1914	0.023***	0.017***	0.053***	0.055***
	[0.004]	[0.003]	[0.011]	[0.011]
101+ Respondents in 1910	-	-	-	-
101+ Respondents in 1910 * Post-1914	0.037***	0.026***	0.046***	0.038**
	[0.008]	[0.007]	[0.017]	[0.019]
Due to Banks/Total Deposits	-	-	-	-
Due to Banks/Total Deposits * Post-1914	-0.005***	-0.003***	-0.018***	-0.017***
	[0.001]	[0.001]	[0.002]	[0.002]
Bank Fixed Effects?	Yes	Yes	Yes	Yes
Location Controls?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
Region X Year Fixed Effects	No	Yes	No	Yes
Observations	66109	66109	66109	66109
R-squared	0.548	0.576	0.083	0.104

Notes: Table presents the results of OLS regressions. Each observation is a national bank-year. The sample includes all national banks that survived from 1910 through 1920. "Location Controls" includes the logarithm of county population. Robust standard errors clustered by county are presented in parentheses below the coefficients. * denotes significance at 10%; ** at 5% level and *** at 1% levels.