

Hubs and Spokes

Network Effects and the Formation of Regional Banking Centers

by

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Abstract

The postbellum period witnessed the formation and articulation of regional correspondent-banking networks. Prior to the founding of the Federal Reserve System, these network connections supplied a number of central banking services to banks which were geographically isolated from the nation's financial centers. Most importantly, the correspondent system provided a mechanism for clearing bank liabilities and managing liquidity. It also served as a conduit for both seasonal and long-term capital flows. I model the genesis of regional correspondent hubs in the postbellum period as an endogenous process of network formation. Moreover, the growing importance of the regional hubs coincided with significant changes in bank behavior.

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Network Effects and the Formation of Regional Banking Centers

In recent years, free-banking theorists have generated new interest in the relationship between banking system structure and the historical origin of central banking. Modern free-banking theorists see the rise of central banking as the result of either the direct imposition of central monetary authority or the ultimate outcome of destabilizing governmental intervention in the banking system. In the absence of such intervention, banking firms will organize their operations so as to internalize central banking functions: bank regulation, liquidity management, and maintenance of the wholesale payments system. As evidence, free-banking theorists cite the historical experience of countries with modest banking restrictions. These banking systems came to be dominated by large banks with extensive branch networks that operated stably without a central bank and with few formal structures to govern interbank relations.¹

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¹For an early statement and case studies, see Vera Smith, *The Rationale of Central Banking* (London: P.S. King & Son, 1936). For a theoretical discussion and identification of a free-banking position in the debates over monetary reform in Britain leading up to Peel’s Bank Acts, see Lawrence H. White, *Free Banking in Britain: Theory, Experience, and Debate, 1800-1845*, Second Edition (Westminster: The Institute for Economic Affairs, 1995). Kevin Dowd provides some perspective to the recent debates in “Competitive Banking, Bankers’ Clubs, and Bank Regulation,” *Journal of Money, Credit, and Banking* 26:2 (May 1994): 289-308.

U.S. restrictions on branch banking severely limited the scope for internal management of liquidity management and payment operations. In the U.S. context, banking historians have traditionally viewed with favor public or private institutional arrangements that provided central banking services. Such services, it was felt, were needed to help mitigate problems seen as inherent in private banking systems.² In the period prior to the founding of the Federal Reserve System, banks obtained such services through private institutional channels organized by the banks themselves.

Among interbank arrangements, the clearinghouse has received the bulk of recent attention.³ Clearinghouses were organized in cities throughout the United States to handle clearing and settlement among member banks. Some clearinghouses eventually guaranteed settlement in the event of the failure of one of its members, coordinated reserve loans between members, and, in connection with these roles, evolved explicit regulatory functions. However,

²The writings of Fritz Redlich and Bray Hammond exemplify this approach. See Redlich, *The Molding of American Banking: Men and Ideas* (New York: Hafner Publishing Company, Part I 1947, Part II 1951; reprinted New York: Johnson Reprint Corporation, 1968); and Hammond, *Banks and Politics in America from the Revolution to the Civil War* (Princeton: Princeton University Press, 1957).

While older literature has focused on the prevention of banking system overexpansion and its macroeconomic consequences, attention has shifted in recent years to the benefits of reducing the information and monitoring costs associated with interbank dealings. An article that bridges old and new concerns with regard to the money supply is Benjamin Klein, "The Competitive Supply of Money," *Journal of Money, Credit, and Banking* 6:4 (November 1974): 423-53.

Others have focused on the increased costs imposed by private arrangements on the public. Jane Knodell, for example, considered the case of the domestic exchange market in the wake of the expiration of the charter of the Second Bank of the United States. "The Demise of Central Banking and the Domestic Exchanges: Evidence from Antebellum Ohio," *Journal of Economic History* 58:3 (September 1998): 714-30.

³See Richard H. Timberlake, Jr., "The Central Banking Role of Clearinghouse Associations," *Journal of Money, Credit, and Banking* 16:1 (February 1984): 1-15; Gary Gorton, "Clearinghouses and the Origin of Central Banking in the United States," *Journal of Economic History* 45:2 (June 1985): 277-83; and Gary Gorton and Donald J. Mullineaux, "The Joint Production of Confidence: Endogenous Regulation and Nineteenth Century Commercial-Bank Clearinghouses," *Journal of Money, Credit, and Banking* 19:4 (November 1987): 457-68.

most of the 27,236 commercial banks operating in the country by the end of the period were located in small towns considerably removed from the nation's financial centers and their clearinghouses.⁴ Their operating environment left them exposed to idiosyncratic reserve shocks and systemic shocks in the form of seasonality of loan demand and deposit supply. In the absence of any connection to the broader financial system, the ability of these banks to clear interbank liabilities and manage reserves—and hence raise funds by providing deposit services—would have been quite limited.⁵ They obtained clearing and reserve-management services through another institutional arrangement for mediating interbank relations that attained a greater prominence in American banking than elsewhere: the correspondent system.

In this paper, I examine the evolving structure of the U.S. correspondent system in the period prior to the founding of the Federal Reserve System. Alternative paths this evolution could have taken are illustrated in Figure 1. In the peer-to-peer model (A), each bank (dot) maintains bilateral relationships (lines) with each other bank. In the national network model (B), each bank maintains bilateral relationships with a bank in the national center, and the national center banks become interbank intermediaries. In fact, the correspondent system came to be dominated neither by peer-to-peer correspondent relationships nor by a monopoly correspondent bank or banking center. From the early antebellum period onward, correspondent networks of

⁴Board of Governors of the Federal Reserve System, *All Bank Statistics, United States 1896-1955* (Washington, D.C.: GPO, 1959; reprinted New York: Arno Press, 1976), pp. 33, 37, and 49. The figure includes all commercial banks operating in 1914.

⁵There are similarities between the problems facing small American commercial banks and those facing small savings institutions in the United States and elsewhere in the world. See Timothy W. Guinnane, "Cooperatives as Information Machines: German Rural Credit Cooperatives, 1883-1914," *Journal of Economic History* 61:2 (June 2001): 366-89; and "Diversification, Liquidity, and Supervision for Small Financial Institutions: Nineteenth-Century German Credit Cooperatives," Yale Economic Growth Center Discussion Paper 733 (October 1995).

regional and national scope coexisted (C). Banks could deal directly with correspondents in regional and national centers or access a national network indirectly through a regional-center correspondent.

While the structure of correspondent networks in the Northeast was firmly established before the Civil War, the postbellum period witnessed the formation and articulation of additional regional correspondent banking networks in other parts of the country. These developments imply that regional-center banks could provide correspondent services sufficiently valuable to cover their associated costs in successful competition with already-organized correspondent networks. This is consistent with the presence of local network effects arising from information and other cost advantages of relative proximity, including lower costs of clearing interbank liabilities and managing reserves. In turn, the declining costs of these services lowered the cost of deposits as a source of funds and is consistent with the trends in excess cash reserve holdings and leverage ratios.⁶

The remainder of this paper is organized as follows. Section I describes the nature of correspondent relationships and their management in greater detail. Section II gives an overview of the evolution of the correspondent system. This overview treats the entire country through 1880, but coverage of the remainder of the period concentrates on the developments in Georgia and Indiana. In Section III, I discuss further issues relating to the structure of the correspondent system and develop a model of the local network effects that gave rise to regional correspondent centers. Section IV discusses difficulties of direct empirical testing and provides some indirect

⁶See Scott Arnold Redenius, "Between Reforms: The U.S. Banking System in the Postbellum Period" (Ph.D. dissertation, Yale University, 2002), chapter 2.

evidence on the impact of regional network development. Concluding remarks are contained in Section V.

I. The Correspondent Relationship.

Where a clearinghouse is a multilateral organization, correspondent relationships are bilateral interbank relationships. The term “correspondent” presumably arises from the necessity that day-to-day business transactions between banks separated by some distance take the form of written correspondence sent by mail or express.⁷ Thus, any two banks that have direct dealings could be considered correspondents.⁸

Pre-Federal Reserve Correspondent Arrangements.

Banks used correspondents to obtain a wide variety of services.⁹ Depending on the

⁷Prior to adoption of the term “correspondent” such relationships were referred to as “connexions.” Redlich, *The Molding of American Banking*, Part I, p. 51. References in the documents Redlich drew upon indicated the term “correspondent” had become widespread in the United States by the late 1830s.

⁸The terminology used to refer to these relationships follows current conventions. For a particular interaction, the correspondent is the service provider for the respondent. Personal correspondence with R. Alton Gilbert, October 15, 2001. In the case of urban and rural banks, urban banks provided the bulk of the services.

In addition to relations with distant institutions, it was common for savings institutions, trust companies, and small private banks to rely exclusively on local commercial banks as intermediaries in handling their nonlocal affairs. In such cases, these local institutions would be considered correspondents even though their dealings were presumably face-to-face.

⁹The main focus of this paper is payment and reserve management services. Katherine Finney gives a more complete list of services provided by correspondents. *Interbank Deposits: The Purpose and Effects of Domestic Balances, 1934-54* (New York: Columbia University Press, 1958), ch. 1. For postbellum national banks, correspondents also played an important role as intermediaries with the Treasury Department and Office of the Comptroller of the Currency. These functions are described in The National City Bank of New York, *National Bank Organization* (New York: Robert Grier Cooke, 1904). The book was distributed by The National City Bank as part of its efforts to solicit the business of banks organizing under the national system.

interests of the banks in dealing with one another, correspondent relationships could be temporary or permanent. A bank might enter into a temporary correspondent relationship with another bank in order that it act as an agent for a specific transaction, usually a collection.¹⁰ Banks in cities throughout the country advertised extensively in bankers' publications and the financial press, soliciting collections within specified geographical areas on which they earned fee income. Among bankers, such arrangements were well understood and many accompanied their collection items and any supporting documents with terse preprinted letters containing instructions regarding remittance and actions to be taken if payment was refused. The instructions in such a letter and the applicable state laws regarding collections defined the obligations of the bank acting as the collection agent. Charges were not necessarily negotiated in advance, but bank advertisements soliciting such business often touted their promptness and care in collection and remittance at "lowest rates."¹¹

Although a bank at any point in time might avail itself of the services of a large number of temporary correspondents, the bulk of its correspondent business would be handled by a small number of permanent correspondents. In establishing a permanent correspondent relationship, banks negotiated mutually acceptable terms that specified the rights and obligations of the parties and included mechanisms to provide adequate compensation for services rendered. It was not the

¹⁰I here use the term "collection" or "collection item" to refer to what contemporaries would have viewed as two distinct classes of item: "transit" and "collection." Transit items consisted mostly of checks. Collection items included notes, time drafts, acceptances, bills of exchange, coupons, bonds, and dishonored checks, all of which require special handling in order to effect payment. Important payments and bills of exchange accompanied by bills of lading also fell into the category of collection items. Thorough treatment of this topic with attention to the role of banks in handling business payments is found in William H. Kniffin, *American Banking Practice* (New York: McGraw-Hill, 1921; reprinted New York: Arno Press, 1980), chs. 9 and 11; and L.H. Langston and N.R. Whitney, *Banking Practice* (New York: The Ronald Press Company, 1921), chs. 8-9.

¹¹Ray B. Westerfield, *Banking Principles and Practice*, Revised Printing (New York: The Ronald Press Company, 1928), pp. 481-3. Bank directories typically included synopses of relevant state laws.

intent of the banks that the agreement serve as a legally binding, long-term contract. Rather, it initiated a business relationship that could be terminated by either party or renegotiated at any time should the compliance or service be deemed inadequate or the relationship prove too expensive or insufficiently profitable. Over time, therefore, correspondent relationships evolved and, like the original agreement, changes were set forth in the body of correspondence between the banks. Banks retained this correspondence and also kept a book or a card file summarizing the terms of their relationships, such records were used to quickly identify the lowest-cost provider of a particular service and to ensure the bank's actions were in compliance with their own commitments.¹²

The dominant form of compensation for services rendered depended upon the nature of the permanent relationship. In contrast with the temporary arrangements discussed above, fee-for-service was not the dominant form of compensation in such relationships. For peer-to-peer relationships established to facilitate collections, adequate compensation was provided by reduction of collection costs. Under American negotiable instrument law, a bank upon which an instrument was drawn was obligated to pay the amount stated when presented at its counter. However, if presented through the mail, the law allowed a bank to subtract an exchange charge from the face value of the instrument to cover its costs of shipping cash or of maintaining an account with another bank against which a check or draft could be drawn as remittance. Thus, by arranging with a correspondent for direct collection of such items, a bank could save on postage and avoid exchange charges. If collection cost reductions were insufficient to make the arrangements mutually beneficial or if competitive conditions allowed, one or both banks might

¹²William H. Kniffin, Jr., *The Practical Work of a Bank* (New York: The Bankers Publishing Company, 1915), p. 327; and Albert S. Bolles, *Practical Banking*, 11th Edition (Indianapolis: Levey Bro's & Co., 1903), p. 188.

also agree to a fixed schedule of collection fees and grant its partner an exclusive collection area or guaranteed volume of business. At specified periods the accounts to which collections were credited would be cleared and the net balance remitted.¹³

In addition to collections, the use of bank liabilities as means of payment gave rise to demand for reserve management services because presentations of claims against a bank did not always match deposits. Arrangements that included reserve management services were not typically established by peer institutions but between small banks and larger, more urban institutions. Though the nature of their business necessitated that their bank clients be given somewhat specialized service, banks handled their relationships with their respondents in much the same way as they did their commercial accounts, including compensation. A correspondent required that each respondent maintain with it compensating balances, the average size of which depended on the volume and cost of services it expected the respondent would call upon it to provide. Correspondents paid zero or low rates on the balances held in this form but could in turn lend them out at prevailing market rates. The relationship between the level of service and the size of the required compensating balance is not identical in all contemporary sources. However, the average balance size was set as a multiple of average weekly clearings through the account or some fraction of the line of credit granted, 20 percent being the figure usually given.¹⁴

¹³Langston and Whitney, *Banking Practice*, p. 133. For examples, see Kniffin, *American Banking Practice*, pp. 101-3; and *Ibid.*, *The Practical Work of a Bank*, pp. 327-8. For a brief summary of negotiable instrument law, see Westerfield, *Banking Principles and Practice*, pp. 515-21.

¹⁴Large credit lines were drawn on to meet seasonal demands for credit. It seems unlikely that credit lines of the size implied by the level of interbank deposits held during the period would have been necessary for normal liquidity management purposes. See Redenius, "Between Reforms: The U.S. Banking System in the Postbellum Period," chapter 5 for further discussion.

The relationship between balance size and weekly deposits is given in Redlich, *The Molding of American Banking*. Since items received were not collected for some days, such balances reduced the likelihood that funds as yet uncollected could be withdrawn. Depending on fee arrangements, additional funds might be required to compensate for the costs of collection services. Kniffin, *The Practical Work*

Provisions for the crediting of deposited items and payment of interest depended on the profitability of the business and level of competition between banks in that and other cities for correspondent business.¹⁵

In the event of a reserve shortfall, the client could request a reserve loan. Such reserve shortfalls could take one of two forms: an insufficient balance in the account maintained with the correspondent or a shortage of cash at the bank itself. To increase the account balance, the loan could be disbursed by crediting the loan amount to the bank's account. Thus, checks or other items received by the correspondent drawn on the respondent could continue to be charged against the account and returned to the respondent without requiring that the account be replenished by cash shipment. Such balances also might help satisfy reserve requirements. Alternatively, correspondents operated cash and coin services that could deliver reserves to the bank for a fee.

Monitoring and Regulation.

Interbank deposits, interbank loans, and holdings of uncollected payment instruments all exposed banks to possible loss in the event of bank failure. When a bank failed, its bank creditors had equal standing with other depositors in bankruptcy court. As a bank might hold on

of a Bank, pp. 323-4. The relationship between the average balance size and credit line is discussed, for example, by Chester Arthur Phillips, *Bank Credit: A Study of the Principles and Factors Underlying Advances Made by Banks to Borrowers* (New York: Macmillan Company, 1931), p. 255.

¹⁵Competitive pressures in the correspondent business were widely noted in contemporary sources.

Westerfield discusses four contemporary arrangements for credit and interest. 1. The account was credited immediately but the deposited item discounted to compensate for the expected interest cost that would be borne while the item was being collected. 2. The account was credited immediately, but availability of the funds deferred. 3. The funds were credited and made available only when collected. 4. The funds were credited and began earning interest upon deposit. *Banking Principles and Practice*, pp. 488-9.

deposit with a correspondent compensating and investment balances in excess of its capital and surplus, the failure of the correspondent could tie up a significant portion of the bank's funds in receivership for years if it did not lead to outright insolvency or failure in a run. Banks therefore had a compelling interest in monitoring their correspondents. If the correspondent was a large bank in a major city, news stories about the institution and stock-price quotations in the financial press could serve this purpose.

Given the higher failure rates of small, rural banks and the lack of ready information about their condition, correspondents engaged in more intense and costly monitoring of their respondents. When first establishing the correspondent relationship, it was common practice for the management of a prospective respondent to invite a representative of the correspondent to visit and examine its condition. Credit agencies, nearby banks, and existing respondents also could be used as initial sources of information on the bank's reputation, the nature of its business, and the economic environment in which it operated. All of this information and information gathered subsequently was recorded in the bank's credit file.¹⁶

Such monitoring continued throughout the relationship. Prior to each borrowing season, a representative of the correspondent typically would pay a visit.¹⁷ Major correspondent banks also sent representatives to regional banker's conventions to meet with and inquire about their respondents. And sworn statements of condition might be required with each loan application. But, as with other accounts, the account activity and written correspondence provided additional

¹⁶*Bank Credit: A Study of the Principles and Factors Underlying Advances Made by Banks to Borrowers*, ch. 15.

¹⁷Earl Bryan Schwulst, *Extension of Bank Credit: A Study of the Principles of Financial Statement Analysis as Applied in Extending Bank Credit to Agriculture, Industry, and Trade in Texas* (Boston: Houghton Mifflin Company, 1927).

information. As Phillips described this in his discussion of interbank loans, “The way in which a bank handles its accounts with the city correspondent is also an indication of character. Balances and loans over long periods are watched; overdrafts, if any, are noted.”¹⁸

Like other bank relationships, most correspondent relationships remained active for extended periods. This suggests that correspondents acquired knowledge about respondent operations and markets that the respondent could not be readily transfer to a new correspondent.

In the event that it was not satisfied regarding a respondent’s condition, a correspondent could take several actions. It could require a larger compensating balance, pay a lower rate of interest, or charge higher loan rates as compensation for the increased risk. Or it could limit credit or require additional collateral to protect itself from loss. Rather than grant temporary overdrafts, if the account had insufficient funds or the balance was below an agreed level, items received could be sent directly on to the respondent for redemption or refused when presented by third parties. In extreme cases, the relationship could be unilaterally severed. Such actions, as well as the failure of the correspondent to act as guarantor of loans from third parties, would signal that the respondent was in difficulty. A correspondent’s implicit or explicit threat to withdraw its certification of soundness served to discipline respondents that might not have faced immediate market pressures to alter their behavior.

II. The Evolution of the Correspondent System.

A. The Evolution of the Postbellum Correspondent System.

¹⁸*Bank Credit: A Study of the Principles and Factors Underlying Advances Made by Banks to Borrowers*, pp. 257-8, quotation from p. 258.

The passage of the National Banking Acts during the Civil War was a major watershed in the history of American banking. The 1864 Act often is claimed to have biased national bank decisions regarding the location of their correspondent balances, and hence the structure of the correspondent system, through its designation of specific reserve cities.¹⁹ However, these cities were designated in the Act precisely because they had already attained, or hoped to attain, prominent positions in the nation's correspondent system. Myers has concluded that the reserve-city designations did not have an immediate impact on correspondent balances.²⁰ Nor did reserve provisions of the law bring about a significant change in the percentage of total assets held as bankers' balances from that which had prevailed in the late antebellum period.

Even as interbank balances swelled later in the period, reserve-city advantages were not so overwhelming as to eliminate the holding of interbank balances with country banks. The percentage of interbank deposits that were held outside of reserve and central reserve cities was fairly stable over the period, if not slightly declining, for the United States as a whole. This held true despite the fact that the ratio of deposits to total liabilities doubled over the period, a development that concentrated additional bankers' balances in reserve city banks. And additions to the roster of reserve centers reduced balances held in cities not so classified. Yet, the growth in country bank balances suggests that new centers of correspondent activity were evolving during this period and growing rapidly in terms of the value of their correspondent business.

The new centers can be identified in one of two ways: by the size of the "due to" items on

¹⁹Reserve provisions of the National Banking Act and state legislation are discussed in Redenius, "Between Reforms: The U.S. Banking System in the Postbellum Period," chapter 1. State and private bank correspondent selection may in turn have been biased by concentrations of national bank deposits. This issue is explored in the model developed in the next section.

²⁰*The New York Money Market, Volume I: Origins and Development* (New York: Columbia University Press, 1931).

bank balance sheets or by correspondents locations given in contemporary bank directories used in check routing. The directories identify both parties to the relationship and can be used to examine the evolving structure of the correspondent system. Bank directories came into publication in the United States beginning in 1851 and by the late 1870s reported each bank's New York and non-New York correspondents.²¹ These directories did not claim to include all relationships but identified those listed as "principal" correspondents. As a consequence, the average number of listed correspondents was much smaller than found in antebellum balance sheets, for example, 2.7 in 1880.

To get a snapshot of the correspondent system against which to compare subsequent developments, I collected data on correspondent relationships from the July 1880 edition of Rand McNally, *The Banker's Directory of the United States and Canada*. The data are used to give a visual representation of the relative attractiveness of particular correspondent hubs to banks in towns located throughout the U.S. In Maps 1.1 - 1.5, each banking town is represented by a dot, the size of which depends on the number of banks reportedly in operation in that town. The number of correspondent connections between the banks in each town and an urban hub is

²¹Bank directories have been used extensively in the study of correspondent relationships. See Michael P. Conzen, "The Maturing Urban System in the United States, 1840-1910," *Annals of the Association of American Geographers* 67:1 (March 1977): 88-108; Beverly Duncan and Stanley Lieberman, *Metropolis and Region in Transition* (Beverly Hills: Sage Publications, 1970), chs. 6, 12, 17, and 18; Stanley Lieberman and Kent P. Schwirian, "Banking Functions as an Index of Inter-City Relations," *Journal of Regional Science* 4:1 (1962): 69-81; Kerry A. Odell, *Capital Mobilization and Regional Financial Markets: The Pacific Coast States, 1850-1920* (New York: Garland Publishing, Inc., 1992); Kerry A. Odell, "The Integration of Regional and Interregional Capital Markets: Evidence from the Pacific Coast, 1883-1913," *Journal of Economic History* 49:2 (June 1989): 297-310; and Kerry A. Odell and David F. Weiman, "Metropolitan Development, Regional Financial Centers, and the Founding of the Fed in the Lower South," *Journal of Economic History* 58:1 (March 1998): 103-25. In addition, H.L. Green uses bank correspondent data—though without citing his source(s)—in "Hinterland Boundaries of New York City and Boston in Southern New England," *Economic Geography* 31:4 (October 1955): 283-300. For a more extensive discussion of these sources, see Scott A. Redenius, "*Rand McNally, Banker's Directory of the United States and Canada*," working paper, 1998.

represented by the thickness of the line used to connect the two locations. Because of the large number of banks in some cities and large number of correspondent connections between large cities, I have used a logarithmic scale.²²

Map 1.1 provides an overall view of the correspondent system. Since the vast majority of banks had a New York correspondent and the lines connecting cities to New York obscured other relationships, I have excluded connections to, but not from, New York banks. The Map shows the concentration of banks and correspondent centers in the Northeast and Midwest. Even with New York connections removed, the outlines of the smaller networks are obscured by the strong connections between reserve cities and, in the Midwest, by the dominance of Chicago. To examine these, I have decomposed the 1880 correspondent system into several parts. Map 1.2 shows the strong connections between reserve-city banks. As can be seen in the subsequent Maps, the remaining reserve cities had, for the most part, fairly extensive hinterlands. In addition, smaller cities such as Indianapolis, Atlanta, Mobile, Galveston, Chattanooga, Richmond, Toledo, Omaha, and Denver also had developed correspondent hinterlands by this time.²³

After 1880, I restricted my efforts to Georgia and Indiana. Maps 2.1 - 3.4 trace the development of the correspondent system in Georgia and Indiana from 1880 to 1910, respectively. It should be noted that the developments in these states were characteristic of other

²²There are, of course, complications. Local correspondent connections are not shown. Also, if the bank directory reported that a bank had more than one correspondent in a particular city, the duplicates were eliminated. Finally, the identities of the correspondents and respondents are not identifiable in the Maps. In almost all cases, banks in smaller centers listed banks in larger centers.

²³For these Maps, I have divided the country into four regions: Northeast, Midwest, South, and West. These groupings were selected because relatively few regional correspondent connections crossed these boundaries and thereby would be omitted from the analysis.

parts of the South and the Midwest. For these Maps, I have used a linear scale.

The hub and spoke pattern of the correspondent system is immediately apparent. Savannah and Atlanta were the dominant regional hubs for Georgia banks and banks in both these cities in turn maintained New York correspondents. However, Macon, the smaller center in central Georgia, maintained links to Atlanta, Savannah, and New York. For Indiana, Indianapolis had a clear hinterland in central Indiana by 1880. In turn, Indianapolis was connected by correspondent links to the larger correspondent centers of Chicago and Cincinnati.

The Maps also show the genesis of new hubs over time. In 1880, Georgia had only two regional hubs of note: Atlanta and Savannah. For Indiana, only Chicago, Indianapolis and Cincinnati are prominent. Over the period, however, new centers of correspondent activity formed between these established centers. In Georgia, Macon and Augusta became increasingly important; in Indiana, Evansville, Lafayette, and Fort Wayne gained prominence. Each successive generation of new hubs formed in smaller and smaller cities, such that by 1910 a fairly dense pattern of hubs had developed.

From the Maps, it appears that regional centers grew in importance during the period as measured by the number of their respondents. The relative growth of these centers can be examined more directly in Table 2, which shows the percentage of banks in the two states with correspondents in particular centers. Atlanta's correspondent business grew such that by the end of the period, 43.2 percent of Georgia banks had an Atlanta correspondent, up from 19.2 percent in 1880. Indianapolis experience similar growth, with 44.2 percent in 1910 from 13.5 percent in 1880. The growth of minor centers also is evident.

While the increased number of connections to the new regional centers suggests they played an increasingly important role in the correspondent system, the extent to which their

respondents relied upon them for correspondent services is better measured by their relative holdings of bankers' balances. It is possible to make some assessment of this using the statements of condition published for individual national banks in the Comptroller of the Currency's *Annual Report*. These statements included entries for interbank balances: the category "Due from other national banks" represents funds deposited with other national banks and "Due to other national banks" are the deposits held on behalf of other national banks. Aggregating the amount banks in a particular center owed other national banks and dividing this by the amount non-center national banks held with national banks yields a rough index that can be used to track the center's importance over time. The results of these calculations are presented in Figure 2 for Indiana.²⁴ According to the graph, regional centers were quite

²⁴The resulting values are not the proportion of balances held for banks in each center's immediate correspondent hinterland. The accuracy of the results depends on the appropriateness of the underlying assumptions.

1. Balances reported by correspondent banks were held on behalf of banks located outside of the state. If significant balances were held for out-of-state banks, the relative importance of the center to banks in the state would be overstated. Since most of these networks were modest in size, this is only a major concern for centers located near state borders. For example, Savannah national banks held more interbank balances than balances given as "Due from" on the balance sheets of Georgia's non-center national banks in some years. Comparing the amount of clearings as reported by the clearinghouses in each city to their importance as computed above suggests that this assumption also was violated for Augusta, Georgia, and Evansville, Indiana.

2. The due to and due from items represented bankers' balances and not loans. This appears to have been substantially the case in most years.

3. National banks held the national-bank portion of each center's correspondent business. In most cities, the national banks were the dominant players as indicated by the number of interbank connections reported in the bankers' directories. However, in the case of Savannah, state banks played the central role as indicated by the number of their country bank clients and balances held.

In computing the balances for Indiana, balances due Indianapolis banks were excluded in calculating the "Due from" totals for Indiana banks. For Georgia, the same was done for Atlanta and Savannah.

Additional complications arise in the actual computations because of changes the Comptroller made in the format of the published reports for individual banks. After 1904, the balance sheet categories used in earlier years were replaced by summary categories insufficiently detailed to allow direct computation of the ratios. In Figure 2, the levels for the years after 1904 are estimated for Indiana centers except Indianapolis. As a reserve city, detailed aggregate balance sheets for Indianapolis national banks were still available in the *Annual Report*.

The small number of Georgia national banks outside of major Georgia cities before the 1890s,

important for banks in their hinterlands, with Indianapolis growing from relative insignificance to just under 40 percent of the balances of other Indiana national banks after the turn of the century. For Georgia, reporting changes make estimating the percentage of balances held in Atlanta difficult for the period after 1904. However, Atlanta held 32 percent of nonreserve-city interbank deposits in 1914, a year for which sufficient information is available.²⁵

Additional evidence on the growing importance of regional networks comes from Georgia state banks. In the call reports filed each year with the Office of the State Treasurer most state banks listed the balances they carried with other banks in two categories: “Due from banks and bankers (in this State)” and “Due from banks and bankers (in other States).” Table 3 shows the increase in the proportion of these balances held in the state, Atlanta and Savannah excluded. In 1895, only 34.8 percent of balances were held in the state, but this had nearly doubled to 64.3 percent by 1910, the largest jump occurring between 1895 and 1900. The Treasurer remarked on this change in his 1901 *Annual Report*: “I have noted, with interest and pride, that a large number of our country banks have, as their financial correspondents, and from whom their loans are obtained, our larger banks in Georgia cities, and there are fewer calls each season upon eastern banks for assistance.”²⁶

B. The Structure of the Correspondent System.

the difficulties of estimation after 1904, and the problems posed by Savannah discussed above led me to omit the comparable graph for that state even though the increased importance of Georgia centers is evident in the 1890-1904 period.

²⁵In 1914, Atlanta became a reserve city in connection with its selection as one of the twelve cities to host a Federal Reserve Bank. Both designations may have attracted additional correspondent business to the city.

²⁶p. 9.

As described above, the Northeast's correspondent system evolved a hierarchical structure in the antebellum period. During the postbellum period, a hierarchical structure of correspondent relationships evolved in other parts of the country. These developments were reflected on bank balance sheets. Table 4 gives a view of the structure of the Indiana correspondent system in 1900. The Table contains average balance sheet ratios and other statistics for banks in Indiana correspondent centers of varying importance and for banks located in towns of under 5,000 population. Two things are apparent. First, the regional correspondent centers became intermediaries between their respondent banks and the wider financial system. This can be seen in those items relating directly to the bank's correspondent functions. The Table shows that banks in the correspondent cities had more correspondents on average and more correspondents in large national financial centers than country banks did. Furthermore, center banks held large balances to the credit of their respondents and in turn held a large proportion of their assets as balances with their correspondents.

Second, the balance sheet items further reveal that there was a division of labor in the banking system in which center banks partially specialized in the production of correspondent services for their respondents. The items for interbank balances make this point clearly. While the center banks specialized in providing correspondent services, the country banks specialized in direct lending within their markets. Small-town national banks held approximately 50 percent of their assets in direct loans, whereas Indianapolis banks held only 34 percent.²⁷

The conscious nature of this specialization of function is further suggested by the names

²⁷The differences reported in the Table are not due simply to city or bank size. In fact, banks in medium-sized Indiana cities that did not develop a correspondent business looked more similar to the small-town banks than to those in the cities listed. Furthermore, not all of the banks in the center cities had the same number of correspondents. Low loan/asset ratios and low capital-asset ratios are more characteristic of banks with large numbers of correspondents than banks with only a few.

of some of the more prominent urban correspondent banks during the period. New York City had the National Bankers Association National Bank and the Bankers Trust Co. Similarly, Chicago and Evansville, Indiana, were home to a Banker's National Bank.

The attraction of regional correspondent centers arose from proximity. The results in Table 5 suggest there was a negative relationship between distance and the usefulness of a correspondent relationship. The regression includes all Georgia state banks, excluding those in the four largest correspondent centers, which listed Atlanta as the first Georgia correspondent in Rand McNally.²⁸ The dependent variable is the percentage of its interbank balances a state bank held with other banks in the state. Under the assumption that most of the balances these banks held in the state were held in Atlanta, it should be possible to examine the relationship between distance and the proportion of activity handled through Atlanta rather than national centers. The regressions control for several bank and environmental characteristics.

The regression results were fairly consistent over time, though the variables of interest are not uniformly statistically significant. The results show that average balances held in the state decline with the distance from Atlanta. In fact, the predicted decline is rather steep, on the order of nearly half a percent per mile near Atlanta.

III. Network Effects and the Formation of Regional Banking Centers.

The previous two sections have considered the nature of correspondent relationships and the evolving structure of the correspondent system in the period prior to the founding of the Federal Reserve System. In this section, I develop a model that identifies the factors responsible

²⁸Bank directories appear to have listed correspondents in order of declining importance.

The same analysis was not done for Savannah because of problems encountered relating to the shape of Savannah's correspondent hinterland.

for the rise of regional correspondent centers within the U.S. correspondent system. This model allows examination of the conditions under which regional networks could form and their implications for other aspects of bank behavior.

The strength of the geographical pattern of correspondent network development suggests it was not the decisive factor in the evolution of the structure of the correspondent system.

Contemporaries and later economic geographers pointed to evolving trade patterns:

Trading is no longer confined to the neighborhood. Commercial transactions are largely between the principal cities, and between smaller places and the principal cities. For instance, the trade between New York and St. Louis is large, and between St. Louis and the surrounding towns likewise large, every large city acting as a distributing center for the adjacent territory. Banking in turn follows the course of trade. The suburban merchant remits to his jobber in the territorial distributing point, and he in turn to the house in the large city. The check which settles the debt follows or should follow approximately the same route as the trade, both in paying the debt and in the collection of the check itself, it being the function of banking to settle the debts trade creates.²⁹

The similarity between the structure of transport networks and correspondent networks reinforces this conclusion.³⁰

The development of regional hubs, however, required more than just changing trade patterns. Either peer-to-peer relationships or a monopoly correspondent bank or center could have accommodated flows of payment and reserve management services as trade patterns became more complex. Imagine, for example, that City A is an established wholesaling center and City B becomes a “territorial distribution point.” Now merchants in City B’s hinterland (and

²⁹*The Practical Work of a Bank*, pp. 319-20.

³⁰This relationship was noted by Weber for antebellum Pennsylvania, “Interbank Relationships in Antebellum Pennsylvania” and above for Indiana. Comparison of the Maps of the postbellum correspondent and rail systems as given in a contemporary railroad guide shows a high degree of similarity.

hence their banks) will want to make payments in City B and City B wholesalers (and hence their banks) collections in City B's hinterland. A peer-to-peer network could accommodate such demands simply through increased interactions between City B banks and the banks in City B's hinterland. On the other hand, if all banks maintained correspondent relationships only with City A banks, payments could still be handled through City A. Checks on City B hinterland banks would be deposited in City B banks, which would in turn deposit them in City A banks. There the accounts of the City B banks would be credited and the accounts of the banks in City B's hinterland debited.

The structure of the correspondent system was determined by the interactions of trade patterns and cost structures that allowed the banks in regional centers to organize correspondent networks on a competitive basis with larger networks. Like modern payments systems, historical correspondent banking was subject to economies of scale and network effects. Within each correspondent hub, the bulk of correspondent business was highly concentrated in the hands of only a few of the center's banks.³¹ And, as the Maps in the previous section show, there were few towns that attracted only one or two correspondents.

In order for a network to be viable, it must generate net gains that can be distributed amongst those who supply network services and the network members. Given the complexity of postbellum trade patterns and the correspondent system, formulating a model to describe the evolution of the correspondent system as a whole is not a tractable problem. However, it is

³¹Myers found antebellum balances with New York to be concentrated in fewer than ten banks. *The New York Money Market, Volume I: Origins and Development*, ch. 6. See also R. Alton Gilbert, "Economies of Scale in Correspondent Banking," *Journal of Money, Credit, and Banking* 15:4 (November 1983): 483-8.

possible to capture relevant factors for the simplified case of Cities A and B considered above.³²

The Model Framework.

The model presented here extends the payment network model of John A. Weinberg to include reserve management, transportation, and interest costs.³³ It formalizes insights found in Odell and Weiman's discussion of the economics of Southern correspondent banking.³⁴

I make a number of assumptions about the structure of the banking system in order to simplify the analysis. (1) I assume that there are N banks that initially maintain accounts with banks in City A but could switch to City B. A number of banks operate in both cities. In each city, the banks are assumed to be members of a local clearinghouse and will be treated as a single unit for purposes of examination. (2) I assume the correspondent network of City A is considered large relative to the potential network of City B. Thus, growth in City B's correspondent business will not affect the unit costs of City A's correspondent services, and it will not be necessary to account for the possibility that City B could overtake City A as the national correspondent center. 3. Correspondent affiliation is modeled as an exclusive choice of relationship with one correspondent center. In order to gain access to City A's network for themselves and their respondents, City B banks make necessary arrangements with their counterparts in City A. This assumption eliminates the need to model two correspondent

³²As presented above, the case applies to a regional center competing with a national center. The same analysis is applicable to a smaller city competing with a regional center.

³³"The Organization of Private Payment Networks," Federal Reserve Bank of Richmond, *Economic Quarterly* 83:2 (Spring 1997): 25-43.

³⁴"Regional Metropolitan Development and Financial Market Integration in the New South," pp. 103-25.

selection choices and the subsequent division of each bank's business between the two networks. Additional simplifying assumptions about costs and the correspondent relationships are given as the model is developed below.

In the model, City B can become a viable regional correspondent center due to the presence of local network effects supplemented by economies of scale. Given that the costs of some correspondent interactions rise with distance, City B may have a cost advantage for some subset n of the N banks due to its relative proximity. The benefits of network membership increase with the amount of business handled through the network. The cost elements included in the model are interest costs, direct collection costs, and reserve management costs. The implications are that development of regional centers reduced costs associated with deposit services. The secondary gains associated with increased use of deposits in bank capital structures are not explicitly modeled here.

Interest Costs.

Payment by check or other non-cash instrument involves credit because definitive money will not be received until collection. In a retail transaction, the interest cost associated with such credit could be borne directly by the customer in the form of higher prices for non-cash purchases or discounting of the payment instrument. In the postbellum period, merchants typically accepted such instruments at par and negotiated with their banks regarding interest costs. Whether the bank accepted the deposited item at par and treated the interest expense as part of the cost of maintaining the account, discounted the items, or deferred fund availability, the goal of the bank was, in Kniffin's words, "to turn the item into money or its acceptable substitute, a

draft on the nearest reserve city, as soon as possible.”³⁵ Prompt collection served to limit the bank’s costs of uncollected items or allowed it to lower the price of its services.³⁶

Like merchants with their banks, banks made arrangements with their correspondents regarding credit and interest for items they deposited in their accounts. Assuming banks granted immediate credit for items as they were received, the interest cost borne by bank i will depend upon the interest rate, the volume of collections, and the length of time the bank “holds” the item.

Let

$r =$ daily interest rate

$\bar{I}_{ij} =$ bank i ’s average daily dollar receipt of items drawn on bank j

where i and j could be any of the N banks or the banks of City A or B, denoted with the subscripts A and B, respectively. I_{ii} is used to represent net daily cash flows from business conducted at the bank’s counter with $\bar{I}_{ii} = 0$. Distances are represented by

$d_{ij} =$ day’s travel time from bank i to bank j

As a simplification, travel times are assumed symmetric so that $d_{ij} = d_{ji}$, and the fastest routes between any two banks are assumed to pass through Cities A and/or B. For banks in City B’s hinterland, the fastest route to City A lies through City B ($d_{iA} = d_{iB} + d_{BA}$).³⁷

³⁵*The Practical Work of a Bank*, p. 327.

³⁶An additional argument in favor of speedy collection is that the longer the period an item remained outstanding, the greater the likelihood of collection difficulties.

³⁷This distance assumption seems reasonable, given that banks used the mails for their collections, mail moved along transportation networks developed to connect cities with their hinterlands,

Items are considered “held” until received as a deposit in an account maintained with a correspondent.³⁸ When an item is deposited in a center where the depositing bank and the bank upon which the item is drawn or its correspondent both have accounts, it is collected through the clearinghouse and the two account balances adjusted accordingly. Routing of checks, and hence total interest costs, will depend on transportation connections and the structure of correspondent relationships. Before City B begins its correspondent business, all items are sent to City A with average daily interest costs of items in the process of collection for each bank i given by

$$rd_{iA} \left(\bar{I}_{iA} + \bar{I}_{iB} + \sum_{j=1}^N \bar{I}_{ij} \right)$$

Clearinghouse collections are assumed to involve no time lag, so interest costs for City A banks are zero. For City B banks, interest costs are

$$rd_{BA} \left(\bar{I}_{BA} + \sum_{j=1}^N \bar{I}_{Bj} \right)$$

and mail routes were presumably selected in response to similar communication demands and cost structures, as were correspondent relationships. Such transportation systems impose additional costs on peer-to-peer networks. The only cost of relaxing the distance assumption is more complex notation.

An additional source of gain not modeled here is the use of express companies to speed delivery of checks between large correspondents. In this case, the direct mail time between a bank in City B’s hinterland and City A may have been greater than routing through a bank in City B.

³⁸As discussed above, the reduction in the payor bank’s balance is something that the payor would like to put off as long as possible. A payor could increase its profits by devising a correspondent strategy such that the gain from delaying collections on it more than offset delays in making its own collections. Such tactics involved more than just a transfer from payee to payor since additional collection costs might arise and the volatility of daily presentations might increase, requiring the payor to hold greater excess reserves. Such strategies are ruled out by the model’s characterization of collection methods.

When City B becomes a correspondent center, collection costs for City A and banks belonging to City A's network ($i \in A$) remain unchanged, but costs for banks on City B's network ($i \in B$) become

$$rd_{iB} \left(\bar{I}_{iA} + \bar{I}_{iB} + \sum_{j=1}^N \bar{I}_{ij} \right)$$

and for City B banks

$$rd_{BA} \left(\bar{I}_{BA} + \sum_{j \in A} \bar{I}_{Bj} + \sum_{i \in B} \sum_{j \in A} \bar{I}_{ij} \right)$$

Banks joining City B's network experience a decrease in interest costs due to the shorter travel time. In turn, some of the interest costs formerly borne by the members of City B's network are passed on to the banks of that center.³⁹ However, there is a net reduction in interest costs since some items now are collected faster through City B. All other things equal, this net gain

³⁹In some sense, the allocation of costs at this stage is arbitrary. The increased costs borne here by City B banks must be passed on to network members in the form of higher prices. However, the method specified above allows City B banks greater pricing flexibility, which they can use to attract members to the network, than the alternative method of charging banks directly the full cost of items ultimately collection through City A.

Because the City B banks now are wholesale intermediaries in the payments system, they may bear additional interest costs. When items drawn on their network are received at City A, they are deducted from the City B accounts and the items sent to City B where they are deducted from respondent accounts. This lag imposes interest costs of

$$rd_{AB} \left(\sum_{j \in B} \bar{I}_{Aj} + \sum_{i \in A} \sum_{j \in B} \bar{I}_{ij} \right)$$

Including this feature in the model might allow some banks to switch to City B's network because of the interest savings arising from the longer time between when an item was received and the amount deducted from its account. Thus, the formation of the network could increase total interest costs.

increases with the distance between Cities A and B, the proportion of each member's receipts that can be handled entirely on City B's network, and the number of network members. It decreases with the distance between the network members and City B.

Collection Costs.

In addition to interest costs, banks incurred explicit costs in check processing and postage and attempted to minimize total collection and interest costs. The least expensive collection method depended on the size of the item. For sufficiently large items, the higher costs of collection by express company were more than offset by the prospective interest cost savings from faster collection. However, most items deposited at small banks were themselves small and were passed on to correspondents for slower collection at lower explicit cost. Correspondent cards and bank directories could be used to find the quickest collection route among established correspondent channels. Even here, potential savings on interest costs from sending separate bundles of checks to each of several correspondents had to be weighed against the lower cost of sending a single bundle to one correspondent and the accompanying delay in some of the collections.

In the model, the administrative costs of preparing the bundle of checks for shipment and necessary postage are modeled as fixed costs identical for all destinations. Since it has been assumed that each bank belongs to only a single correspondent network, these costs will not change if a bank switches networks. In addition to costs incurred by the bank, clearing and settlement imposed costs on the correspondent. These costs are taken to be a function of the average dollar value of clearings through the center, $C(\cdot)$, which is increasing, $C'(\cdot) > 0$, but

subject to economies of scale, $C''(\cdot) < 0$.⁴⁰ Since flows through City A are greater than through City B, unit costs are lower for City A and remain so after the formation of City B's network.

To simplify the summations, I assume deposited items are drawn on nonrespondents only and so must be collected from other local banks. With the formation of City B's correspondent network, items received by City B banks drawn on members of its network and items drawn by City B network members on one another or City B banks are no longer cleared through City A,

$$-\left(\sum_{j \in B} \bar{I}_{Bj} + \sum_{i \in B} \bar{I}_{iB} + \sum_{i \in B} \sum_{j \in B} \bar{I}_{ij} \right)$$

The net change in costs for City A banks is $C_{A_A} - C_{A_B}$. For City B banks, there is a net increase in clearings equal to the value of items member banks deposit that are drawn on City A, City B, and other banks,

$$\sum_{i \in B} \bar{I}_{iA} + \sum_{i \in B} \bar{I}_{iB} + \sum_{i \in B} \sum_{j=1}^N \bar{I}_{ij}$$

the consequent increase in clearing costs of $C_{B_B} - C_{B_A}$.

The total change in clearing costs is ambiguous. However, all other things equal, unit clearing costs for City B banks decrease with the proportion of member receipts that can be

⁴⁰In reality, the cost of clearing and settlement was a function of the volume of checks rather than their dollar value.

Contemporary bankers' manuals contained descriptions of the clearing process in small and large centers. In addition to gains from specialization and division of labor, the higher volume of large centers undoubtedly encouraged them to take greater advantage of the new labor-saving technologies advertised in contemporary publications.

handled entirely on its network and the number of network members.

Reserve Management Costs.

The reserve management problem banks face can be thought of as a stochastic inventory control problem, where the inventory in question is bank reserves. Every day, there is a random net flow of reserves (I_{ii}) into or out of bank i 's vault as a result of deposits and withdrawals at the bank's office. The variance of these flows will be denoted $\sigma_{I_{ii}}^2$. To protect against the consequences of illiquidity, it holds reserves (R) at a daily cost of $r * R$. Given a fixed cost of inventory adjustment with a City A bank (F_{iA}), it will not be optimal for the bank to adjust its reserves at the end of each business day because the costs of doing so may outweigh the benefits. Instead, the bank will adopt a decision rule regarding inventory adjustments that will minimize its reserve management costs over time. The daily average reserve management cost function under this optimal decision rule will be given by $RC(\)$.

The solution to the above problem developed by Merton H. Miller and Daniel Orr for the case where net cash flows follow a stationary random walk will be used to characterize this reserve management cost function.⁴¹ The bank's optimal decision rule is to adjust reserve levels

⁴¹Miller and Orr further assumed that the process consists of independent Bernoulli trials involving equally probable fixed increases or decreases in inventory in each period. Thus, changes in excess cash balances are entirely unpredictable. Given predictable seasonal and other credit demands, only a portion of bank cash flow behavior was unpredictable in the postbellum period. The variance of cash flows was also presumably seasonal. Jeffrey A. Miron, "Financial Panics, the Seasonality of the Nominal Interest Rates, and the Founding of the Fed," *American Economic Review* 76:1 (March 1986): 125-40. Miller and Orr state that the model is applicable even if minimum levels of reserves were required.

The Miller-Orr model allows for multiple changes in net cash balances over the course of each period. In the above formulas, I consider a single change in balances per period. "A Model of the

to

$$Z^* = \sqrt[3]{\frac{3F_{iA}\sigma_{I_{ii}}^2}{4r}}$$

whenever reserve levels rise to $H^* = 3Z^*$ or fall to $L^* = 0$ so that the total change in reserves is the sum of net cash flows over the counter and positive or negative reserve adjustments (RA_i),

$\Delta R_i = I_{ii} + RA_i$. Under this policy, average cash holdings will be

$$\frac{H^* + Z^*}{3} = \frac{4}{3}Z^*$$

and average reserve management costs

$$RC(F_{iA}, \sigma_{I_{ii}}^2, r) = \frac{F\sigma^2}{2(Z^*)^2} + \frac{4}{3}rZ^*$$

These costs increase in each argument.

As a simplifying assumption of their model, Miller and Orr assume that reserve adjustments are instantaneous—an assumption violated in a meaningful way in the case of historical vault cash management. Incorporating travel time into this model as a lag between the time when reserves are requested and when they are added to a bank's inventory produces a decision rule in which Z^* , L^* , and H^* are increasing functions of the lag and so, therefore,

Demand for Money by Firms," *Quarterly Journal of Economics* 80:3 (August 1966): 413-35.

would be average reserve levels and reserve management costs.⁴²

Using the Miller-Orr solution, the change in average reserve management costs for bank i associated with changing from a City A to City B correspondent is

$$RC(F_{iB}, d_{iB}, \sigma_{I_{ii}}^2, r) - RC(F_{iA}, d_{iA}, \sigma_{I_{ii}}^2, r)$$

Cost savings increase with the F_{iA} and d_{iA} and decrease with F_{iB} and d_{iB} .

Prior to the development of their network, the City B banks had to manage their own reserves through the clearinghouse and, as needed, through recourse to their correspondents in City A. With the formation of their network, increased net reserve flows increase their reserve management costs. This change can be treated in the same way as for their respondents,

$$RC(F_{BA}, d_{BA}, \sigma_{B_B}^2, r) - RC(F_{BA}, d_{BA}, \sigma_{B_A}^2, r)$$

Thus, the extent of the increase will depend critically on the functional form of the cost function and the change in the variance of City B bank net daily cash flows.⁴³

⁴²As Miller and Orr state, this assumption serves “to eliminate the need for a precautionary ‘buffer stock’ whose function in stochastic inventory problems is to protect against runouts during the lead-time.” “A Model of the Demand for Money by Firms,” p. 416.

The second derivatives of $RC(\)$ with respect to each of its arguments are negative.

⁴³This is the outcome, provided the increase in business leads to the same transaction pattern as existing business such that net daily cash flows increase according to a scale factor, $a * I_{ii}$. Thus,

$\text{var}(a * I_{ii}) = a^2 \sigma^2$. Average reserve costs are increasing as business increases, $\frac{\partial RC}{\partial a} > 0$, but there

are economies of scale, $\frac{\partial^2 RC}{\partial a^2} < 0$.

I also have assumed that the increase in business does not result in proportionately more interday netting, which might reduce actual variability $< a^2 \sigma^2$.

It remains to determine the variance, starting with the computation of the variance for the individual accounts. The net cash flows from maintaining a respondent account is net payments (deposits minus withdrawals) and reserve adjustments with variance given by

$$\sigma_i^2 = \text{var} \left(\left(I_{iA} + I_{iB} + \sum_{j \neq i} I_{ij} \right) - \left(I_{Ai} + I_{Bi} + \sum_{j \neq i} I_{ji} \right) - RA_i \right)$$

Under Mill-Orr assumptions, it can be shown that $\text{var}(RA_i) = \sigma_{I_{ii}}^2$.

The variance of net daily reserve flows for the City B banks once the network forms is

$$\sigma_{B_N}^2 = \sigma_B^2 + 2 \sum_{i \in B} \sigma_{Bi_B} + \sum_{i \in B} \sum_{j \in B} \sigma_{i_B j_B}$$

The increase in the variance depends not only upon the variance for the individual accounts but also on the covariance between flows for City B banks and those of its network and between the network clients. The lower these covariances, the greater the netting effect from maintaining the network, the lower the overall variance, and the lower the reserve costs arising from operating the network.⁴⁴

City A banks are assumed to have recourse to the call loan market for their own reserve management. The fixed cost of transacting in that market is assumed to be zero, so there is no attendant change in City A reserve management costs.

Conditions for the Viability of the Regional Network.

⁴⁴For recent evidence, see Gilbert, “Economies of Scale in Correspondent Banking,” pp. 483-8.

A regional correspondent network is viable if membership can provide net benefits for its members and organizers. The network also has to be supported by a pricing scheme that entices banks to join and allows the network organizers to cover the net costs of operating the network. For purposes of the model, I have assumed that pricing takes the form of the size of the compensating balance (CB_i) members are required to hold with center banks. The opportunity cost of holding these compensating balances is $r * CB_i$. I assume that this expense is borne in each period. If an account has a deficiency, the correspondent lends at r , and r is paid in the case of a surplus. Thus, the bank's management of these accounts need not be included in the model.

Using this pricing scheme, a bank i would be willing to switch to a City B correspondent from a City A correspondent if the cost savings from interest and reserve costs exceed the increase in price.

$$rd_{AB} \left(\bar{I}_{iA} + \bar{I}_{iB} + \sum_{j=1}^N \bar{I}_{ij} \right) + \left(RC(F_{iB}, d_{iB}, \sigma_{I_{ii}}^2, r) - RC(F_{iA}, d_{iA}, \sigma_{I_{ii}}^2, r) \right) \geq r(CB_{iB} - CB_{iA})$$

For City B banks, organizing the network is beneficial if the increased interest, collection, and reserve management costs are more than compensated by the net change in earnings on correspondent balances,

$$\begin{aligned} & rd_{BA} \left(\sum_{i \in B} \sum_{j \in A} \bar{I}_{ij} - \sum_{j \in B} \bar{I}_{Bj} \right) + (C_{B_B} - C_{B_A}) + \left(RC(F_{BA}, d_{BA}, \sigma_{B_B}^2, r) - RC(F_{BA}, d_{BA}, \sigma_{B_A}^2, r) \right) \\ & \leq r \left(\sum_{i \in B} CB_{iB} - (CB_{B_B A_B} - CB_{B_A A_A}) \right) \end{aligned}$$

In order for the new network to compete successfully, its formation must produce net social benefits. In the above equations, this is equivalent to the condition that the sum of the left-hand side of the first equation for all network members minus the left side of the second equation is less than the cost savings for the City A banks from the defections. Under this condition, the banks in City A cannot reclaim the defecting members through a change in pricing.

The larger the number of banks and amount of deposits the network can attract, the lower cost it will be. This will reduce the costs of outside services purchased and reduce reserve management costs for the urban banks. Thus, correspondent networks benefit from local network effects in which there are locational characteristics that may make network organization feasible, even in the face of larger but more distant national networks with lower costs. As in other network models, the desirability of joining depends on the amount of business that can be conducted on the network. The addition of new banks to an area makes network formation more profitable, and, once formed, new additions make membership more attractive for banks that currently are nonmembers. This makes them more likely to join and further increases in membership increase the business they conduct through, and hence balances held in, the regional correspondent hub.

IV. Evidence.

Testing the model's predictions empirically is complicated by several features of the correspondent system. (1) Because individual banks chose their correspondents, there is a selection issue. Banks that felt the benefits of a particular correspondent relationship outweighed its costs would enter into and maintain such the relationship. Since some benefits were in the form of improved reserve and liability management, they were correlated with the balance sheet

ratios examined. (2) Correspondent relationships were not exclusive. Banks could, and did, form additional relationships without compromising their existing network links. Thus, selection of a set of correspondents could be thought of as representing the selection of a portfolio of payment and liquidity services. [Further discussion of problems.]

[New presentation of indirect evidence.] The postbellum was a period of dramatic change for the U.S. banking system, especially the period of the country's emergence from the Depression of the 1890s. The banking system grew rapidly as measured by assets per capita, the number of banks per capita, and the number of locations banks served. Capital-asset and excess cash reserve ratios declined substantially. Checks came into more widespread use for retail and wholesale payments. The correspondent system evolved a dense, hierarchical network structure, and regional hubs became increasingly important service providers.

This paper provides at least a partial explanation for these changes. The model and empirical results suggest that the changes in the structure of the correspondent system and these other developments were mutually reinforcing. Banking growth and the increased use of checks for intraregional payment increased the attraction of regional networks for clearing and settlement. These developments in turn reduced payment costs, desired reserve holdings, and the cost of deposit liabilities. In addition to fostering further banking growth, access to nearby loan facilities reduced liquidity risk and hence bank failure rates, even as reserve ratios fell and leverage ratios increased. Thus, though correspondents monitored and, to some extent, regulated the behavior of respondent banks, the evolving structure of the correspondent system created an environment in which they could engage in behavior which would have been considered reckless a few decades earlier.

This work adds to the growing literature on Southern banking development. Despite

rapid growth, the Southern banking system remained relatively small in total resources, as did Southern banking centers. The bank assets of Indianapolis and Atlanta did not differ much at the end of the period. However, Indianapolis was a relatively modest Midwestern correspondent center where Atlanta was selected as one of three Southern Federal Reserve districts because of its dominance in the Southeast.⁴⁵ The work in this paper suggests that though the level of economic and financial development differed, the dynamics of banking growth did not. The two regional centers, Atlanta and Indianapolis, experienced rapid growth in the number of correspondents and the number of balances just prior to 1900. And in both states smaller subregional centers emerged and grew between 1880 and 1910. The similarity of these developments may come as a surprise given the large literature suggesting that Southern financial development differed from that of the North. Yet here as well, there were differences. The South did not develop a center as regionally dominant as Chicago. The Southern environment was also more costly as suggested by Scott A. Redenius and David F. Weiman.⁴⁶

V. Conclusion.

This paper provides some perspective on the impact of the Federal Reserve System at the end of the period. The Federal Reserve System assumed many of the responsibilities which had formerly been performed by the correspondent and clearinghouse systems. R. Alton Gilbert has argued that the Federal Reserve System speeded clearing and settlement and allowed banks to

⁴⁵For more discussion, see Odell and Weiman, "Regional Metropolitan Development and Financial Market Integration in the New South," pp. 103-25.

⁴⁶"Financing the Crop Cycle: Seasonality, Southern Financial Underdevelopment, and the Founding of the Federal Reserve System," working paper, 2002.

operate with lower ratios of cash to total assets.⁴⁷ The resulting decline was, however, much smaller than the postbellum declines in excess cash reserve ratios. In addition, it is likely that as wholesaling centers became centers of regional payment processing, there was substantial reduction in clearing times. The Federal Reserve System was thus building on an already highly evolved payment system.

The results of this paper also have implications for the structure of an American central bank. Imagine that a central bank had been organized in New York prior to the late 1890s. While its ability to provide central banking services would have been limited by its single location, this disadvantage would have been relatively small given New York's dominance as a correspondent center. However, the subsequent rapid growth of regional correspondent centers suggests the disadvantages would have increased over time. In this light, the Fed's structure of regional banks and branches can be seen as an attempt to preserve and extend the advantages offered by the hub and spoke network structure of the correspondent system. This structure also allowed the Fed to supply financial services to individual banks. In providing payments processing services, reserve deposit accounts, and discount window facilities, the Fed sought to take over the financial service role that had been performed by correspondents. Thus, the Fed's organizers hoped to nationalize the services that were critical to information collection and private regulation within the banking system.

⁴⁷“The Advent of the Federal Reserve and the Efficiency of the Payments System: The Collection of Checks, 1915-1930,” *Explorations in Economic History* 37:2 (April 2000): 121-48.

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