

Panics and The Disruption of Payments Networks: The United States in 1893 and 1907

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Abstract

Panics in which banks temporarily restricted the redemption of their deposit liabilities in cash were virtually regular events in the United States before the establishment of the Federal Reserve System. Here we examine the disruption of the intercity or interregional payments system caused by the restriction of cash payments in the panics of 1893 and 1907. Daily domestic exchange rate data from major regional financial centers allow us to chart the effects of the panic and subsequent cash restriction (in New York) across cities. In turn we show that the degree of disruption to domestic exchange markets in regional financial centers over this period was increasingly a function of their place or centrality in intercity correspondent networks rather than local conditions. We then provide both qualitative and quantitative evidence on the effects of these cash restrictions and payments disruptions. Although the private payments networks based on the correspondent banking system which had developed to clear and settle interregional or intercity transactions in the pre-Federal Reserve period were normally quite efficient arrangements, when the convertibility of New York balances was threatened or limited, these networks were also important channels for transmitting financial pressures. Such restrictions in turn had serious consequences for payments settlement at both the local and interregional level and consequently for the level of economic activity

Panics were virtually regular events in the United States before the establishment of the Federal Reserve System. We define a panic here as an event in which holders of bank liabilities, notes or deposits, demand that banks convert their debt claims into cash in sufficient numbers that collective action on the part of the banking system becomes necessary. In the roughly half century between the end of the Civil War (1865) and the founding of the Federal Reserve (1914), there were seven financial crises which may be classed as panics. Indeed, Bordo (1985, p.73) observes that “the United States experienced banking panics in a period when they were a historical curiosity in other countries.” Milder ones, such as those in 1884 and 1890, could be dealt with by issues of clearing-house loan certificates alone. But more severe instances, as in 1873, 1893, and 1907, also resulted in suspensions or restrictions of cash payments at par, in which banks temporarily restricted or denied altogether the redemption of their deposit liabilities in cash (specie or legal tender notes) (Calomiris and Gorton 1991, pp. 96-100).

In this paper we examine the nature and consequences of intercity payments system disruptions in the panics of 1893 and 1907. We focus on three primary issues. First, the turmoil in the intercity payments system over the course of the two panics reveal fundamental changes in the character of interbank relationships under the National Banking System over the late nineteenth and early twentieth century which were less apparent during normal times. In particular, after 1893 New York banks began to assume an even more integral role in mediating long-distance payments and in supplying banks with central-bank-like services (James and Weiman 2010). And in turn in the aftermath of the 1907 panic the apparent vulnerability of the national payments system to panics and suspensions in New York spawned a reform movement to create the Federal Reserve, which then nationalized the clearing-settlement functions of New York banks. We therefore examine here what the panics of 1893 and 1907, as well as the non-panic of 1914 at the beginning of World War I, reveal about the changing role of New York in the interregional payments system.

Second is the role of the payments system in transmitting financial pressures across cities during panics. During panics and cash payment restrictions ready access to New York funds was

impeded (i.e., they became less liquid), so we concentrate on dislocations in interior markets for New York funds which in turn interfered with the transferal of balances to meet local or non-local payments needs. While studies of panics have usually been limited to just New York banks and financial markets (e.g., Mishkin 1991; Donaldson 1992, 1993)¹ and/or on the causes and patterns of bank suspensions and failures, here we examine their impact on the correspondent payments network, more specifically on regional financial centers.

Finally, we consider potential real effects of payments system dislocations resulting from restrictions of cash payments during panics. Serious payments system disruptions are of course still possible in the modern economy. Gridlock, for example, was prevented after the September 11 attacks only through swift and decisive intervention by the Federal Reserve (McAndrews and Potter 2002). But the issue takes on particular relevance for the pre-Federal Reserve period, when both local and non-local transactions were cleared and settled through private payments networks. As we describe in the next section, New York correspondent banks were central in these networks. They constituted the “clearing house of the country” in O.M.W. Sprague’s phrase (1910, p. 126), holding interior banks’ (excess) clearing and secondary reserves. Consequently, payments restrictions especially in New York could significantly reduce access to “good funds” for local and non-local payments and thereby impede normal operations of production and exchange (i.e., reducing liquidity of banks’ clearing and secondary reserves).

The plan of the paper therefore is as follows: Section 1 is a brief description of the institutions and operations of the interregional payments system before the Federal Reserve, a time in which there was no formal government role; section 2 outlines the chronologies of the Panics of 1893 and 1907 and their impact on interior cities as measured by changes in domestic exchange rates. We take the longer view first, so Section 3 is concerned with what these panics reveal about the changing nature of the payments system over time. Sections 4 and 5 focus

¹ Carlson (2005), who looks at the pattern and causes of suspensions of interior banks in the panic of 1893, and Wicker (2000) are notable exceptions. Tallman and Moen (1995) pay close attention to the course of the panic of 1907 in Chicago.

instead on more immediate effects– in 4, the dissemination of panic pressures across space, while the economic impact of payments system disruptions due to the restrictions of cash payments during panics is addressed in section 5. Section 6 concludes.

1. Private Payments Networks

After the demise of the Second Bank of the United States, making payments at a distance posed a difficult problem in a country characterized predominately by independent unit banks with no central monetary authority or integrated nationwide banking system (see Knodell 1998). It could have been accomplished by shipping specie to the payee, but a system of intercity payments involving the physical transfer of cash to settle every transaction would have been a costly one indeed. Unlike the product side, interregional integration of the system of collecting and clearing financial obligations could not be internalized along Chandlerian (1977) lines through the formation of large-scale enterprises, due to the prohibition against branch banking. Monetary integration, then, depended on the formation of a “national” banking system to transfer deposits among banks without corresponding shipments of cash. Instead, independent banks developed two types of private networks to facilitate interbank transactions, local clearing houses and correspondent relationships.

1a. Correspondent banking networks

Banks instead formed two types of networks to broker interbank transactions – local clearing associations and correspondent relations. During the 1850s banks in New York, Boston, Philadelphia, and Baltimore began to form clearing associations for the collection and clearing of local checks (Cannon 1910; Gorton and Mullineaux 1987). The spatial gap in the payments system between local clearing houses and between city and country banks was filled by the development of the correspondent banking system. In the antebellum period “country” banks began routinely to maintain reserve balances in commercial centers, notably Boston and New

York, for the redemption of note issues (see Myers 1931; Weber 2003). By mid-century a tiered system of bank correspondents with New York as a national center mediating interregional payments had begun to emerge (Bodenhorn 2000, pp. 192-198). The organizational form of the networks of independent banks which developed was a rather novel one, based on longer-term relationships between banks, something between the tighter clubs of urban clearing-houses, which restricted membership and actively monitored operations, and the competitive market. Technological and organizational innovations by railroad and telegraph companies beginning in the 1850s greatly reduced the costs of shipping information and goods, laying the foundation for a more integrated, national market (Chandler 1977) and increasing the need for non-local payments.

The shipment of specie was, of course, an obvious way of settling such accounts, but rarely used in non-local, non-retail transactions (Colwell 1860, pp. 135, 190, 262, 447). Most intercity financial transactions instead involved the use of a bank credit instrument of some type—in the immediate aftermath of the demise of the Bank of the United States primarily bank notes, somewhat later supplanted by the use of drafts. The bank draft, a check drawn by one bank against funds deposited in another (financial center) bank authorizing payment to a named individual, shared the security, convenience, and efficiency advantages of checks, while avoiding the idiosyncratic information problems. As the draft developed as a general means of non-local payment, so also did the correspondent banking system mature, being two sides of the same coin. This in turn allowed for a quite efficient system of essentially net collective settlement of non-local payments— transactions between parties whose banks shared the same city correspondent could be settled as an intrabank “on us” transfer of funds; those between parties whose banks had different correspondents in the same financial center involved only a transfer of funds within the local clearing-house, greatly reducing the necessary shipment of reserves (Garbade and Silber 1979, pp. 5-6; Goodfriend 1991, p. 11)

The emergence of New York as the preeminent commercial center meant that maintaining a New York correspondent became increasingly important for interior banks. Even in 1835 net

bankers' balances held in New York amounted to \$4.40 million as compared with \$2.93 million in Philadelphia and \$1.03 million in Boston; by 1850 that total had risen to \$12.51 million vis-à-vis \$2.45 million in Philadelphia and \$4.17 million in Boston (Bodenhorn 2000, p. 196). Almost 600 out of 700 incorporated U.S. banks by that time maintained New York accounts (Myers, 1931, p. 115). In turn, New York developed as the national center mediating interregional payments. New York funds became the readily acceptable means of payment everywhere because so many agents made payments there. Drafts or other credit instruments payable in New York City drawn on the local bank's correspondent account there consequently became the most common medium for settling debts not just between interior cities and New York, but even between agents in different communities.

In the period after the Civil War however both the structure and function of the correspondent banking system began to change. First of all, the use of drafts on New York represented only an intermediate stage in the evolution of interregional payments. Banks in the postbellum period were increasingly primarily banks of deposit rather than banks of issue (see James 1978, pp. 22-27) with the overall ratio of deposits in commercial banks to currency rising from 1.50 in 1870 to 2.03 in 1880, then more than doubling the 1870 value to 3.22 in 1890, and more than doubling again to 6.67 by 1910 (Carter, *et al.* 2006, p.3-604). Checks offered distinct advantages to bank customers, as compared with drafts, in making non-local payments. For one thing, the use of checks was clearly more convenient for payers, who avoided the transactions costs (the trip to the bank) and fees of purchasing drafts. Moreover, with the purchase of a draft the payer's account was debited immediately, while with a check it was not debited until the check was collected. Nevertheless, because of informational problems, the non-local use of checks in payment was initially quite limited. The use of checks in non-local payments began to rise considerably roughly circa 1880, and by the early twentieth century it was estimated that about 95 percent of the wholesale trade in the country, transactions most likely to have been non-local, was paid for by checks (Kinley 1910, pp. 196-199).

The institutional structure of correspondent banking system, originally dictated by the

pattern of drafts drawn used to finance non-local transactions, later served as the framework to facilitate the interregional clearing and collection of checks. The move from drafts to checks necessitated major changes in clearing procedures for out-of-town items. Banks were not obligated to redeem checks promptly or at par unless they were presented for collection at their office. Rather than most collections being focused in a central locale, New York, as under the draft system, collection points became much more dispersed. Although clearing of out-of-town payments had become significantly more complicated, the correspondent banking system provided a framework in which to facilitate them. It could have been considered negligence for a bank to collect checks by sending them to the paying bank through the mail, making the paying bank also the collecting agent (Spahr 1926, p. 104). Banks therefore would increasingly rely on their correspondent relations for the collection and clearing of individual checks. Typically, local banks would send their out-of-town checks to their city correspondent for collection. It, in turn, would forward them to one of its country (i.e., non-New York) correspondents in the vicinity of the paying bank, which would present the item at the counter for payment. Even though clearing had become more involved, settlement procedures remained relatively unchanged. Settlement was generally accomplished by the issue of a draft on a financial center, usually New York, in interregional transactions. The concentration of reserves and efficiency of settlement that developed with the draft system continued in spite of the change in the standard payments instrument from drafts to checks.

Second, with more complex trade patterns and increased intraregional or intrastate trade, regional correspondent networks developed in which regional financial center banks held correspondent accounts of hinterland country banks (Conzen 1977; Redenius 2003; Weiman and James 2006). Redenius (2003) describes the evolution of such networks in Indiana and Georgia after 1880. The proportion of Indiana country bank interbank deposits held within the state which had been close to zero in 1870 rose to more than one-quarter by 1900; in Georgia in 1900 the figure was more than half (p. 16). Most banks however maintained their New York relationships for interregional transactions. In Georgia, while the share of banks with Atlanta

correspondents grew from around 20 per cent in 1880 to almost half after the turn of the century, the share with New York correspondents never fell below 90 per cent. In Indiana there was a bit more erosion, with shares of those with Chicago correspondents rising from over a third to almost 60 per cent, those with Indianapolis correspondents increasing from under 15 per cent to almost 50 per cent, while those with New York correspondents fell from over 90 per cent to about two-thirds over the period (pp. 14-15).

What emerged therefore was basically a tiered system of bank correspondents with banks in regional financial hubs (e.g., Boston, Philadelphia, Chicago, St. Louis, San Francisco, and so forth) holding correspondent accounts of hinterland country banks and New York as a national center mediating interregional payments. This more elaborate payments network is illustrated by the diagram in Figure 1 which shows New York correspondents at the center of a tiered hub-and-spoke network. Table A1 shows the pattern of interstate cash flows into and out of selected cities for four years as reported by local clearing houses to the National Monetary Commission (Kemmerer 1910, pp. 276-357). Flows to and from New York are also reported separately in addition to those to and from the eastern region. Note that the channels of substantial cash flows in regional financial centers such as Boston, Philadelphia, Cincinnati, and San Francisco² were almost always limited to those between the given city and its hinterland (Boston and New England, Philadelphia and the East/Mid-Atlantic, Cincinnati and points in the South and Midwest, San Francisco and the West coast, etc.) and between the city and New York. Other interregional flows, such as between Boston and the South, Cincinnati and the West, and so forth, were generally negligible or zero. Interregional payments from such cities therefore must have been overwhelmingly intermediated by New York balances rather than through correspondent accounts in other regional financial centers. In turn, in most smaller cities here intercity dealings were almost exclusively with the regional financial center (Providence and

² We omit here the other central reserve cities, Chicago and St. Louis, which were closer to interregional financial centers. Also, intrastate cash flows were not reported, so these figures generally omit interactions between regional financial centers and their immediate hinterlands.

Boston, Wilmington and Philadelphia, Little Rock and St. Louis) rather than New York directly. The tiered structure is evident in these flows.

Even though the New York share of total due to banks held in national banks was declining over this period as this more complex network developed, from 46 per cent in 1893 to 33 percent in 1906, New York retained its place as the focus of the interregional payments system. Banks throughout the country settled their check transactions via a New York correspondent, either directly by debiting or crediting their New York balances or indirectly through the mediation of correspondents in regional centers. Banks in regional centers maintained a New York correspondent for this purpose as well as to serve their local business customers. Additionally, they functioned as clearing nodes, forwarding checks to and from hinterland banks for collection, but also settled check transactions within their market area.

1b. Domestic exchange markets

New York balances or exchange were traded among local banks in interior cities, thereby allowing them to adjust the level of their correspondent accounts. Business customers sold exchange to their banks by depositing drafts or checks drawn on a New York (or other money center) bank. Banks would remit these items to their correspondent for collection and receive payment usually in the form of ledger entries to their correspondent balances, rather than shipments of cash. Thus, in the course of providing routine payment services to business customers, banks would deplete and replenish their correspondent balances. In turn, at any point in time, they could find themselves with deficient or excess correspondent balances. To remedy these imbalances, banks could arrange to ship cash to or from their correspondents, but would then incur significant transactions costs.

As an often cheaper alternative, banks developed a local wholesale or interbank market in exchange where they bought and sold surplus correspondent balances. Such a transaction – e.g., the purchase of a New York balance with vault cash – simply converted one form of excess (or clearing) reserve into another and so enabled banks to manage their overall portfolio of excess (or

clearing) reserves. The price of New York funds, the domestic exchange rate, therefore was a function of the forces of local demand and supply and a direct measure of the cost of making long-distance payments. These internal exchange rates, representing the premium or discount which \$1000 in New York funds commanded in the local market, were commonly quoted in the business or financial press,. A positive number indicated New York exchange sold at a premium, and a negative figure, a discount. Thus, if the rate in St. Louis was \$1.00, \$1000 in New York sold for \$1001.00 locally, or at a .10 percent premium.

This system of internal or inland exchange rates was a fixed rate regime in normal times since the value of a dollar (in terms of gold) in New York was the same as that of one in Chicago. The spot price of New York funds in Chicago however could differ from the mint parity exchange rate (one) within the currency points, the cost of shipping cash from Chicago to New York or *vice versa*, without eliciting an interregional/intercity currency flow (analogous to the gold points in the foreign exchange market under the gold standard). Weekly domestic exchange rates reported in *Bradstreet's* magazine for six cities are shown in Figure 2 for the period between the major panics, September, 1893 to September, 1907. The graphs convincingly show that in normal times the range of fluctuations was quite circumscribed. In many or most cases an eyeball test seems sufficient to establish the bands. However in periods of panic and restrictions of cash payments, when cash was not readily obtainable at par, the usual bounds defined by shipping costs would not apply, as we shall see.

2. The Panics of 1893 and 1907 and Their Impact Across Cities

The New York stock market collapsed in early May, 1893 with the failure of the National Cordage Trust. Nevertheless, most of early financial disruptions occurred in interior cities rather than in New York with panics and bank runs in several interior cities. In June 1893 runs on banks began in Chicago, Omaha, Milwaukee, spreading to the Pacific Coast (Los Angeles, San Diego, and Spokane). Cash drains from New York banks to the interior began (Wicker 2000, pp.

65-77).^{3 4} In response to these drains on June 15 the New York Clearing House authorized the issuance of Clearing House certificates as a precautionary measure. These loan certificates, granted by a special committee Clearing House to members upon application and presentation of appropriate bank asset collateral, could be used to settle adverse balances at the clearing house. They thus functioned in effect as a currency substitute in settling local interbank balances and prevented currency drains to other local clearing-house banks.

In July 1893 interior bank suspensions intensified, and there were city-wide panics in Kansas City, Denver, Louisville, Milwaukee, and Portland, Oregon (Wicker 2000, pp. 65-77) . With continued external drains on reserves on August 3 New York banks restricted cash payments, strongly limiting but not completely prohibiting cash payments to liability holders. This decision was followed immediately by banks throughout the country. The restriction in New York was not however complete and banks continued to ship cash to some degree to interior banks drawing down their bankers' balances (Sprague 1910, pp. 177-178, 182). The period of restriction for New York banks lasted around one month with resumption there beginning on September 2. A chronology of the panic appears in Table 1.

In Figure 2 we present daily domestic exchange rates for the panic period from five major

³ During periods of financial crisis interior banks clearly must have experienced strong cash withdrawal demands due to hoarding as well as to the more standard needs of (retail) trade and meeting payrolls (usually paid in currency). See Andrew (1908a).

⁴ The drop in the Treasury gold reserve below \$100 million in April 1893, which amplified fears that government liabilities might be redeemed in silver rather than only gold as had been the practice, was often been identified by contemporaries as the harbinger of the crisis. Sprague (1910, p. 169) however noted that bank failures and suspensions “occurred principally in the West and Southwest, where there is no evidence that people were distrustful of silver money... Distrust of the solvency of the banks rather than dissatisfaction with the circulating medium was clearly the direct cause which brought about runs upon banks and the numerous failures and suspensions.” DuPont (2008) however has suggested that agricultural distress may have played a role in initiating the panic in the west in the early summer.

Hanes and Rhode (2009) argue persuasively that financial crises between 1879 and 1914 were fundamentally rooted in adverse cotton harvests which created fertile financial conditions for disruptions.

financial centers-- Boston, Chicago, St. Louis, San Francisco, and New Orleans-- as reported to the *New York Times*. Figure 3 supplements with weekly exchange rates (every Friday) from *Bradstreet's* for six more cities-- Philadelphia, Cincinnati, Louisville, Milwaukee, Kansas City, and Memphis. The cash restriction and resumption dates are marked by vertical lines. Regional patterns differed. Exchange rates move strongly negative in the weeks before New York suspension in Chicago, St. Louis, and Kansas City (in Milwaukee the quotes simply disappear just before and just after restriction). Since domestic exchange rates represent the price of New York funds in terms of local vault cash, when local reserves are relatively scarce New York exchange should sell at a discount (i.e., local funds at a relative premium), while when New York funds are relatively scarce they should command a premium. In contrast, in Eastern cities, such as Boston and Philadelphia, New York exchange rather than going to a discount in the weeks before restriction rises to a significant premium (falling to a substantial discount in Philadelphia afterwards, but not in Boston). In Southern cities such as New Orleans and Memphis there was little evidence of disturbance before the restriction date.⁵

During the panic period, exchange rates clearly become much more volatile, attaining values far outside the normal currency shipping point bounds.⁶ Rates during the period of restriction rose as high as \$8 in Boston and \$10 in New Orleans and Philadelphia. On the flip side, they fell at points as low as -\$8 in St. Louis, -\$18 in Philadelphia, -\$20 in Milwaukee, and -\$30 in Chicago.⁷ In July/August 1893 the standard deviation of the exchange rate, for example, was over 5 times larger in St. Louis, over 10 times larger in Boston, and 26 times larger in

⁵ Contrary also to the situation in the midwest, it was reported that in Charleston "New York exchange is scarce" (*Bradstreet's*, August 5, 1893, p. 496).

⁶ Widely cited figures from just after the turn of the century put express rates per \$1000 on currency shipments between New York and four cities as follows: Chicago, 50¢; St. Louis, 60¢; New Orleans, 75¢; San Francisco, \$1.50 (Johnson 1905, p. 82).

⁷ In St. Paul and Minneapolis New York exchange was an "unquotable commodity," "unsalable at any price" (*Bradstreet's*, August 5, 1893, p. 496; August 12, 1893, p. 513). But interestingly, the changes in exchange rates in Kansas City and Louisville during the city-wide panics in late July were not as dramatic as in a number of other places.

Chicago than in a non-panic year.⁸

In 1893 financial disturbances originated in the interior leading to a crisis in New York, but in 1907 the panic was closer to those in 1873 and 1884 where the initial crisis among New York banks radiated out to the interior.⁹ On October 16 when a copper corner by Augustus Heinze collapsed so also did two brokerage houses which were involved and runs developed on three banks associated with Heinze. Assistance from the New York Clearing House preserved the Heinze banks, but the financial disturbance began in earnest less than a week later with runs on New York trust companies— first the Knickerbocker, followed by the Trust Company of America and the Lincoln Trust. Although a money pool organized by J. P. Morgan fended off disaster for the trust companies in the near term, interior bank withdrawals from national banks led the New York Clearing House to issue clearing-house loan certificates and suspend cash payments on October 26. Spreading from New York, virtually a nationwide restriction of cash payments resulted. A. Piatt Andrew was able to identify only fifty-three cities with populations over 25,000 where restriction did not occur (1908b, p. 503).¹⁰ Cash payments were not resumed in New York until after the first of the year, a period of suspension more than twice as long as in 1893. Again, the chronology appears in Table 1.

Figure 4 presents daily domestic exchange rates in six financial centers (including St. Paul this time), with weekly rates for five more appearing in Figure 5. The restriction date in New

⁸ Sprague (1910, p. 297) cautions that in panic periods “the quoted rates of exchange were often without much significance” since markets might have been so disorganized that the rates were “purely nominal, representing little or no actual transactions.” Nevertheless, such extreme values might still be a useful indicator of the state of the market.

⁹ Odell and Weidenmier (2004) argue that the after effects of specie drain caused by the San Francisco earthquake of 1906 had left New York banks low on gold reserve and more vulnerable to shocks than usual.

¹⁰ In the aftermath of the panic pleas for restraint came not only from government and the financial community but also from above. Archbishop Farley, for example, “pointed out that the chief thing to be feared in connection with the ship of finance was that during the squall some of its passengers might jump overboard.” Mgr. Lavelle at St. Patrick’s cathedral also “cautioned against unwise action on bank depositors”(Chicago Tribune, October 28, 1907).

York is marked by a vertical line as before. In contrast to 1893 when the panic moved from interior points to New York, we might expect to observe “normal” conditions in regional domestic exchange markets until the unexpected shock of New York banks’ suspension in late October 1907. The patterns of exchange rates show a striking similarity across Eastern and several Midwestern (Chicago, St. Louis, St. Paul) cities here; rates increased sharply after cash restriction by New York banks.¹¹

3. Differences in Exchange Rate Behavior between 1893 and 1907

An eyeball comparison of domestic exchange rate movements in 1893 (Figures 2 and 3) with those in 1907 (Figures 4 and 5) indicates striking differences. First, in the other central reserve cities of Chicago and St. Louis average exchange rates moved from strongly negative in 1893 to positive in 1907. By 1907 the pattern of New York exchange in financial centers across the country looked like that of Boston in 1893 with a sharp rise in the New York premium. Again, New Orleans stands apart here. Second, the range of exchange rate fluctuations was generally much smaller in 1907 than in 1893. During restriction New York exchange rates in Chicago ranged over almost \$30; in 1907 the range was \$3. In Boston the figures were \$6 and less than \$3 respectively, while in San Francisco they were \$15 and \$2. Table 2 summarizes the behavior of local domestic exchange rates during the two panics based on the daily data and illustrates the differences. Two measures of duration are used here– the first from the beginning of the panic to the resumption of cash payments; the second from the beginning of the restriction period.¹²

¹¹ Weekly rates however in Cincinnati, Milwaukee, and Kansas City however seem generally to have been little affected by the New York panic and cash restriction. And as for the South, New Orleans and Memphis, Sprague (1910, p. 297) notes that exchange was at a discount or at par because due to cotton sales in the late autumn banks there were able to draw money from the Northeast.

¹² . The period of Panic Onset is dated from the issue of clearing-house loan certificates in New York-- in 1893, June 21, and in 1907, October 21; the periods of cash restriction began August 3, 1893 and October 26, 1907.

One factor contributing to the decreased fluctuations of 1907 might have been that the number of days in which local domestic exchange markets did not seem to function (the gaps between the dots in Figures 2-5) was much higher in 1907 than in 1893. In Chicago, for example, where the range of exchange rate movements had been the widest in 1893, in 1907 there were no quoted transactions in domestic exchange at all for more than a week after the cash restriction date. In San Francisco in 1907 the market essentially disappears with no quotes for two months after suspension (Figure 4). The number of days over the period in which domestic exchange rates were not quoted is reported in Table 2. In every comparison save one (panic onset in St. Louis) the number of no quote days is higher in 1907 than in 1893, usually substantially so. In Chicago there were only 2 no quote days in the period of cash payments restrictions in 1893 but there were 20 in 1907; in Boston the figures were 2 and 8, respectively; in St. Louis, 8 and 13; in New Orleans, 3 and 24; in San Francisco, 1 and 46. The number of cities for which no quote was reported on a given day is displayed in Figure 6. The rather random pattern of no quote days in 1893 could have been in part the result of idiosyncratic reporting as well as idiosyncratic disturbances. But in 1907 the pattern is much more evident, with no quote days rising around the restriction date. Perhaps even more interesting is the fact the domestic exchange market disappears completely in Louisville (weekly and hence not reported in Table 2) after the 1907 panic (and hence also not shown in Figure 5) and flatlines in Memphis.

Although there was certainly variation across cities, there appear to have been three significant differences then in the behavior of domestic exchange rates in major Midwestern financial centers between 1893 and 1907. First, New York exchange generally sold at a substantial discount in 1893 and at a premium in 1907. Second, exchange rates were much more volatile in the panic of 1893 than in 1907. Third, the number of days in which there seemed to have been no activity in the domestic exchange market was much higher in 1907 than in 1893. We argue that these differences in the behavior of domestic exchange rates reflected fundamental changes in correspondent bank relationships and the nature of the intercity payments system between 1893 and 1907.

3a. Increasing centrality of New York in the payments system

With the nationalization of markets and increased internal trade, the breakdown of “island communities” in favor of far-reaching geographically integrated product and factor markets (see Wiebe 1967; Conzen 1977), in the later nineteenth century, the volume of interregional or intercity financial transactions zoomed. In turn, New York exchange, the standard settlement medium for non-local payments, took on greater importance. The increased use of checks as a payments instrument in intercity/interregional transactions reinforced the importance of New York exchange.¹³ The shift from drafts to checks altered the reserve management problem for banks. With drafts the demands on city correspondent accounts at a point in time had been completely predictable, but of course this was not the case with checks. Banks faced greater uncertainty about their customers’ long distance payments and in turn the demand for clearing balances. This greater prominence of New York exchange is reflected in the rise in its share of base money or assets used in interbank settlements, currency plus New York bankers’ balances, the proportion of New York exchange growing by more than half from around 15 percent in 1893 to over 25 percent in 1906.¹⁴

As New York balances assumed greater importance to interior banks, banks were increasingly reluctant to run them down in panic times when such balances could not have been easily replenished. For example, in times when loan certificates could be used to settle clearing-house balances, banks might be reluctant to sell exchange.¹⁵ In selling exchange, the resulting

¹³ Irving Fisher (1911, p. 298) found a pronounced increase in the velocity of bank deposits, much of which must have been due to increased non-local payments over this period. From 1896 to 1910 it rose by almost half— from 36.6 to 52.7-- while the velocity of currency hardly changed (from 18.8 to 21.0).

¹⁴ Similarly, we see the share of New York exchange relative to the sum of New York exchange plus vault cash in state and national banks growing by around a third between 1896 and 1906 (Carter, et al., pp. 3-635, 3-643).

¹⁵ See Roberds (1995) for a detailed discussion of clearing-house loan certificates as a source of liquidity during financial crises.

favorable balance would have been settled in loan certificates, and if the bank had faced an unfavorable clearing-house balance it could have met it by taking out loan certificates itself. Therefore, each bank might have to be more reliant on its own resources for New York balances (Sprague 1910, p. 294).

If in normal times collections roughly balanced remittances, the levels of New York correspondent accounts would have remained relatively stable. However in abnormal times, if some banks, say those from Chicago, delay or discontinue remitting to New York, then other banks, say those from St. Louis, cannot rely on inflows to replenish their New York bankers' balance accounts. Interior banks would, as a result, be similarly reluctant to sell New York exchange and the premium on it would rise. Sprague (1910, pp. 295-296) notes that while "the extent to which banks in different cities delayed or refused to remit to New York on items collected by them for other banks can not be determined, . . . there can be no question that banks in certain cities, in these as well as other matters, adopted a policy wholly designed to strengthen themselves regardless of consequences."¹⁶ Here again in times of uncertain settlement prudence dictated strategies to maintain levels of New York balances.¹⁷

¹⁶ An agent reported to *Bradstreet's* from Philadelphia: "The scarcity and high rate of exchange on New York has no doubt militated against the customary prompt settlements with that city, the banks for the reason named being unwilling to part with their currency" (July 29, 1893, p. 480). Similarly, Noyes (1894, p. 26) observes that in 1893 even before formal cash restrictions "country banks were charged with refusing to remit their cash collections... The express companies did a very large business, during the panic, in presenting out-of-town checks at the banks on which they were drawn, and bringing the money to the city bank whence the check was remitted. The out-of-town banks frequently resisted this by paying in silver dollars or fractional coin. Domestic exchange between two great Eastern cities was at one time fixed by the express charges for transporting silver dollars." And as well "banks in some larger cities were next accused of withholding similar remittances."

¹⁷ Such coordination failures in which the failure of one bank to make expected payments in turn impairs the ability of other banks to make payments as well, creating a downward cycle, could certainly occur today in a regime based on real-time gross settlement (McAndrews and Potter 2002, pp. 62-64). Under the national banking system, local clearing and settlement through the clearing-house was net, so coordination was not an issue, but the continuous clearing and settlement of out-of-town items through New York correspondents made such disruptions possible.

The dramatic discounts at which New York exchange sold (or premia which local vault cash commanded) in the panic of 1893 in many/most interior cities therefore reflected the importance of cash and the scramble for it in local markets.¹⁸ What changed fundamentally between 1893 and 1907 was not necessarily that local demands for cash had become less intense, although in 1907 the widespread issue of cash substitutes did increase the local supply of funds in most cities (Andrew 1908b), but that New York exchange had become more valuable. New York exchange had become more important in monetary arrangements with increased internal trade and use of checks as means of payment, thereby making the maintenance of balances in New York accounts a critical consideration. Thus, the generally large discounts for New York exchange in 1893 gave way to premia in 1907.¹⁹

3b. Changes in volatility of exchange rates

As bankers' balances became more important, New York banks after 1893 began effectively to assume some central banking functions in assisting their interior correspondents in managing their New York exchange accounts. Lines of credit – that is, routine overdraft privileges – were increasingly substituted for the local wholesale exchange market. Instead of buying additional balances from a neighboring bank, local banks simply borrowed reserves from their correspondent (Lockhart 1921, p. 142). Borrowing rather than buying exchange became a more attractive, less costly alternative over time. The local exchange market only pooled the reserves of banks in a particular location and so was ultimately constrained by the region's

¹⁸ In the Panic of 1873, which originated in New York not in the interior, domestic exchange rates in Chicago also fell dramatically, reaching levels of -\$35, again indicating the importance of cash in the local market relative to New York exchange in the earlier period.

¹⁹ The more general rise in the price of New York exchange in the 1907 panic across cities might also be taken as evidence of increasing integration of the interregional payments system. Certainly by 1893, when domestic exchange rates during the panic in Boston were rising rather than falling, the Eastern United States had become a closely integrated area, economically and financially. But by the 1907 panic the pattern of New York exchange in financial centers across the country looked like that of Boston in 1893, a sharp rise in the New York premium.

balance of payments, while, in contrast, banks in New York pooled the excess reserves of banks from many areas and so were able to diversify against transitory and seasonal flows of funds. Interior banks then minimized the risk of transitory shortfalls arising in the course of trade by holding greater correspondent balances. And by holding excess reserves they purchased a credit line and so if necessary would borrow the difference. As a consequence, the volatility of domestic exchange rates declined markedly in the period after 1893 (James and Weiman 2010).

Ironically then as New York balances became more important as means of settlement, the importance of the local domestic exchange market in adjusting the levels of those balances waned. Over time the overarching structure within which New York balances were managed evolved from an essentially horizontal one involving dealings among banks in a given city to a vertical one across cities, namely in dealings between interior banks and their New York correspondents. To be sure, the ability of New York banks to offer routine overdraft privileges depended on the shocks to individual bank correspondent account levels being relatively idiosyncratic, so such operations were undoubtedly more limited during financial crises.

The question thus becomes to what extent did this quasi-central bank function of New York banks in providing liquidity to interior correspondents during normal times extend to abnormal or panic times. To be sure, these overdraft privileges would surely have been strained during financial crises (although reserve pressures on New York were clearly eased by the issue of clearing-house loan certificates),²⁰ The *prima facie* evidence for New York banks having been willing and able to continue to aid interior banks in stabilizing their bankers' balance levels is the relatively low levels (in absolute value terms) and volatility of domestic exchange rates in 1907 as compared to 1893.²¹ In view of the substantial cash drains from New York to the interior

²⁰ Noyes (1894, p. 21) observes that even in the 1893 panic interior banks were “clamorous for ‘rediscounts’; in other words, for the purchase from them for cash of paper already discounted for their own customers... and the larger banks responded.”

²¹ Nonetheless, there is still possibly something of a puzzle here. First of all, note that local banks always could have shipped vault cash to New York to build up their balances there. Rates should have then been bounded above by the usual costs of shipping cash to New York

(Kemmerer 1910) before and during the cash restriction period, something must have happening on the supply side to keep exchange rates from soaring.

3c. Changes in no quote days

The substantial increase in the number of days in which no quotes in the domestic exchange market were reported, as evidenced in Table 2 and Figure 6, also probably contributed to the greater stability of exchange rates in 1907. Rather than rates taking on extreme values as in 1893, in 1907 the market seems to have just disappeared instead. There are two alternative scenarios here. The first is that New York exchange was so valuable at that time that banks were not willing to part with it at any price, so the market simply collapsed. The second would be that banks wanting exchange were not willing to pay any price for it since some of their needs at least could be satisfied by their New York correspondent. In view of the relatively moderate rates generally on the days when trading resumed, we deem the latter case to be the more plausible. In Figure 4 note that in Boston, Chicago, St. Paul, and St. Louis the no quote days around the time of the announcement of restriction of cash payments are followed by gradually rising exchange rates through the middle of November. Such a pattern would be consistent with, during the early phase of the panic, initial pressure on New York balances to supply funds to country customers of regional financial center banks offset by the provision of liquidity by New York banks. However as New York banks became unable or unwilling to continue to provide liquidity over the first part

(i.e., 50¢ per \$1000 from Chicago, 60¢ per \$1000 from St. Louis). But obviously they were not. The rates in Figure 4 move outside the bounds of normal currency shipping points, except perhaps in New Orleans and San Francisco. Why were local banks, for example, willing to pay higher prices for New York funds rather than shipping cash? One possibility is that these higher rates, outside the shipping points, reflected the price of immediacy in a thin market. To the extent that remittances must be met right now today (and in panic times they might have been more unpredictable than in normal times), there would not be enough time to dispatch currency to settle accounts, a process that might take a couple of days. Another might have been that bankers' balances for some local banks had already been reduced to dangerously low levels. And the net flows of cash in this period were out of New York rather than into New York (Kemmerer 1910).

of November this was reflected in upward pressure on exchange rates.²²

3d. The currency premium

During periods of cash restriction, when the convertibility of bank balances into currency at par could have been limited, a free market developed in New York (most importantly) and other cities in which currency could have been purchased with deposits (at a premium, needless to say). Demanders of cash would have included merchants, firms which needed to meet payrolls, and interior banks which needed to meet the withdrawal demands of their country correspondents. In lieu of being able to convert their New York balances into cash without restriction on demand, these banks had the option of using these balances in New York to buy currency and then ship it home. Thus, even during periods of restriction there should have existed bounds to movements in domestic exchange rates determined by shipping costs, although of course they were not nearly as tight as in normal times.

We calculate the new (restriction periods) bounds to exchange rate movements based on the buying currency premium in New York in 1893 and then simply the reported currency premium in 1907 (Sprague 1910, p. 187; also Noyes 1894, pp. 27-28). Figure 7 shows the relationship between the negative of the New York exchange rate, the value (in terms of deviation from par) of local vault cash in terms of New York balances, and the currency premium in New York plus currency shipping costs, in effect the cost of obtaining cash in New York and repatriating it. It is shown here for Chicago, the most graphic case, during the periods of cash restriction in 1893 and 1907. In 1893 the value of a local dollar in terms of New York funds was almost always less than the cost of obtaining a dollar of currency in New York and shipping it home. Furthermore, the (negative of the) domestic exchange rate tracked the currency premium quite closely. In 1907 in contrast the exchange rate changes sign and shows no relation to the

²² This certainly seems to have been the factor underlying the large rise in domestic exchange rates in St. Louis. “A great deal of money has been withdrawn from New York by local institutions [in St. Louis]. This has been indirectly the cause of the spectacular market in domestic exchange” (*Wall Street Journal*, December 23, 1907).

currency premium.

This relationship is reinforced by a panel regression of daily domestic exchange rates during restriction in our five cities on the daily currency premia in 1893 and 1907 (t statistics in parentheses). In 1893 the estimated coefficient is rather large and significantly negative. The local cost of domestic exchange moved with the currency premium in New York, with a decline in the currency premium associated with a decline in the relative value of local vault cash (increase in New York exchange rate). In 1907 the estimated coefficient is much smaller and

$$\begin{aligned} \text{xrate}_{it} = & -0.2454 \text{ currencypremium1893}_t + 0.0595 \text{ currencypremium1907}_t + 1.4024 \\ & (-6.02) \qquad \qquad \qquad (1.61) \qquad \qquad \qquad (2.12) \\ & \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad R^2 = .1254 ; \text{ NOBS} = 202 \end{aligned}$$

insignificantly different from zero. Domestic exchange rates had been decoupled from the currency premium, reflecting the decreased substitutability of cash and exchange and the increased importance of New York exchange.

3e. The non-panic of 1914

Anticipating a large gold outflow if the British liquidated their holdings of American securities in the days leading up to the outbreak of World War I, Secretary of the Treasury William McAdoo pressured the governing board to close the New York Stock Exchange on July 31, 1914 (and it remained shut for over four months, until December 12). The closure had the effect of making call loans collateralized by securities, which constituted a significant portion of the asset portfolio of New York banks, illiquid and especially of those with a substantial correspondent banking business. As Sprague (1915, p. 514) noted, “Obviously, the payment of collateral loans could not be insisted upon when there was no market in which either borrowers or bankers could sell securities.”²³ He goes on: “At the time of the closing of the stock exchange,

²³ This was not quite true in practice since there was a Curb market on New Street during this time, although its volume was just a fraction of that on the NYSE (Silber 2007, pp. 104-115).

indications were not lacking that the same influences were at work which in past crises had occasioned the dislocation of the banking machinery of the country. . . It is evident that anxiety over the situation was having its customary effect in precipitating withdrawals of balances by banks in other parts of the country and Canada” (1915, p. 517). Furthermore, the gold outflows in late July might “inspire fear” and lead to a stampede into cash (Silber 2007, p. 66).²⁴

At this time the Federal Reserve System was still being set up, with opening day not coming until November 16. However instead the executive committee of the New York Clearing House met on Sunday, August 2, and agreed, as in previous crises, to the issue of clearing-house loan certificates. More importantly, liquidity was injected into the banking system through the provisions of the Aldrich-Vreeland Act, a temporary measure passed in the aftermath of the Panic of 1907 to provide some breathing room while the configuration of a central bank could be established. It was originally scheduled to expire on June 30, 1914, but the Federal Reserve Act extended its final date for one more year. In times of financial crisis national banks would be allowed to issue asset-backed emergency currency, with a nationwide ceiling of \$500 million set. A progressive tax on currency outstanding based on time in circulation would ensure timely retirement.

On July 31, the day the stock exchange closed, McAdoo invoked the Aldrich-Vreeland Act, although in its original form it offered little relief to New York banks. Emergency currency could only be issued by banks which had already issued national bank notes valued at at least 40 percent of their capital, and most New York banks had many few national bank notes outstanding than that. In a meeting on August 2 New York bankers told McAdoo that they needed emergency currency. Frank Vanderlip of National City Bank said, for example: “We certainly do. . . Probably more than anybody else. We have more country correspondents than any other New York bank” (Silber 2007, p. 71). As a result, an amendment to the Act suspending the 40 percent

²⁴ A *New York Times* editorial (August 4) argued: “Probably never has the world witnessed a more general embarrassment of commercial relations. Its relation to our troubles in 1907 is about the same as a conflagration to a fire” (quoted in Silber 2007, p. 66).

requirement, allowing banks to issue emergency currency up to 125 percent of capital and removing the \$500 million ceiling sped through Congress.

Even before the passage of the bill (on August 3) \$46 million of emergency currency had been delivered to the New York Subtreasury (and “if a greater amount should be required many millions could be transferred within five or six hours” (*New York Times* August 4, 1914, p. 4)). The largest initial demanders were the banks with the most correspondents— National City, Chase, Park National. But once the currency was available, the need for it in New York waned.²⁵ No suspension of cash payments occurred in New York or anywhere else in the country. By the end of August the *Wall Street Journal* was already asking, “Is emergency currency surfeiting the interior?” with the usual August outflow of cash from New York replaced in 1914 by an inflow (*Wall Street Journal* August 31, 1914, p. 8; also September 7, 1914, p.8). Total emergency currency outstanding peaked at \$368.8 million in the last week of October.

The issue of Clearing House loan certificates began on Monday, August 3. Some \$20 million of them, it was estimated, were used in Monday and Tuesday clearings, however once the emergency currency became available, it quickly displaced the loan certificates. Emergency currency was allowed to be used in settling balances at the Clearing House and could be paid out to depositors as well. Moreover, the Clearing House loan certificates cost the banks 6 percent interest, while the emergency currency cost 3 percent for the first three months (*Wall Street Journal* August 5, 1914, p. 8)

The 1914 experience reinforces the importance of New York settlement media in the national payments system, this time the remedy coming in the form of Aldrich-Vreeland emergency currency rather than Clearing House loan certificates. But it is clear that New York, particularly those with many interior correspondents, banks were the principal focus in the

²⁵ “An officer of one of the largest banks in New York says: ‘The emergency currency issue has obviated any fright which may have been caused. My bank had telegrams from nearly every out-of-town correspondent asking “can we get it,” meaning money or anything to build up reserves. I replied “yes.” The result of my telegrams was that the out-of-town banks wired in return “I do not want it.” ‘ (*Wall Street Journal* August 6, 1914, p. 1).

expeditious amendment and implementation of the Aldrich-Vreeland Act. If building up the cash balances of interior banks had been the principal concern, that could have been done directly rather than shipping currency to the New York Subtreasury even before the amended act had passed.

4. Differences in Severity across Cities

The impact of panic and cash restrictions clearly differed dramatically across cities as well as across time. What factors might influence the severity of the impact of a panic on the local domestic exchange market? Here we examine the extent to which domestic exchange dislocations or perturbations were associated with the balance sheet structures of local banks. Such data for national banks were available for five call dates per year at the reserve city level in the U.S. Comptroller of the Currency annual reports.

4a. As measured by domestic exchange rate movements

There are two measures of panic disruption which we could use here, the average and/or range of domestic exchange rates or the number of days over the period in which quotes did appear in periodicals but there is no quote for the city in question. As argued above, as interior banks were increasingly able to borrow from their New York correspondents after 1893 they might not generally have been forced to pay extreme prices for exchange in the market in times of crisis; under such circumstances the domestic exchange market simply collapsed, and there was no trading. Both therefore are measures of stress in internal exchange markets,²⁶ and it seems prudent to control for the one while using the other as a dependent variable. The extent of involvement of reserve city national banks (and central reserve cities, Chicago and St. Louis) in the correspondent banking system is captured by the ratio of “due to banks,” correspondent

²⁶ Both here are calculated over the period of cash restriction, but similar results obtain over the period from the panic onset. By the same token, due to banks ratios relative to total assets rather than deposits produced similar results.

balances of country banks held in, say, Chicago, to individual deposits, predominately local claims, or by the ratio of net interbank claims (net due to banks defined as “due to banks” minus “due from banks,” bankers’ balances held in other reserve city or central reserve city banks) to deposits. The balance sheet data are taken from the call date immediately preceding the onset of the panic– the second, May 4, for 1893 and the fourth, August 22, for 1907. The estimation results from panel regressions with fixed effects on both daily and weekly data are reported in Table 3. The limited number of observations alas constrains us to just a couple of independent variables, although richer specifications would of course be quite interesting.

Even though the overall fits of the regressions are not that impressive, the results are nevertheless quite suggestive. First of all, perhaps unsurprisingly, the number of no quote days is statistically significantly inversely related to the average exchange rate during restrictions and *vice versa*. More interestingly, the higher the ratio of net due to banks to deposits in interior cities, the higher the average level of domestic exchange rates (or alternatively, the more important deposits were relative to net due from banks, the lower the exchange rate or the more valuable local reserves were relative to bankers’ balances). Similarly, the number of no quote days was also positively associated with the relative level of obligations to interior or country banks. Furthermore, it was the level of due to banks, obligations to interior country banks, that was the statistically significantly more important factor in creating stringency in the local market for New York exchange. These results hold regardless of whether based on the more detailed daily data with fewer cities or on the less detailed weekly data based on more cities.

After the panic of 1893 bankers’ balance holdings became much more important relative to individual deposits for national banks in many regional financial centers (James and Weiman 2010). For example, between our 1893 and 1907 call dates the ratio of due to banks to deposits roughly doubled in Chicago and St. Louis and almost did so in Cincinnati, St. Paul, and San Francisco.²⁷ In turn, these banks held higher levels of balances in New York, but generally

²⁷ Chicago- .64 to 1.28; St. Louis- .65 to 1.28; Cincinnati- .39 to .66; St. Paul- .33 to .51; San Francisco- .36 to .66. In Philadelphia the increase was even larger, .23 to .82.

somewhat less than proportionally since the ratio of net due to banks to deposits increased a bit in most cities. The premia on New York exchange which one generally observes in 1907 reflect, among other things, the increased role of the correspondent banking system and the position of New York in that system.²⁸

4b. As measured by intercity cash flows

A quantity measure, intercity cash flows, collected by Kemmerer (1910) for his National Monetary Commission study, represents an alternative index of panic severity in interior cities. Based on circulars sent to clearing houses in major money centers, he reported the monthly cash flows into and out of each city by their geographical origin and destination respectively. The series covers the period 1905 to 1908 for most cities (and thus includes the months of November and December 1907 in particular).²⁹ There are then two possible measures of intercity cash flows.

²⁸ To be sure, things are complicated by the fact that some of our cities— Chicago, Kansas City, Louisville, Milwaukee— experienced local banking panics in 1893 which may have led to discounts on New York exchange there, but the pattern is more general than that and such local distress can not account for the large discounts in other cities such as Cincinnati or St. Louis, where also the value of vault cash relative to New York funds rose dramatically.

²⁹ Surveys were received from 32 city clearing houses (26 were usable) reporting monthly cash inflows and outflows. The sources and destinations of these flows were typically listed as states rather than specific cities. But it seems reasonable to take flows from Chicago to New York to have been directed to New York City and flows reported from New York City to Illinois to have been primarily directed to Chicago. There are therefore two possible measures of intercity flows which do not necessarily coincide. First of all, New York City clearing house banks reported cash inflows and outflows to all Illinois (Chicago) banks whether they belonged to the local clearing house or not. Second, the Chicago clearing house reported cash inflows and outflows to all New York banks regardless of their clearing house status (thus including trust companies). Indeed, Chicago also illustrates a problem with some interior city (in contrast to New York) reports— the Chicago clearing house had 20 members (Cannon 1910, p. 276) but only eight to ten of them reported cash flows to the NMC (Kemmerer 1910, p. 53). Generally however the two series are reasonably close, so the choice of reporting city is not crucial to the pattern of results. Finally, these data are reflective of intercity cash flows but not of total inflows and outflows since typically intrastate flows are not covered. For example, cash flows between New York City and the rest of New York state or between Chicago and the rest of Illinois are not reported.

The first (nycflow) is cash shipments reported by New York banks to and from interior points, say Chicago, plus transfers of cash by New York banks to the interior accomplished through the U.S. Subtreasury in New York City;³⁰ the second (cityflow) is cash flows to and from New York as reported by interior, say Chicago, banks.

Table 4 presents inflows, outflows, and net flows of cash from New York to nine interior cities, as reported by the New York Clearing House (nycflow), for the panic months of October, November, and December 1907. New York is the reference point, so a negative net flow figure indicates a net drain of cash from New York to the interior city. The first three columns show value in \$1,000; the second three show the ratio of the 1907 figure to the 1905/06 average for the respective months; the last three columns relate the size of the flows to reserves on hand (specie plus legal tender notes) at the call date immediately preceding the panic. First of all, it is clear that the restriction of cash payments in New York on October 26 did not stop the cash outflows from the city. The currency drain from New York to interior reserve city banks continued, often at increased volume, during the restriction period of November and December. These outflows were generally much larger than usual (as compared with the average monthly flows for 1905 and 1906), as evidenced in the middle three columns of Table 4.³¹ Moreover, they were generally

³⁰ The U.S. Treasury was willing to transfer cash for New York banks to interior Subtreasuries via telegraph at rates equal to express charges (Kemmerer 1910, pp. 129-131, 361).

³¹ Curiously, these strong cash outflows from New York occurred in months when New York exchange generally sold at a significant premium in interior cities. Perhaps this could be reconciled if most of the outflow occurred in the days immediately following restriction when the domestic exchange market disappeared in many cities. For example, the subsequent high exchange rates in Philadelphia and St. Louis were attributed to banks having “drawn down their balances at New York so low that they cannot supply New York exchange for mercantile and other remittances to this city” (*Wall Street Journal*, November 15, 1907, p. 8). In the days around the announcement of restriction in New York in Chicago. Because of the uncertainties of the payments restrictions, “Chicago banks refused to increase their credits in New York for the reason that they did not want evidences of money instead of money itself.” While domestic exchange was offered, there were no bids, “a most significant circumstance” (*Chicago Tribune*, October 25, 26, 1907). However, less than two weeks later \$1.50 a thousand was bid, but none was offered (*Chicago Tribune*, November 5, 1907).

large relative to cash on hand prior to the panic. Most cities here experienced at least one month in which inflows were equal to a quarter to a third of prior call date reserves on hand (and even more in San Francisco).

The cross-section regressions reported in Table 5 relate the magnitude of net cash flows between New York and interior cities to the balance sheet structure of reserve city national banks – levels of due to banks, due from banks, and individual deposits– at the call date (August 22) immediately preceding the panic. Since the sale of New York balances in the local domestic exchange market, converting New York funds into local vault cash, represented an alternative to drawing down balances there directly, we also include an index of the activity of the domestic exchange market, the number of weekly observations in which no quotes were listed, as an additional independent variable. In panel I the dependent variable is the total net flow of cash between New York and the interior city; in panel II it is the difference between the 1907 flow and the 1905/06 average. The first two columns use flows as reported by the New York Clearing House (an outflow from New York to an interior city is negative); the next two use flows as reported by the interior city clearing house (a flow from New York to the interior city is positive). Columns 1 and 3 cover the months of October, November, and December; columns 2 and 4 cover only the restriction months of November and December.

Again, regardless of the specific specification, the general tenor of results is quite consistent. The less active the local domestic exchange markets, as measured by the number of no trades reported weeks, the larger the intercity flows (outflows from New York in columns 1 and 2; inflows into interior cities in columns 3 and 4). The larger the level of due from banks, the smaller the level of net outflows to the interior rather surprisingly (except for column 1 in panel II, where the estimated coefficient is not significantly different from zero). More importantly, the size of due to banks liabilities, country banks accounts in reserve city banks, was a strong and statistically significant influence on the volume of New York outflows during the last part of 1907. This results holds in every specification. Moreover, the magnitude of the estimated coefficients of duetobanks are also consistently much larger than those of local deposits, which

are also generally not statistically significantly different from zero except in columns 3 and 4 of Panel II. Due to bank liabilities rather than local deposit liabilities appear to have been the primary factor underlying the volume of cash outflows to reserve city banks during the panic.

Both the price evidence on domestic exchange rates and the quantity evidence on the size of cash flows from New York to regional financial centers point in the same direction. The local disruptions of the exchange market, as measured by exchange rate movements, no trade days, or the volume of net cash flows, in interior financial centers were strongly related to the level of due to bank liabilities at reserve city national banks. Withdrawals by hinterland country banks rather than by local depositors must have been the principal factor leading to the pressure on the intercity payments network (Noyes 1894; Sprague 1910). This is unfortunately primarily a inference (albeit a strong one) however because it is not possible to measure cash drains to the hinterland from reserve cities directly-- the NMC cash flow data do not include intrastate movements.³²

5. Payments Disruptions and Their Impact

Friedman and Schwartz (1963, pp. 163-168) have famously contrasted the response to panics under the national banking system (pre-1914), restrictions of cash payments, with that in the Great Depression under the Federal Reserve System. In the earlier period such restrictions were argued to have mitigated the effects of panics by stopping bank runs. Bank failures, as a consequence, were, if not completely arrested (e.g., see Wicker 2000, pp. 78-80), certainly greatly reduced, thereby damping the rate of monetary contraction.³³ To be sure, they conceded (1963, p.

³² However the Chicago Clearing House did report currency shipments to country banks of \$37,694,250 in contrast to currency received from the east of \$10,505,740 in October, 1907 (\$30,200,500 and \$9,620,000 respectively in October 1906) (*Chicago Tribune*, November 7, 1907).

³³ These “therapeutic” effects of cash restrictions have been questioned in turn by Dewald (1972) and Timberlake (1984), but on the other hand consider Dwyer and Hasan (2007). We follow Friedman and Schwartz’s terminology of restrictions of cash payments instead of the more common contemporary term of suspension to distinguish it from the temporary closure of particular beleaguered banks.

698) that such restrictions may have caused “severe but brief difficulties,” but with little or no elaboration. Here we now consider the downside effects of cash payment restrictions— there was one significant aspect that was not stabilizing, disruptions of the payments system.

5a. Potential aggregate supply effects of payments restrictions

Modern-day studies of the effects of panics and financial crises have concentrated on the transmission channels of changes in interest rates and/or credit availability (e.g., Mishkin 1996). Recent research in macroeconomics though has raised the possibility that monetary changes might affect the real economy through changes in aggregate supply as well as changes in aggregate demand. Contemporary studies have generally emphasized the impact on investment in working capital (and consequently on the firm's short-run ability to produce), but at a more basic level the “hemorrhaging” of payments networks which delayed the transfer of good funds in settlement of transactions, purchases of labor or commodity inputs, would have had (much more) pronounced real effects through aggregate supply dislocations as well (Barth and Ramey 2002; Christiano, Eichenbaum, and Evans 1997; Christiano and Eichenbaum 1992).

Aggregate supply dislocations could occur for several reasons. One channel described in modern monetary theory is based on the idea that money acts as a social memory device for the economy (Kocherlakota 2000). If there is a disruption in the system by which agents in the economy make long-distance monetary transfers, as occurred during the panics under review, the agents must turn to less well-suited instruments (such as cash transfers) to accomplish the information-tracking task that the drafts and checks performed during normal times. This results in an increase in information costs for producers as the preferred means of transferring and tracking transaction information is out of service. Because of this monetary role of payment systems, a disruption in their operation represents a supply shock.

Shocks that disrupt payment networks can have effects on broader measures of financial liquidity which today could be observed in bid-ask spreads in financial markets, for example. Empirical evidence shows that various measures of financial market liquidity in the U.S. Treasury

bonds as well as in the stock market are reduced during periods of crises; in addition, unexpected injections of money can have positive liquidity effects in these markets (Fleming, 2003; Chordia, Sarkar, and Subrahmanyam 2004). Theoretical work suggests that delayed settlement in the payment system can exacerbate the resolution of uncertainty and credit risks which regular settlement is designed to achieve (Koepl, Monnet, Temzelides 2005). These disruptions caused by the banking crises we study delayed settlements for both financial and real transactions. If the counterparties could not costlessly resort to alternative means of settlement, which we assert they could not do, then real risks and uncertainty in the economy were persisted longer than anticipated, reducing the ability of counterparties to take on new transactions or to extend additional credit.

5b. Cash restrictions and substitutes in the panic of 1907

By limiting access to their money center accounts, withdrawal restrictions can seriously if not fatally compromise the liquidity of local banks, and in turn deprive their customers of the means to effect vital transactions such as meeting payrolls. Moreover, if agents are liquidity-constrained and so prefer to (or out of necessity must) finance their current payments on the basis of their current cash flows, these disruptions can set off a downward spiraling chain reaction through the payments system. The magnitude of such payments disruptions will depend on many factors, but most obviously and directly the greater frequency of local cash payments and local banks' excess (clearing) reserves held as vault cash. These two factors are clearly related. If the non-bank public conducts a larger share of its transactions in cash – or equivalently if banks function more as “coat checks” storing customers' cash until needed – banks will tend to hold larger shares of their excess reserves as vault cash. Excess cash reserves will provide banks with an initial buffer that may tide them over a short, mild suspension shock. If it persists, however, customers' normal and “panicky” cash demands will deplete banks' excess reserves. Responding in kind, local banks will also restrict payments, which will have more severe effects because of

customers' greater reliance on cash payments.

In the alternative scenario banks economize on their excess cash reserves, because their customers conduct a larger share of payments in drafts and checks – so called “credit instruments.” Unlike cash payments, they can be settled through the transfer of correspondent deposits through the (local or distant) clearinghouse without any withdrawal of funds. In turn, they hold larger excess correspondent balances because of uncertain clearing demands, especially from customers' less predictable check payments. In this case the impact of a cash restriction is potentially greater, especially if customers run on the banks and increase their cash relative to deposit transactions. On the other hand, the impact of a restriction will be weaker, if customers continue to rely on some form of bank money, which can be settled through the transfer of their “frozen” correspondent balances.³⁴

As we have argued here and elsewhere (James and Weiman 2010), the Panic of 1893 and resulting Great Depression was a significant watershed in the formation of the modern U.S. payments system, characterized by the greater use of check transactions relative not only to bank drafts but also to cash. With the diffusion of deposit banks and check transactions, more cities formed local clearing-houses to mediate local payments and interbank settlement depended more on banks' correspondent balances, not vault cash. Consequently, payments restrictions in 1907 would have had more devastating impacts, at least in theory, if panicky bank customers lost confidence in banks and increased their relative demands for cash and cash payments instruments. Given the differences in velocity between cash and checks (Fisher 1911), real effects could have been even greater in magnitude than would have been predicted by simple money multiplier effect.

³⁴ Again, the willingness of banks and the public to hold these “coat checks” rather than convert them into cash is crucial. Otherwise, situations might become as in Louisville in 1893, where business was “almost at a standstill, banks declining to receive country checks even for collection and preferring not to handle New York exchange” (*Bradstreet's*, August 12, 1893, p. 511).

We qualify this last prediction, because it abstracts from the complementary institutional innovation of the clearing-house organization which enabled banks to mount a collective, not individual, response to the withdrawal restrictions. Clearing-houses had assumed a critical lender of last resort function, supplying member banks with loan certificates as substitutes to cash reserves for their clearing-house settlements (Timberlake 1984; Roberds 1995). During the 1907 panic, they greatly broadened the scope of their quasi-central-bank authority by issuing low-denomination loan certificates which circulated as cash substitutes. Of dubious legal authority, this innovation could effectively tide local banks over the potential restrictions storm, if it restored customers' confidence in the banking system, not individual banks.

Andrew (1908b, p. 502) chronicles local cash payment restrictions during the Panic of 1907. Inquires sent to banks in all cities with populations greater than 25,000 revealed that in two thirds of them banks restricted cash payments to some degree, with Washington, DC being the only financial center not to restrict. In some cities bank customers were limited to a total cash withdrawal (of, say, \$25 or \$100); in others, daily withdrawals were restricted to \$25, or \$50, or \$100 per day; in many or most cities including New York the restrictions were “discretionary.”³⁵ Such limitations on the ability of bank customers to convert their deposits into cash most probably had serious and immediate effects.³⁶ The Comptroller of the Currency (1907, p. 70) noted that “all domestic exchanges were at once thrown into disorder and the means of remittance and collection were almost entirely suspended... This [derangement of the machinery for making

³⁵ Refusals by New York banks to pay out cash for their interior correspondents in 1907 are described in Senate Document No. 435 (U.S. Senate 1908). In 1893 restrictions were discretionary as well. “The majority of New York institutions continued to pay cash on demand to all depositors, and those which did refuse cash payments not only offered to such depositors checks on other banks, but cashed small checks without inquiry,” but “the banks which did shut down on cash payments to depositors included several of the soundest institutions in the city” (Noyes 1894, pp. 26-27).

³⁶ Kroszner (2000, p. 162), however *au contraire* argues “the temporary suspension of cash payments in late 1907, while causing some inconveniences, allowed the banks to continue to provide payments functions...”

collections and remittances] has interfered with every kind and class of business and led to great curtailment of business operations of every kind.”

To the extent that checks were not readily acceptable everywhere and that recipients were not content simply to deposit them into their accounts, bank liabilities did not fully fulfill their role as a medium of exchange. Rockoff (1993) argues that this fact alone represented a decrease in the quality-adjusted money supply and could have disrupted planned spending. Moreover, business firms, unable to procure cash to meet payrolls, were forced to layoff workers and shut down plants. Sprague (1910, pp. 202-203) notes that while in July, 1893 newspapers published many accounts of factories closing due to failures, inability to make collections or to obtain credits from banks, by August, after restriction, the most frequently cited cause had become the inability to procure cash to make payrolls. Toward the end of the month however some factories began to reopen and cash payments were restored in September.

Difficulties in meeting cash payrolls appeared to have been less pronounced in 1907 than in 1893 (Sprague 1910, p. 290)³⁷ even though Andrew judged the 1907 panic as the more disruptive to local payments. “Probably the most extensive and prolonged breakdown of the country’s credit mechanism which has occurred since the establishment of the national banking system... Even during the critical periods of 1873 and 1893 it is unlikely that as many banks limited the payment of their obligations in cash” (1908b, p. 497). The 1907 panic was characterized by the extensive issue of local emergency currency or currency substitutes.³⁸ Banks in many localities issued small denomination clearing house certificates, obligations of the clearing house which could circulate from hand to hand (as opposed to the traditional large denomination ones used in interbank settlement); clearing house checks, again typically in small

³⁷ Although the *Chicago Tribune* (November 23, 1907) notes that “some plants are idle because of the difficulty experienced in obtaining cash with which to pay employees...”

³⁸ These instruments were employed in 1893 as well, although not to the extent as in 1907. See Warner (1896).

denominations and payable through the clearing house (i.e., not convertible into cash), but drawn on particular banks; cashier's checks in convenient denominations which were "practically circulating notes"; New York drafts in denominations of \$1 up (in Birmingham); negotiable certificates of deposit to be used in local payments; or, finally, pay checks drawn by bank customers upon their banks in small denominations and used for payments of wages (widely used in Pittsburgh) (1908b, pp. 506-512).

Clearing house loan certificates in large denominations for interbank settlement however constituted the great bulk (over 70 percent of the total) of the measurable issues of emergency currency in the 145 largest independent cities polled by Andrew. This was true in both reserve and non-reserve cities. The results of a regression with the total volume of cash substitutes issued by city in 1907 on the balance sheet structure of national banks (as of September 1906) and dummy variables for reserve city status are reported below (t statistics in parentheses).

$$\begin{aligned} \text{Totalissue}_i = & .1254 \text{ Duetobanks}_i - .1283 \text{ Duefrombanks}_i + .0458 \text{ Individualdeposits}_i \\ & (3.17) \qquad \qquad \qquad (-3.65) \qquad \qquad \qquad (1.91) \\ & + 7591.479 \text{ Centralreservecity}_i + 528.285 \text{ Reservecity}_i - 1.760 \text{ Population}_i - 132.673 \\ & (2.99) \qquad \qquad \qquad (0.58) \qquad \qquad \qquad (0.59) \qquad \qquad \qquad (-0.16) \end{aligned}$$

Adjusted R² = .9877; NOBS= 33

Note first of all the symmetry in the effect on the volume of cash substitutes issued between duetobanks and duefrombanks-- one dollar more in obligations to other banks increasing the amount of cash substitutes created, while a one dollar increase in interbank balance holdings decreasing it by a similar amount. More importantly here however, the level of interbank balances held by national banks in the city had a much stronger influence on the volume of issue than did the level of individual deposits (both have significantly positive estimated coefficients

however). This result holds even allowing for differences in reserve city status across cities. In particular, central reserve cities seem to have faced much stronger withdrawal demands from their correspondents (given the level of duetobanks), resulting in the issue of more cash substitutes. Such a result supports the observations of contemporaries (Sprague 1910; Andrew 1908a) who primarily blamed country correspondent banks for the large withdrawals creating pressure on reserves and leading to cash restrictions and the issue of substitutes rather than local individual depositors.³⁹ Finally, population is included in the regression as a scaling factor.

Andrew estimated the volume of cash substitutes outstanding during the 1907 restrictions at over \$500 million, as compared with a currency stock of \$1,810 million in 1907 IV (Friedman and Schwartz 1970, p. 65). “For two months or more these devices furnished the principal means of payment for the greater part of the country, passing almost as freely as greenbacks or bank-notes from hand to hand” (1908b, p. 515).⁴⁰ To be sure, these instruments must have been imperfect substitutes for true currency, and this deterioration of the quality of the money stock may have had some adverse effects, but at the same time they must have relieved some of the pressure on local banks’ vault cash. After all as we have seen, during the 1907 restriction New York exchange was typically at a substantial premium (until late in the period in

³⁹ The Comptroller of the Currency (1907, p. 70) for example observed “that there has actually been more of a panic among the banks themselves than there has been among the people. The banks have been fearful as to what might develop, and finding their usual reserve deposits only partially available, if available at all, they have been compelled in self-protection to gather from every source all the money they could possible reach... With the exception of the first excitement in New York and smaller runs in other places, there has really been surprisingly little excitement or uneasiness among the people.”

Note as well that clearing-house certificates, which most directly addressed the needs of country bankers’ balances holders by freeing up cash to be paid out to them, constituted the great bulk of cash substitutes created. Local currency substitutes, which would have been of little use to country banks, were quantitatively much less important overall.

⁴⁰ We don’t know the total volume of cash substitutes created in 1893, but we can compare the magnitudes of the largest component, large-value clearing house loan certificates--\$238 million in 1907 as compared with an issue of \$69.1 million in 1893 (see Table 1).

any case), indicating that however scarce local reserves may have been, New York exchange was even scarcer. Andrew (1908b, p. 516) concluded that the substitutes “worked effectively and doubtless prevented multitudes of bankruptcies which otherwise would have occurred.”

5c. Potential real effects of cash restrictions

The issue of currency substitutes must have mitigated the problems in making local payments to some degree, even though converting New York balances into vault cash during restrictions remained quite costly. There was no such substitute available however to offset the dislocations of the non-local, interregional payments system.⁴¹ The timeliness and predictability of intercity payments was disrupted, with the only alternative being shipping currency (if available), a process which clearly delayed final settlement of transactions. Such interferences with making payments at a distance and hence with the smooth functioning of the payments system should have had an adverse effect on internal trade. *Bradstreet's* in 1893 noted “the clog to trade shown by prohibitive rates for New York exchange at centers east, west, and northwest” (August 5, 1893, p. 495). Similarly, the *Wall Street Journal* observed in 1907 the “disorganization of domestic exchanges which prevents the free movement of commodities for export” (December 2, 1907, p. 8).⁴²

⁴¹ A resolution of the Merchants' Association of New York passed November 21, 1907 read in part: “Checks payable ‘through clearing-house only’ are useful for local settlements, but do not pay non-local debts. The business of all large manufacturing and mercantile concerns is chiefly non-local, and cannot go on if local funds are everywhere tied up. Interstate exchange is essential to the conduct of interstate business, and this constitutes the greater part of our domestic exchanges. Provision for the settlement of local indebtedness is helpful, but provision for the settlement of non-local indebtedness is essential, and, therefore, still more helpful” (*Bankers' Magazine*, December, 1907, p. 970).

⁴² The grain trade seemed to have been particularly affected. “Naturally, there has been some dislocation of the nation's business, notably in domestic exchanges, which has reacted on the collecting and forwarding forces by a time stopping the buying of wheat in the Northwest and of cotton at the South” (*Bradstreet's*, November 2, 1907, p. 698). By mid-month, “One especially hopeful sign has been renewal of grain purchases in the Northwest, exchange checks

It is, of course, impossible here to isolate precisely the impact of payments disruptions alone from the concurrent effects of credit contraction during panics and cash restrictions.⁴³ In 1893 panic and also payments disruptions preceded general cash restrictions in several interior cities; in 1907 panic and cash restrictions were only days apart (October 21 and 26). That said, the economy did seem to go into a tailspin during periods of restrictions of cash payments. Monthly figures for four quantity measures of trade and economic activity— freight ton-miles, pig iron production, the Babson (physical quantity) index of business activity, followed by the Miron-Romer monthly index of industrial production (U.S. Bureau of the Census 1949, pp. 332-334; Moore 1961, p 130; Miron and Romer 1990)— for 1893 and 1907 are presented in Figure 8. The NBER-dated business cycle peaks were in January, 1893 and May, 1907 (Burns and Mitchell 1946, p. 78). Clearly the graphs show little indication of a serious downturn in either case until the onset of the financial panics in May, or particularly in June, 1893 and October, 1907, after which time the indicators fall sharply. The months bracketing the restriction periods— July and September in 1893, October and January (1908) for 1907— are marked by vertical lines. The pronounced declines in the series during the cash restrictions period in 1907 are evident. In 1893 the sharp decline begins in June but accelerates after July, with cash restrictions, although this is less evident to the untrained eyeball.^{44, 45} Moreover, rather dramatically in virtually every case the

on larger interior markets being the medium of exchange, thus allowing of the resumption of grain forwarding...” (November 16, 1907, p. 730). In the flour trade, “shipments [were] falling off by reason of difficulty in financing drafts, and the wheat price is now secondary to the question of finance” (*Bradstreet's*, November 23, 1907, p. 747).

⁴³ For example, between the May 4 and October 4 call dates in 1893 loans of national banks fell by almost 15 percent (Sprague 1910, p. 208).

⁴⁴ Log-linear regressions on time from June to September, 1893 show statistically significant sharper rates of decline after July.

⁴⁵ Railroad earnings could be another measure of the volume of trade. While they ran higher in 1893 than in same month in 1892 for the first half of the year and then declined by almost 5 percent relative to 1892, in August, the month of suspension, the figure was more than

decline stops and/or the series turn up with the resumption of cash payments in September, 1893 and January, 1908.⁴⁶

The declines over the periods of cash restrictions in 1893 and 1907 in most cases were quite comparable. The Miron-Romer industrial production index, for example, declined by 16.7 percent between July and September in 1893 and by 21.7 percent between October 1907 and January 1908.⁴⁷ The period of cash restriction was twice as long in 1907 as in 1893, so if one thinks of the effects of restriction as being a continuing process— the difficulty of obtaining cash to meet local payrolls or of making payments at a distance— then the per month real effects of restriction in 1907 were less severe than in 1893, even though the cash restrictions in 1907 have been characterized as both more widespread and more severe than in 1893 (1908b, p. 497). There are a couple of reasons why this may have been so. First, of course, the issue and use of local cash substitutes was much more extensive in 1907. Second, by around the turn of the century checks had become standard payments in interregional transactions (Kinley 1910). To the extent that recipients were willing simply to deposit checks received in their accounts, rather than attempting to cash them, and in turn use the proceeds to issue checks of their own, there would not have been a total collapse of the payments system, although collections may have been rather slower.

13 percent lower than for the comparable month in 1892 (and 10 percent lower in September after resumption) (*Commercial and Financial Chronicle*, February 25, 1894).

⁴⁶ Sprague (1910, pp. 201-02) notes for 1893, “Much of the decline in August, with the subsequent partial recovery, can only be ascribed to the trade paralysis produced by the financial situation at that time.” Of course, the economy only stabilized rather than bounced back after resumption, but “after the beginning of September the course of the crisis of 1893 was no longer a banking affair” (p. 209).

⁴⁷ Freight ton-miles fell by 10.8 percent between July and September, 1893 and by 10.4 percent between October, 1907 and January, 1908. The declines in pig iron production were 42.2 and 52.8 percent, respectively, while in the Babson index they were 12 and 18 percent.

6. Conclusions

The private payments networks based on the correspondent banking system which had developed to clear and settle interregional or intercity transactions in the pre-Federal Reserve period were normally quite efficient arrangements. However when the convertibility of New York balances was threatened or limited, these networks were also important channels for transmitting financial pressures. Such problems intensified as New York exchange became more and more important in the payments system. Cash restrictions in turn had serious consequences for payments settlement at both the local and interregional level and consequently for the level of economic activity. The degree of disruption to regional financial centers over this period was a function of their place in these intercity networks rather than local conditions. Banks in reserve cities with larger holdings of bankers' balances from country banks relative to individual deposits experienced greater strains in 1907. On the other hand, the increasing acceptance of checks relative to cash mitigated some of the real shock.

Most contemporary writers (e.g., Noyes 1894; Sprague 1910) thought restrictions of cash payments were disasters, and monthly evidence from 1893 and 1907 suggest that the downturns intensified during these periods. In the more recent literature, the effects of these restrictions have been usually minimized or neglected. Even though widespread bank failures were avoided, the medicine may nevertheless have had serious debilitating effects. Richard Grossman (1993) demonstrates that cyclical downturns were more severe in the national banking period when associated with a financial crisis than when they were not. His simulations show that a relatively small bank failure shock could have led to a 2 percent decline in real GNP, while a large shock would have been catastrophic. Based on the timing of the bank failures and the immediacy of the effects on output, it seems reasonable however to suppose that some of the short-run adverse effects, perhaps most, of what Grossman attributes to bank failures may well have been the impact of payments system disruptions.

Prevention of such widespread and severe disruptions of the payments system in the

wake of financial crises was the fundamental financial reform issue to many or most contemporaries and led directly to the establishment of the Federal Reserve system. A principal feature of the new central bank was the nationalization of the interbank settlement network. Fed institutions such as the gold settlement fund and Fedwire (for telegraphic transfers of reserves) replaced their private analogues, New York balances held to settlement payments and the domestic exchange markets.

The Fed's takeover of the interbank settlement system was not peculiar to the U.S. payments system. According to the most recent survey of payments systems by the Bank for International Settlements (2005), central banks own and operate the main large-value (interbank) payments network in virtually all developed economies, either outright or in a partnership arrangement. What distinguishes the U.S. payments system from that of other countries and remains controversial to this day was the Fed's entry into the check clearing system and the relative efficiency of public and private clearing systems (Stevens 1996; Lacker, Walker, and Weinberg 1999; Gilbert 2001). However even today in the face of the increased privatization of the payments system spurred in large part by the Monetary Control Act of 1980, the Federal Reserve still plays an potentially crucial role as the clearing house of last resort in financial crises (Summers and Gilbert 1996; James and Weiman 2005).

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References

- Andrew, A. Piatt (1908a). "Hoarding in the Panic of 1907," *Quarterly Journal of Economics* 22, 290-299.
- Andrew, A. Piatt (1908b). "Substitutes for Cash in the Panic of 1907," *Quarterly Journal of Economics* 22, 497-516.
- Bank for International Settlements, Committee on Payment and Settlement Systems (2005). "Statistics on Payment and Settlement Systems in Selected Countries." CPSS Publications No. 66 (March).
- Bankers' Magazine* (1907). various issues.
- Barth, Marvin, and Valerie Ramey (2002). "The Cost Channel of Monetary Transmission," *NBER Macroeconomics Annual, 2001*. Pp. 199-239.
- Bernanke, Ben (1983). "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review* 73, 257-276.
- Bodenhorn, Howard (2000). *A History of Banking in Antebellum America*. New York: Cambridge University Press.
- Bordo, Michael D. (1985). "The Impact and International Transmission of Financial Crises: Some Historical Evidence, 1870-1933," *Rivista di Storia Economica* 2, 41-78.
- Bradstreet's* (1893, 1907), various issues.
- Burns, Arthur F., and Wesley C. Mitchell (1946). *Measuring Business Cycles*. New York: NBER.
- Calomiris, Charles, and Gary Gorton (1991). "The Origins of Bank Panics: Models, Facts, and Bank Regulation." In R. Glenn Hubbard, ed., *Financial Markets and Financial Crises*.

- Chicago: University of Chicago Press. Pp. 109-173.
- Cannon, James G. (1910). *Clearing Houses*. National Monetary Commission. Washington D.C.: Government Printing Office.
- Carlson, Mark (2005). "Causes of Bank Suspension in the Panic of 1893." *Explorations in Economic History* 42, 56-80.
- Carter, Susan B. *et al*, eds. (2006). *Historical Statistics of the United States*. New York: Cambridge University Press.
- Chandler, Alfred D. (1977). *The Visible Hand*. Cambridge, Mass.: Belknap Press.
- Chicago Daily Tribune* (1893, 1907), various issues.
- Chordia, Tarun, Asani Sarkar, and Avindar Subrahmanyam (2004). "An Empirical Analysis of Stock and Bond Market Liquidity." *Review of Financial Studies* November.
- Christiano, Lawrence J., and Martin Eichenbaum (1992). "Liquidity Effects and the Monetary Transmission Mechanism," *American Economic Review* 82, 346-353.
- Christiano, Lawrence J., Martin Eichenbaum, and Charles Evans (1997). "Sticky Price and Limited Participation Models of Money," *European Economic Review* 41, 1201-49.
- Colwell, Stephen (1860). *The Ways and Means of Payment: A Full Analysis of the Credit System, with its Various Modes of Adjustment*. Philadelphia: J.B. Lippincott & Co.
- Commercial and Financial Chronicle* (1893, 1907), various issues.
- Conzen, Michael (1977). "The Maturing Urban System in the United States, 1840-1910." *Annals of the Association of American Geographers* 67, 88-108.
- Dewald, William G. (1972). "The National Monetary Commission: A Look Back," *Journal of Money, Credit, and Banking* 4, 930-956.

- Donaldson, R. Glen (1993). "Financing Bank Crises: Lessons for the Panic of 1907," *Journal of Monetary Economics* 31, 69-95.
- Donaldson, R. Glen (1992). "Sources of Panics: Evidence from Weekly Data," *Journal of Monetary Economics* 30, 277-305.
- Dupont, Brandon (2007). "Bank Runs, Information and Contagion in the Panic of 1893," *Explorations in Economic History* 44, 411-431.
- Dwyer, Jr., Gerald P., and Iftekhar Hasan, "Suspension of Payments, Bank Failures, and the Nonbank Public's Losses," *Journal of Monetary Economics* 54, 565-580.
- Dykes, Ellen S., and Michael Whitehouse (1989). "The Establishment and Evolution of the Federal Reserve Board: 1913-23," *Federal Reserve Bulletin* 75, 227-242.
- Fisher, Irving (1911). "The Equation of Exchange, 1896-1910," *American Economic Review* 1, 296-305.
- Fleming, Michael (2003). "Measuring Treasury Liquidity," *Federal Reserve Bank of New York Economic Review* 9, 83-108.
- Friedman, Milton, and Anna Schwartz (1970). *Monetary Statistics of the United States*. New York: NBER.
- Friedman, Milton, and Anna Schwartz (1963). *A Monetary History of the United States, 1867-1960*. Princeton: Princeton University Press.
- Garbade, Kenneth D., and William L. Silber (1979). "The Payments System and Domestic Exchange Rates: Technological versus Institutional Change," *Journal of Monetary Economics* 5, 1-22.
- Gilbert, R. Alton (2000). "The Advent of the Federal Reserve and the Efficiency of the Payments System: The Collection of Checks, 1915-1930," *Explorations in Economic History* 37, 121-148.
- Goodfriend, Marvin (1991). "Money, Credit, Banking, and Payments System Policy," *Federal*

Reserve Bank of Richmond Economic Review 77, 7-23.

Gorton, Gary, and Donald Mullineaux (1987). "The Joint Production of Confidence: Endogenous Regulation and Nineteenth Century Commercial-Bank Clearinghouses," *Journal of Money Credit and Banking* 19, 457-468.

Grossman, Richard S. (1993). "The Macroeconomic Consequences of Bank Failures under the National Banking System," *Explorations in Economic History* 30, 294-320.

Hanes, Christopher, and Paul Rhode (2009). "Harvests and Financial Crises in Gold-Standard America," unpublished manuscript.

James, John A. (1978). *Money and Capital Markets in Postbellum America*. Princeton: Princeton University Press.

James, John A., and David F. Weiman (2010). "From Drafts to Checks: The Evolution of Correspondent Banking Networks and the Transformation of the Modern U.S. Payments System, 1850-1914," *Journal of Money, Credit, and Banking* 42, 237-265 .

James, John A., and David F. Weiman (2005). "Financial Clearing Systems." In Richard R. Nelson, ed., *The Limits of Market Organization*. New York: Russell Sage Foundation. Pp. 114-155.

Johnson, Joseph F. (1905). *Money and Currency*. Boston: Ginn and Co.

Kemmerer, Edwin W. (1910). *Seasonal Fluctuation in the Demand for Currency and Capital*. National Monetary Commission. Washington, DC: Government Printing Office.

Kinley, David (1910). *The Use of Credit Instruments in Payments in the United States*. National Monetary Commission. Washington: Government Printing Office.

Knodell, Jane (1998). "The Demise of Central Banking and the Domestic Exchanges: Evidence from Antebellum Ohio," *Journal of Economic History* 58, 714-730.

Kocherlakota, Nayarana (2000). "Money is Memory," *Journal of Economic Theory*. 81(2), 232-251.

- Koepl, Thorsten, Cyril Monnet, and Ted Temzelides (2005). "Mechanism Design and Payments," 2005 Meeting Papers 11, Society for Economic Dynamics.
- Kroszner, Randall L. (2000). "Lessons from Financial Crises: The Role of Clearinghouses," *Journal of Financial Services Research* 18, 157-171.
- Lacker Jeffrey M., Jeffrey D. Walker, and John A. Weinberg (1999). "The Fed's Entry into Check Clearing Reconsidered," *Federal Reserve Bank of Richmond Economic Quarterly* 85, 1-32.
- Lockhart, Oliver C. (1921). "The Development of Interbank Borrowing in the National Banking System, 1869-1914." *Journal of Political Economy* 29, pp.138-160, 222-240.
- McAndrews, James J., and Simon M. Potter (2002). "Liquidity Effects and the Events of September 11, 2001," *Federal Reserve Bank of New York Economic Review* 8, 59-79.
- Meltzer, Allan H. (2003). *A History of The Federal Reserve. Vol. 1: 1913-1951*. Chicago: University of Chicago Press.
- Miron, Jeffrey A., and Christina D. Romer (1990). "A New Monthly Index of Industrial Production, 1884-1940," *Journal of Economic History* 50, 321-337.
- Mishkin, Frederic S. (1996). "The Channels of Monetary Transmission: Lessons for Monetary Policy," NBER Working Paper 5464.
- Mishkin, Frederic S. (1991). "Asymmetric Information and Historical Crises: A Historical Perspective." In R. Glenn Hubbard, ed., *Financial Markets and Financial Crises*. Chicago: University of Chicago Press. Pp. 69-108.
- Moore, Geoffrey H., ed. (1961). *Business Cycle Indicators, Volume II*. Princeton: Princeton University Press.
- Myers, Margaret G. (1931). *The New York Money Market, Volume 1: Origins and Development*. New York: Columbia University Press.
- New York Times* (1893), various issues.

- Noyes, Alexander D. (1894). "The Banks and the Panic of 1893," *Political Science Quarterly* 9, 12-30.
- Odell, Kerry A., and Marc D. Weidenmier (2004). "Real Shock, Monetary Aftershock: The 1906 San Francisco Earthquake and the Panic of 1907," *Journal of Economic History* 64, 1002-1027.
- Patterson, E.M. (1913). "Certain Changes in New York's Position as a Financial Center," *Journal of Political Economy* 21, 523-539.
- Redenius, Scott (2003). "Hubs and Spokes: Network Effects and the Formation of Regional Banking Centers," unpublished manuscript.
- Roberds, William (1995). "Financial Crises and the Payments System: Lessons from the National Banking Era," *Federal Reserve Bank of Atlanta Economic Review*, 15-31.
- Rockoff, Hugh (1993). "The Meaning of Money in the Great Depression." NBER Historical Paper No. 52.
- Silber, William L. (2007). *When Washington Shut Down Wall Street*. Princeton: Princeton University Press.
- Smith, Bruce D. (1991). "Bank Panics, Suspensions, and Geography: Some Notes on the 'Contagion of Fear' in Banking," *Economic Inquiry* 29, 230-248.
- Spahr, Walter E.(1926). *The Clearing and Collection of Checks*. New York: Bankers Publishing.
- Sprague, O.M.W. (1915). "The Crisis of 1914 in the United States," *American Economic Review* 5, 499-533.
- Sprague, O.M.W. (1910). *A History of Crises under the National Banking System*. National Monetary Commission. Washington, DC: Government Printing Office.
- Stevens Edward J. (1996). "The Founders' Intentions: Sources of the Payments Services Franchise of the Federal Reserve Banks." Federal Reserve Bank of Cleveland Working Paper Series, 03-96.

Summers, Bruce J., and R. Alton Gilbert (1996). "Clearing and Settlement of U.S. Dollar Payments: Back to the Future?" *Federal Reserve Bank of St. Louis, Review* 78, 3-27.

Tallman, Ellis W., and Jon R. Moen (2006). "Liquidity Creation with a Lender of Last Resort: Clearinghouse Loan Certificates in the Banking Panic of 1907," Federal Reserve Bank of Atlanta Working Paper 2006-23.

Tallman, Ellis W., and Jon R. Moen (1995). "Private Sector Responses to the Panic of 1907: A Comparison of New York and Chicago," *Federal Reserve Bank of Atlanta Economic Review* 80, 1-9.

Timberlake, Jr., Richard H. (1984). "The Central Banking Role of Clearinghouse Associations," *Journal of Money, Credit, and Banking* 16, 1-15.

U.S. Bureau of the Census (1949). *Historical Statistics of the United States, 1789-1945*. Washington, D.C.: Government Printing Office.

U.S. Comptroller of the Currency (1907). *Annual Report*. Washington, D.C.: Government Printing Office.

U.S. Senate (1908). *Refusal of National Banks in New York City to Furnish Currency for Needs of Interior Banks*. Senate Document No. 435, 60th Congress, 1st Session.

Wall Street Journal (1893, 1907), various issues.

Warner, J. DeWitt (1896). "The Currency Famine of 1893," *Sound Currency* 2, 339-356.

Weber, Warren E. (2003). "Interbank Payments Relationships in Antebellum Pennsylvania," *Journal of Monetary Economics* 50, 455-474.

Wiebe, Robert H. (1967). *The Search for Order, 1877-1920*. New York: Hill and Wang.

Wicker, Elmus (2000). *Banking Panics of the Gilded Age*. Cambridge: Cambridge University Press.

Table 1: Panics of 1893 and 1907

	<u>1893</u>	1907
Panic onset	May 1	Oct 21
Issue of Clearing House loan certificates in NYC	June 21	Oct 26
Aggregate loan certificate issue, NYCH (\$ million)	16.6	41.5
Maximum amount outstanding (\$ million)	15.2	38.3
Bank reserves of NYCH members (\$ million)*	95.6	121.0
Ratio of maximum certificates issued to reserves	15.9 %	31.7 %
Loan certificate issue nationwide (\$ million)	69.1	238.1
Restriction of cash payments in NYC	Aug 3	Oct 26
Resumption of cash payments in NYC	Sept 2	Jan 1

* on May 6, 1893; Oct 19, 1907.

Sources: Andrew (1908b), p. 507; Sprague (1910) , pp. 34, 145, 163, 261-62, 432-33 ; Roberds (1995), p. ; Wicker (2000), pp. 9, 121.

Table 2: Domestic Exchange Rates during the Panics of 1893 and 1907

	1893		1907	
	<u>Panic Onset¹</u>	<u>Restriction²</u>	<u>Panic Onset³</u>	<u>Restriction⁴</u>
Boston				
Minimum	-.45	0	-.875	-.875
Maximum	6.00	6.00	2.00	2.00
Average	.77	1.92	.36	.39
No quote days	6	2	10	8
Chicago				
Minimum	-30.00	-30.00	-.50	-.50
Maximum	.375	-.25	2.50	2.50
Average	-6.26	-12.14	.52	.56
No quote days	5	2	24	20
St. Paul				
Minimum			-5.00	-5.00
Maximum			6.50	6.50
Average			1.19	1.40
No quote days			14	14
St. Louis				
Minimum	-8.00	-8.00	-1.25	-.25
Maximum	.50	0	8.00	8.00
Average	-3.25	-5.38	4.32	4.79
No quote days	16	8	14	13
New Orleans				
Minimum	-1.50	-1.50	-.75	-.75
Maximum	10.00	10.00	0	-.50
Average	.68	.17	-.56	-.58
No quote days	6	3	27	24
San Francisco				
Minimum	-.05	0	-2.00	-2.00
Maximum	20.00	15.00	0	0
Average	3.52	6.22	-.48	-.88
No quote days	9	1	46	46

¹ June 21-Sept 2, 1893;² Aug 3-Sept 2, 1893;³ Oct 21,1907-Jan 1,1908;⁴ Oct 26, 1907-Jan 1, 1908
 Source: *New York Times* (1893), *Wall Street Journal* (1907)

Table 3: Balance Sheet Panel Regressions
(t statistics in parentheses)

I. Daily data¹

<u>Independent variable</u>	<u>Dependent variables</u>				<u>constant</u>	<u>R²</u>	<u>Prob>F</u>
	<u>xrateaverage</u>	<u>notradedays</u>	<u>netduetobanks/deposits</u>	<u>duetobanks/deposits</u>			
notradedays	-3.8015 (2.92)		113.186 (3.30)		-26.500 (-2.12)	.0143	.0987
notradedays	-2.5265 (-3.33)			60.3037 (4.52)	-25.056 (-2.83)	.0592	.0452
xrateaverage		-0.1947 (-2.92)	27.6489 (5.62)		-7.1764 (-4.28)	.0007	.0251
xrateaverage		-0.3114 (-3.33)		21.2247 (4.61)	-9.4111 (-3.87)	.0011	.0429

II. Weekly data²

<u>Independent variable</u>	<u>xrateaverage</u>	<u>notradeweeks</u>	<u>netduetobanks/deposits</u>	<u>duetobanks/deposits</u>	<u>constant</u>	<u>R²</u>	<u>Prob>F</u>
notradeweeks	-0.1276 (-1.64)		4.7174 (1.61)		-1.3318 (-1.19)	.0001	.2616
notradeweeks	-0.1765 (-2.82)			4.3287 (3.04)	-2.7321 (-2.59)	.0017	.0410
xrateaverage		-2.1784 (-1.64)	27.0337 (2.74)		-9.9676 (-2.93)	.0770	.0610
xrateaverage		-3.0133 (-2.82)		20.0548 (4.20)	-13.847 (-4.42)	.1347	.0096

¹ Boston, Chicago, St; Louis, New Orleans, San Francisco

² Boston, Philadelphia, Cincinnati, Chicago, Milwaukee, St. Paul, St. Louis, Kansas City, New Orleans, San Francisco

Table 4: Cash Flows between New York and Interior City Banks as Reported by the New York Clearing House, 1907

<u>City</u>	\$1,000			Relative to 1905/06			Relative to reserves on hand		
	<u>netflow</u>	<u>outflow</u>	<u>inflow</u>	<u>netflow</u>	<u>outflow</u>	<u>inflow</u>	<u>netflow</u>	<u>outflow</u>	<u>inflow</u>
I. Central Reserve Cities									
Chicago									
October	-8631	8633	2	1.45	11.503	4.00	-0.13	0.13	0.00
November	-17231	17241	10	4.98	68.96	.	-0.26	0.26	0.00
December	-9507.9	9539.9	32	2.03	9.79	0.14	-0.14	0.14	0.00
St. Louis									
October	-2701	2701	0	1.04	9.39	.	-0.10	0.10	0
November	-7587.2	7588.2	1	2.72	18.97	.	-0.28	0.28	0.00
December	-4941.5	5002.5	61	5.16	200.1	2.44	-0.18	0.19	0.01
II. Reserve Cities									
Boston									
October	-8105	8452	347	4.79	19.41	0.80	-0.36	0.38	0.02
November	-1667	1900	233	-7.23	1.18	0.14	-0.07	0.09	0.01
December	342	674	1016	0.51	0.23	0.35	0.02	0.03	0.05
Philadelphia									
October	-7921	8810	889	10.05	8.77	0.89	-0.30	0.34	0.03
November	-6477	7171	694	3.77	8.09	0.78	-0.25	0.27	0.03
December	-746	2977	2231	-0.60	0.96	0.72	-0.03	0.11	0.09

Cincinnati									
October	-293	660	367	0.52	2.09	3.15	-0.04	0.10	0.05
November	-2494.5	2695.5	201	-9.07	6.06	0.45	-0.37	0.40	0.03
December	-942.9	1248.9	306	-6.44	3.27	.80	-0.14	0.19	0.05
Milwaukee									
October	-723	723	0	10.71	10.71	.	-0.14	0.14	0
November	-595	603	8	34.0	34.46	.	-0.12	0.12	0.01
December	-162	362	200	3.24	3.24	.	-0.03	0.07	0.04
Minneapolis/St. Paul									
October	-1040	1045	5	8.56	2090.0	10.0	-0.29	0.29	0.00
November	-895	895	0	-4.25	3.31	0	-0.25	0.25	0
December	55	256	311	0.06	0.28	0.34	0.02	0.07	0.09
New Orleans									
October	-892	910	18	0.34	0.51	7.20	-0.34	0.34	0.01
November	-2117	2196	79	0.77	1.32	52.67	-0.80	0.83	0.03
December	-3143.5	3193.5	50	0.86	1.37	16.67	-1.19	1.21	0.02
San Francisco									
October	-2723	3694	971	-4.47	5.81	1.55	-0.27	0.37	0.10
November	-13163.6	13169.6	6	5.12	3.29	0.01	-1.32	1.32	0.00
December	-2858.5	3441.5	583	0.71	0.83	1.78	-0.29	0.35	0.06

Source: Kemmerer (1910), pp. 276-357.

Table 5: Cash Flow Regressions
(t statistics in parentheses)

I. Total intercity net cash flows

<u>Independent variable</u>	Dependent variable			
	nycflow		cityflow	
	(1)	(2)	(3)	(4)
notradeweeks	-3452.56 (-6.79)	-3423.20 (-7.83)	4685.74 (16.53)	3762.08 (18.38)
duetobanks	-0.1943 (-6.79)	-0.2153 (-6.76)	0.2815 (13.81)	0.2176 (14.78)
duefrombanks	0.2305 (4.46)	0.3574 (6.22)	-0.4156 (-11.06)	-0.3913 (-14.42)
deposits	-0.0147 (-1.43)	0.0025 (0.21)	-0.0090 (-1.22)	0.0061 (1.15)
constant	-2233.76 (-2.12)	-3246.57 (-2.79)	1419.36 (1.65)	852.47 (1.37)
R ²	.9749	.9527	.9895	.9922
NOBS	9	8	9	8

II. Difference between 1907 and 1905/06 net cash flows

<u>Independent variable</u>	Dependent variable			
	nycflow		cityflow	
	<u>(1)</u>	<u>(2)</u>	<u>(3)</u>	<u>(4)</u>
notradeweeks	-2287.449 (-4.58)	-2041.272 (-5.00)	3414.618 (10.51)	2446.614 (13.60)
duetobanks	-0.0845 (-2.33)	-0.1412 (-4.76)	0.2416 (10.33)	0.2142 (16.55)
duefrombanks	-0.0200 (-0.31)	0.1796 (3.35)	-0.2872 (-6.67)	-0.3393 (-14.23)
deposits	-0.0080 (-0.61)	0.0031 (0.29)	-0.0338 (-4.00)	-0.0106 (-2.27)
constant	484.479 (0.36)	-1304.725 (-1.19)	1437.90 (1.46)	1021.318 (1.87)
R ²	.9150	.9139	.9707	.9899
NOBS	9	8	9	8

Figure 1

Schematic Representation of the Late-19th Century Correspondent Banking System

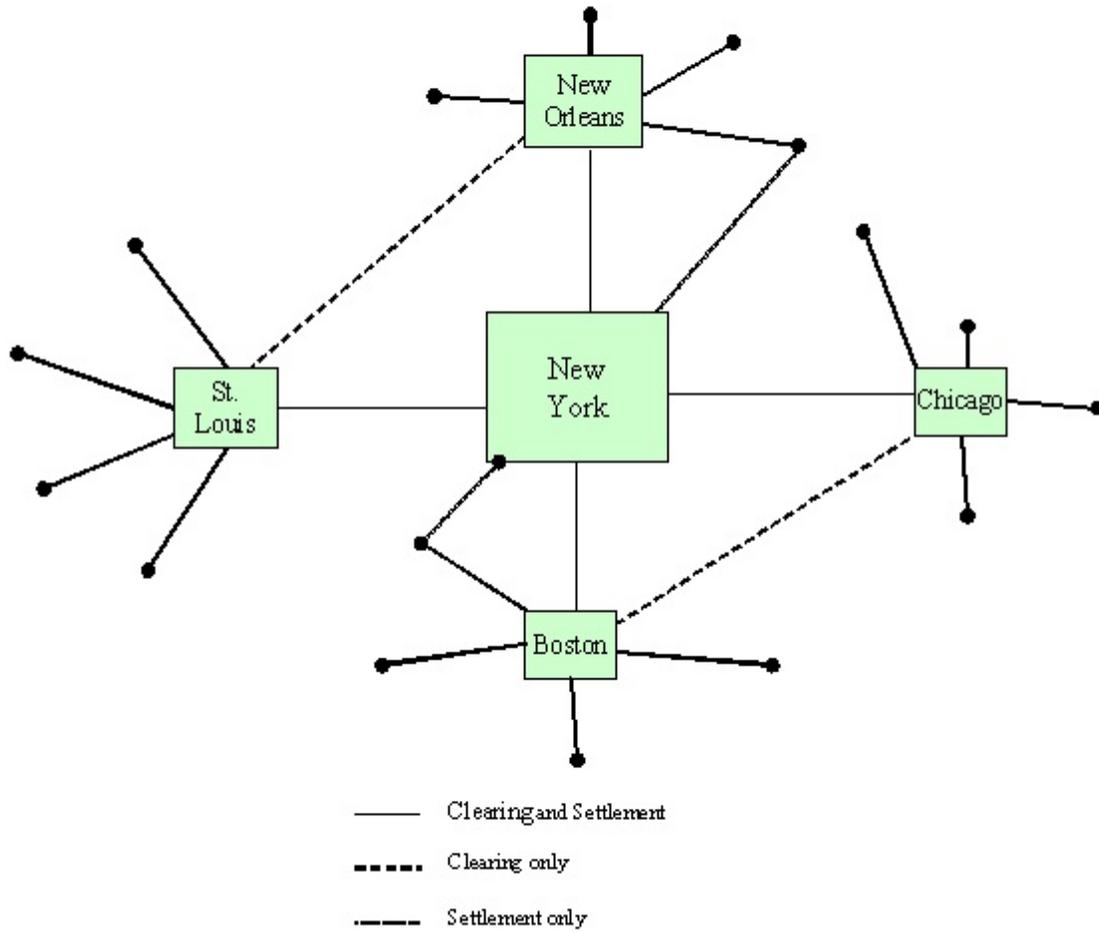


Figure 1: Weekly Domestic Exchange Rates for Selected Cities, 1894-1906

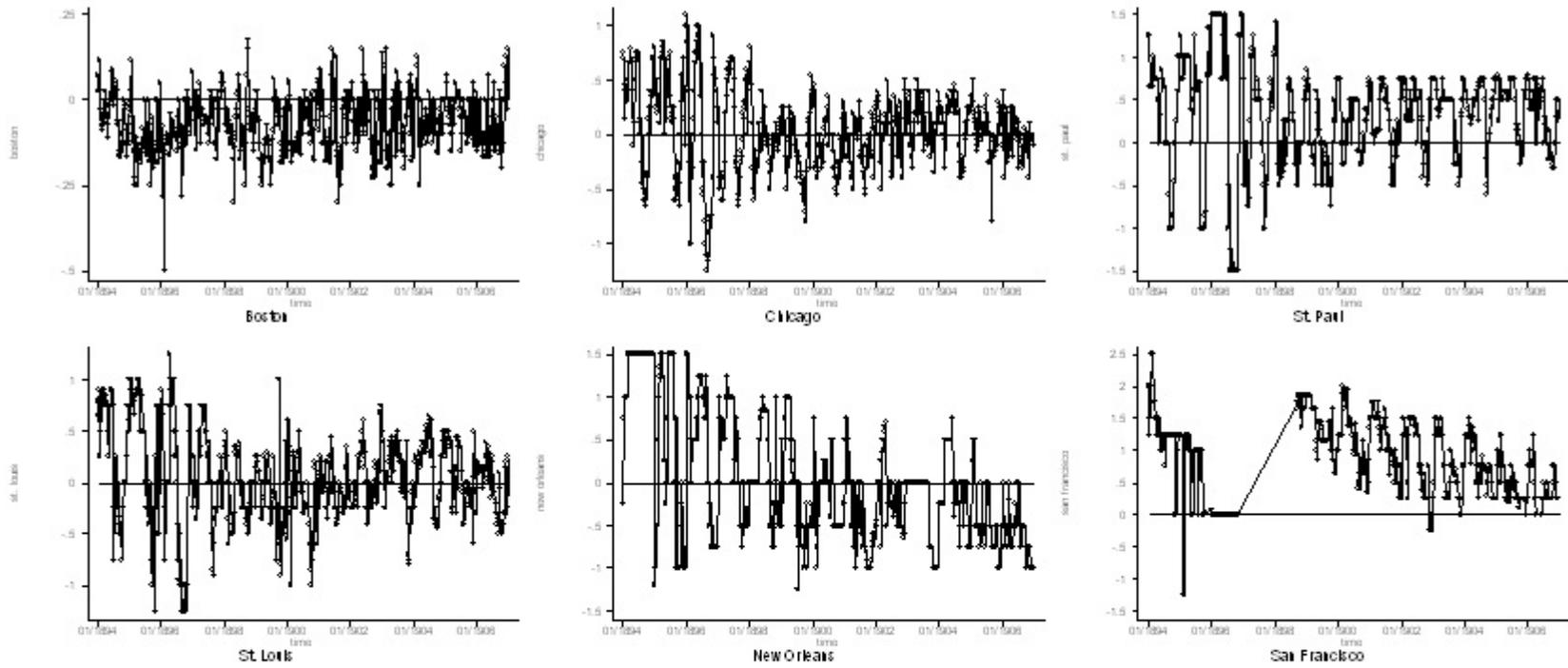


Figure 2: Daily Domestic Exchange Rates in the Panic of 1893

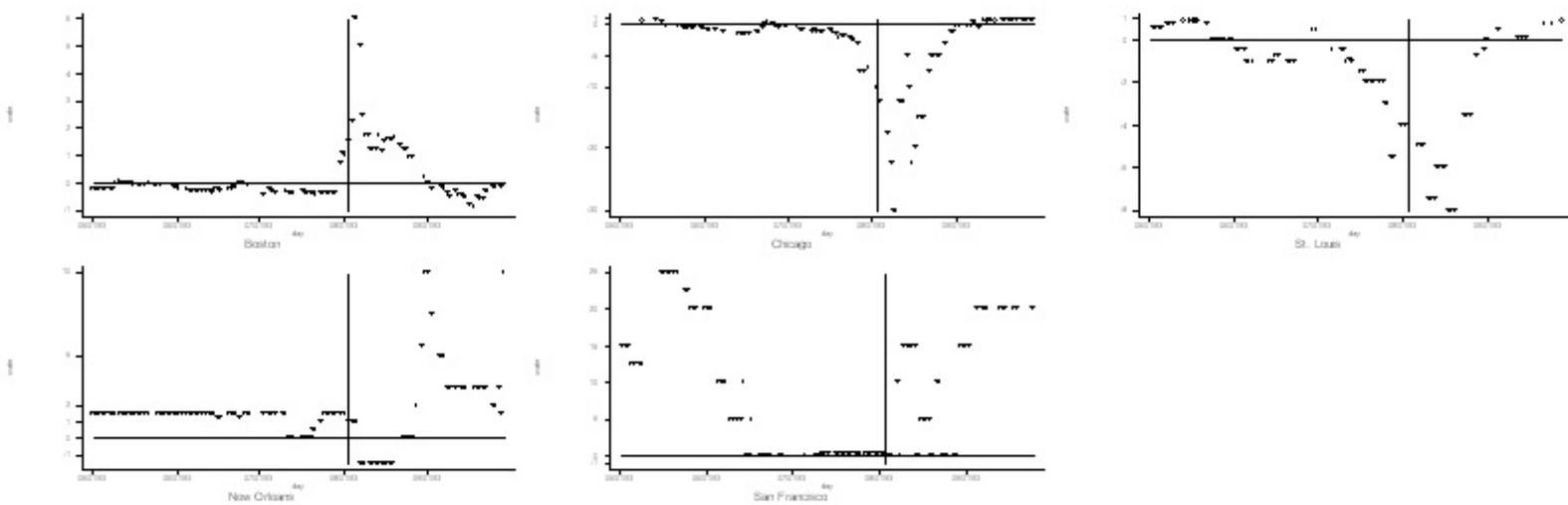


Figure 3: Weekly Domestic Exchange Rates in the Panic of 1893

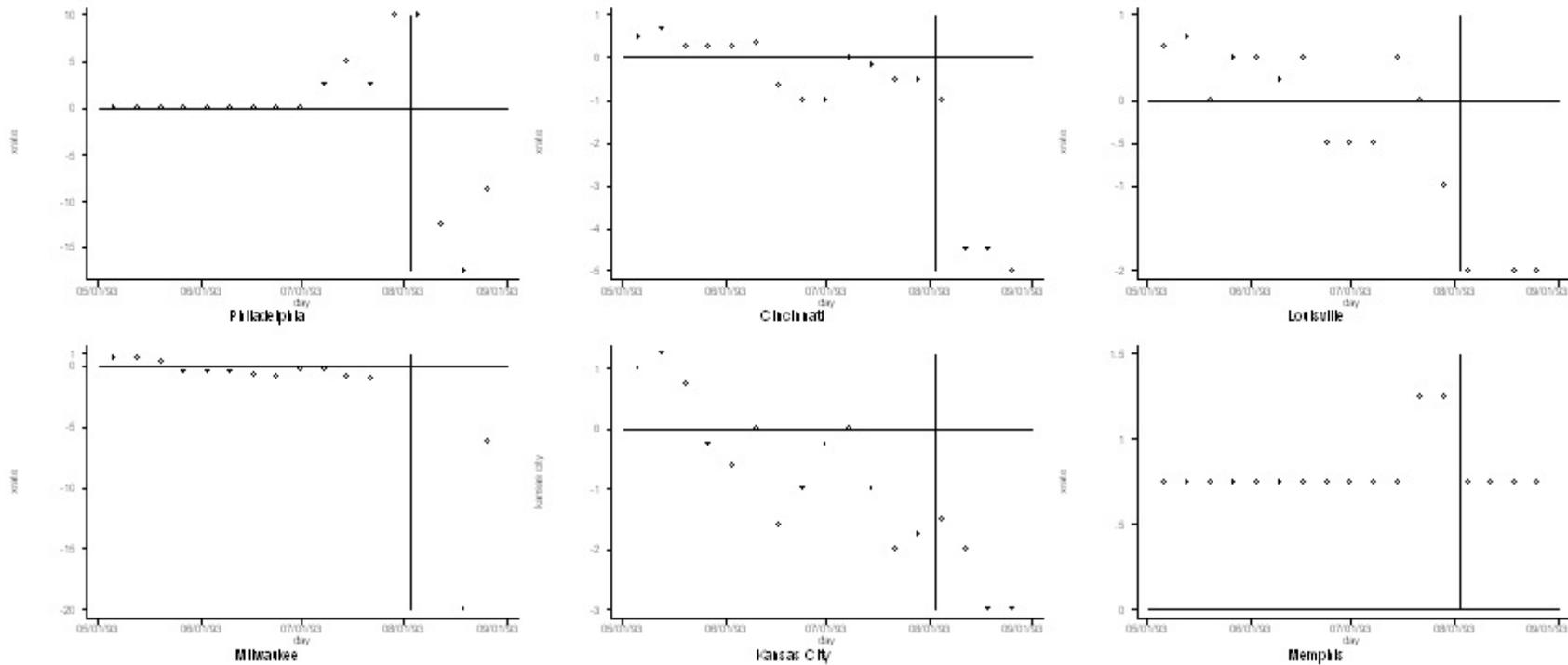


Figure 4: Daily Domestic Exchange Rates in the Panic of 1907

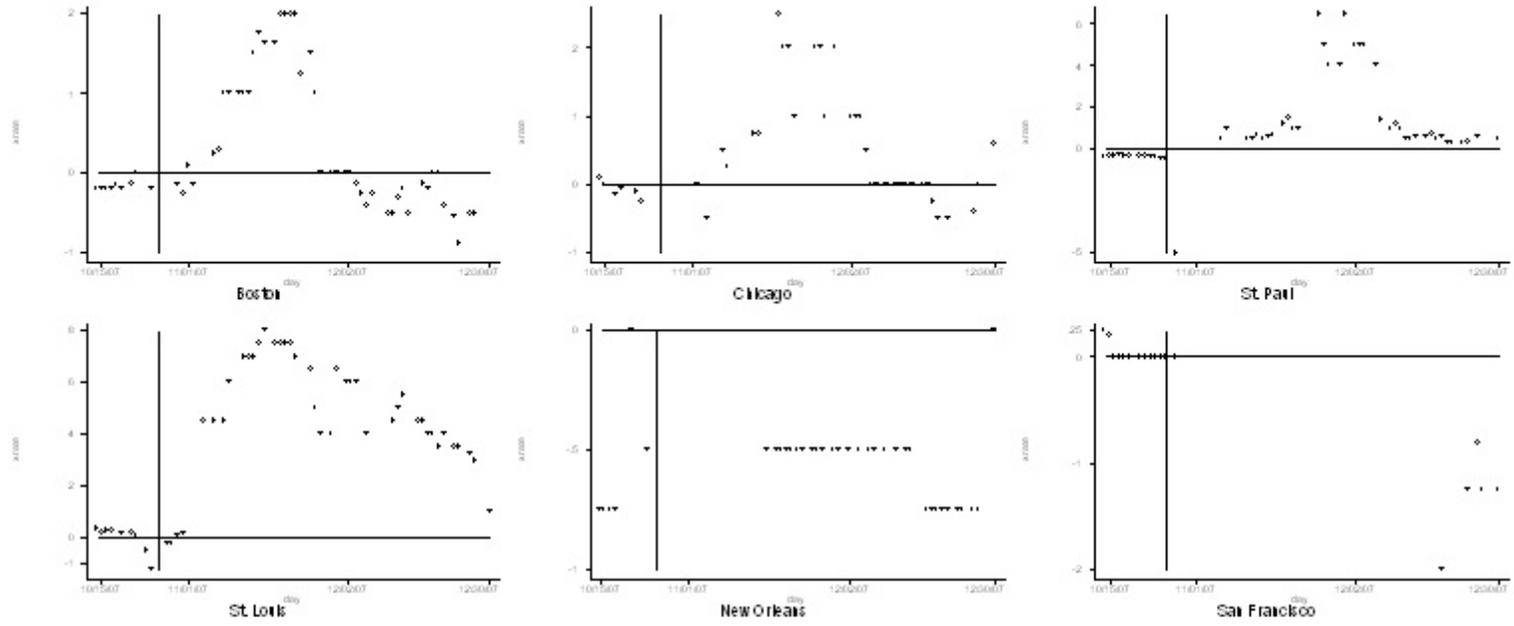


Figure 5: Weekly Domestic Exchange Rates in the Panic of 1907

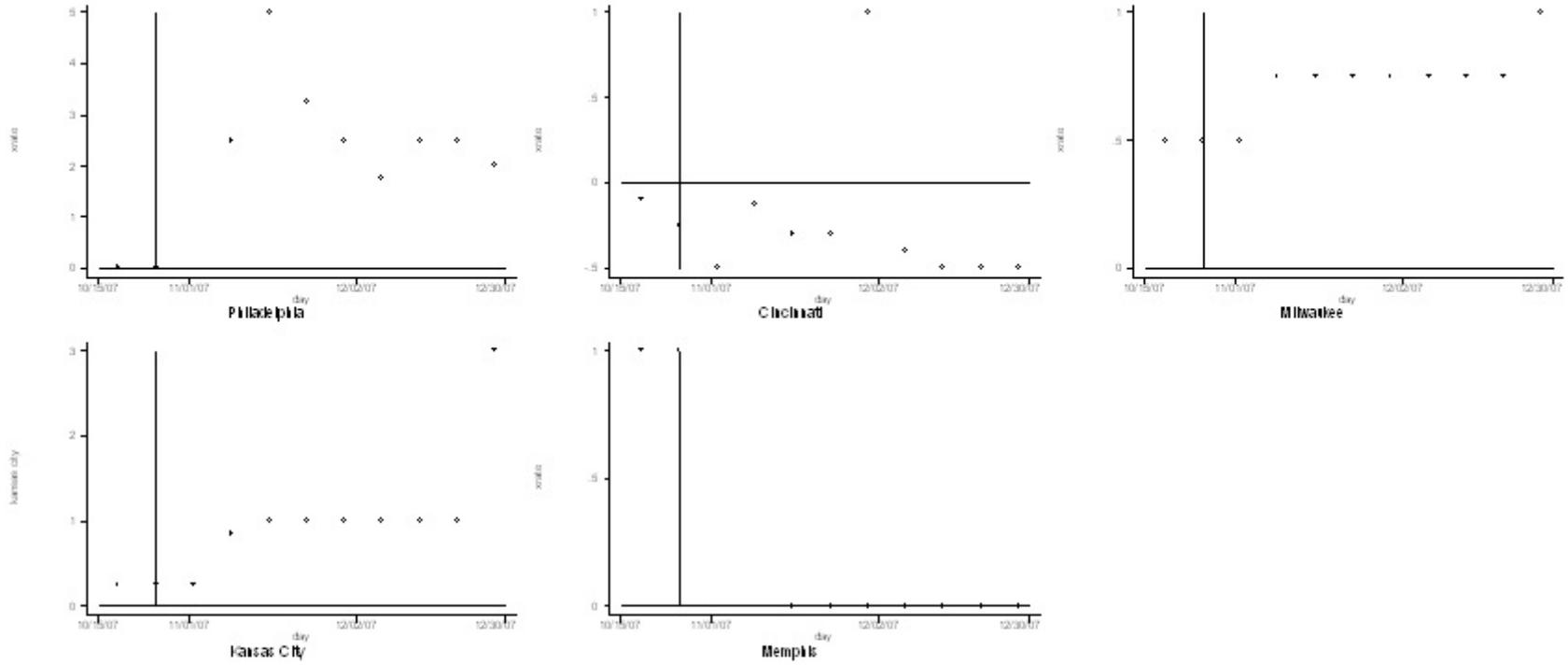
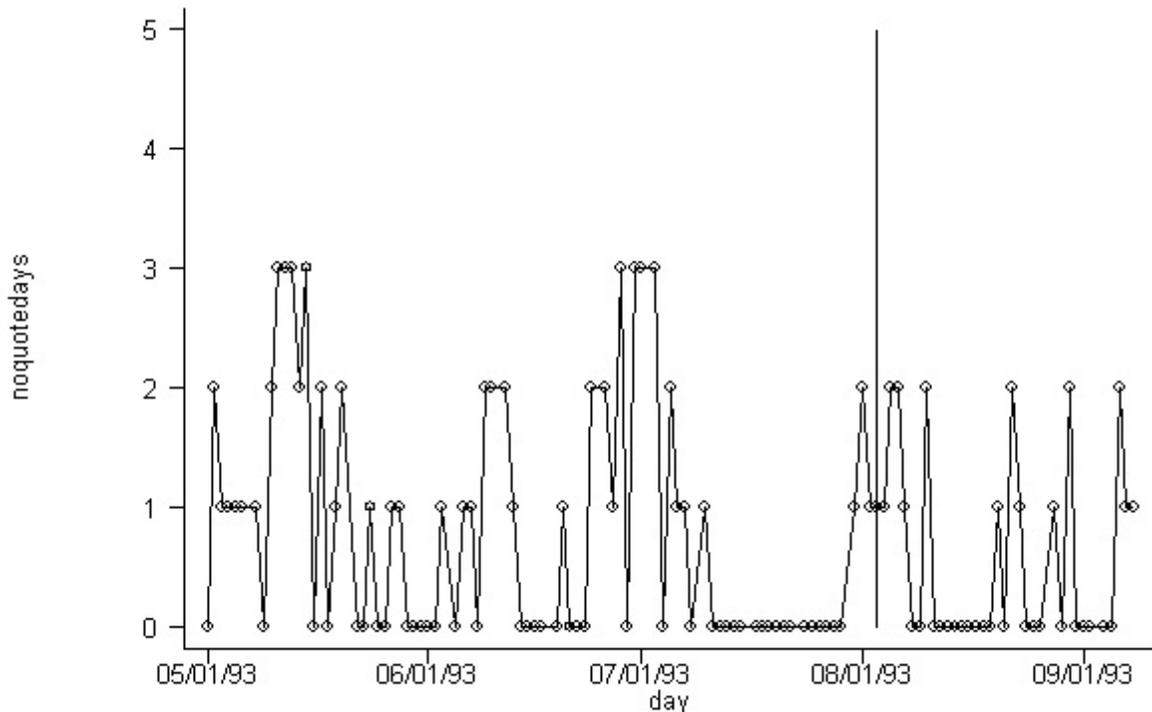
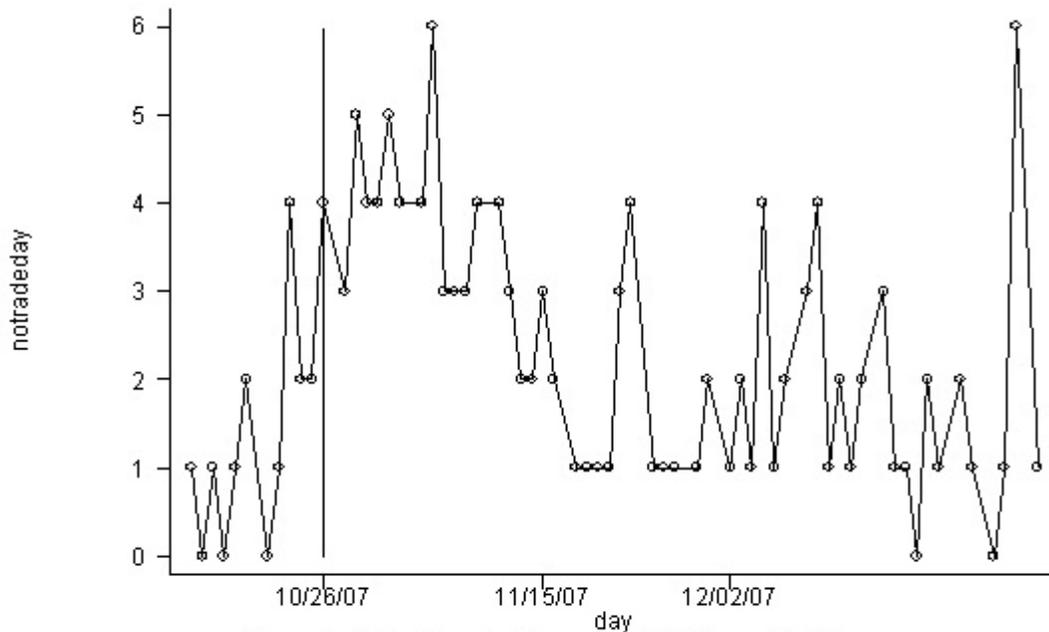


Figure 6: Number of Cities by Day for Which Domestic Exchange Rates Are Not Quoted



Count of No-Trade Days in 5 Cities, 1893



Count of No-Trade Days in 6 Cities, 1907

Figure 7: Currency Shipping Points and Domestic Exchange Rates, 1893 and 1907

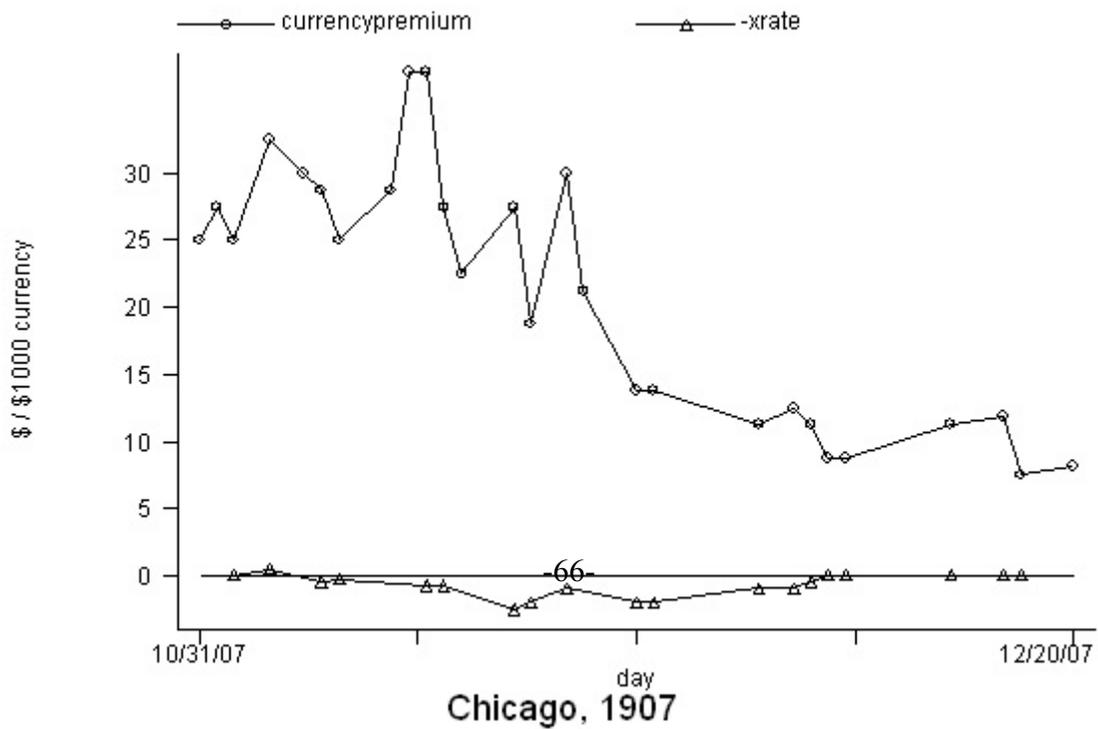
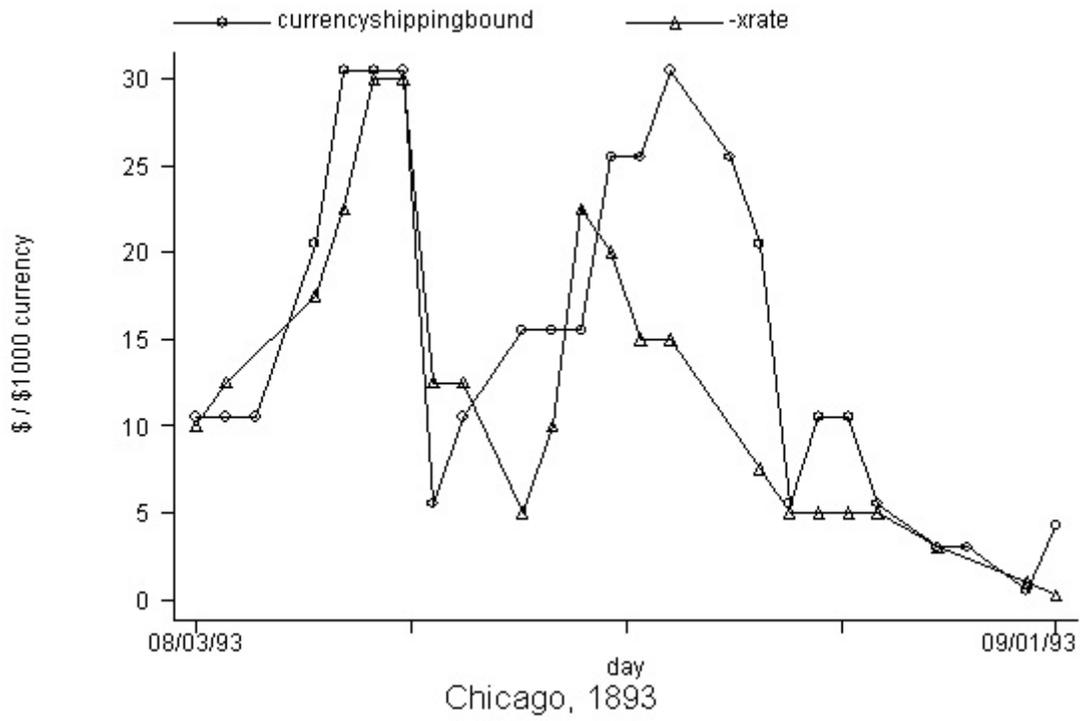


Figure 8: Monthly Indicators of Economic Activity in 1893 and 1907

