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The Founding of the Federal Reserve, the Great Depression and the Evolution of the U.S. Interbank Network

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Matthew Jaremski and David C. Wheelock

Abstract

Financial network structure is an important determinant of systemic risk. This paper examines how the establishment of the Federal Reserve and Great Depression affected U.S. interbank network structure. Seeking liquidity sources, banks generally preferred to connect to Federal Reserve member banks in cities with Fed offices or clearinghouses. Overall network concentration declined initially as banks connected to Federal Reserve cities other than New York, but increased in the Depression. Banks that survived the Depression generally had higher percentages of connections to Federal Reserve cities and to correspondent banks that also survived.

JEL Codes: G21, L14, N22

Keywords: Interbank Networks, Bank Concentration, Contagion, Systemically Important Financial Institutions, Federal Reserve Act, Great Depression

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1. Introduction

The interconnected nature of financial networks can propagate shocks, increase systemic risk, and magnify economic downturns. A growing literature finds that contagion in networks of interlinked financial institutions was important during recent and historical financial crises (e.g., Cohen-Cole, et al. 2016; Puhr, et. al 2012; Calomiris and Carlson 2017; Mitchener and Richardson 2019). Insights from theoretical studies suggest that the tendency of interbank networks to amplify shocks reflects the relative size of network members, extent of interconnections between them, and the magnitude of shocks hitting the system, whereas the systemic risk posed by individual institutions depends on heterogeneity in network structure and the concentration of counterparty exposures (Cont et al. 2013). Prominent in this literature is the idea that greater interconnectedness can make networks "robust-yet-fragile" (e.g., Allen and Gale 2007; Acemoglu, et al. 2015). Specifically, greater interconnectedness makes an interbank network more resilient to relatively minor shocks, but can be destabilizing if adverse shocks are sufficiently large to eliminate the excess liquidity of the banking system. This is especially true for core-periphery systems that have a small number of very well-connected banks at the center of the network, including those of Germany (Craig and von Peter 2014), the United Kingdom (Gai, et al. 2011), and the United States.[1]

Although studies suggest that network structure affects systemic risk, there has been relatively little empirical work on how the structures of interbank networks evolve over time. Using newly digitized data on the entire U.S. interbank network in 1900, 1910, 1919, 1929, and 1940, this paper studies how the network evolved in response to important institutional changes and financial crises during the first half of the twentieth century. The historical analysis offers a unique opportunity to examine how these types of events affected the interbank market, with implications for interbank liquidity risk. In modern times, contractual links between financial institutions are often complex and opaque. By comparison, interbank connections were relatively straightforward and transparent during the first half of the twentieth century, and consisted primarily of correspondent relationships.[2] Most banks contracted with one or more other banks

[1] Other theoretical studies that examine the channels through which networks can transmit shocks include Allen and Gale (2000), Allen, et al. (2010), Freixas, et al. (2000), Lagunoff and Schreft (2001), and Dasgupta (2004). Allen and Babus (2009) provide a survey of the theoretical and empirical literature on bank networks.

[2] 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

(i.e., their correspondents) for seasonal liquidity, payments services, and portfolio diversification. Bankers directories published the names of each bank's correspondents. We use this information to investigate changes in network structure and patterns in correspondent relationships after the introduction of the Federal Reserve (Fed) and during the Great Depression. We examine the interbank network as a whole, seeking to understand the concentration of connections among banks and cities to gauge the potential for contagion and to identify the most highly-connected and potentially most systemically-important banks at the time. We also investigate how individual banks chose their correspondents and how institutions, regulation, and panics influenced those choices.

The United States developed a large and active interbank network in the nineteenth century to meet the challenges of a growing national economy and extreme seasonal variability in the demands for money and credit. Prohibitions on branching across state lines and within most states forced banks to rely on contractual connections with correspondents in other cities. The network helped dissipate minor disturbances and accommodate seasonal liquidity needs, but broke down when large shocks caused a scramble for liquidity that led banks to suspend withdrawals across the network, as in the Panics of 1893 and 1907.[3] Dissatisfaction with the performance of the network led to the establishment of the Federal Reserve System in 1914. The Fed was intended to supplant the interbank network by offering a source of liquidity, an interregional payments network, and a repository for the nation's bank reserves.

To investigate how the Fed's founding affected the structure of the interbank network, we compare network concentration and patterns in the network connections of individual banks before the Fed's founding and at five and 15 years afterward. We also investigate how concentration and interbank connections evolved during the Great Depression. Waves of bank failures and panics occurred during the Depression and the interbank system again seems to have amplified distress (Heitfield, et al. 2017; Mitchener and Richardson 2019; Das, et al. 2018; Calomiris, et al. 2019). In response, Congress sought to lessen the role of the interbank network by prohibiting the payment of interest on interbank deposits and thereby reducing incentives for banks to compete with Federal Reserve Banks for correspondent deposits.

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and complex. The relatively straightforward and transparent nature of interbank relationships in the late nineteenth and early twentieth centuries facilitates study of network structure over time.

[3] See Calomiris and Gorton (1991) or Wicker (2000) for general information about nineteenth and early twentieth century banking panics.

Prior studies of the U.S. interbank network mostly relied on data for small samples of banks or geographic locations, and few studies have examined the impact of regulatory changes or banking crises on network structure. Only Paddrik, et al. (2017) examine explicitly how the interbank network responded to a regulatory change. Based on a sample consisting of banks in Pennsylvania, they find that the National Banking Acts of the 1860s led banks to shift their interbank relationships to correspondent banks in New York City and Chicago, which increased network concentration and potentially systemic risk. Das, et al. (2018) consider the impact of the Great Depression on the interbank network. They present several descriptive measures of the entire U.S. interbank network in 1929 and 1934, and estimate that failures and mergers caused systemic risk per bank to increase by 33 percent between 1929 and 1934. We extend previous studies by investigating how the founding of the Fed and the Great Depression affected the distribution of network connections among banks and cities with different characteristics. In particular, we investigate how the Fed's founding affected the types of banks and cities that banks chose to connect to as well as whether the changes in the network observed during the Depression continued or interrupted trends in the evolution of the network that began after the Fed's founding.

The data confirm that at the end of the nineteenth century the U.S. interbank network was pyramidal in structure with a small number of banks serving as correspondents for a high percentage of the nation's banks. Nearly every bank deposited funds in at least one other bank, yet very few banks held funds for other banks. By far, the banks with the most connections were large national banks located in New York City. In 1900, 54 percent of all U.S. banks had at least one correspondent among the top 10 correspondent banks (all of which were national banks), and 85 percent of all U.S. banks had at least one New York City correspondent.

The network became less concentrated after the establishment of the Federal Reserve System as banks shifted their correspondent relationships away from New York City toward banks in other cities – especially those with Federal Reserve offices in their local district. While the percentage of banks with a New York City correspondent had declined to 63 percent in 1929, the percentages for most other cities with a Federal Reserve office increased. Thus, the Fed not only served as a direct alternative to private correspondent banks, but its founding changed the relative attractiveness of correspondents in different locations. Federal Reserve member banks located in Fed cities were especially attractive as correspondents because of their unique access

to Federal Reserve liquidity and payments services, which they were able to pass through to other banks (Anderson et al. 2018).

Reduced network concentration meant that the risk of contagion emanating from a crisis hitting a core city, as in the Panic of 1907, was somewhat lessened. However, the system remained vulnerable to local and regional panics, and ultimately depended on the individual Federal Reserve Banks to respond to those events to prevent them from spreading across the banking system.[4] The Fed's failure to prevent or stem the panics of the Great Depression, which mainly arose outside the central money markets, enabled full-blown banking crises to spread through the interbank system. Indeed, we find evidence that the network transmitted distress between connected banks, in that banks were significantly more likely to fail or otherwise close during the Depression if many of their correspondents had also closed. Congress enacted additional reforms to stem these types of connections and to reduce the autonomy of individual Federal Reserve Banks by concentrating policymaking authority in the Federal Reserve's Board of Governors. Hence, the role of the interbank system in transmitting distress across the banking system led to reforms with long-lasting impacts on both U.S. bank regulation and the structure of monetary policy decision making.

The paper proceeds as follows: Section 2 provides historical background on the nation's interbank network. Section 3 describes the data that we use to examine the characteristics of the interbank network and examines overall network concentration in each year. Section 4 investigates patterns in the correspondent connections of individual banks. Section 5 concludes.

2. The Interbank Network

The U.S. developed a deep and active interbank network in the nineteenth century. As a result of legal restrictions on branch banking, the U.S. banking system was comprised of thousands of small, unit banks that depended on relationships with banks in major cities for payments services, securities transactions, and to manage seasonal imbalances between local deposits and local loans. Interbank relationships consisted primarily of account agreements between banks. Each connection involved a bank and a correspondent in which the bank maintained a deposit. Following convention, we refer to the banks that held deposits with a given

[4] Davison and Ramirez (2014) find that local banking panics were common during the 1920s, whereas Richardson and Troost (2009) find that the impact of Great Depression panics on local economic conditions depended on the responsiveness of individual Federal Reserve Banks to them.

correspondent bank as the correspondent's respondents. While the deposit balance would fluctuate over time and respondents sometimes borrowed from their correspondent resulting in a net debt to the bank, the respondent bank would generally be a net creditor of the correspondent. Banks typically received interest on their correspondent deposits (until prohibited by the Banking Act of 1933), which were a source of investable funds for the correspondent bank.

Banks had a strong incentive to maintain relationships with well-connected correspondents for the payments and other services they provided. As part of the deposit agreement between a bank and its correspondent, the correspondent bank typically would clear any checks, drafts, or notes drawn on banks in its city or any other bank in its network and deposit the proceeds into the respondent's account.

Banks also relied on their correspondents to invest surplus funds and as a source of extra funds when needed. Agricultural production in particular generated large demands for cash and loans in spring and autumn months (Kemmerer 1910). Banks in farming areas could invest surplus funds with city correspondents between planting and harvest seasons, and then withdraw the funds (or borrow additional funds) when local demands spiked (James 1978; James and Weiman 2010). The location and size of large correspondent banks gave them unique investment opportunities, such as access to the call loan market, and a position to profit from interbank relationships (Watkins 1929).

Finally, the National Banking Acts of the 1860s further encouraged a hierarchical system by permitting banks in small cities to hold a portion of their required reserves in interest-bearing accounts at banks in larger cities. While national banks in designated central reserve cities (New York City, Chicago, and St. Louis) were required to hold their required reserves as cash in their vaults, national banks in other locations could maintain a sizable portion of their required reserves as balances in other national banks in designated reserve or central reserve cities. This structure encouraged national bank balances to flow to reserve and central reserve cities. State banking laws varied, but almost every state also allowed their state-chartered banks and trust companies to hold a large portion of their required reserves as balances with correspondent banks (White 1983).

The interbank system was large in terms of total deposits and relative to banking system assets. Shown in Figure 1, deposits "due from banks and Fed" (i.e., funds held by banks on deposit in correspondent banks or the Federal Reserve) totaled roughly $2 billion in 1914 (in

constant 1900 dollars), $2.5 billion in 1929, and topped out at more than $12 billion in 1940. All of the net increase between 1914 and 1929 reflected balances held with Federal Reserve Banks rather than with commercial bank correspondents. Deposits "due to banks" represent funds held by correspondent banks for the accounts of their respondents, and exclude balances that banks held with the Fed. Total interbank deposits held in correspondent banks changed little (in inflation-adjusted dollars) between 1914 and 1929, and declined from about 10 percent of total banking system assets to 5 percent, while deposits held at the Fed rose to about $500 million (in 1900 dollars). However, both deposits with correspondent banks and deposits with the Fed rose substantially during the 1930s, in dollar terms and as a percentage of banking system assets.

The banking system depended on a well-functioning interbank system. However, the system tended to break down and become a source of instability when hit by run-inducing shocks (Calomiris and Gorton 1991). Shocks to banks in core cities, especially New York City, sometimes produced major panics that reverberated throughout the banking system, as in the Panic of 1907. In panics, banks with deposits in correspondents were unable to access their funds when those banks suspended withdrawals, causing the panic to spread across the system. Shocks originating outside the central money markets could also impact banks throughout the system, as in the Panic of 1893 when adverse weather conditions caused western banks to withdraw funds from their New York City correspondents (Calomiris and Carlson 2016, 2017; Dupont 2017). In this way, contagion spread through the entire banking system via the interbank network (Kemmerer 1910; Sprague 1910; Wicker 2000; Carlson and Wheelock 2016, 2018).

The Panic of 1907 illustrates how trouble at a handful of New York City banks could affect the entire country through the interbank network. With reserves already drained from the New York money market to satisfy insurance claims resulting from a devastating earthquake in San Francisco in 1906 (Odell and Weidenmier 2004), the panic started with the failure of a scheme by the Heinze brothers to corner the stock of United Copper Company. The brothers' connections to New York City banks, brokers, and trust companies called into question the soundness of the city's financial system. Depositor runs quickly arose at the financial institutions associated with the Heinzes and spread to other New York City firms. New York City banks suspended withdrawals, triggering bank suspensions throughout the country as banks were unable to obtain funds from their New York correspondents. The panic finally subsided and

payments resumed when J.P. Morgan coordinated a bailout of the New York City trust companies (Moen and Tallman 1992, 2000; Bruner and Carr 2007; Tallman and Moen 2018).

Tasked with studying the U.S. and international banking systems after the Panic of 1907, the National Monetary Commission's final report to Congress in 1912 identified 17 "principal defects in our banking system" (p. 6) of which 13 related to liquidity risk. Inspired by the Commission's findings and recommendations, the Federal Reserve was established in 1914 to reduce, if not eliminate, the banking system's reliance on the interbank network and concentration of the nation's bank reserves in New York City, both of which were seen as sources of instability. The Fed's decentralized structure consisting of 12 quasi-independent Reserve Banks serving distinct regional districts reflected a desire to minimize control of the nation's financial system by the major New York City banks.[5] The Federal Reserve Act required banks with federal charters (i.e., national banks) to become members of the Federal Reserve System and hold reserves in a regional Federal Reserve Bank (state-chartered banks could also become members but were not required to do so). The Reserve Banks offered payments services and liquidity to their members through discount window loans.

The founding of the Fed was a major watershed for the interbank network. Banks responded to the establishment of a lender of last resort by substantially reducing their own liquidity (Carlson and Wheelock 2018; Calomiris et al. 2019). By lending to banks through its discount window, the Fed largely eliminated seasonal tightness in money markets, which had long been associated with banking panics (Miron 1986; Bernstein et al. 2010; Carlson and Wheelock 2016, 2018). The nation's banks continued to rely on interbank connections for services that the Fed did not provide, however, such as a conduit for investing in securities markets (Watkins 1929). Moreover, many state-chartered banks chose not to join the Federal Reserve System, and those banks had no choice but to connect to other commercial banks in the network. However, as we explore below, the Fed's establishment did seem to affect both the concentration of the network and bank's choices of correspondents. The Great Depression resulted in still more changes in the network's structure, both as a consequence of bank failures and of changes in the correspondent ties of banks that survived the Depression.

[5] Lowenstein (2016) describes the political history of the founding of the Fed. Odell and Weiman (1998) investigate the impact of interbank connections on the selection of Atlanta and Dallas for Federal Reserve Banks. Jaremski and Wheelock (2017) examine the determinants of Federal Reserve district boundaries and selection of cities for Federal Reserve offices.

The historical record makes clear the reasons why the interbank network arose organically in the United States and how it transmitted financial disturbances across the banking system, sometimes producing major banking panics. However, the existing literature has not yet provided a full account of the network's structure or how it evolved in response to the establishment of the Federal Reserve System or the Great Depression. The rest of this paper examines bank- and city-level information on interbank connections to gain a broader understanding of how the nation's network changed over time.

3. Interbank Network Data and Macro Facts

To provide a comprehensive view of the U.S. interbank network at different points in time, we digitized the correspondent relationships published by the *Rand McNally Bankers'* Directory in 1900, 1910, 1919, 1929, and 1940. The directories claim to provide "a full and complete list of banks, bankers and savings banks in the United States" (1899, title page) as well as each bank's "principal correspondents." While giving no definition of principal correspondents, the evidence suggests that the Directory attempted to capture the largest and most important correspondents. From the few surviving archival records that contain full correspondent information for comparison, we determined that by 1900 the correspondent lists in Rand McNally covered the vast majority of funds placed in correspondents. In addition to providing a source for identifying the correspondents of every bank, the information allows us to identify every bank's respondents.[6]

We chose to digitize years that enable us to study the evolution of the interbank market across three distinct regimes. Specifically, 1900 and 1910 provide a view of the network before the establishment of the Federal Reserve in 1914, while the years 1919 and 1929 cover the early Federal Reserve period. Finally, by comparing data for 1929 and 1940, we obtain a view of how the network changed during the Great Depression.[7]

[6] The earliest editions of *Rand McNally Bankers' Directory* published in the nineteenth century only listed correspondents in New York City or in the largest nearby financial center. Coverage increased over time and it appears that by 1900 most correspondents were included. Directories include listings of private 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., unincorporated 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 those banks actually had no correspondents.

[7] We chose 1919, rather than 1920, to avoid the post-World War I recession that began in 1920, and 1929, rather than 1930, to capture the network on the eve of the Great Depression.

When describing the U.S. interbank network, we find it helpful to measure network concentration and establish other facts about the network in each year before examining patterns in the underlying interbank connections. We first examine patterns in the number of correspondent and respondent connections. Most banks had more than one correspondent. Shown in Table 1, the average number of correspondents per bank rose from 2.3 in 1900 to 3.2 in 1940. However, while most banks had multiple correspondents, relatively few had any respondents. That is, few banks were correspondents of other banks. In each year, close to 90 percent of banks had no respondents and 6-8 percent had only one or two. Fewer than one-half percent of banks had more than 150 respondents. Therefore, while nearly every bank participated in the network, only a handful of banks were network hubs linking together large numbers of banks.

Table 2 lists the 10 banks with the highest number of respondents in each year, as well as the percentage of U.S. banks that were directly connected to at least one of the top 10 banks. Clearly, the U.S. interbank system was highly concentrated. In 1900, for example, 14.7 percent of all U.S. banks (1,465 banks) were respondents of the top correspondent bank (Hanover National Bank of New York), while 53.8 percent of all banks (6,984 banks) were respondents of at least one of the top correspondent banks. The banks with hundreds or thousands of respondents had the greatest potential for contributing to systemic risk in the interbank network.[8]

The concentration of connections to the top correspondent banks varied somewhat over time. The percentage of banks connected to the top bank declined from 14.8 percent in 1910 to 13 percent in 1919, but then rose over the subsequent two decades, reaching 21.4 percent in 1940. The percentage of banks connected to any of the top 10 increased from 53.8 percent in 1900 to 59.9 percent in 1910, but then fell to 53.1 percent in 1929 before rising to 56.8 percent in 1940. Thus, these measures indicate that while concentration remained high throughout the

[8] The literature on networks generally views concentration as one of the most important factors affecting the potential transmission of risk through a network (e.g., Acemoglu et al. 2015, Anderson et al. 2018). Of course, the extent to which a given correspondent bank contributed to systemic risk depended also on the share of its liabilities comprised of interbank deposits, and its capital and liquidity buffers, all of which play a part in determining the potential loss to the network if the bank were to fail. The number of respondents and share of a bank's total deposits consisting of interbank liabilities were highly correlated. Using national bank balance sheet data available before 1929, the correlation between the logarithm of the number of respondents and fraction of due to banks/total deposits is 0.55. Unfortunately, however, data on interbank assets and liabilities are not available in published balance sheets for individual banks after 1928, which would necessarily make any estimates of systemic risk imprecise.

period, it declined somewhat over the first decade and half after the founding of the Federal Reserve but increased during the Great Depression.

The information in Table 2 also shows that New York City and Chicago banks were always at the center of the interbank network. For instance, in 1900, seven of the top 10 correspondent banks were located in New York City and two were located in Chicago, whereas in 1940, six of the top 10 were in New York City and one was in Chicago. Table 3 lists the 10 cities with the largest number of interbank connections in each year. As suggested by the previous tables, U.S. banks were highly connected to New York City and, to a lesser extent, Chicago. In 1900 and 1910, the three central reserve cities (New York City, Chicago, and St. Louis) had the highest percentages of respondent connections.

The percentage of U.S. banks with a New York City correspondent declined after 1900 when it peaked at 85.2 percent. Substantial numbers of new banks opened during the first two decades of the twentieth century, especially in the Midwest, South, and West. Many of those banks connected to correspondents in regional banking centers, such as Kansas City, Minneapolis, and Chicago, rather than to New York. Between 1900 and 1919, the fraction of banks located in the Northeast declined from 23.1 percent to 13.8 percent, and the percentage of banks with a New York City correspondent declined to 63.7 percent.[9] Failures and mergers eliminated hundreds of banks during the 1920s, however, especially in the regions that had seen rapid growth during the previous two decades. The fraction of banks located in the Northeast rose to 17.4 percent in 1929, but in spite of this, the percentage of banks with a New York City correspondent continued to fall, down to 63.0 percent in 1929. Thus, something other than a shift in the geographic mass of the banking system—likely the establishment of the Federal Reserve—must have influenced where banks chose to establish correspondent ties during the 1920s. During the Depression, both the percentage of banks with a New York City correspondent and the fraction of banks located in the Northeast rose. By 1940, 21.6 percent of banks were located in the Northeast and 74.8 percent of all banks had a New York City correspondent.

Coinciding with the shift in correspondent connections away from New York City between 1900 and 1929, the percentage of total interbank connections to any of the top 10 cities also declined, from 95.5 percent in 1900 to just 83.8 percent in 1929. As we show later, the

[9] The regional bank aggregates in this section are from Board of Governors of the Federal Reserve System (1959).

decline among the top 10 cities occurred as banks established ties to correspondents in Federal Reserve Bank and branch cities in their own Fed districts.

The total number of correspondent links to a given bank or city can be a misleading indicator of the importance of that bank or city to the nation-wide network. A city whose banks are connected to correspondents that are themselves well connected will be more central to the network, and hence likely to pose more systemic risk, than a city whose banks are connected to correspondents with few other connections. Eigenvector centrality measures the importance of a given location to the network by taking account of the entire chain of connections throughout the network. Measured at the city level, eigenvector centrality reflects the collective importance of the banks in a particular city to the network based on 1) the direct interbank connections of a city's banks to banks in other cities and 2) the relative importance of the banks in the latter cities to the network. The relative centrality score for a given city is defined as:

$$C_i = \frac{1}{\lambda} \sum_{j:j \neq i} y_{i,j} C_j$$

where C_i is the eigenvector centrality score of city i, λ is a constant, and $y_{i,j}$ is an indicator variable for whether city i is directly connected to city j. There are many possible λs that would solve the equation, but the requirement that all the entries in the eigenvector be non-negative implies that only the largest eigenvalue results in the desired eigenvector centrality measure.[10] Only the ratios of the centralities of the cities are well defined. Hence, we normalize the scores to sum to 100 in each year in order to obtain a unique score for each city. A city with a given number of respondent or correspondent connections to fringe cities (i.e., those with few connections) would receive a lower score than a city with a similar number of connections to important cities (i.e., those with many connections).

Table 4 reports the mean eigenvector centrality score across all cities in each year, the scores for the 12 cities with Federal Reserve Banks from the System's inception in 1914, the average score for cities with branches of a Federal Reserve Bank, and the average score for the most populated cities with no Federal Reserve office. As might be expected with a large number of cities and a highly concentrated, hierarchical system, the mean eigenvector centrality value is quite low across all years, indicating that relatively few cities were "important." The scores for

[10] See discussion in Newman (2008) for more details and explanation.

Federal Reserve Bank and branch cities are considerably higher than the mean, even in 1900 and 1910. However, the scores for the three central reserve cities—New York City, Chicago, and St. Louis—are higher than those of other Federal Reserve cities before the Fed was established, and New York City and Chicago have by far the highest scores throughout the years spanned by our data, reflecting their importance to the network.

The centrality scores for all 12 Federal Reserve cities declined between 1900 and 1910, likely because of the large increase in the number of banks, especially in small towns and rural locations. The Gold Standard Act of 1900 halved the minimum capital level for national banks in smaller cities, from $50,000 to $25,000, which in turn prompted many states to cut the minimums required for state-chartered banks. The number of banks in the United States as well as the number of cities with at least one bank approximately doubled between 1900 and 1910 (Table 1). Many of the new banks were quite small and most established their first correspondent links to banks in nearby cities, rather than to banks in distant financial centers. As a result, the network centrality scores of individual cities declined.

The centrality scores for New York City and St. Louis also fell between 1910 and 1919, as did the score for Philadelphia. However, the scores for other Federal Reserve cities increased, indicating that they became more important to the network after the founding of the Fed. With the exceptions of St. Louis, Minneapolis and Kansas City, the centrality scores of cities with Federal Reserve Banks also increased between 1919 and 1929.[11] Although the score for New York City was among those that increased between 1919 and 1929, it was still lower in 1929 than it had been in 1910. The centrality scores for cities that received branches of Federal Reserve Banks generally increased during the 1920s. The Fed placed branch offices in important cities located some distance from the headquarters city. The average centrality scores for cities with a branch increased between 1910 and 1919, and again from 1919 to 1929. By contrast, the average centrality score for the most populated cities with no Federal Reserve office was unchanged between 1910 and 1919, and increased less than the average for cities with a Fed office between 1919 and 1929.

[11] Although the Federal Reserve Banks opened in November 1914, initially the nation-wide clearing system was not fully operational, and it was not until after a 1917 amendment that all of a member bank's reserves were required to be placed in a Federal Reserve Bank. Therefore, we would not expect the full effect of the Federal Reserve to be present in 1919.

Centrality scores for all cities with Federal Reserve Banks increased between 1929 and 1940, indicating that those cities became even more central to the network during the Depression. To some extent this likely reflected the disproportionate failure rate of small banks with more local connections, though as we show below, the main explanation seems to be that banks chose to increase their connections to Federal Reserve cities at the expense of other cities. The next section examines patterns in the network connections of banks and correspondents with particular characteristics for additional insights about how the founding of the Fed and the Great Depression reshaped the network.

4. Micro-Level Network Statistics

Next, we examine patterns in the correspondent choices of individual banks. As noted previously, on average, banks had between two and four correspondents. The vast majority of correspondents were national banks. Shown in Table 5, over our sample period, between 72 and 91 percent of all correspondents links were to national banks, even though national banks comprised only 40 percent of all U.S. banks. Correspondent links to state-chartered commercial banks ranged from 3.5 percent in 1940 to 7.1 percent in 1919. By contrast, the percentage of total links to state-chartered trust companies rose over time from just 3.3 percent in 1900 to 24.5 percent in 1940. The vast majority of trust company correspondents were Federal Reserve members, and several trust companies were among the top 10 correspondents in 1940 (Table 2). Correspondent banks and trust companies were also disproportionately located in financial centers. Over 90 percent of all correspondent links were to banks located in cities with a clearinghouse, and at least 75 percent were to banks located in cities with Federal Reserve Banks or branches.[12]

The patterns shown in Table 5 suggest (1) that banks in cities with a clearinghouse or a Federal Reserve office, and thus a source of emergency liquidity, were important interbank nodes; (2) the founding of the Federal Reserve led to a broadening in the type and location of correspondent banks; and (3) the Great Depression further increased the relative number of connections to regional Fed cities. In the following subsections, we examine changes in bank-

[12] All cities with Federal Reserve offices had a clearinghouse by 1910, as did most other major cities. We obtained the establishment date of each bank clearinghouse from the *Rand McNally Bankers' Directory*. The number of cities with clearinghouses rose from 108 in 1900 to 178 in 1910, 251 in 1919, and 358 in both 1929 and 1940.

level connections over time to provide additional clarity about the patterns we observe in the broader statistics.

4.1 Establishment of Clearinghouses

Clearinghouses played a substantial role in the nation's payment system and interbank network before the founding of the Federal Reserve. First established in New York City in 1853, clearinghouses were private organizations created by banks to reduce clearing and settlement costs by providing a central location and fixed daily time to clear checks, notes, and drafts within their city. Clearinghouses quickly evolved to also monitor banks, publish information, and provide emergency liquidity during financial panics (Timberlake, 1984; Gorton, 1985; Gorton and Mullineaux, 1987). Much like a central bank, clearinghouses facilitated the clearing of checks, notes, and drafts for their members and, by extension, the respondents of their members, and provided a liquidity backstop should a panic emerge. Jaremski (2019) shows that cities saw large increases in interbank funds after they established a clearinghouse, suggesting that banks preferred to establish connections to banks in cities with a clearinghouse.

Table 6 provides further evidence on the importance of clearinghouses to the interbank network. Here we examine the association between the presence of a clearinghouse and both the number of correspondent connections per bank and the city-level eigenvector centrality score. We include only cities that had at least one bank throughout the sample period to avoid confusing changes due to the establishment of a clearinghouse with changes resulting from adding cities that gained their first bank. The results indicate that banks in cities with a clearinghouse had substantially more correspondent and respondent connections, and more growth over time in the average number of connections, than banks in cities that never established a clearinghouse. For those locations that established a clearinghouse during the sample period, the table suggests that the importance of individual cities (measured, for example, by eigenvector centrality score) increased the most in the decade of the clearinghouse's establishment. The evidence thus confirms that cities with bank clearinghouses served as especially important nodes on the interbank network.

4.2 Establishment of the Federal Reserve

The Federal Reserve Act of 1913 brought about the most dramatic regulatory changes during the period. Congress intended the Fed to replace the interbank network, and while its presence did not cause banks to stop using commercial bank correspondents, the interbank

network was markedly less concentrated after the Fed was established. This section examines how changes in the structure of the interbank network aligned with the presence of the Fed.

Fewer than 1,750 of the more than 19,000 state bank and trust companies in existence during our sample period ever joined the Federal Reserve System. However, as suggested from Table 5, many of those that did join experienced large increases in their share of correspondent links. This was especially true for trust companies. In 1940, for example, 24.5 percent of all correspondent links were to trust companies, and 95 percent of those links were to members of the Federal Reserve System. To examine the effect of Fed membership directly, Table 7 reports changes between 1910 and 1919, and between 1910 and 1929, in average number of correspondents by bank type and membership status for banks present throughout those years.[13] The table shows that the average number of respondents per bank increased substantially for banks that joined the Fed. For example, the average number of respondents among state banks and trust companies that joined the Fed rose from 2.9 in 1910 to 6.3 in 1919, whereas the average number of respondents for other state banks and trust companies rose from just 0.09 in 1910 to 0.25 in 1919. Membership conveyed advantages, including access to the Fed's discount window and payments services, which made member banks attractive as correspondents, similar to banks that were members of clearinghouses. Indeed, Anderson et al. (2018) show that state banks that already were established correspondent banks were more likely to join the Fed, and gained even more business by doing so. Our data support that finding.

The Fed's presence seems to have caused a distinct shift in where banks chose to have correspondents. In 1900 and 1910, more than half of all correspondent connections were to banks in New York, Chicago, and St Louis (the three central reserve cities). By 1919 that percentage had dropped to 39.2 percent, and by 1940, only 37.6 percent of all correspondent ties were to banks in the three cities. At the same time, links to banks in Federal Reserve Bank and branch cities other than New York, Chicago and St. Louis become more important, rising from 31.0 percent in 1900 to 36.1 percent in 1919 and 36.6 percent in 1929 (Table 5). The Fed's establishment enhanced the ability of banks in those cities to provide payments services and liquidity to banks in their regions, reducing the need for banks to have connections to New York City and Chicago.

[13] We identified the state banks that belonged to the Federal Reserve System in each year and the districts in which they were located from the Annual Report of the Federal Reserve Board.

The shift away from New York City, Chicago, and St Louis toward other Fed cities was not random, but rather matched the regional layout of Federal Reserve districts. Specifically, banks sought correspondents in Reserve Bank and branch cities within the districts in which they were located. For example, banks in Ohio increased their connections to correspondents in Cleveland, Cincinnati, and Pittsburgh (the Fifth District's Reserve Bank and branch cities) while reducing connections to New York City and Chicago. By 1940, 45 percent of the average bank's correspondents were located in cities with a Federal Reserve office in the bank's Fed district. Matching the relative decline in correspondent ties to the largest financial centers, the average distance to a correspondent declined from 404 miles in 1910 to 233 miles in 1940. This suggests that the geographic redistribution of correspondent relationships reflected the structure of the Federal Reserve System, rather than simply a desire of banks to diversify their correspondent connections across financial centers.[14]

More evidence of the impact of the Fed's founding is apparent by comparing changes in correspondent ties of Federal Reserve member and non-member banks. Congress required all national banks to join the Federal Reserve System but membership was optional for state banks and trust companies. The data in Table 7 show that Fed member banks shifted their correspondent links more towards banks in the cities with Federal Reserve offices in their Fed district than did non-member banks. For example, between 1910 and 1919, the average percentage of a bank's correspondents that were located in a city that obtained a Reserve Bank or branch within a bank's Fed district increased by 1.2 percentage points for non-members, 3.5 percentage points for state bank and trust company members, and 5.0 percentage points for national banks, suggesting that the changes were likely driven by the Fed's establishment rather than a trend towards larger cities in general.

4.3 The Great Depression

Next, we investigate the structural changes that account for the increase in network concentration during the Great Depression. In particular, we ask whether the increase resulted from banks shifting their correspondent relationships toward nearby Federal Reserve cities, or

[14] Jaremski and Wheelock (2017) show that a survey of national banks was highly influential in determining the boundaries of Federal Reserve districts and selection of cities for Federal Reserve office. The results of that survey, in turn, largely reflected pre-existing correspondent links. Hence, while the cities where Federal Reserve offices were located were already relatively important nodes of the interbank system, they became even more important after the Fed was established.

simply reflected closures of banks with more dispersed correspondents. We address this question by examining changes in the correspondents of banks that did not close, and then by examining differences in correspondents between surviving and closed banks.

The top panel of Table 8 displays correspondent information for banks that survived from 1929 to 1940. These data show that surviving banks shifted their correspondent links toward banks in Federal Reserve cities, particularly Fed cities in their district. For example, among all banks that survived the decade, the average percentage of correspondents in a local Federal Reserve city increased by 3.1 percentage points, from 44.5 percent to 47.6 percent. Therefore, bank closures alone cannot account for the rise in concentration between 1929 and 1940.

The bottom panel of Table 8 reports average values for various correspondent measures in 1929 separately for banks that closed during the Depression and those that survived.[15] Although survivors and closed banks were somewhat similar in terms of most values, survivors generally had higher percentages of their correspondents in their district's Fed cities. Surviving banks also had lower percentages of correspondents that closed by 1940. For example, among all banks, survivors had on average 43.9 percent of their correspondents located in a local Federal Reserve city, compared with an average of 41.3 percent for banks that closed during the decade. The average distance in miles to a correspondent was also substantially shorter for survivors, at 253.4 miles compared to 301.5 miles for banks that closed. These findings are consistent with the idea that access to a Fed office in a bank's district, perhaps only indirectly through a correspondent in that city, conveyed an advantage that reduced a bank's likelihood of closing during the Great Depression. Because data on Federal Reserve lending to specific banks are unavailable, we cannot determine whether that advantage resulted from direct injections of liquidity or perhaps simply that having a correspondent in a Fed city enhanced a bank's reputation with its depositors. Nonetheless, the differences between closed and surviving banks in average numbers (and percentages) of correspondents located in nearby Fed cities are striking.

Also striking is the relationship between a bank's odds of surviving the Depression and the survival rate of its correspondents. Among banks that survived the Depression, the average correspondent closure rate was 24.2 percent, whereas among banks that closed, the average correspondent closure rate was 31.9 percent. The figure plots the percentage of banks that closed

[15] We consider a bank closed if it was listed in the *Rand McNally Bankers' Directory* in 1929 but not in 1940. Therefore, we treat banks that suspended but later reopened during the decade as survivors.

between 1929 and 1940 for various correspondent closure percentages. Although the pattern is not uniformly increasing, closure rates were generally higher for banks with higher closure rates among their correspondents. The upward slope holds separately for national banks as well as for state banks and trust companies. For example, 55 percent of national banks closed among those with a correspondent closure rate over 85 percent. By contrast, fewer than 40 percent closed among those with a correspondent closure rate below 46 percent. Lacking the exact dates when banks close, we cannot definitively determine the direction of causality between the closures of banks and their correspondents. However, a bank would be more likely to suffer impaired assets leading to failure when its correspondent closed, than would a correspondent bank when its respondent closed.[16]

5. Conclusion

The interconnected nature of financial networks can propagate shocks, increase systemic risk, and magnify economic downturns. Theoretical studies suggest that the vulnerability of interbank networks to systemic risk is related both to the extent of interconnections between members of the network and their relative sizes, as well as to the magnitude of shocks hitting the system. The "core-periphery" structure of the U.S. interbank system during the second half of the nineteenth century and first decades of the twentieth century had a high potential for contagion via formal correspondent connections between banks. The failure of a major correspondent bank could have ripple effects across the entire system, but even the failure of a mid-size correspondent bank in a regional banking center could trigger local contagion.

The Federal Reserve was intended to reduce the banking system's reliance on the interbank network, and especially the concentration of the system's reserves in New York City. Although the share of interbank deposits held by major New York City banks did fall after the Fed was established, previous studies have not examined how the interbank network changed with the introduction of the Fed. Using newly digitized data on the interbank relationships of every U.S. depository institutions in 1900, 1910, 1919, 1929 and 1940, we quantify changes in network concentration and other aspects of network structure over four decades. We show that while the banks most central to the network remained those located in New York City and other

[16] Respondent closures could impose costs on correspondent banks. For example, Mitchener and Richardson (2019) show that correspondent banks reduced their lending when they experienced outflows of respondent deposits. However, while such outflows would force correspondents to either reduce lending or turn to more expensive sources of funds, outflows of respondent deposits are not likely to put a correspondent bank out of business.

major centers, the regional Federal Reserve cities took on a more important role in the network after the Fed was established and again during the Great Depression. Ironically, by pushing the network toward the regional Fed cities, the System's founders may have inadvertently made the banking system more vulnerable to regional liquidity shocks and to the responsiveness of local Federal Reserve Bank officials to those events.[17]

Interbank connections were a conduit for bank distress during the Great Depression. Banks with correspondents that failed or otherwise closed were themselves more likely to close during the Depression. Banks apparently responded to the Depression by linking even more to correspondents in cities with Federal Reserve offices, especially to banks in New York City, which saw a relative increase in correspondent links between 1929 and 1940. Thus, while the establishment of the Federal Reserve altered the structure of the interbank network, the Fed's presence neither eliminated the network nor prevent it from transmitting shocks across the banking system. Moreover, the amplification of distress through the network in turn contributed to events that further altered the network's structure while at the same time having even more profound long-term impacts on the regulation of the U.S. banking system.

[17] Friedman and Schwartz (1963) emphasize parochialism and inattention to national concerns among local Federal Reserve officials during the Great Depression, which they argue contributed to the Fed's failure to respond aggressively to banking panics or the sharp decline in economic activity. Richardson and Troost (2009) show that differences in the degree to which officials of different Reserve Banks responded to liquidity shortfalls resulted in significant differences in bank and economic distress between Fed districts.

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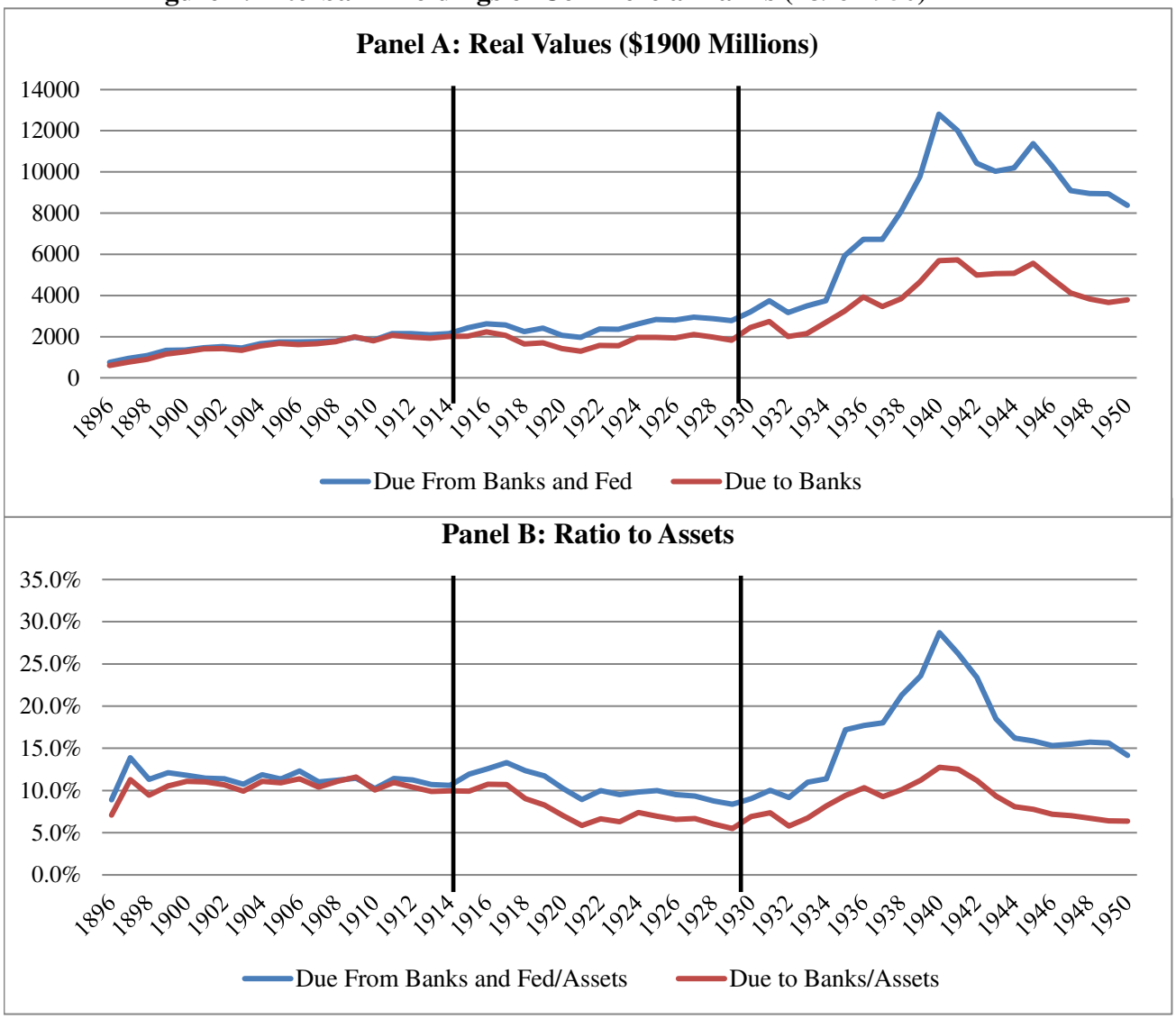
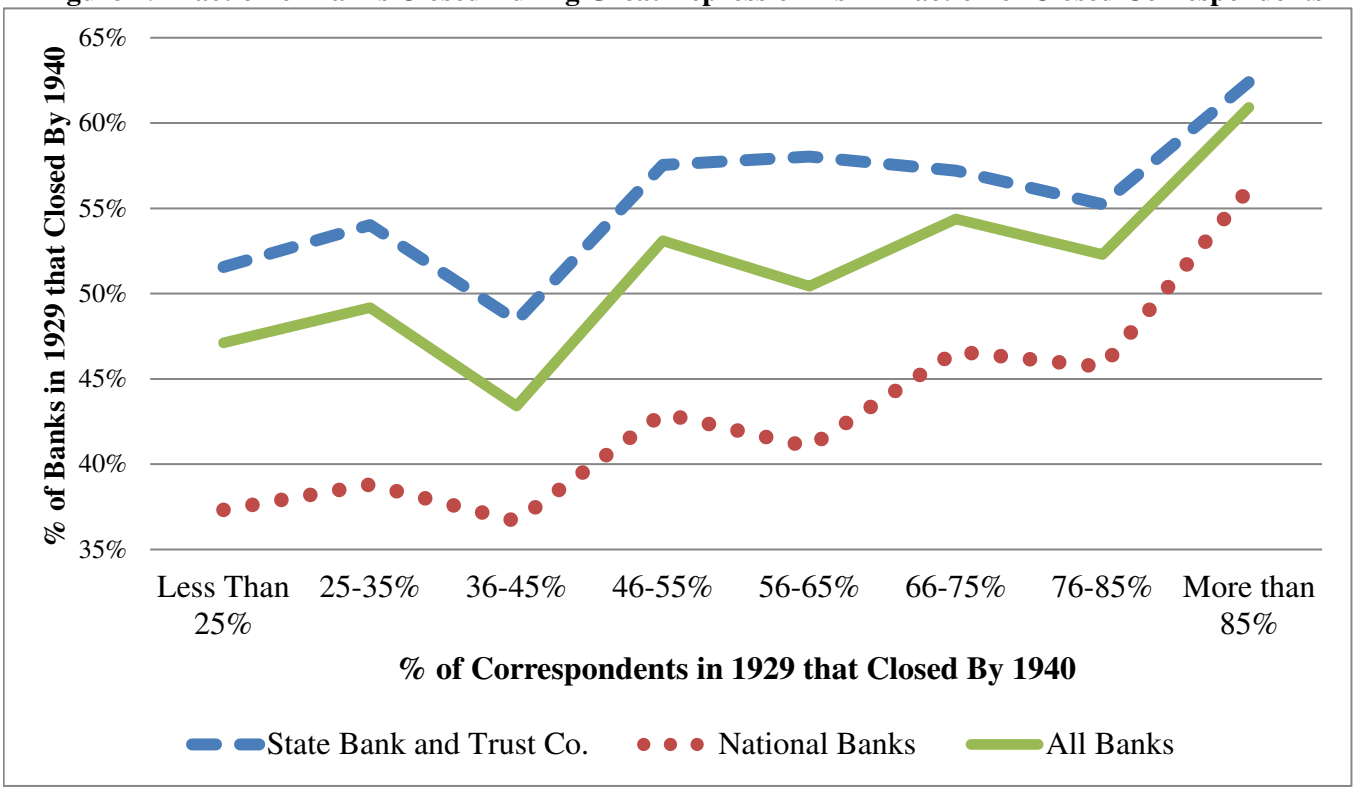
Figure 1: Interbank Holdings of Commercial Banks (1896-1950)



Notes: Figures present the aggregate values of due from banks (i.e. interbank assets) and due to banks (i.e., interbank liabilities). Data come from Federal Reserve Board (1959). Dollar values are deflated to 1900 using Officer (2008).

Figure 2: Fraction of Banks Closed During Great Depression As A Fraction of Closed Correspondents



Notes: Figures provides the percent of banks in 1929 that closed before 1940 as a function of the percent of their correspondents in 1929 that closed before 1940.

Table 1: Macro-Level Network Statistics (1900-1940)

	All Banks				
	1900	**1910**	**1919**	**1929**	**1940**
Number of Banks	12,975	25,101	29,857	27,279	15,840
Avg. # of Correspondents	2.336	2.191	2.840	2.882	3.185
% With 1 Correspondent	18.4%	15.0%	9.9%	12.2%	10.2%
% With 2 Correspondents	42.3%	62.6%	33.2%	30.0%	25.9%
% With 3 Correspondents	29.2%	13.9%	30.2%	31.2%	32.4%
% With 4 Correspondents	7.8%	6.6%	20.3%	19.2%	19.8%
% With 5 Correspondents	1.3%	1.2%	4.4%	4.2%	5.5%
% With 6+ Correspondents	0.8%	0.6%	2.0%	3.0%	5.7%
% With 0 Respondents	90.4%	90.3%	87.1%	86.9%	87.5%
% With 1 Respondent	4.1%	4.6%	5.8%	5.5%	5.5%
% With 2 Respondents	1.3%	1.4%	2.0%	2.1%	1.7%
% With 3-5 Respondents	1.4%	1.3%	1.9%	2.2%	2.1%
% With 5-15 Respondents	1.1%	1.0%	1.4%	1.5%	1.3%
% With 16-50 Respondents	1.0%	0.7%	0.9%	0.9%	0.9%
% With 51-150 Respondents	0.5%	0.3%	0.5%	0.5%	0.6%
% With 150+ Respondents	0.3%	0.2%	0.3%	0.3%	0.4%

Notes: Table presents number of banks, average number of correspondents per bank, and the percentages of banks with various numbers of correspondents and respondents in each year.

Table 2: Top 10 Correspondent Banks By Year

1900

Bank	Location	# of Resp.	% of Banks
Hanover National Bank	New York	1,465	14.71%
Chase National Bank	New York	1,204	12.09%
First National Bank	Chicago	994	9.98%
National Park Bank	New York	690	6.93%
Western National Bank	New York	595	5.98%
National Bank of Commerce	Kansas City	523	5.25%
Importers and Traders National Bank	New York	440	4.42%
Continental National Bank	Chicago	434	4.36%
Chemical National Bank	New York	393	3.95%
National City Bank	New York	365	3.67%
% of Banks Connected To At Least One Of The Top 10 Correspondents			**53.83%**

1910

Bank	Location	# of Resp.	% of Banks
Hanover National Bank	New York	3,374	14.82%
Continental and Commercial National Bank	Chicago	3,053	13.41%
Chase National Bank	New York	2,489	10.93%
National Park Bank	New York	2,038	8.95%
National Bank of Commerce	New York	1,424	6.25%
First National Bank	Chicago	1,403	6.16%
National City Bank	New York	1,338	5.88%
National Bank of Commerce	St Louis	1,192	5.23%
Seaboard National Bank	New York	787	3.46%
Corn Exchange National Bank (2)	Chicago	674	2.96%
% of Banks Connected To At Least One Of The Top 10 Correspondents			**59.93%**

1919

Bank	Location	# of Resp.	% of Banks
Continental and Commercial National Bank	Chicago	3,659	13.07%
Hanover National Bank	New York	3,620	12.93%
Chase National Bank	New York	2,530	9.04%
National Park Bank	New York	1,942	6.94%
National City Bank	New York	1,941	6.94%
First National Bank	Chicago	1,749	6.25%
National Bank of Commerce	New York	1,563	5.58%
First and Security National Bank	Minneapolis	1,469	5.25%
Mechanics and Metals National Bank	New York	1,172	4.19%
National Bank of Commerce	St Louis	1,058	3.78%
% of Banks Connected To At Least One Of The Top 10 Correspondents			**56.64%**

1929

Bank	Location	# of Resp.	% of Banks
Continental Illinois Bank and Trust Co	Chicago	4,785	18.34%
Chase National Bank	New York	3,181	12.19%
Hanover National Bank	New York	2,868	10.99%
National City Bank	New York	1,887	7.23%
First National Bank of Chicago	Chicago	1,675	6.42%
National Park Bank	New York	1,565	6.00%
National Bank of Commerce	New York	1,301	4.99%
First National Bank	Minneapolis	1,206	4.62%
Irving Trust Co	New York	1,194	4.58%
Philadelphia National Bank	Philadelphia	1,193	4.57%
% of Banks Connected To At Least One Of The Top 10 Correspondents			**53.06%**

1940

Bank	Location	# of Resp.	% of Banks
Chase National Bank	New York	3,346	21.36%
Continental Illinois National Bank and Trust Co	Chicago	2,375	15.16%
Central Hanover Bank and Trust Co	New York	1,634	10.43%
Manufacturers Trust Co	New York	1,378	8.80%
National City Bank	New York	1,325	8.46%
Guaranty Trust Co	New York	1,055	6.73%
Commerce Trust Co	Kansas City	916	5.85%
Philadelphia National Bank	Philadelphia	864	5.51%
Chemical Bank and Trust Co	New York	790	5.04%
First National Bank and Trust Co	Minneapolis	740	4.72%
% of Banks Connected To At Least One Of The Top 10 Correspondents			**56.77%**

Notes: Table displays the top 10 correspondent banks in each year. The "% of Banks Connected To At Least One Of The Top 10 Correspondents" denotes the precent of banks that were connected to at least one of the top 10 correspondents. Since some banks were connected to multiple of the top 10 correspondents it is not a simple sum of the individual percentages.

Table 3: Top 10 Correspondent Cities By Year

1900

State	Location	# of Resp.	# of Resp.
NY	New York	8,488	85.26%
IL	Chicago	3,449	34.64%
MO	St Louis	1,295	13.01%
PA	Philadelphia	1,181	11.86%
MA	Boston	1,074	10.79%
MO	Kansas City	1,045	10.50%
MN	Minneapolis	667	6.70%
OH	Cincinnati	577	5.80%
NE	Omaha	488	4.90%
KY	Louisville	385	3.87%
% of Banks Connected to At Least One of Top 10 Cities			**95.54%**

1910

State	Location	# of Resp.	# of Resp.
NY	New York	15,690	68.90%
IL	Chicago	7,269	31.92%
MO	St Louis	2,996	13.16%
MO	Kansas City	2,298	10.09%
MN	Minneapolis	2,148	9.43%
PA	Philadelphia	2,061	9.05%
MA	Boston	1,055	4.63%
OH	Cincinnati	890	3.91%
NE	Omaha	862	3.79%
PA	Pittsburgh	860	3.78%
% of Banks Connected to At Least One of Top 10 Cities			**91.95%**

1919

State	Location	# of Resp.	# of Resp.
NY	New York	17,829	63.70%
IL	Chicago	9,915	35.43%
MN	Minneapolis	5,008	17.89%
MO	Kansas City	4,493	16.05%
MO	St Louis	3,491	12.47%
PA	Philadelphia	2,564	9.16%
NE	Omaha	1,875	6.70%
MA	Boston	1,380	4.93%
CA	San Francisco	1,342	4.79%
PA	Pittsburgh	1,199	4.28%
% of Banks Connected to At Least One of Top 10 Cities			**88.94%**

1929

State	Location	# of Resp.	# of Resp.
NY	New York	16,437	63.00%
IL	Chicago	9,229	35.38%
MN	Minneapolis	3,504	13.43%
MO	Kansas City	3,149	12.07%
MO	St Louis	3,138	12.03%
PA	Philadelphia	2,595	9.95%
PA	Pittsburgh	1,611	6.18%
MA	Boston	1,608	6.16%
NE	Omaha	1,457	5.58%
WI	Milwaukee	1,063	4.07%
% of Banks Connected to At Least One of Top 10 Cities			**83.84%**

1940

State	Location	# of Resp.	# of Resp.
NY	New York	11,719	74.80%
IL	Chicago	3,845	24.54%
MO	Kansas City	2,276	14.53%
MN	Minneapolis	2,129	13.59%
MO	St Louis	1,939	12.38%
PA	Philadelphia	1,762	11.25%
MA	Boston	1,588	10.14%
PA	Pittsburgh	1,185	7.56%
NE	Omaha	810	5.17%
WI	Milwaukee	801	5.11%
% of Banks Connected to At Least One of Top 10 Cities			**81.75%**

Notes: Table displays the top 10 correspondent cities in each year. The "% of Banks Connected To At Least One Of The Top 10 Cities" denotes the precent of banks that were connected to at least one of the top 10 cities. Since some banks were connected to multiple of the top 10 cities it is not a simple sum of the individual percentages.

Table 4: City-Level Eigenvector Centrality Statistics (1900-1940)

	All Cities With At Least One Bank In Year										
	1900	**1910**	**1919**	**1929**	**1940**	**Δ1900-10**	**Δ1910-19**	**Δ1919-29**	**Δ1929-40**	**Δ1910-29**	**Δ1910-40**
# of Cities	5,602	12,846	15,797	15,676	10,973	7,244	2,951	-121	-4,703	2,830	-1,873
Mean	0.0179	0.0078	0.0063	0.0064	0.0091	-0.010	-0.001	0.000	0.003	-0.001	0.001
New York	1.2453	0.8788	0.7766	0.7904	0.9686	-0.366	-0.102	0.014	0.178	-0.088	0.090
Chicago	0.5681	0.3930	0.4105	0.4698	0.4900	-0.175	0.018	0.059	0.020	0.077	0.097
St Louis	0.2479	0.1623	0.1418	0.1395	0.1740	-0.086	-0.020	-0.002	0.034	-0.023	0.012
Boston	0.1299	0.0555	0.0588	0.0748	0.1257	-0.074	0.003	0.016	0.051	0.019	0.070
Philadelphia	0.1745	0.1110	0.1070	0.1278	0.1953	-0.063	-0.004	0.021	0.068	0.017	0.084
Cleveland	0.0713	0.0407	0.0466	0.0719	0.0791	-0.031	0.006	0.025	0.007	0.031	0.038
Richmond	0.0434	0.0315	0.0452	0.0496	0.0598	-0.012	0.014	0.004	0.010	0.018	0.028
Atlanta	0.0474	0.0345	0.0403	0.0518	0.0854	-0.013	0.006	0.011	0.034	0.017	0.051
Minneapolis	0.2090	0.1217	0.1355	0.1203	0.1688	-0.087	0.014	-0.015	0.049	-0.001	0.047
Kansas City	0.1342	0.1158	0.1287	0.1183	0.1292	-0.018	0.013	-0.010	0.011	0.002	0.013
Dallas	0.0390	0.0376	0.0490	0.0563	0.0886	-0.001	0.011	0.007	0.032	0.019	0.051
San Francisco	0.0955	0.0521	0.0692	0.0818	0.1046	-0.043	0.017	0.013	0.023	0.030	0.052
All Fed Branches	0.0505	0.0301	0.0325	0.0396	0.0599	-0.020	0.002	0.007	0.020	0.010	0.030
Top 100 Non-Fed Cities	0.0369	0.0209	0.0210	0.0256	0.0368	-0.016	0.000	0.005	0.011	0.005	0.016

Notes: Table provides eigenvector scores for each year. Bank-level data are aggregated to the city-level before calculating the statistics. Intra-city connections are not counted in this calculation. "Top 100 Non-Fed Cities" is based on city population in 1910.

Table 5: Micro-Level Interbank Network Statistics (1900-1940)

	All Banks				
	1900	**1910**	**1919**	**1929**	**1940**
Avg. # of Correspondents	2.336	2.191	2.840	2.882	3.185
Avg. % State Bank Correspondents	6.9%	4.5%	7.1%	5.1%	3.5%
Avg. % Fed Member State Banks Correspondents	-	-	3.2%	2.0%	2.0%
Avg. % Non-Fed Member State Banks Correspondents	-	-	3.9%	3.1%	1.5%
Avg. % Trust Co Correspondents	3.3%	4.8%	6.3%	22.7%	24.5%
Avg. % Fed Member Trust Co Correspondents	-	-	4.5%	17.5%	23.2%
Avg. % Non-Fed Member Trust Co Correspondents	-	-	1.8%	5.2%	1.4%
Avg. % National Bank Correspondents	89.8%	90.7%	86.7%	72.2%	72.0%
Avg. % Clearinghouse City Correspondents	92.7%	92.8%	90.3%	92.3%	95.3%
Avg. % Any Fed Bank or Branch City Correspondents	85.9%	83.4%	75.3%	74.8%	78.3%
Avg. % New York Correspondents	33.5%	30.5%	21.8%	21.7%	23.4%
Avg. % Chicago Correspondents	16.3%	15.3%	12.9%	12.4%	10.3%
Avg. % St Louis Correspondents	5.1%	5.9%	4.4%	4.1%	3.9%
Avg. % Non-CRC Fed Bank or Branch City Correspondents	31.0%	31.8%	36.1%	36.6%	40.7%
Avg. % Correspondents in District's Fed Cities	40.1%	38.3%	40.3%	42.6%	46.0%
Avg. Distance to Correspondents (in Miles)	379	404	316	277	233

Notes: Tables provides summary statistics for each variable in each year. "Avg. # of Correspondents" provides the average number of correspondents of banks in the year. "Avg. % X" denotes the average fraction of the total number of correspondents that have the characteristic "X". "State Bank Correspondents" denotes correspondent banks that have state charters and is separated into "Fed Member State Banks Correspondents" which are Federal Reserve members and "Non-Fed Member State Banks Correspondents" which are not Fed members. "Trust Co Corrrespondents" denotes correspondent trust companies that are state chartered and is separated into "Fed Member Trust Co Correspondents" which are Fed members and "Non-Fed Member Trust Co Correspondents" which are not. "National Bank Correspondents" denotes correspondent banks that are national banks. "Clearinghouse City Correspondents" denotes correspondents that were members of their city's clearinghouse. "Any Fed Bank or Branch City Correspondents" denotes correspondents that were located in any city with a Federal Reserve Bank or Branch. "New York Correspondents" denotes correspondents located in New York City. "Chicago Correspondents" denotes correspondents located in Chicago. "St Louis Correspondents" denotes correspondents located in St Louis. "Non-CRC Fed Bank or Branch City Correspondents" denotes correspondents located any city with a Federal Reserve Bank or branch except New York City, Chicago, or St Louis. "Correspondents in District's Fed Cities" denotes correspondents that were located in a city with a Federal Reserve Bank or branch in the bank's district. "Avg. Distance to Correspondents (in Miles)" denotes the average distance in miles between a bank and all of its correspondents.

Table 6: Interbank Networks Statistics for Clearinghouse Cities (1900-1919)

	Never Had Clearinghouse				
	1900	**1910**	**1919**	**Δ1900-10**	**Δ1910-20**
Avg. # of Respondents Per City	0.30	0.90	2.42	0.60	1.52
Avg. # of Correspondents Per City	3.79	5.26	7.59	1.47	2.34
Avg. Eigenvector Centrality Per City	0.0196	0.0196	0.0195	0.0000	-0.0001
	Clearinghouse Existed Before 1890				
	1900	**1910**	**1919**	**Δ1900-10**	**Δ1910-20**
Avg. # of Respondents Per City	368.27	714.55	1000.96	346.29	286.41
Avg. # of Correspondents Per City	56.55	70.55	85.76	14.00	15.20
Avg. Eigenvector Centrality Per City	0.0944	0.0941	0.1007	-0.0003	0.0067
	Clearinghouse Existed 1890-1900				
	1900	**1910**	**1919**	**Δ1900-10**	**Δ1910-20**
Avg. # of Respondents Per City	10.05	26.14	58.50	16.09	32.36
Avg. # of Correspondents Per City	17.73	21.59	28.41	3.86	6.82
Avg. Eigenvector Centrality Per City	0.0324	0.0322	0.0328	-0.0002	0.0005
	Clearinghouse Established 1900-1910				
	1900	**1910**	**1919**	**Δ1900-10**	**Δ1910-20**
Avg. # of Respondents Per City	5.92	23.05	51.98	17.13	28.94
Avg. # of Correspondents Per City	13.67	20.88	26.94	7.20	6.06
Avg. Eigenvector Centrality Per City	0.0300	0.0310	0.0321	0.0010	0.0012
	Clearinghouse Established 1910-1919				
	1900	**1910**	**1919**	**Δ1900-10**	**Δ1910-20**
Avg. # of Respondents Per City	4.14	11.75	26.31	7.61	14.56
Avg. # of Correspondents Per City	8.48	13.45	18.86	4.97	5.40
Avg. Eigenvector Centrality Per City	0.0277	0.0278	0.0293	0.0001	0.0016

Notes: Table provides average statistics for groups of cities listed in column headings. Only cities that had at least one bank present from 1900 through 1940 are included in the calculations.

Table 7: Change in Correspondent Distributions Among Surviving Banks (1910-1919)

	Banks that Survived 1910-19											
	Non-Fed State Banks and Trust Companies			Fed Member State Banks and Trust Companies			National Banks			All Banks		
	1910	1919	Diff.	1910	1919	Diff.	1910	1919	Diff.	1910	1919	Diff.
# of Banks	12,078	12,078	-	811	811	-	6,360	6,360	-	19,249	19,249	-
Avg. # of Respondents	0.09	0.25	0.15	2.90	6.29	3.39	6.25	9.71	3.46	2.25	3.63	1.38
Avg. % Any Fed Bank or Branch City Correspondent	78.4%	71.7%	-6.7%	88.8%	85.6%	-3.3%	92.1%	87.9%	-4.2%	84.0%	78.1%	-6.0%
Avg. % New York Correspondents	26.7%	19.5%	-7.2%	37.4%	30.4%	-7.0%	36.8%	29.6%	-7.3%	31.0%	23.6%	-7.5%
Avg. % Chicago Correspondents	14.1%	11.9%	-2.2%	18.8%	17.3%	-1.5%	15.3%	13.7%	-1.6%	14.7%	12.8%	-2.0%
Avg. % St Louis Correspondents	6.0%	4.9%	-1.1%	4.0%	3.6%	-0.4%	5.6%	4.1%	-1.4%	5.7%	4.6%	-1.2%
Avg. % Non-CRC Fed City Correspondents	31.5%	35.5%	3.9%	28.7%	34.3%	5.6%	34.4%	40.5%	6.1%	32.5%	37.2%	4.7%
Avg. % Correspondents in District's Fed Cities	39.4%	40.6%	1.2%	35.4%	38.8%	3.5%	36.5%	41.5%	5.0%	38.3%	40.8%	2.6%
Avg. Distance to Correspondents (in Miles)	367.4	294.6	-72.8	475.2	399.6	-75.6	462.1	372.9	-89.2	403.2	324.9	-78.3
	Banks that Survived 1910-29											
	Non-Fed State Banks and Trust Companies			Fed Member State Banks and Trust Companies			National Banks			All Banks		
	1910	1929	Diff.	1910	1929	Diff.	1910	1929	Diff.	1910	1929	Diff.
# of Banks	6,947	6,947	-	646	646	-	4523	4523	-	12116	12116	-
Avg. # of Respondents	0.08	0.31	0.23	1.79	8.65	6.86	5.20	7.84	2.64	2.08	3.57	1.49
Avg. % Any Fed Bank or Branch City Correspondent	77.8%	69.0%	-8.8%	89.5%	86.5%	-3.0%	92.0%	84.7%	-7.4%	84.5%	76.3%	-8.2%
Avg. % New York Correspondents	26.6%	17.3%	-9.4%	39.7%	30.5%	-9.2%	37.2%	27.8%	-9.4%	31.8%	22.3%	-9.6%
Avg. % Chicago Correspondents	14.1%	11.1%	-2.9%	16.2%	13.7%	-2.5%	14.8%	12.0%	-2.8%	14.5%	11.7%	-2.8%
Avg. % St Louis Correspondents	6.5%	5.4%	-1.1%	4.0%	3.9%	-0.1%	5.6%	3.5%	-2.1%	6.0%	4.5%	-1.4%
Avg. % Non-CRC Fed City Correspondents	30.6%	35.2%	4.6%	29.7%	38.4%	8.8%	34.4%	41.3%	6.9%	32.2%	37.8%	5.6%
Avg. % Correspondents in District's Fed Cities	39.8%	42.2%	2.4%	38.1%	43.7%	5.6%	37.1%	43.4%	6.3%	38.7%	42.7%	4.0%
Avg. Distance to Correspondents (in Miles)	342.7	236.0	-106.7	444.4	335.1	-109.4	445.97	315.83	-130.1	386.67	271.01	-115.7

Notes: Tables provides the summary statistics for each variable for the group of banks specified in the column heading. The top panel provides the statistics for those banks that survived from 1910 through 1919, whereas the bottom panel provides the statistics for those banks that survived from 1910 through 1929. Fed membership of state bank and trust companies is denoted as of 1919. "Avg. # of Respondents" denotes the average number of banks that claim a bank as a correspondent. See notes to Table 5 for other definitions.

Table 8: Correspondent Distributions of Closed and Surviving Banks (1929-1940)

	Banks that Survived 1929-40											
	Non-Fed State Banks and Trust Companies			Fed Member State Banks and Trust Companies			National Banks			All Banks		
	1929	1940	Diff.	1929	1940	Diff.	1929	1940	Diff.	1929	1940	Diff.
# of Banks	7,372	7,372	-	570	570	-	4,396	4,396	-	12,338	12,338	-
Avg. % Any Fed Bank or Branch City Correspondents	69.9%	72.8%	3.0%	86.4%	88.6%	2.2%	85.7%	86.4%	0.7%	76.8%	79.0%	2.1%
Avg. % New York Correspondents	18.6%	18.3%	-0.3%	32.5%	36.3%	3.8%	29.0%	30.0%	1.1%	23.3%	23.9%	0.5%
Avg. % Chicago Correspondents	11.0%	10.5%	-0.6%	11.8%	11.1%	-0.7%	10.1%	9.0%	-1.0%	10.7%	9.9%	-0.8%
Avg. % St Louis Correspondents	4.2%	4.3%	0.2%	3.0%	3.4%	0.4%	3.7%	3.5%	-0.3%	3.9%	3.9%	0.0%
Avg. % Non-CRC Fed City Correspondents	36.1%	39.7%	3.6%	39.0%	37.8%	-1.2%	42.9%	43.9%	0.9%	38.9%	41.2%	2.3%
Avg. % Correspondents in District's Fed Cities	43.7%	47.5%	3.8%	45.8%	48.7%	2.9%	45.8%	47.7%	2.0%	44.5%	47.6%	3.1%
Avg. Distance to Correspondents (in Miles)	221.1	200.3	-20.7	293.4	277.0	-16.4	302.6	276.4	-26.1	253.4	230.9	-22.5
	Comparison of 1929 Correspondent Distribution of Closed and Surviving Banks											
	Non-Fed State Banks and Trust Companies			Fed Member State Banks and Trust Companies			National Banks			All Banks		
	Closed	Surv.	Diff	Closed	Surv.	Diff	Closed	Surv.	Diff	Closed	Surv.	Diff
# of Banks	9,719	7,372	-	604	570	-	3,381	4,401	-	13,704	12,343	-
Avg. % Any Fed Bank or Branch City Correspondents	68.4%	69.9%	1.5%	87.6%	86.4%	-1.2%	81.8%	85.7%	3.9%	73.0%	76.8%	3.8%
Avg. % New York Correspondents	16.9%	18.6%	1.7%	30.3%	32.5%	2.2%	26.7%	29.0%	2.3%	20.2%	23.3%	3.1%
Avg. % Chicago Correspondents	13.4%	11.0%	-2.3%	14.5%	11.8%	-2.7%	14.2%	10.1%	-4.2%	13.7%	10.7%	-3.0%
Avg. % St Louis Correspondents	4.7%	4.2%	-0.6%	4.8%	3.0%	-1.8%	3.3%	3.7%	0.4%	4.4%	3.9%	-0.4%
Avg. % Non-CRC Fed City Correspondents	33.4%	36.1%	2.6%	38.0%	39.0%	1.0%	37.6%	42.9%	5.4%	34.8%	38.9%	4.1%
Avg. % Correspondents in District's Fed Cities	40.7%	42.9%	2.1%	45.1%	45.7%	0.6%	42.1%	45.6%	3.5%	41.3%	43.9%	2.7%
Avg. Distance to Correspondents (in Miles)	260.5	221.1	-39.4	353.1	293.4	-59.7	410.9	302.6	-108.4	301.5	253.4	-48.1

Notes: Tables provides the summary statistics for each variable for the group of banks specified in the column heading. The top panel contains only those banks that survived from 1929 through 1940. The bottom panel contains all banks present in 1929. Fed membership of observed state bank and trust companies is denoted as of 1929. Fed membership of correspondents is denoted in the specified year (i.e., 1929 or 1940 for the top panel and 1929 in the bottom panel). With the exception of the first and the last, each of the rows provides the average fraction of total correspondents that take the particular characteristic described. See notes to Table 5 for other definitions.