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Interbank Networks in the National Banking Era: Their Purpose and Their Role in the Panic of 1893

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The unit banking structure of the United States gave rise to a uniquely important interbank correspondent network, which linked banks throughout the country during the National Banking Era. During normal times, these interbank network relationships provided banks with access to money markets, facilitated payment processing, and helped banks meet legal reserve requirements. We collect and analyze data on individual correspondent relationships of national banks to map the structure of the network, identify the factors that led banks to adopt different correspondent network structures, and examine the consequences of network choices for bank liquidity risk. Banks' network profiles differed according to the range of services they needed or provided to their customers. For instance, banks providing more checking services focused their interbank relationships on banks in New York City, which was central to the payment clearing system. Location characteristics also mattered; banks in areas with more manufacturing firms maintained more network connections. Differences in network profiles propagated liquidity risk during the Panic of 1893, one of the most severe panics of the National Banking Era. Banks with relatively high two-sided interbank liquidity risk—those that both held more of their liquid assets with their correspondents and were funded to a greater extent by the deposits of other banks—were more likely to close. New York City banks suspended convertibility during the crisis. Banks that relied more heavily on New York correspondents as a source of liquidity were more likely to close.

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1. Introduction

The National Banking System in the United States in the latter half of the 19th century was famously fragmented. Due to legal restrictions on branching, it consisted almost entirely of individual unit banks limited to single offices. That structure made it considerably more difficult for banks to tap sources of funding or conduct extensive business outside their immediate location. Meanwhile, commerce in the US economy expanded geographically as developments in transportation, such as the expansion of the railroad, reduced the costs of moving people and goods. Expanding trade increased the needs of bank customers to conduct long distance transactions. While in countries such as Canada, the financing of the movement of goods from the interior was accomplished by nationwide branching banks that maintained locations and customer relationships at all points along the supply chain, in the United States, banks were geographically isolated; interbank relationships were necessary as part of the funding of seasonal swings in lending and the clearing of payments within and across regions (Conway and Patterson 1914, James 1978, Lockhart 1921, White 1983).

The fragmented structure of the US banking system has also been implicated in the unparalleled instability of U.S. banks historically (Calomiris and Gorton 1991, Calomiris 1993, Bordo, Redish, and Rockoff 1996, Calomiris and Haber 2014). Unit banking made banks' loans portfolios less diversified, and made it harder for banks to coordinate their actions in response to shocks, in contrast to the branching systems of Canada, Great Britain, or the antebellum South. While a small number of banks that belonged to clearing houses operating in major cities could establish means of assisting one another, acting collectively, and monitoring each other's behavior to prevent free riding, those arrangements could not be extended to the nation as a whole. In the United States during the National Banking Era, thousands of geographically separate banks simply could not coordinate their actions or monitor each other's behavior effectively.

Indeed, to the extent that interbank connections existed among unit banks to facilitate normal business interactions, it has been argued that such connections may have magnified the extent of liquidity risk in the system during crises. Distance alone could create liquidity problems for a bank that had placed

its cash in a distant correspondent bank but faced a large immediate demand for cash by its local depositors. Furthermore, a scramble for liquidity by interior banks, drawing down deposits they had placed with city bank correspondents, could overwhelm the ability of city bank correspondents to convert deposits into cash, prompting a liquidity crisis of city banks and a suspension of deposit convertibility in major cities. Conversely, a bank operating in the interior that depended upon being able to access deposits that it had placed with city correspondents might become suddenly illiquid as the result of a suspension of convertibility by its correspondent banks in New York City.

Although illiquidity risk has been identified as a potentially important propagator of systemic illiquidity during the panics of the National Banking Era (Wicker 2000, Carlson 2005, 2013) and during the Great Depression (Friedman and Schwartz 1963, Carlson, Mitchener and Richardson 2014, Mitchener and Richardson 2015), previous work has not been able to identify clearly the effects of interbank transmission of illiquidity risk through individual interbank relationships. The challenges include measuring the extent of interbank liquidity dependence among banks and controlling for other influences when isolating the effects of interbank liquidity dependence on bank risk.

To address those challenges, we construct a new and unique bank-specific dataset on the correspondent network in operation during the National Banking Era (described in Section 2) – which measures the strength of each subject bank's dependency on other individual banks – and use it to gauge the importance of this interbank network for the operation of banks and for the fragility of the banking system during the Panic of 1893. In particular, we map in detail the heterogeneity within the interbank network (in Section 3), and model how business lines, customer needs, locational characteristics, and other factors contributed to differences in the network profiles of banks (theoretically, in Section 4, and empirically, in Section 5).[1] We then use that model to identify whether, after controlling for other factors,

[1] While there has been work on the use of correspondents in the National Banking Era, most of that work either has characterized the interbank network in broad terms (James 1978, James and Weiman 2010, White 1983) or has focused on how it shaped banking in New York (James and Weiman 2011, Tallman and Moen 2012). There is very little information on the details of the network structure during this time. One paper that examined network structure in detail is Weber (2003), which looks at the networks of banks in Pennsylvania in the 1850s. He finds that

the interbank network contributed to liquidity risk by transmitting stresses in the banking system during the Panic of 1893 (in Section 6). Section 7 concludes.

This paper builds upon the growing work on networks, especially those operated by banks, and the relation between network structure and financial stability. Allen and Gale (2007) provide a number of theoretical examples regarding how different network structures could either enhance stability or transmit instability. This paper explains how bank networks evolved in the United States within a unit banking environment to facilitate transactions during normal times, and shows how those adaptations magnified the destabilizing consequences of shocks during crisis episodes. Our findings illustrate the important role of regulatory history in determining the extent to which networks are destabilizing or stabilizing. In countries like Canada, where nationwide banking was permitted, interbank networks mitigated the systemic consequences of shocks through voluntary cooperation among banks (Calomiris and Haber 2014, Chapter 9), while in the United States, networks had the opposite effect.

2. Data

Our sample contains 208 banking institutions and consists of all the national banks located in 38 cities. As national banks (i.e., those chartered by the federal government), these institutions were subject to the same set of rules and regulations regardless of where they were located. All the banks were unit, or single-office, banks, which means that we are able to use data characterizing their local environments to control for differences in economic conditions.

National banks were required to provide information to the Comptroller of the Currency, their primary regulator, several times a year. One method was through the Call Report, which contains information on the banks' balance sheets and was filed about five times a year. The second method of providing information consisted of Examination Reports filed by examiners who visited each bank once or twice a year. To be included in our sample, a bank needed to have provided information for the

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trade linkages were important in shaping network structures. We also find evidence that trade networks were important, but are able to explore the importance of other banking services as well.

September 1892 Call Report and to have had at least one Examination Report completed prior to May 1893 (the onset of the Panic). Those Reports provide the information used for this analysis.[2]

The cities covered in the sample include many of the larger cities in the Western and Southern parts of the United States.[3] We focus on this part of the country because the adverse consequences of the panic were especially severe there. Because these cities are located in the interior, they are also places where interbank connections were likely to play a significant role in the management of bank liquidity.

As described in detail below, banks were divided into three groups based on their location: those in central reserve cities, in reserve cities, and "country" banks. All the reserve cities in the West and South are included in our sample as are many of the other larger cities that might have served as regional hubs even if they were not officially reserve cities. It is important to note that although all banks located outside of designated reserve cities are referred to as "country banks" from the standpoint of reserve requirement regulation (as described in Section 2.1 below), our entire sample consists of banks located in important regional cities. For example, Denver was a regional hub in Western payments, but it was not a reserve city for regulatory purposes. From a fundamental behavioral standpoint, notwithstanding differences in regulatory treatment, we chose our sample of "country" banks and reserve city banks to be quite similar in their orientation toward the interbank network.

2.1. Primary Data Sources

The Examination Reports provide a wealth of information regarding the assets, liabilities, and governance of the bank.[4] For the purposes of our analysis, the most valuable material is related to the relationships with reserve agents. In particular, the examiner reported the amount that was due from each agent and the

[2] Two banks file the September 1892 call report but close prior to May 1893. For these institutions, we use the examination report nearest closure, so long as it was filed at least four months prior to closure.
[3] The cities are: Birmingham, AL; Mobile, AL; San Diego, CA; San Francisco, CA; Los Angeles, CA; Denver, CO; Pueblo, CO; Indianapolis, IN; Des Moines, IA; Dubuque, IA; Lexington, KY; Louisville, KY; New Orleans, LA; Minneapolis, MN; Rochester, MN; St. Paul, MN; Stillwater; MN; Kansas City, MO; St. Joseph, MO; Helena, MT; Lincoln, NE; Omaha, NE; Albuquerque, NM; Fargo, ND; Cincinnati, OH; Portland, OR; Knoxville, TN; Memphis, TN; Nashville, TN; Dallas, TX; El Paso, TX; San Antonio, TX; Salt Lake City, UT; Spokane, WA; Tacoma, WA; Milwaukee; WI; Racine, WI; and Cheyenne, WY.
[4] Calomiris and Carlson (2014a) provide a detailed summary of the contents of the Examination Reports during this period. See also Robertson (1968) for more information on the examination process.

name of each of those agents. These were recorded for purposes related to regulatory reserve requirements.

Reserve agents were the repositories for each national bank's required reserves. Banks were required to hold a certain amount of "liquid assets" (cash or deposits with reserve agents) relative to their deposits (where deposits were measured as the sum of individual deposits and net interbank deposits—due to banks minus due from banks). The calculation used by the examiners is described in detail in Coffin (1896).[5] The particulars of the reserve requirement varied by the location of the bank. At the top of system were banks located in the central reserve cities of New York, Chicago, and St. Louis. These banks were required to hold reserves of 25 percent of their deposits all of which needed to be held as cash. Banks in reserve cities, other relatively large cities, were also required to hold a reserve equal to 25 percent of their deposits, but they were allowed to hold half of it in the form of deposits at their agent banks in central reserves cities. Most national banks were "country banks" located in smaller cities. These banks were required to hold a reserve equal to 15 percent of deposits, up to 3/5 of the reserve could be held as interbank deposits at agent banks in either reserve cities or central reserve cities.

The regulatory function of the data on balances held with reserve agents has several implications for us. Beneficially it means that the examiner was responsible for verifying that these amounts were actual on deposit at correspondent banks by sending postcards to the institutions listed as reserve agents; any discrepancies, of which we encountered examples of very few, were then noted and an explanation was provided. The regulatory role of these data also meant that only balances that could be used to satisfy legal reserve requirements were required to be listed in the Examination Report. Thus, for subject banks located in reserve cities, only the amounts due from banks in central reserve cities were required to be listed; amounts due from banks in other reserve cites need not have been enumerated. Similarly, for "country" banks (defined by reserve requirement regulation as banks located outside of reserve cities),

[5] Early in the National Banking Era, banks also had to hold reserves against the bank notes they issued. By the 1890s, the period covered in the analysis here, reserve requirements were solely against deposits.

amounts due from banks in central reserve cities and from banks in reserve cities were enumerated, while amounts due from other country banks did not need to be.

The coverage of interbank deposits is extensive as deposits at reserve agents accounted for the majority of interbank deposits (deposits at reserve agents in reserve cities and central reserve cities comprise 60% of the total amount due from banks while for banks located in reserve cities 57% of their interbank balances were held in central reserve cities). On occasion, the examiner would provide more information than was required, for instance listing amounts due from banks in other reserve cities for some reserve city banks. This information provides us with a more complete picture of what the networks look like, but such information is not provided often enough for a more formal analysis to be made of the interbank deposits of reserve city banks placed in banks located in other reserve cities.[6]

The examination reports also describe whether the bank borrowed on a collateralized basis from other banks, the amounts of those borrowings, and the identity of the lender. These data allow one to track the connections that exist between the payments system role of interbank relationships and the funding role of those relationships. Most of these borrowings took the form of rediscounts or bills payable. However some took the form of collateralized certificates of deposit, which examiners viewed as a general substitute for the other types of borrowing, but one that was not always listed in other report forms, such as the Call Report.

The examinations also provide information about the ownership structure and the corporate governance of the banks.[7] For instance, the reports provide detailed information regarding the extent of ownership by the bank's management and its board, as well as the information about the use of oversight committees and the frequency with which the board met. We use some of this information to control for the risk preferences of the bank. The examination reports also provide information about the occupations of the board members that were not a part of the ownership team. We use this information to provide

[6] We also have information on the amounts "due to" reserve agents if any. For very few banks are there non-zero amounts listed. For expositional simplicity we do not incorporate this information. Analysis that does so provides similar results.
[7] These data are described in detail in Calomiris and Carlson (2014b).

insight regarding the types of businesses operating locally and that the bank might lend to. The governance and board membership attributes provide instruments we employ in our identification of determinants of bank network profiles in our empirical work.

The Examination Reports also considered a variety of aspects of the balance sheet beyond the categories covered by the Call Report. For instance, there is quantitative information about the loan book, such as the amount of loans that were categorized either as demand (callable) or time (fixed maturity) loans, the amount of loans secured by real estate, and the amount secured by other collateral.[8] There was also information on the bank's liabilities, such as the portions of individual deposits that consisted of checking deposits and of time deposits.

In our analysis, we also employ information from the September 1892 Call Report. The Call Report format in use at this time provides considerable detail about the balance sheet. While some additional information is available from the Examination Report, the Call Report has the advantage of providing data for all national banks at the same point in time, which reduces concerns about spurious differences due to seasonal or other time-related factors. Information on the age of the banks is taken from the Annual Reports of the Comptroller of the Currency and from Rand McNally's Bankers Directory.

As distance presumably influenced decisions about network structure, we collect data on the distance of each city from each of the central reserve cities. Finally, we include several variables related to the economic environment in which the bank operated. These include variables from the various U.S. censuses, such as population and number of manufacturing businesses of the county and the share of state income from agriculture as opposed to manufacturing.

All variables, their definitions, and their sources appear in Table 1. Summary statistics for these variables appear in Table 2.

[8] Although real estate lending was "prohibited" by national banks, national banks nonetheless found ways to lend against real estate. A loan made without real estate as collateral could become collateralized by real estate if the creditworthiness of the borrower deteriorated.

3. Mapping the Interbank Network

We rely on information about individual correspondent relationships identified in the Examination Reports, which list the legal correspondents with whom the national banks placed funds and the amounts held with each individual correspondent on the day of the examination.[9] Our data map in detail the connections of each respondent with all of its reserve agents in the three "central reserve cities" of New York, Chicago, and St. Louis. Our analysis therefore focuses primarily on these relationships, but also offers a less detailed picture of other interbank connections. Connections with the central reserve cities tended to be among the most important for national banks and balances at these correspondents accounted for, on average, nearly half of all interbank balances, constituting about six percent of total assets.

A map showing intercity connections listed by banks in each city in our sample is provided in Figure 1 (large dots indicate cities in our sample, smaller dots are cities where our sample banks have correspondents). Banks throughout the country maintained linkages with the larger cities on the East Coast – primarily with New York – as well as with banks in Chicago and St. Louis, consistent both with geographically determined trade connections and with other influences that produced the pyramidal reserve structure. In particular, the dominance of New York in securities trading was important because New York banks made use of the excess reserves of interior banks to fund call loans in the securities market.

Banks – even those operating within the same city – often differed greatly in the intensity with which they made use of the network, and in the number and locations of their correspondent banks. While all banks report having at least one correspondent, some banks had considerably more extensive networks with as many as eighteen correspondents in as many as seven or eight cities (Figures 2a, 2b, 3a, 3b). With respect to the central reserve cities, the dominance of New York City in the interbank network is clear with nearly every bank in our sample having an agent there; some banks had as many as 6 correspondents

[9] We use the term "correspondent" to refer to the bank in which another bank places deposits. Sometimes, we also refer to these institutions as "agents" given that this was the formal name for holders of the reserve balances that were listed in the examination report. We use the term "respondent" to refer to the bank that placed deposits with the correspondent.

in the city. As illustrated in Figures 2a and 3a, some banks opted to establish connections with the other two central reserve cities as well, while, as shown in Figures 2b and 3b, other banks did not. About three-fourths of the banks in our sample had at least one correspondent in Chicago while only one-third had a correspondent in St. Louis.

Presumably, common local factors affected the shape of network connections. The characteristics of the local customer base, for instance, likely were an important influence. Different customers, such as individuals, nonfinancial businesses, and other banks, may have required different services from their banks and consequently preferred banks with a particular structure of network connections. For example, if a respondent catered to local agricultural producers that shipped goods to various cities, then it may choose to maintain a more geographically diverse correspondent network. A bank with financial firms as customers might maintain a larger number of correspondent relationships to better enable it to execute transactions on behalf of its clients with many counterparties. Distance of the locality of the respondent also likely played a role: ceteris paribus, it is easier to establish relationships with counterparties that are physically close.

As banks within the same cities established different correspondent networks, some of the factors shaping network decisions must be related to bank-specific factors not shared by all banks within a particular location. We hypothesize that potential differences in the services provided to the subject bank by its correspondent banks reflect, in part, differences in the business models of the subject banks, which affected the kinds of services needed from correspondents. We explore the consequences for network choice from differences in business models in detail in Section 4 and 5 below.

Identifying potential influences on network decisions is only a first step toward establishing causal explanations about the structure of bank networks. Many of the variables we use to measure potential influences on network choices are likely to be endogenous with respect to the structure of the network. For example, we expect prior network choices would have influenced the propensity of banks to borrow from other banks to fund seasonal upswings in lending, or the extent to which banks would have purchased securities. Any model that relates bank behavior to network choice must consider both how

exogenous bank circumstances influenced network choices, and how network choices affected bank behavior.

Fortunately, however, we are able to address these endogeneity questions because the data set we use contains a number of variables that can serve as instruments. Potential instruments include characteristics pertaining to the governance structure of the bank and the occupations of the non-management members of the Board of Directors. We posit that the occupations of the non-management directors reflected the exogenous general business model of the bank, which in turn determined preferences for particular types of correspondent services. Thus, directors' occupations may be useful as instruments for many of the variables about which there would be endogeneity concerns. Of course, non-management directors were not involved in the particulars of the operations of the bank and were thus unlikely to directly influence the network variables we consider (See Alcorn 1908, Bolles 1890, and Coffin 1896). We defer further discussion of the relationship between banks' business models and their network choices to Sections 4 and 5 where we present evidence that each of the aforementioned business model characteristics was important in shaping bank's network choices.

3.1 Overall amount of interbank activity

We begin by characterizing the general level of connectedness of our banks to the interbank system, captured by the total amount of interbank deposits as a share of assets. For banks in our sample, the average ratio of deposits due to other banks (which includes due to national banks and to state banks) relative to assets was 13.2 percent. The average ratio of deposits due from other banks (which includes due from reserve agents, other national banks, and from state banks) was 12.6 percent. Based on aggregate comparisons (the only data available for that purpose) our banks appear to be more connected to the interbank system than other banks in the states in which they were located. To be specific, for all the banks operating in the states covered by our sample, the aggregate amount of deposits due from other banks is 13.5% of assets, while for our sample banks, as an aggregate, the sum of deposits due from banks constitute 14.9% of the sum of total assets for the sample. The difference with respect to deposits due to

banks is even greater; for all the banks operating in the states covered by our sample, deposits due to banks is 10.7% of assets, while for our sample banks, the sum of deposits due to banks is 18.7% of the aggregate amount of assets. That is not surprising given that our sample includes a larger proportion of reserve city banks than in the general population. Reserve city banks occupied a position in the reserve pyramid in between the country banks and the banks in the central reserve cities.

3.2 Relationships with the central reserve cities

The correspondent relationships about which we have the most complete information are those between respondents and central reserve city banks. Characterizing networks can be somewhat challenging, and therefore, we consider a variety of measures of network choice that capture different aspects. Among the dimensions of network choice we consider are the size of balances held with correspondents, the number of correspondent connections, the number of cities in which the bank had correspondents, the proportion of reserves held in New York City, and the concentration of balances held with correspondents. Some measures capture the intensity of the connections (whether business in concentrated in a few interbank connections or many) while others look at the locational distribution of connections. The summary statistics for these measures are shown in the upper portion of Table 2.

One important network choice is the share of all interbank deposits that are held with central reserve city agents. As shown in Table 2, these relationships tended to represent a very sizeable portion of banks' interbank connections; deposits at central reserve city banks, on average, accounted for 46 percent of all deposits due from banks but reached as high as 94 percent. An alternative approach to measuring the importance of interbank connections is the number of central reserve city connections maintained by each respondent. The number of central reserve city correspondents per respondent in our sample averages about 3 but ranges as high as 12.

All of the banks in our sample except one had a correspondent in New York City. This is not surprising given the role that New York played in the payment system, and given its position as the home to the largest securities markets. New York is by far the most important destination for bank deposits. On

average, 65% of balances held in central reserve city banks were held in New York banks, and for most of our banks, this share exceeded 50 percent.

We also measure the number of correspondents within each central reserve city. As nearly every bank had a correspondent relationship with at least one bank in New York, we consider instead whether each bank maintained multiple correspondents within New York. One bank had 6 such correspondents. By contrast, only about a third of the banks in our sample had a correspondent relationship with a bank in St Louis, despite the skew in the sample toward banks located in the West and South. Chicago fell between New York and St. Louis in its popularity as a correspondence destination. Seventy-two percent of the banks in our sample had a correspondent in Chicago and about 20 percent of our sample had multiple correspondent banks there. Given these facts, in our empirical work, when measuring banks' network choices, we focus on tracking simply whether a respondent bank maintained a correspondent in Chicago or St. Louis.[10]

Our final measure of network connection is the concentration of balances at the central reserve cities. There is a somewhat bimodal shape to the concentration of balances. A substantial proportion of our sample (96 banks) maintained only one or two correspondent relationships at a central reserve city. Most of these banks (64) maintained one correspondent in New York and one in Chicago. The remaining 112 banks maintained between three and twelve correspondents. For this latter group of banks with 3-13 relationships, the ratio of the value of the largest deposit balance held at any central reserve city correspondent relative to the total amount of balances held at all central reserve banks averaged 54% and ranged between 19% and 96%.

Table 3 illustrates how several of the measures of the shape of the correspondent networks vary with different bank attributes; these results help motivate some of the more formal empirical analysis we

[10] In his discussion of banks in Pennsylvania, Weber (2003) finds that most of these banks had a correspondent in Philadelphia. He further finds that the correspondent market in Philadelphia was fairly competitive and fairly fluid. We find that the New York City correspondent market also looks fairly competitive with the top 5 banks each having relationships with between 10 and 20 percent of the banks in our sample. By contrast, in Chicago, one bank had a considerably greater share of the market, holding balances with about 25 percent of the banks in our sample, while the next closest Chicago bank had a relationship with just under 10 percent of the sample.

conduct below. Looking first at the influence of respondent size, we see that banks in the top size quartile had more correspondents and held more of their deposits with other banks in central reserve city correspondents. Banks in the smallest quartile of assets tended to hold their central reserve city correspondent balances with banks in New York rather than with banks in Chicago or St. Louis.

Table 4 estimates a simple probit model, where the dependent variable is an indicator variable that takes the value of one if the bank has only one or two central reserve city correspondent relationships and zero otherwise. As explanatory variables we include bank size and locational characteristics, all of which we regard as exogenous with respect to bank network choices. Consistent with our expectations, described above, we find that small banks and banks located in counties where manufacturing is relatively less important tend to be more likely to maintain only one or two correspondent relationships. Distance from New York increases the likelihood of having more correspondents, though nearness to other reserve cities or being on the Pacific Coast adjusted the effect of distance.

A respondent bank's location clearly mattered for its network choices (as shown in Table 3). Banks farther away from New York tended to have fewer agents and held a smaller portion of their interbank balances with banks in central reserve cities. Banks closest to New York held greater proportions of their balances with central reserve city agents in New York. Banks a "moderate" distance away—which would have put them a bit West, but fairly close to either Chicago or St. Louis—held the smallest portion of all balances with central reserve city agents in New York. These results point to the general importance of New York, but also indicate that other central reserve cities could serve as substitutes if they were close to the respondent.

Respondents located in reserve cities had more central reserve city agents. Banks in reserve cities also held more of their balances due from banks with central reserve city correspondents; this is consistent with the idea that the legal requirements might have affected the distribution of reserve holdings – reserve city banks did not get "credit" in satisfying their reserve requirements for balances held in other reserve city banks.

We conclude from these measures that the banks in our sample are more connected to other banks through the correspondent system than the Pennsylvania banks operating in the 1850s that were studied by Weber (2003), which suggests that, more generally, the network of interbank relationships deepened during the National Banking Era. Our averages for "due from banks" and "due to banks" are larger than in his sample. The banks in our sample also appear to have connections to banks in more places than Weber's sample of banks. For instance, country banks in our sample often had connections to more central reserve cities and reserve cities than did the Pennsylvania banks in the 1850s. Moreover, the banks in the largest city in Weber's sample, Philadelphia, are reported to have had little connection with New York City, while the banks in the larger cities in our sample tend to be even more connected to New York (and Chicago/St. Louis) than other banks.

3.3 Country banks' relationships with reserve cities

There are 130 country banks in our sample. All but about 10 percent of these banks had agents in at least one reserve city. Roughly 40 percent of country banks had a correspondent in only one city. Nevertheless, there were a few banks that had agents in four or more reserve cities. In our formal analysis below, we consider various factors that might explain whether country banks maintained correspondent relationships in a large number of reserve cities.

The five most commonly cited reserve cities used by country banks as correspondent destinations were Kansas City, MO (more country banks listed Kansas City as a having one of their reserve agents than listed St. Louis); Omaha, NE; St. Paul, MN; Cincinnati, OH; and Boston, MA. It is perhaps surprising that Boston would be amount the most frequently cited cities given that the sample is drawn from banks in the West and South.

4. Modeling the factors influencing correspondent network choices

In this Section, we develop a model linking respondent bank attributes to their network correspondent choices. These factors include the location of the bank relative to the central reserve cities, the local

characteristics of the customer base in the city where the respondent bank is located, and other bank-specific exogenous influences on the respondent bank's demand for services offered by different correspondents. In developing that model, we are cognizant of endogeneity concerns (especially concerns about reverse causality), which lead us to identify instruments capable of capturing exogenous variation in respondents' demands for correspondent services.

Section 4.1 Services offered by the correspondents

Agent banks typically paid interest on balances placed with them, which was generally about 2 percent (James 1978, Examiner reports). Banks had two reasons to hold reserves: their economic desirability as a low-risk, liquid asset, and their value for meeting regulatory reserve requirements. It appears that reserve requirements were not very onerous in the sense that banks' economic demands for reserves often exceeded required reserves. Myers (1931) shows that the requirements were initially set to codify preexisting standards (for example, New York City's Clearinghouse had long required a 25% cash reserve requirement for its members).

Indeed, most of the banks in our sample held reserves substantially in excess of the legal requirement. However, some banks maintained cash holdings that were very close to their legal minimums, and for these banks, presumably the reserve requirement was a binding constraint on their behavior. These banks likely were particularly mindful of the distribution of their due from banks in order to prevent falling below the regulatory requirement. Thus, banks with low excess reserves may have structured the distribution of their reserve balances differently to facilitate their ability to monitor and manage incremental changes. We indicate such banks as those with "low cash reserves," defined as having ratios of cash to individual deposits plus net due to banks within a two percentage points of the legal minimum reserve requirement.

As noted in Section 2, reserve balances held at banks in large cities, especially New York, had some special advantages apart from their treatment for reserve requirement purposes. Such balances could be uniquely useful as part of the payment settlement process, especially for transactions related to

international trade. Long-distance payments, such as those by merchants, were typically made either by draft or check. The transactions could be cleared by shifting balances between the correspondents of the bank of the party writing the check or draft and the bank of the party receiving the check, especially if those correspondents were in the same city (See James 1978, James and Weiman 2010, White 1983). Drafts on New York banks were accepted nationwide and were vital for interregional payments. For payments within a region, balances held in regional centers would play a similar role.

To measure the potential value of deposit customer clearing, we use the ratio of checking deposits to total individual deposits (which consisted of checking plus time deposits).[11] We consider this variable to be exogenous with respect to bank network choices, and we expect to find that the greater are a respondent's check clearing needs, the more concentrated its correspondent balances will be. Given the randomness of the timing of check arrivals at correspondents, the law of large numbers (LLN) implies that maintaining fewer correspondent accounts allows respondents to economize on the total amount of reserves maintained for that purpose.

A third benefit of establishing a relationship with a reserve agent was the potential ability to obtain short-term funding from that agent. Banks could obtain a short-term loan from another bank while posting a loan or other security as collateral (this practice was labeled as "bills payable" by the respondent) or by selling one of its loans to another bank (this was known as rediscounting). Banks also borrowed by issuing collateralized certificates of deposit to other banks. Typically borrowing in any one of these forms carried higher interest rates and notable stigma was attached to it by country banks in the East, and also by national bank examiners who regarded such borrowing as a signal of potential funding problems, particularly if its use was accompanied by the withdrawal of retail deposits (Calomiris and Mason 1997, 2003, Calomiris and Carlson 2014b). But there was reportedly less stigma for country banks in the West and South (Lockhart 1921). The lower stigma there may have reflected the fact that such borrowing often occurred during crop moving season to finance a seasonal surge in bank lending. Our

[11] Results are essentially the same if we measure checking account intensity with the ratio of checking account deposits relative to total assets.

data indicate that a fair portion of this lending was done by borrowing from correspondents, although other banks were also involved. The correspondents reportedly did not attach much stigma to borrowing and some report that regular borrowing was viewed positively as it facilitated monitoring by allowing the lending bank regular insight into the types and quality of the loans made by the borrowing banks (Lockhart 1921).[12] Conway and Patterson (1914, p. 95) report that correspondents typically were only willing to provide loans or rediscounts equal to four or five times the balances held with them. Thus preferential treatment by correspondents regarding interbank borrowing, which was allocated on the basis of interbank deposit balances, may have had an important effect on the cost of accessing credit via the interbank network.

In our analysis, we use an indicator variable for whether the bank borrowed at all from other banks. An indicator variable is preferred because borrowing tended to be either zero or a fairly sizable amount (averaging 18% of deposits, conditional on being greater than zero); thus, it appears that the decision to move beyond zero was important, but this discrete decision might be lost in the noise associated with the range of borrowing on the balance sheet. The decision to use borrowed funds presumably was affected by its cost, and therefore, likely was endogenous to the network participation decisions of respondent banks. To the extent that respondents anticipated borrowing from correspondents regularly, we expect respondents to maintain fewer, more intensive relationships (see, for example, Rajan 1992). Furthermore, given that these loans were collateralized, we expect that respondents may have wanted to concentrate their borrowing in order to maintain only one or two pools of collateral against which to borrow, rather than many.

The fourth and final benefit of correspondents that we consider is their ability to provide a cost-effective means by which banks could invest funds in securities. Correspondents, particularly those in New York City, typically invested a considerable portion of their funds in Call Loans made to stock brokers that were secured by stock and could be called at any time (Gendreau 1979, White 1983). When

[12] The Call report also seems to have been used for monitoring borrowing banks. In fact, in 1890, the Comptroller of the Currency recommended increasing the number of times a year that individual call reports were published in order to facilitate this monitoring (Comptroller 1890, p. 57).

rates on call loans were elevated, correspondents sometimes enabled their respondent banks to invest directly in the call loan market rather than indirectly through respondent deposits in correspondents. Additionally, correspondents acted as agents to allow their respondent banks to purchase corporate bonds or other securities and also provided information on the credit quality of the securities (James 1978, Phillips 1924). Banks with relatively unattractive local lending opportunities should have found these services particularly desirable and may have consequently adjusted their correspondent networks toward places like New York, where these investment opportunities were focused. Subject banks with fewer profitable local investment opportunities, and which consequently purchased more securities from financial centers, may have found those bundled services more valuable. We therefore expect that banks with greater demand for securities purchases will find New York City correspondents more desirable, and that – to ensure competitive pricing of brokerage fees – they will maintain multiple correspondent relationships with New York banks.

While we cannot observe business opportunities directly, we can observe indicators of having a smaller set of profitable lending options. In particular, we use the ratio of non-U.S. Treasury securities holdings to the sum of non-Treasury securities plus loans and discounts. This ratio indicates the degree to which the bank was achieving its desired level of credit risk exposure by buying securities rather than through lending.[13] We posit that our measure of lending opportunities reflects the local lending environment faced by the bank, and is thus exogenous with respect to network participation decisions.

4.2 Other bank characteristics

One aspect of a respondent bank's network participation likely affected other aspects. In particular, the degree to which a bank relied on interbank deposits as a funding source or had other banks as loan

[13] As an alternative, we looked at whether the bank issued more than the legally required amount of notes. In the National Banking Era, banks were required to purchase a certain minimum amount of Treasury securities and issue a certain amount of notes. Banks earned a modest return on this endeavor, but it did require them to expend some balance sheet. Thus banks generally preferred to minimize note issuance. The banks that issued more notes than required to by law were generally those that were in areas with fewer good loan opportunities which made this alternative, low margin revenue stream more worthwhile (Calomiris and Mason 2008). This alternative indicator variable produced generally similar qualitative results although they tended to be less statistically significant.

customers likely influenced how it used correspondents to place its own deposits. Conversely, its deposits and related points of connection to central reserve city banks potentially influenced whether other banks would seek to hold deposits at the bank. This should have been particularly important for respondent banks operating in cities (like the banks in our sample) whose appeal to rural banks a deposit repository likely depended upon their connections to larger cities. Thus, we posit the relevance of the deposits due to other banks (as a ratio to assets) for network participation decisions involving correspondents, as well as the endogeneity of deposits due to banks to those network participation decisions. Similarly, we regard the share of bank assets that the respondent bank held with other non-central reserve city banks as both influencing and endogenous to its network participation decisions.

Larger banks should have had greater ability to conduct a wider range of business. Thus, we expect that larger banks would have more correspondents (consistent with Table 3). We control for size using log assets.

Another potentially important influence on network participation is ownership structure. Calomiris and Carlson (2014b) find that ownership structure influences the level of default risk targeted by the bank. Banks with greater proportions of management ownership tended to be more conservative. Those banks also tended to make greater use of cash, and less use of capital, as a means of reducing failure risk. Those risk preferences and preferences about cash holdings may also have affected choices about network connections. Our measure of ownership structure is the fraction of outstanding equity shares owned by the top three managers: the president, vice-president, and cashier.

4.3 Locational attributes

Being located in a reserve city altered the legal environment for banks. Although within our sample, "country" banks are really city banks operating in important regional reserve hubs (like Denver), regulatory designations still mattered. Being located in a reserve city should have made it easier for a bank to attract deposits from banks located outside of reserve and central reserve cities, as country banks' deposits in reserve city banks counted as part of the legal reserve of those banks. However, being a bank

in a reserve city also meant that only one's deposits due from banks in central reserve cities counted toward their own legal reserve. Thus, whether the bank was in a reserve city should serve as a control when modeling network participation decisions.[14]

As suggested by the Table 3, distance likely influenced choices regarding reserve agents. Being closer to a reserve city may have increased its attractiveness as there may well have been more trade between the local city and that reserve city. Additionally, physical proximity may have facilitated moving cash between a respondent bank and its agents, which might have made deposits more attractive from a liquidity management perspective. Alternatively, greater distance may have increased the value of having an agent in a far off city, as it might enable the bank to transact at least some types of business in more distant locations. We thus include the log distance from each of the three central reserve cities in the regressions. There may be notable non-linearities associated with distance, so we also add an indicator for whether the bank is located on the Pacific Coast.

The sectoral characteristics of the local customer base may have influenced the network linkages chosen by the bank. Business customers may have valued banks that could better connect them to particular places. To the extent that different businesses may have conducted commerce with different locations, the sectoral distribution of businesses may have mattered. Thus, we include in our analysis the number of manufacturing firms in the county as reported in the 1890 census.

We also include the population of the county (again from the 1890 census). One might expect that a larger population would have a greater variety of needs and thus be associated with more network connections.

Agricultural areas may also have had particular needs. Various scholars have documented the seasonal flows of money through the financial system associated with the harvest season (Kemmerer 1910, Miron 1986, Hanes and Rhode 2013). More heavily agricultural areas may therefore have had different needs with respect to the financial system. As a measure of the agricultural intensity of the area,

[14] We also tried estimating versions of the regressions reported below separately for reserve city and country banks but did not find notable differences between coefficient estimates for these two sub-samples.

we include the ratio of agricultural income to agricultural income plus manufacturing income at the state level.

5. The role of various factors in shaping bank networks

In this section, we present our empirical analysis of the relationship between these explanatory factors and the shape of bank correspondent networks. We connect various bank and locational characteristics to network participation choices, which include the aggregate size of interbank balances, the number of correspondent agents, the proportion of balances held in New York City, the concentration of balances among agents, and the number of cities in which agent relationships were maintained. Before discussing those results, we discuss our instrumental variables approach for addressing estimation challenges that arise from the likely endogeneity of many bank characteristics with respect to their network participation decisions.

5.1 Endogenous variables, instruments, and first stage regressions

As we noted in Section 4, several characteristics that are likely to influence bank network decisions were also influenced by network choices, including: the amount of deposits due to banks, the amount of deposits due from banks, the indicator for holding low cash reserves, and the indicator for using borrowed funds. To deal with these endogeneity concerns, we exploit several variables that serve as instruments in our specifications. One set of variables contains information about the governance of the bank that are available in the examiner report, and about the occupations of non-management directors of the bank.

We posit that the occupations of the outside directors serving on the Board likely reflected and influenced preferences about the types of loans made by their banks and the general composition of banks' liabilities. The occupations of directors consisted of several categories: farmers, merchants, doctors, lawyers, government officials, manufacturers, financiers, real estate developers and "capitalists" (a category that seems to indicate a wealthy investor in the bank without a current occupation in a particular sector). After experimenting with the potential relevance of these various factors and how best

to group them, we concluded that the most useful division is into four categories: farmers, real estate developers, capitalists, and other (the omitted category in our regressions). Having more outside board members that were farmers, or in a related agricultural occupation such as operating a grain elevator, presumably reflected or increased the likelihood that the bank made agricultural loans, and that the bank would need to rely on borrowing to fund its seasonal swings in lending. The activities of outside directors that were involved in real estate development likely created less need than other sectors for distant network connections. Their needs may have tilted banks away from a larger or more complex network profile, given that banks with fewer deposits in correspondents would have more resources to devote to local borrowers. Capitalists, the most common occupation for outside directors, presumably did not favor particular sectors, per se, but may have been more conscious of considerations related solely to the consequences for bank profitability of the network decisions of the bank. We include the log of the number of directors on the Board in each of these occupations as instruments.

Several other instruments are derived from the oversight procedures used by the Board to constrain risk taking by management. For instance, whether the cashier or president posted a bond to insure against bad behavior, such as fraud, may have affected their other risk-related behaviors, such as reliance on borrowed money. Other types of oversight, such as whether there was an independent committee to review loans made by the management or the frequency of board meetings—defined to capture whether it met at least monthly—likely affected the bank's risk of closure and the amount of cash that the bank kept on hand (Calomiris and Carlson 2014b).

Finally, a bank's relative position within its local banking environment likely affected its ability to attract interbank depositors. As one such measure, we compute the "paid in capital" of the subject bank relative to the "paid in capital" of other banks in the city where it is located. A second measure is the age of the bank relative to the age of the other banks in its city. We expect that banks that were relatively large or old may have been better able to attract deposits. Thus, we expect that these variables should positively influence due to banks as a share of assets.

Our regression methodology consists of two stages of analysis. In the first stage, we combine instruments and control variables to explain cross-sectional differences in four endogenous variables that we believe should influence network choices of respondent banks (the use of borrowed money, status as a "low-cash" assets bank, the ratio of deposits due to banks as a proportion of assets, and the ratio of deposits due from banks as a proportion of assets). Controls include exogenous characteristics of banks and of bank locations that we assume are relevant both to these four bank characteristics and to the network choices of banks, which we model in the second stage of the analysis.[15] In addition to the instruments and control variables already discussed, we also include a variable that adjusts for the time of year in which the examination was undertaken.[16] Our exclusion restrictions, which permit us to identify causal determinants of network choices, require that these various instruments affect risk, lending, and cash holding preferences, and that they only affect network participation decisions indirectly through their effects on those variables.

The first-stage regressions for our analysis can be summarized in the following four cross-sectional OLS equations:

(1a) Use of borrowed money$_i$ = f_a(Instruments$_i$, Bank Controls$_i$, Other Controls$_i$) + error1a$_i$,

(1b) Low Cash$_i$ = f_b(Instruments$_i$, Bank Controls$_i$, Other Controls$_i$) + error1b$_i$,

(1c) Due to Banks / Assets$_i$ = f_c(Instruments$_i$, Bank Controls$_i$, Other Controls$_i$) + error1c$_i$,

(1d) Due from Banks / Assets$_i$ = f_d(Instruments$_i$, Bank Controls$_i$, Other Controls$_i$) + error1d$_i$,

where i indexes a national bank. Results for these first-stage regressions are shown in Table 5, where the first nine regressors appearing in the table are instruments and the remaining variables are controls. All

[15] We also examined the possibility that due to banks and due from banks may be jointly determined, but did not find evidence of this after controlling for various local economic conditions.

[16] Bank examinations took place year round. There were also notable seasonal fluctuations in bank behavior which were driven by needs to move crops (James 1978, Kemmerer 1910, Lockhart 1921, Miron 1986, Hanes and Rhode 2013). For instance, Calomiris and Carlson (2014a) find elevated borrowing during the late fall and winter. As the time of year when the examination occurred might affect the likelihood that the bank was using borrowed funds, we include a dummy for crop moving season (defined as October through January).

four regressions are estimated using ordinary least squares (OLS), even when the dependent variable is an indicator variable, as Wooldridge (2002, Chapter 5) explains that OLS often provides more robust first-stage estimation results.[17]

In general, the instruments have the expected impact on the four endogenous variables. Having more farmers as board members is associated with a higher likelihood of using borrowed funds as well as with being a low-cash reserves bank. Banks with more capitalists tended to have more interbank deposits. (Bank deposits paid interest rates of 2 percent. Rates paid on time deposits were sometimes reported in the Examiner Reports and these rates averaged 4.25 percent for the banks in our sample with a minimum of 2.25 percent. Thus, bank deposits may have been viewed by non-borrower directors as a reasonably cheap source of funding.) Banks with more directors involved with real estate finance tended to have lower ratios of due from banks to assets, as expected. Banks where the president was bonded tended to have lower cash.[18] Banks where the cashier was bonded were less likely to use borrowed money and had lower interbank balances—both in terms of due from other banks and due to other banks. Banks with an independent loan committee were less likely to use borrowed funds and banks where the board met more frequently tended to have less deposits due from other banks. Banks with relatively more capital paid in compared to nearby banks were less likely to have low cash reserves and to have lower ratios of due from other banks relative to assets. Relatively older banks were also less likely to have low cash reserves but, rather surprisingly, also displayed smaller ratios of deposits due from other banks relative to assets.

[17] We had originally expected that deposits due to banks and those due from banks might be co-determined, possibly because banks that received more funding from deposits due to banks were those that placed more deposits with other banks. However, a variety of analysis, including the estimation of a three-stage least squares model positing that inter-relationship between deposits due to banks and deposits due from banks, found no significant relationship between those two variables, especially after including locational controls. Although we found that result somewhat surprising, it simplifies our analysis by permitting the independent estimation of the four endogenous variables described in equations 1a-1d.

[18] This is consistent with Calomiris and Carlson (2014b) who find that banks with more ownership management are likely to have more cash and are less likely to have formal governance such as the bonding of the President. See also Calomiris, Heider, and Hoerova (2015) for why cash should vary with different corporate governance arrangements.

5.2 Banking operations and the shape of the correspondent network

We now turn to the second stage of our analysis, which assesses the role the various factors we have identified in shaping the correspondent network choices of respondent banks. In each case, we employ the instrumented values of endogenous variables (estimated in equations 1a-1d), alongside Bank Controls and Other Controls, to estimate how each of these factors influenced network participation decisions.

We first examine the role of these various factors in determining the general importance of connections with central reserve city correspondents, measured by the proportion of due from banks that consisted of balances at central reserve city agents, and by the number of central reserve city agents (Table 6). We then look at what factors influenced the banks to hold a greater proportion of their balances in New York City relative to Chicago or St. Louis (Table 7). In Table 8, we present an analysis of the determinants of the number of agents used in each central reserve city. There we report results for three regressions, which examine factors associated with (1) having multiple agents (as opposed to a single agent) in New York City, (2) having at least one correspondent relationship in Chicago, and (3) having at least one correspondent relationship in St. Louis. We examine the roles different factors played in determining the concentration of balances in a single agent in Table 9. For non-reserve city ("country") banks, we also look at the number of reserve cities in which they had an agent (Table 10). Rather than discussing each table independently, we discuss the role of each of the determinants of network choice (both for instrumented variables and controls) in shaping the overall network across different regressions. Doing so permits us to provide a more coherent narrative of how various factors shaped the network decisions of respondents.

One of the factors that consistently shaped various dimensions of network choice is the proportion of deposits that take the form of individual checking accounts. We find that banks funded more by checking accounts tended to concentrate their deposits, particularly with New York reserve agents. This can be seen in Table 7, where more reliance on checking deposits is associated with placing a higher share of total funds due from central reserve city banks in New York. The importance of checking accounts is also apparent in Table 6, where we find that banks with more checking deposits

tended to have fewer agents. These findings are especially striking in light of the fact that having more checking deposits is also associated with a higher general proportion of deposits due from banks relative to assets (Table 5). These findings suggest that there were significant check clearing benefits to respondent banks from concentrating their deposits at a few correspondent institutions that did most of their clearing.

Banks that held more private securities relative to total private credit exposure (the sum of loans, overdrafts, and privately issued securities), which we view as a proxy for fewer local lending opportunities, tended to place more of their central reserve city balances in New York City (Table 7). They also tended to have correspondents in fewer reserve cities (Table 11). However, these banks did not concentrate their funds with a particular agent, but instead tended to make use of many agents in New York City (Table 8). These findings are consistent with the literature that suggests that correspondents provided a means of investing funds, and that there were advantages to promoting competition among one's agents for purposes of buying securities. This is consistent with the accounts of James (1978) and Phillips (1924), who emphasize that correspondents produced credit analyses of the securities being offered in public markets; having more correspondents in New York would have given banks more opinions and more execution options when choosing and making investments.

We expected that Low Cash banks (those with low excess reserves), would be banks more concerned about making sure that they satisfied their reserve requirements, and therefore, ceteris paribus, would have tended to hold more of their interbank deposits in central reserve cities, where balances counted for regulatory purposes (Table 7). Given the legal differences in whether balances in reserve city banks could count, we tested whether this relationship was similar for banks in reserve cities and country banks by estimating this regression separately for the two groups of banks. We found similar effects in both regressions. The greater reliance of Low Cash banks on central reserve city agents to meet reserve requirements does not appear to have affected how many agents the banks chose to have.

Consistent with our expectation, banks that used borrowed money tended to have fewer correspondents (Table 7) and they tended to concentrate their deposit balances at a single institution

(Table 9). Doing so economized on information costs related to lending (Rajan 1992), and also may have facilitated the mechanics of providing collateral to lenders. These borrowings were almost always secured (Conway and Patterson 1921), so banks may have found it advantageous to keep collateral pools with a small number of agents rather than having to keep collateral accounts at multiple institutions.

We find that banks that relied more on interbank deposits due to other banks as a source of their own funding tended to concentrate their own central reserve city balances in New York City more.

Distance played an important role in network decisions. This effect is most obvious in Table 7 and Table 8 where distance from the three central reserve cities strongly influenced the locational decisions regarding use of additional central reserve city agents and influenced the use of balances in New York versus the other cities. Being farther from Chicago and closer to St. Louis promoted use of St. Louis while being closer to Chicago and farther from New York encouraged the use of an agent in Chicago. Curiously, distance to the central reserve cities seems to have had only a modest impact on the number of central reserve city agents used (Table 6) with banks farther from New York tending to have a slightly higher number of agents. Being located on the Pacific Coast reduced the proportion of interbank balances held in the central reserve cities. From Table 9, we observe that banks farther from New York were less likely to concentrate their central reserve city balances at a single institution.[19]

Having more potential manufacturing firm customers is associated with having more agents (Table 7) and having agents in more places (and this particularly increased the likelihood of having an agent St. Louis, as shown in Table 8, and of having correspondents in more reserve cities, as shown in Table 10).[20] These findings are consistent with the idea that banks maintained more correspondent relationships to cater to their business clients (or potential business clients). A larger county population appears to have little effect other than to reduce the likelihood of having a correspondent in St. Louis.

[19] Given the smaller samples used in Table 9 and Table 10, we dropped some of the distance measures.
[20] Also consistent with this idea, we find that banks with more large loans (loans that exceeded10% of capital), and thus presumably had fewer business borrowers, had correspondents in fewer locations.

National banks in our sample that were located in reserve cities were not very different from those located in non-reserve cities, although they kept slightly smaller shares of their central reserve city balances in New York City and concentrated their deposits at a single correspondent a bit more.

Larger banks had more correspondents, ceteris paribus. This is clear in the analysis of the number of correspondents (Table 7) and in the greater likelihood that large banks had an agent in St. Louis (Table 8). Given that greater number of agents, larger banks also tended to maintain a lower proportion of their balances in New York City, especially as a fraction of total balances maintained in central reserve cities (Table 7).

6. Correspondent networks and the Panic of 1893

The Panic of 1893 was one of the most severe in the National Banking Era. More banks closed permanently during this panic than after any of the other panics of the era. Various scholars have pointed to a number of causes of the panic and they range from financial instability associated with worries about the U.S. commitment to the gold standard to a decline in economic activity and increase in corporate bankruptcies (see Carlson 2013 for a discussion). The panic prompted banks to convert the interbank deposits due to them into cash. Partly in response to the elevated redemption requests, banks in New York City suspended the ability of depositors to convert deposits held there into cash (Wicker 2000). Suspending convertibility prevented the forced liquidation of many of the loans extended by the New York banks to stock brokers, which could have resulted in the liquidation of equities at fire sale prices and potentially triggered bankruptcies of brokers and dealers. However, the suspension also meant that banks elsewhere in the country had some of their more liquid assets (deposits due from New York City banks) suddenly changed into illiquid assets. This loss of liquidity may have contributed to spreading the crisis.

Anticipation of suspension of convertibility may also have magnified the crisis. New York City banks had suspended convertibility in 1857, 1861, and 1873, so it would not have been far-fetched for respondent banks or respondent banks' depositors to have anticipated suspension risk, which itself could have motivated deposit withdrawals of deposits from both correspondent banks and respondents prior to

New York's suspension.[21] Similar concerns might have been relevant with respect to the possibility of suspensions by St. Louis or Chicago banks, although in the event, neither city saw a suspension of convertibility in 1893.

We test whether bank network connections, and especially those related to deposits in New York City, in comparison with other central reserve cities, played a role in spreading the crisis. To determine whether interbank networks mattered in the panic, we test whether holding more balances with central reserve city agents is associated with an increased likelihood that the bank closed during the panic. Banking panics are large scale tests by bank liability holders of the ability of banks to meet their obligations. Thus, our measure of the channel of influence though which network effects mattered during the Panic is the proportion of the liquid assets of the bank—defined as cash assets and due from banks (not just agents)—held in the central reserve cities. We examine separately the role of balances held in New York City banks and at balances held at either Chicago or St. Louis banks. Note that our regressions for the second sample period, therefore, exclude banks that failed in the early stage of the panic.[22]

The suspension of deposit redemptions by New York banks occurred partway through the panic (the unusually long-lived panic started in May but the suspension in New York did not occur until August). The impact of balances held in New York, and in the two other central reserve cities, may have changed following the New York suspension. Thus, we consider the role of network effects in causing respondent closures separately for the two time periods of the Panic divided by the day New York City

[21] Carlson (2015) suggests that concerns about suspension on the part of New York banks may have prompted banks in reserve and country cities to withdraw even faster and thus reinforcing the run on New York. While the amount of deposits due from New York City banks would not have been known to respondent banks' depositors, the number of New York City correspondent banks was observable publicly, as that information was published regularly in bank almanacs. Thus, it is conceivable that banks with many New York correspondents could come under greater pressure if their depositors were concerned about a possible New York suspension.

[22] Some banks closed and reopened during the Panic. In our regressions, we treat those as closures. If a bank closes in the first period, it is dropped from the second panic period sample even if it reopens during the second panic period.

banks suspended.[23] We illustrate the effects of New York' suspension on our sample of banks (which is drawn from cities such as Denver, New Orleans, etc.) in Figure 4.

Interbank deposits were the liabilities that tended to be drawn down most quickly during a panic.[24] To account for the possibility that deposits held in central reserve cities were more likely to result in troubles for respondent banks that had lots of interbank due to deposits of their own, we interact the ratio of a respondent's interbank deposits due to other banks relative to assets with the ratio of due from deposits held by the respondent in the central reserve cities.

We also consider whether the closure of a correspondent affected the probability of closure of the respondent. Within our sample there were two banks located in Chicago, one bank located in New York City, and zero banks located in St. Louis that closed during the Panic of 1893. All three of those banks closed and were placed into receivership. The New York City bank that closed (National Bank of Deposit) was not linked to any respondents in our sample. The two Chicago banks that closed (Chemical National Bank on May 9, and Columbia National Bank on May 11) were linked to two and six respondents, respectively. Of Chemical's two respondent banks, one closed in the early phase of the panic (on May 11), and three of Columbia's six respondents closed (July 5, July 17, and August 16). All four of these respondents that were connected to either Chemical or Columbia reopened (Capital's respondent reopened June 19, and Chemical's respondents reopened between August 21 and 23).

These facts led us to consider two additional questions: (1) did the failure of a correspondent bank increase the probability that a respondent would close, and (2) did closures of respondents that were related to network liquidity shocks tend to result in reversible suspensions (closures followed by reopenings) rather than receiverships? We test the first question by including an indicator variable for whether a correspondent bank fails during the panic. We test the second question by investigating whether

[23] We count as "closed" both banks that suspended but later reopened and banks that failed or voluntarily liquidated after being closed. As we discuss further below, we also consider whether network effects matter differently for closure without reopening than for closure with reopening.
[24] Other banks are likely to be among the most knowledgeable about the health of other banks. Banks are also likely to be quite risk averse when placing funds that they are using for liquidity purposes.

network influences on closure are less pronounced when we define closure more narrowly to only include banks that failed and did not reopen.

We include in our regression specifications variables reflecting business needs associated with the services provided by central reserve city agents and the location-related variables. For the purpose of the analysis here these variables are exogenous to the unexpected shock of the panic. We also add further controls for the condition of the bank that prior studies have found useful for predicting bank failure. Specifically, we include the ratio of net worth to assets and the ratio of other real estate owned to assets. The former ratio is a measure of leverage. Other real estate owned typically consisted of real estate collateral that was seized when loans went bad, and is indicative of loan quality. We also include a bank's relative age, as new banks were often risker. During the crisis – in response to Congressional action repealing the Sherman Silver Purchase Act of 1890 – it became clear that the U.S. would stop purchasing silver and the price of silver dropped. This in turn caused the closure of many silver mines and related businesses and, consequently, may have put additional strains on banks in these areas (Carlson 2013). To account for this effect, we include an indicator for whether the state had considerable mining activity.

Our results showing the impact of interbank connections on the likelihood that a bank closed in the early stage of the crisis (prior to the suspension of redemptions in New York) are reported in Table 11. By themselves, neither the proportion of liquid assets held in New York City, nor the amount of deposit due to other banks from the respondent, mattered for the risk of closure in the early panic period (both have negative insignificant coefficients in predicting failure). We find, however, that banks that were *both* more dependent on interbank deposits as a funding source and that also kept a greater portion of their liquid assets in New York City (measured by the interaction of those two variables in the regression) were considerably more likely to close. We find that interbank deposits held in Chicago or St. Louis mattered somewhat differently from deposits in New York prior to New York's suspension. Holding funds in Chicago or St. Louis, as opposed to New York, reduced the risk of closure. Furthermore, although not reported in the table, the estimated effect of interacting those deposits with the respondent bank's due to

balances is statistically insignificant. These findings suggest that the two sides of "two-sided" liquidity risk amplified one another's importance in our sample, and that banks anticipations of a suspension in New York may have been important, and that banks that acted as a conduit between other banks and New York City were the most vulnerable to those concerns. This result is consistent with narrative accounts in Wicker (2000) of runs on banks that were understood to be important in the interbank network.

We find that the failure of a correspondent does increase the risk of a respondent's closure, but the statistical significance of that effect is marginal (significant at the 7 percent level). This likely reflects the small number of observations on which that estimate is based (eight respondents linked to two correspondents, of which four close).

The impact of balances held in the other central reserve cities appears to shift in the wake of the suspension of New York. In the latter part of the panic, balances in any of the three central reserve cities increased the likelihood of suspension (Table 12), although the effect of New York City remains relatively large. Moreover, the impact of balances held there seems independent of the degree to which the respondent bank itself was funded by interbank deposits (i.e., there is no significant interaction effect). Additionally, we find that the impact of maintaining liquid assets in central reserve cities is larger for banks that were located father away from the central reserve cities. This latter finding confirms the view that our results are capturing liquidity effects, which should have been magnified by distance, as greater distance made it harder for respondent banks to access those funds quickly suffered.

The effects of the other variables in the regressions are as expected. Banks that relied more on borrowed money were more likely to close, especially late in the panic, as has been found in several other studies. Banks that relied more on checking deposits in individual funding were less likely to close; that finding is similar to the results reported by Ramirez and Zandbergen (2013), who show that time deposits were a particularly volatile source of funding.[25] As expected, banks with more other real estate owned were more likely to close. Larger banks were less likely to close, as were banks located in reserve cities.

[25] Interestingly, we do not find that the interaction of time deposits and the share of liquid assets held in New York City mattered in the same way that the interaction between due to banks and the share of liquid assets held in New York mattered.

Consistent with Calomiris and Carlson (2014b), we find that banks with higher management ownership were somewhat less likely to close. Finally, and also as expected, we find that banks in states with more mining were more likely to close.

How economically important were network liquidity effects for predicting bank failure risk during the two panic periods? To answer that question we drop the network variables from the probit models reported in Tables 11 and 12, and then compare the pseudo R-squareds for the models with network effects to the pseudo R-squareds for the models without network effects. For the early panic period, including the network effects increases the pseudo R-squared from 0.156 to 0.225, a 7 percentage point improvement, which is a 44% increase. For the later period, the pseudo R-squared rises from 0.43 to 0.57 when network effects are included, a 14 percentage point improvement and an increase of 33%. We conclude that network effects are important.

Finally, we investigate whether network effects are mainly confined to closures of banks that subsequently reopen. If that were true, then redefining the dependent variable to be liquidation rather than simply closure (which is possibly reversed when a bank reopens) in the regressions previously reported would result in less statistically and economically significant estimated network effects.[26] Of course, given the reduced fraction of the sample coded as a failure, we expect the statistical significance of our network coefficients to be diminished, which they are. We find, however, that the relevance of network effects is similar in these (unreported) regressions to the effects found in the regressions reported before. Specifically, for the early period, using the narrow definition of bank liquidation, the pseudo R-squared rises from 0.22 to 0.28 when network effects are included (a 6 percentage point increase, implying a rise of 27%).[27] We conclude, therefore, that network effects were important both for causing bank closures that resulted in liquidation and for causing those that resulted in temporary suspension.

[26] In these specifications, suspensions that result in reopening are treated as the same as banks that remain open. We also ran regressions where the reopening banks were omitted from the sample, which produced similar results.
[27] There are too few liquidation observations to perform this analysis for the later panic period, so we confine ourselves to a comparison of the early period.

7. Conclusion

The interbank deposit network was an extremely important part of banking operations in the US in the late 1800s. Banks depended on this network of relationships to clear payments, obtain short-term financing, meet reserve requirements, and to provide an alternative source of investment opportunities when local opportunities were insufficient. Furthermore, as banks were limited to a single office in a single location, the smooth functioning of the interbank network was essential for commerce, which was expanding rapidly as transportation costs fell.

While all banks connected to this network to some degree, the nature and depth of those connections varied; some connected considerably more than others. We find that the services offered by the correspondent banks in conjunction with the business model of the bank were important in shaping the respondent banks' connections to correspondent banks. For instance, banks for whom access to payment clearing services or to investment opportunities were particularly important tended to link most strongly with New York. Banks more dependent on borrowing money from other banks tended to establish fewer, more concentrated depository relationships. Larger banks, and banks in areas with more potential business clients, tended to seek more, and more diverse, interbank relationships.

While the operation of the system in good times was beneficial, during stress situations, it could be a propagator of instability. Banks that were interbank deposit intermediaries within the banking system, in that they both were the recipients of more deposits from other banks and had more balances in New York banks, appear to have suffered more during the initial stages of the Panic of 1893. Difficulty accessing liquidity held in central reserve cities also proved problematic, both before and after the suspension of New York City banks in August of 1893, and New York was consistently a more problematic central reserve city repository from that perspective. The interbank network appears to have been a source of contagion during the panic.

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Table 1
Variable names/definitions

Variable	**Source**	**Definition**
Due from central reserve cities relative to all due from banks	Exam report	Amount due from central reserve city agents divided by due from all banks
Number of agents in central reserve cities	Exam report	Number of agents located in central reserve cities
Ratio of due from New York banks to due from all central reserve city banks	Exam report	Amount due from New York City agents to amounts due from all Central Reserve city agents
Had multiple agents in New York	Exam report	More than one agent in New York City listed on report
Had an agent in St. Louis	Exam report	At least one agent in St. Louis listed on report
Had an agent in Chicago	Exam report	At least one agent in Chicago listed on report
Maximum amount from one CRC agent to all CRC balances (3 or more CRC agents)	Exam report	Maximum amount reported at any one Central Reserve city agent divided by amounts due from all Central Reserve city agents
Number of reserve cities (country banks only)	Exam report	Number of Reserve Cities in which the report listed at least one agent
Checking deposits to individual deposits	Exam report	Checking deposits to individual deposits
Non-Treasury securities to sum of loans, overdrafts, and non-Treasury securities	Exam report	Value of non-Treasury securities divided by the value of loans, overdrafts, and non-Treasury securities
Uses borrowed money	Exam report	Bank uses borrowed money: bills payable, rediscounts, certificates of deposit issued to other banks, or other
Had a low cash reserve	Exam report	Bank has cash holdings relative to individual deposits and net due to banks close to the legal minimum (threshold of 10 percent for city banks and 12.5 percent for reserve city banks)
Due to all banks relative to assets	Exam report	Due to all banks divided by assets
Due from all banks relative to assets	Exam report	Due from all banks divided by assets
(log) assets	Exam report	(log) assets of the bank
Portion of bank shares owned by top 3 mgrs	Exam report	Portion of outstanding share of the bank owned by the president, vice-president, and cashier
Reserve city	Comptroller annual report	Bank in reserve city
Distance to NYC		(log) distance in miles to NYC
Distance to Chicago		(log) distance in miles to Chicago
Distance to St Louis		(log) distance in miles to St. Louis
On Pacific Coast		City is located on the West Coast. Cities include: Tacoma, Portland, San Francisco, Los Angeles, and San Diego
(log) population of county	1890 census	Log population of county
(log) number of manufacturing	1890 census	Log of the number of manufacturing firms in the

firms		county
Percent of state income from agriculture	1890 census	State income from agriculture divided by the sum of income from agriculture and manufacturing value added
(log) number of farmers or agricultural industry related outside directors	Exam report	(log) number of individuals on the board of directors whose occupation was listed as farmer, grain elevator operator, or similar.
(log) number real estate finance people on Board	Exam report	(log) number of individuals on the board of directors associated with real estate investment
(log) number capitalists on Board	Exam report	(log) number of individuals on the board of directors identified as capitalists
President bonded	Exam report	President posts a surety bond
Cashier bonded	Exam report	Cashier posts a surety bond
Active discount committee	Exam report	Examiner reports the bank has an active discount committee
Board meets at least monthly	Exam report	Board of directors meets monthly or more frequently
Exam conducted during crop moving season	Exam report	Exam conducted during the months of October, November, December or January.
Relative age of bank	Comptroller annual reports / Rand McNally	Relative age of bank (bank's age minus average age in city)
Relative capital paid in of bank	Call report	Relative size of paid-in capital (banks' capital-city average capital) in hundreds of thousands of dollars
Closed	Comptroller's annual report	Bank is closed between the September 1892 call report and January 1, 1894
Correspondent fails		A correspondent of the bank fails
Balances with NYC agents to liquid assets	Examiner report	Balances with New York agents divided by due from banks plus cash assets (items counted as cash for reserve requirements)
Balances with non-NYC CRC to liquid assets	Examiner report	Balances with Chicago and St Louis agents divided by due from banks plus cash assets (items counted as cash for reserve requirements)
Distance from nearest central reserve city		Minimum distance to Chicago, St. Louis, and New York (thought this is never New York)
State has notable mining operations	Statistical Abstract of the United States	$1 million in gold/silver mined in state in 1891
Net worth to assets	Call report	Ratio of capital paid in, surplus, and undivided profits to assets
Other real estate owned to assets	Call report	Other real estate owned relative to assets

Table 2
Summary statistics.

Variable		Mean	Standard Deviation	Minimum	Maximum
Network measures					
	Due from central reserve cities relative to all due from banks	.46	.21	0	.94
	Number of agents in central reserve cities	3.1	1.97	0	12
	Ratio of due from New York banks to due from all central reserve city banks	.65	.30	0	1
	Had multiple agents in New York	.43	.50	0	1
	Had an agent in St. Louis	.35	.48	0	1
	Had an agent in Chicago	.72	.45	0	1
	Maximum amount from one CRC agent to all CRC balances (3 or more CRC agents)	.54	.18	.19	.96
	Number of reserve cities (country banks only)	1.68	1.25	0	7
Factors affecting network structures					
	Checking deposits to individual deposits	.74	.20	.18	1
	Non-Treasury securities to sum of loans, overdrafts, and non-Treasury securities	.05	.08	0	.57
	Uses borrowed money	.29	.46	0	1
	Had a low cash reserve	.34	.48	0	1
	Due to all banks relative to assets	.13	.12	0	.47
	Due from all banks relative to assets	.13	.07	.01	.41
	(log) assets	14.1	.85	12.0	15.9
	Portion of bank shares owned by top 3 mgrs	.24	.23	.005	.97
	Reserve city	.375	.49	0	1
	Distance to NYC	7.07	.46	6.35	7.86
	Distance to Chicago	6.34	.76	4.13	7.53
	Distance to St Louis	6.28	.66	5.46	7.47
	On Pacific Coast	.12	.32	0	1
	(log) population of county	4.44	.84	2.75	5.93
	(log) number of manufacturing firms	6.3	1.4	2.2	9.1
	Percent of state income from agriculture	.46	.15	.09	.92

Variables used as instruments					
	(log) number of farmers or agricultural industry related outside directors	.02	.16	0	1.8
	(log) number real estate finance people on Board	.14	.32	0	1.6
	(log) number capitalists on Board	.52	.30	0	.69
	President bonded	.33	.47	0	1
	Cashier bonded	.57	.50	0	1
	Active discount committee	.60	.49	0	1
	Board meets at least monthly	.63	.48	0	1
	Exam conducted during crop moving season	.37	.48	0	1
	Relative age of bank	.006	.85	-2.5	1.9
	Relative capital paid in of bank	.09	.64	-1.56	1.43
Other variables					
	Closed	.28	.45	0	1
	Correspondent fails	.04	.19	0	1
	Balances with NYC agents to liquid assets	.17	.12	0	.67
	Balances with non-NYC CRC to liquid assets	.19	.11	0	.50
	Distance from nearest central reserve city	6.18	.77	4.13	7.47
	State has notable mining operations	.23	.42	0	1
	Net worth to assets	.33	.13	.08	.76
	Other real estate owned to assets	.01	.02	0	.11

Table 3
Simple comparisons of network shape

	Number of agents	Ratio due from CRC agents to all due from	Due from NYC CRC agents to all CRC agents
By Size			
Small banks (52)	1.8 (.8)	.39 (.21)	.72 (.30)
Medium banks (104)	2.9 (1.3)	.44 (.20)	.62 (.30)
Large banks (52)	5.0 (2.5)	.54 (.20)	.62 (.32)
By distance to NYC			
Nearest (55)	3.3 (2.1)	.49 (.22)	.78 (.26)
Mid-distance (99)	3.5 (2.1)	.49 (.20)	.55 (.31)
Farthest (54)	2.3 (1.2)	.36 (.19)	.68 (.28)
Reserve city status			
Country Bank (130)	2.6 (1.6)	.41 (.21)	.67 (.30)
Reserve city bank (78)	4.1 (2.1)	.54 (.18)	.61 (.30)

Table 4

Relationship between locational factors and having only one or two correspondents

	Does the bank have only one or two agents
Log assets	-.23*** (.04)
Reserve city	-.03 (.09)
Distance to NYC	-.55*** (.18)
Distance to Chicago	-.001 (.10)
Distance to St Louis	.30** (.14)
Pacific Coast	.23** (.12)
Population of county	.30** (.14)
Log manufacturing firms in county	-.23*** (.09)
Percent of state income from agriculture	.16 (.22)
Constant	19.1*** (3.8)
Pseudo R^2	.29
LR χ^2	82.5
Observations	208

Notes: Estimated using a probit specification. We report marginal effects evaluated at the mean. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 5 - First stage regressions with Instrumental Variables

	Use borrowed money	Low cash	Due to banks to assets	Due from banks to assets
Log number of farmers/agriculture industry on Board	.40** (.19)	.46** (.20)	-2.0 (3.8)	-3.8 (3.0)
Log number of capitalists on Board	-.06 (.10)	.04 (.11)	3.3 (2.1)	1.5 (1.6)
Log number of real estate finance people on Board	.07 (.10)	.08 (.11)	-.08 (2.0)	-3.3** (1.6)
President bonded	-.12 (.08)	.16** (.08)	.69 (1.6)	.86 (1.2)
Cashier bonded	-.17** (.07)	-.07 (.08)	-3.1** (1.5)	-2.3** (1.2)
Has independent loan committee	-.17** (.07)	-.01 (.08)	-.54 (1.5)	.77 (1.1)
Board meets monthly or more frequently	.10 (.07)	.02 (.07)	.17 (1.3)	-3.2*** (1.0)
Relative capital paid in of bank	.07 (.06)	-.18*** (.06)	-.12 (1.2)	-2.1** (.93)
Relative age of bank	-.03 (.04)	-.10** (.04)	-2.1** (.85)	-.23 (.65)
Checking deposits to total individual deposits	-.55*** (.20)	-.31* (.21)	.11 (4.0)	14.7*** (3.1)
Private securities to loans + private securities	.29 (.39)	-.01 (.42)	-19.7** (8.0)	-1.8 (6.2)
Portion of bank shares owned by top 3 managers	-.40*** (.15)	-.24 (.16)	5.4* (3.0)	-1.2 (2.3)
Log assets	-.11* (.06)	.18** (.07)	7.5*** (1.3)	3.2*** (1.0)
Reserve city	.01 (.10)	.25** (.11)	8.0*** (2.1)	.49 (1.6)
Distance to NYC	-.24 (3.4)	-.60*** (3.6)	5.9 (4.0)	2.8 (3.0)
Distance to Chicago	05 (.11)	.03 (.12)	2.6 (2.3)	-5.6*** (1.8)
Distance to St Louis	.26* (.16)	.07 (.15)	-15.6*** (2.8)	3.9* (2.1)
Pacific Coast	.06 (.14)	.36** (.15)	8.1*** (2.8)	-1.8 (2.2)
Population of county	.20 (.14)	-.18 (.15)	-5.8* (3.0)	-.85 (2.3)
Log manufacturing firms in county	-.01 (.08)	-.11 (.09)	1.6 (1.8)	-2.0 (1.3)
Percent of state income from agriculture	.61** (.27)	.26 (.26)	1.6 (4.9)	-2.5 (3.8)
Exam conducted during crop moving season	.16** (.06)	.05 (.07)	-1.8 (1.3)	-2.3** (1.0)
Constant	.93 (1.1)	2.9** (1.2)	-41.5 (23.1)	-30.5* (17.7)
Adj. R^2	.23	.18	.55	.22
F-stat	3.8	3.1	12.7	3.6
Observations	208	208	208	208

Note: The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level.

Table 6
Various measures of the intensity of interbank connections

	Balances with CRC agents to total due from banks	Total number of CRC agents
Checking deposits to total individual deposits	.15 (.16)	-.94*** (.31)
Private securities to private securities + loans	.44* (.25)	.31 (.51)
Used borrowed money (Inst.)	-.20 (.19)	-.56** (.28)
Low cash balances (Inst.)	.33*** (.12)	-.20 (.24)
Due to banks to assets (Inst)	-.003 (.01)	-.006 (.01)
Due from all banks to assets (Inst.)	-.01 (.01)	.006 (.02)
Portion of bank shares owned by top 3 managers	.001 (.11)	-.11 (.19)
Log assets	.004 (.06)	.29*** (.12)
Reserve city	-.05 (.07)	.01 (.12)
Distance to NYC	.53*** (.15)	.52* (.29)
Distance to Chicago	-.23** (.08)	.02 (.18)
Distance to St Louis	-.02 (.16)	-.24 (.27)
Pacific Coast	-.21** (.09)	-.28 (.21)
Population of county	.10 (.08)	-.03 (.18)
Log manufacturing firms in county	.03 (.05)	.22** (.11)
Percent of state income from agriculture	-.03 (.19)	.18 (.26)
Constant	-2.3** (.92)	-5.8 (1.7)
χ^2	50.2	
Observations	208	208

Note. Balances with CRC estimated using IV-least squares regressions. Regression involving total number of agents estimated using an IV Poisson regression. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 7
Importance of New York

	Balances with NYC CRC to balances with all CRC agents
Checking deposits to total individual deposits	.40* (.24)
Private securities to private securities + loans	.71** (.37)
Used borrowed money (Inst.)	-.28 (.29)
Low cash balances (Inst.)	.08 (.16)
Due to banks to assets (Inst)	.02** (.01)
Due from all banks to assets (Inst.)	-.02 (.02)
Portion of bank shares owned by top 3 managers	-.17 (.15)
Log assets	-.15** (.09)
Reserve city	-.17* (.12)
Distance to NYC	-.81*** (.20)
Distance to Chicago	.04 (.11)
Distance to St Louis	.80*** (.22)
Pacific Coast	-.35*** (.12)
Population of county	.14 (.11)
Log manufacturing firms in county	-.04 (.07)
Percent of state income from agriculture	.23 (.24)
Constant	2.6** (1.2)
Wald χ^2	79.0
Observations	207

Note. Estimated using IV-least squares regressions. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 8
Number of agents in central reserve cities

	Multiple NYC Agents	Use Chicago	Use St. Louis
Checking deposits to total individual deposits	-1.1 (1.3)	-.67 (1.6)	-1.4 (1.3)
Private securities to private securities + loans	4.4** (2.2)	-4.2 (2.9)	-1.5 (1.8)
Used borrowed money (Inst.)	-2.7* (1.5)	.59 (2.1)	-.25 (1.5)
Low cash balances (Inst.)	1.0 (.91)	.83 (1.4)	-.73 (1.1)
Due to banks to assets (Inst)	.03 (.06)	-.10 (.08)	.02 (.05)
Due from all banks to assets (Inst.)	-.06 (.09)	.13 (.11)	-.01 (.08)
Portion of bank shares owned by top 3 managers	-2.1** (.92)	.09 (1.4)	.61 (.94)
Log assets	.07 (.39)	.84 (.63)	.64* (.37)
Reserve city	-.17 (.56)	1.1 (.53)	-.51 (.48)
Distance to NYC	-1.4 (1.2)	8.4*** (2.4)	1.5 (1.3)
Distance to Chicago	.51 (.73)	-5.4*** (1.8)	2.8*** (.93)
Distance to St Louis	2.1* (1.3)	-.77 (1.9)	-4.1*** (1.4)
Pacific Coast	-2.5*** (.79)	.99 (.93)	.14 (.65)
Population of county	1.0 (.71)	.09 (.93)	-2.0*** (.72)
Log manufacturing firms in county	.16 (.44)	-.04 (.58)	1.4*** (.48)
Percent of state income from agriculture	.79 (1.5)	-.73 (2.0)	1.2 (1.5)
Constant	-11.2 (7.6)	-31.2*** (11.1)	-11.8 (7.5)
Wald χ^2	46.7	33.3	42.1
Observations	208	208	208

Note. Estimated using IV probit regressions. We report marginal effects evaluated at the mean. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 9
Max at one agent to balances at all CRC agents
(Where the bank has at least 3 CRC agents)

Checking deposits to total individual deposits	.23 (.16)
Private securities to private securities + loans	-.18 (.29)
Used borrowed money (Inst.)	.18* (.10)
Low cash balances (Inst.)	-.16 (.12)
Due to banks to assets (Inst)	-.006 (.005)
Due from all banks to assets (Inst.)	.005 (.007)
Portion of bank shares owned by top 3 managers	.01 (.10)
Log assets	.05 (.06)
Reserve city	.12* (.07)
Distance to NYC	-.17* (1.1)
Pacific coast	.13 (.11)
Population of county	-.03 (.09)
Log manufacturing firms in county	-07 (.07)
Percent of state income from agriculture	-.08 (.07)
Constant	1.5) (.9)
Wald χ^2	19.2
Observations	112

Notes: Estimated using IV-least squares regressions. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 10
Number of Reserve Cities in which the bank has an agent
Country banks only

	Number of reserve cities in which have a correspondent
Checking deposits to total individual deposits	.37 (.47)
Private securities to private securities + loans	-2.7*** (.70)
Used borrowed money (Inst.)	-.07 (.28)
Low cash balances (Inst.)	.26 (.38)
Due to banks to assets (Inst)	-.02 (.02)
Due from all banks to assets (Inst.)	-.01 (.02)
Portion of bank shares owned by top 3 managers	.23 (.19)
Log assets	.60*** (.15)
Distance to NYC	-.06 (.25)
Pacific coast	.59** (.27)
Population of county	-.33 (.24)
Log manufacturing firms in county	.26* (.16)
Percent of state income from agriculture	1.2** (.49)
Constant	-8.4** (3.2)
Observations	130

Notes: Estimated using an IV Poisson regression. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 11
Effect of holding balances in New York City CRC agents on closure before NYC suspends

Balances with NYC agents to liquid assets	-.47 (.35)
Balances with NYC agent to liquid assets * due to banks to assets	5.4** (2.2)
Balances with non-NYC CRC to liquid assets	-.67** (.31)
Correspondent fails	.24* (.13)
Checking deposits to total individual deposits	-.28 (.18)
Private securities to private securities + loans	-.19 (.45)
Used borrowed money	-.01 (.07)
Low cash balances	.05 (.06)
Due to banks to assets	-.36 (.55)
Due from all banks to assets	.32 (.46)
Portion of bank shares owned by top 3 managers	-.13 (.64)
Log assets	-.07 (.05)
Net worth to assets	.05 (.28)
Other real estate owned to total assets	2.6* (1.4)
Age relative to age of nearby banks	.02 (.04)
Reserve city	-.16* (.09)
Distance to NYC	.13 (.08)
Population of county	.06 (.13)
Log manufacturing firms in county	.02 (.07)
Percent of state income from agriculture	-.07 (.21)
State has notable mining activity	.10 (.08)
Constant	4.4 (4.8)
Pseudo R^2	.23
Likelihood ratio χ^2	45.4
Observations	203

Notes: Estimated using a probit specification. We report marginal effects evaluated at the mean. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Table 12
Effect of holding due from banks in various CRC agents on closure

	Specification 1	Specification 2
Balances with NYC agents to liquid assets	.52** (.21)	
Balances with non-NYC CRC to liquid assets	.33** (.14)	
Distance from nearest central reserve city		-.10* (.05)
Distance from nearest central reserve city * balances due from CRC agents to total liquid assets		.05** (.02)
Checking deposits to total individual deposits	-.20* (.11)	-.15 (.11)
Private securities to private securities + loans	-.22 (.49)	-.32 (.50)
Used borrowed money	.15*** (.05)	.17*** (.06)
Due to banks to assets	.07 (.19)	.005 (.18)
Portion of bank shares owned by top 3 managers	-.30** (.13)	-.25* (.14)
Log assets	-.06* (.03)	-.07* (.04)
Net worth to assets	.06 (.17)	.14 (.18)
Other real estate owned to total assets	1.5* (.79)	1.3 (.82)
Age relative to age of nearby banks	.03 (.03)	.68 (.58)
Distance to NYC	.04 (.08)	.17 (.13)
Population of county	-.09 (.09)	-.03 (.08)
Log manufacturing firms in county	.05 (.05)	.02 (.05)
Percent of state income from agriculture	.15 (.14)	.17 (.13)
State has notable mining activity	.12* (.07)	.16** (.08)
Constant	7.0 (10.8)	.83 (12.6)
Pseudo R^2	.57	.57
Likelihood ratio χ^2	45.9	46.1
Observations	163	163

Notes: Estimated using a probit specification. We report marginal effects evaluated at the mean. The symbols ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors in parentheses.

Figure 1
Overall network structure

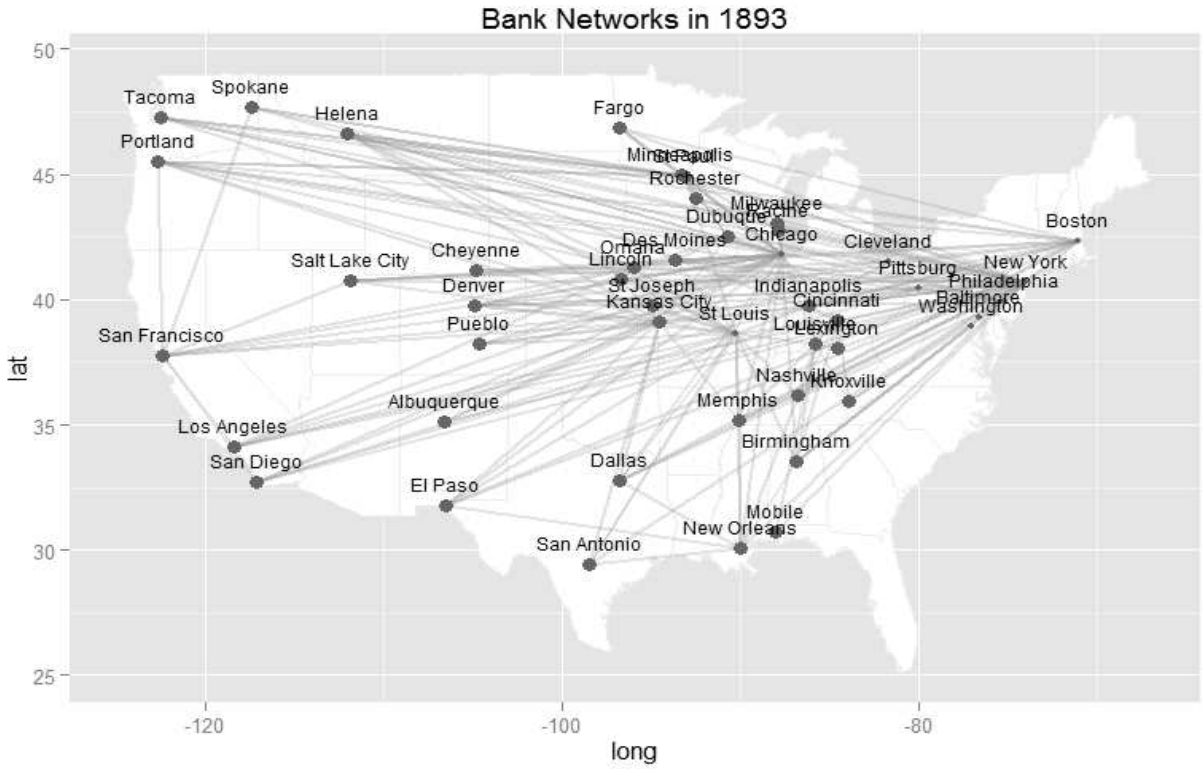


Figure 2 - Networks for Selected Banks in Dallas

Figure 2a

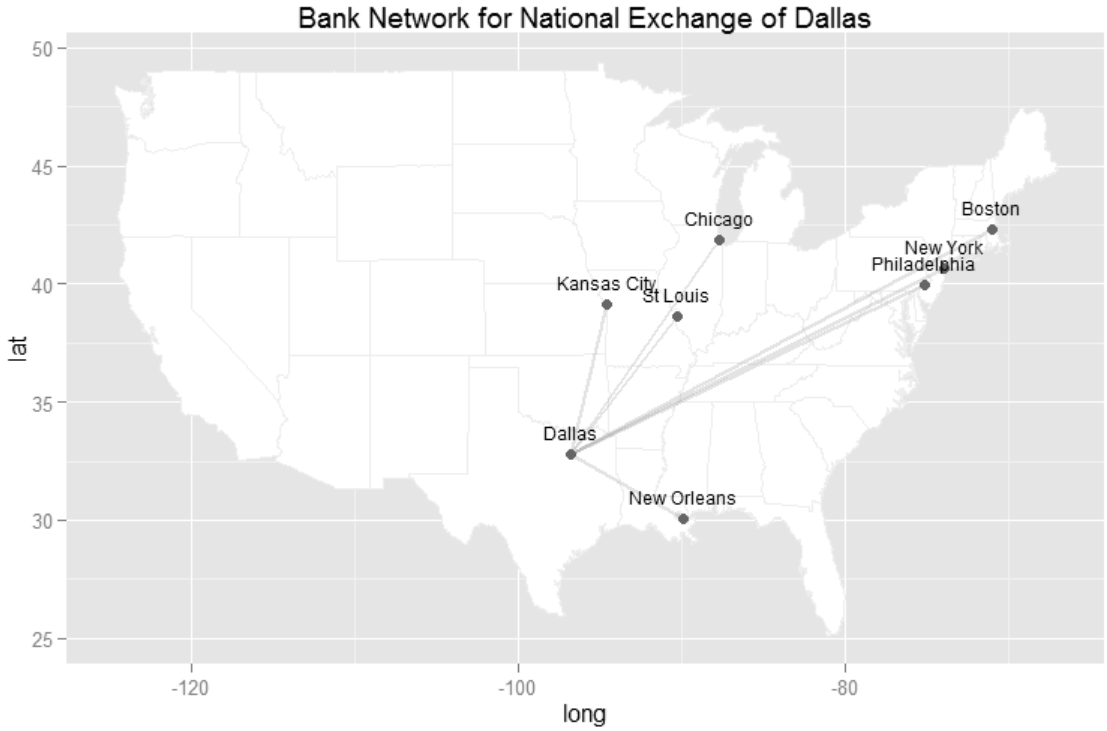


Figure 2b

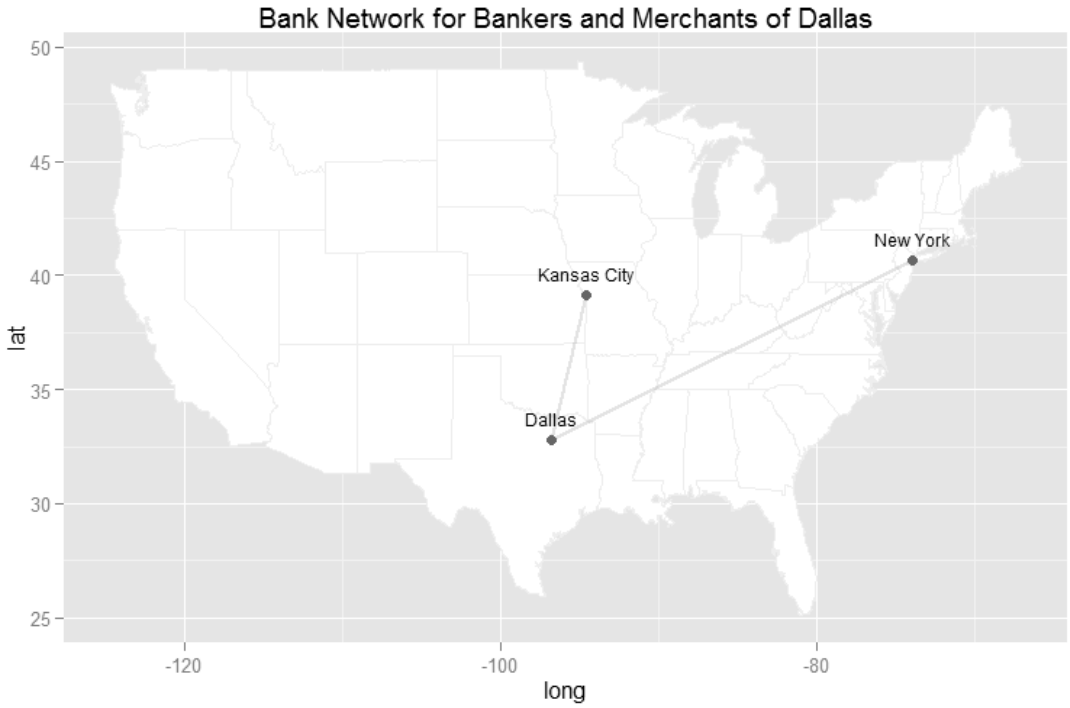


Figure 3 - Networks for Selected Banks in Portland

Figure 3a

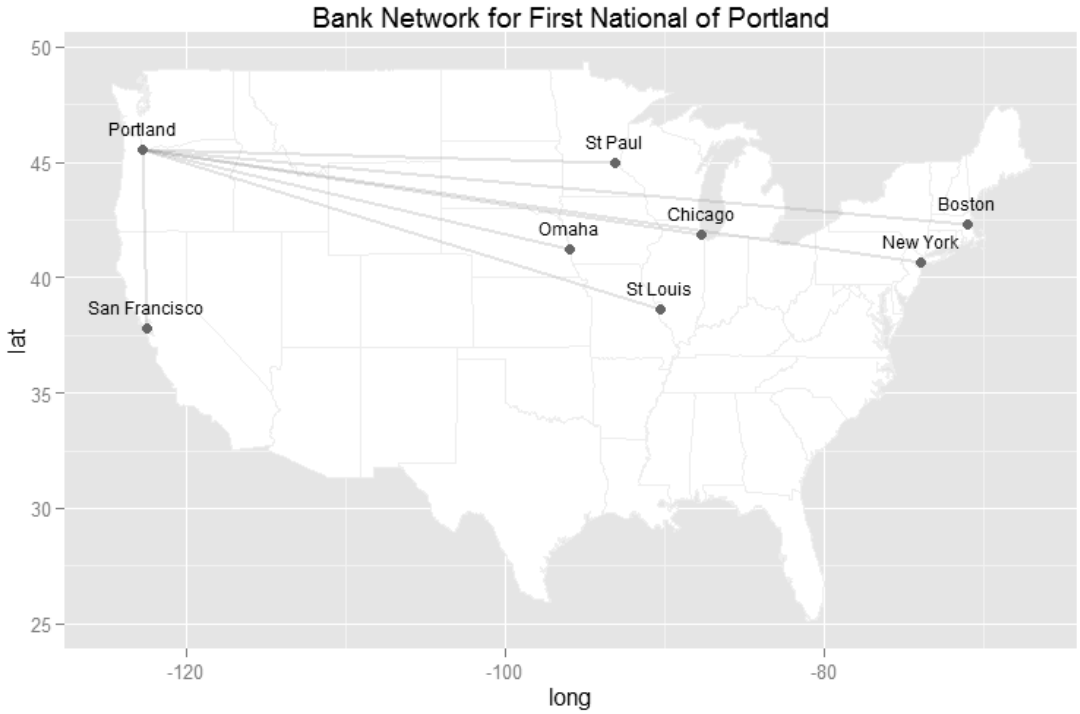


Figure 3b

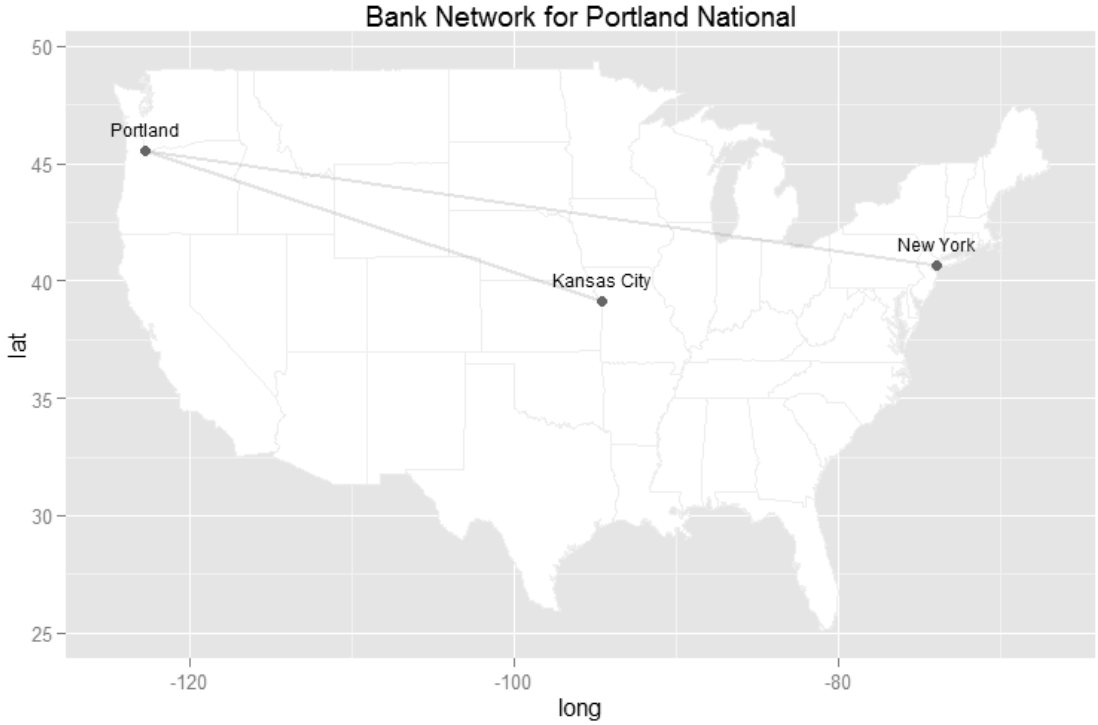
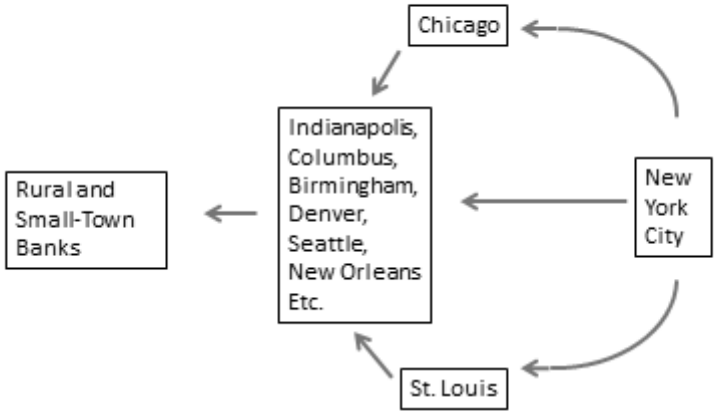


Figure 4: Network Connections Before and After New York City's Suspension

A. Before NYC Suspension



B. After NYC Suspension