

Lessons from the Historical Use of Reserve Requirements in the United States to Promote Bank Liquidity*

Mark Carlson
Board of Governors of the Federal Reserve System

Efforts in the United States to promote bank liquidity through reserve requirements, a minimum ratio of liquid assets relative to liabilities, extend as far back as 1837. Despite such requirements, banking panics and suspensions of deposit convertibility continued to occur. Eventually, policymakers created a central bank to ensure bank liquidity. This paper reviews the historical debates about reserve requirements, supplemented by empirical evidence, to provide insights relevant today about using reserve requirements to regulate liquidity. The insights are related to convincing institutions to use the reserve during stress events and the ways reserve requirements for banks affect interactions with other financial firms before and during a panic.

JEL Codes: G21, N21, E58, B00.

1. Introduction

Shortly after the Panic of 1837, states began instituting reserve requirements which mandated that banks had to hold some minimum ratio of liquid assets relative to their liabilities. When Congress passed the National Bank Acts in the 1860s, banks receiving

*Lindsay Boersma provided valuable research assistance. I thank Burcu Duygan-Bump, Brandon DuPont, Galina Hale, John James, Tom King, Jamie McAndrews, Bill Nelson, Enrico Perotti, Jonathan Rose, and Eugene White as well as seminar participants at the Federal Reserve Bank of Chicago and the Federal Reserve Bank of New York for helpful comments. The views expressed in this paper are solely those of the author and do not necessarily reflect those of the Federal Reserve Board or its staff. Author Contact: Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue, Washington, DC 20551. E-mail: mark.a.carlson@frb.gov.

national bank charters also faced a reserve requirement. These rules were part of an effort to promote liquidity and soundness by ensuring that each individual bank had a pool of liquid assets that it could draw on during times of stress.¹

Despite these efforts, the banking system remained vulnerable to banking panics and suspensions of convertibility in which banks temporarily stopped or restricted withdrawals of funds (Calomiris and Gorton 1991, Sprague 1910, Wicker 2000). These suspensions of convertibility disrupted economic activity and demonstrated that the reserve requirements were not sufficient to ensure that the financial system remained liquid during periods of stress (James, Weiman, and McAndrews 2013). Partly to address these concerns, Congress established the Federal Reserve to create an “elastic” currency that could add liquidity to the banking system and serve as a lender of last resort.²

This paper reviews the historical thinking and experience in the United States regarding reserve requirements to provide insights for policymakers today regarding efforts to promote individual bank liquidity and the relation of those efforts with a lender of last resort. Following the recent financial crisis, there has been increased interest in liquidity requirements among policymakers, such as the liquidity coverage ratio proposed by the Basel Committee on Banking Supervision (2010) or in countries such as the United Kingdom, the Netherlands, and others, and in academic research such as Buiter (2009), Cao and Illing (2011), Perotti and Suarez (2011), and Rochet (2008). Historical policymakers, academics, and bankers thought deeply about reserve requirements, and their discussions provide insights into broad theoretical concerns and practical issues regarding the effectiveness of reserve requirements. Moreover, important

¹The United States was one of a few countries to have a formal reserve requirement (Comptroller 1895). Other countries, such as Canada and Scotland, had informal, and more flexible, best practices about the appropriate level of reserves (Bordo, Redish, and Rockoff 1993, Kroszner 1995, and MacKenzie 1932).

²There were other sources of instability in the financial system at this time, such as seasonal fluctuations in interest rates, the inelasticity of the money supply, and a fragmented banking system. These issues have been discussed extensively elsewhere (see, for example, Bordo and Wheelock 2010, Calomiris 2009, and Friedman and Schwartz 1963). This paper focuses more on how reserve requirements affected bank behavior during and around panics, and the other issues are discussed only to the extent they bear on this issue.

lessons regarding how reserve requirements perform during stress situations can be drawn from the historical narrative and by analyzing changes in bank balance sheets during the panics of the era in which reserve requirements were in use.

One important lesson that is apparent from historical experience is that it is quite difficult to convince banks to use their reserve. Banks appear to have been willing to close their doors and temporarily suspend operations, which had notable reputational consequences, well before they had exhausted their reserve. This tendency appears to have been exacerbated by uncertainties regarding the rules about when use of the reserve was permitted. Relatedly, concerns about the dependability of the usual liquidity backstop impact panic dynamics. Banks often depend on other banks or particular financial markets to meet their regular liquidity needs. During a panic, the ability of those other banks or markets to furnish that liquidity support may become impaired. Uncertainty about how a liquidity backstop will operate during a crisis can lead banks to hoard liquid assets during stress events, a dynamic that may exacerbate the problems (see also Allen and Gale 2007). The importance of having a credible and dependable lender of last resort to prevent this dynamic was a key argument made by proponents of a central bank (Warburg 1916).

The historical experience also provides a lesson on the relationship between reserve requirements and moral hazard issues. Some of the modern literature has focused on using liquidity requirements to reduce banks' reliance on the central bank as a backstop (Cao and Illing 2011, Rochet 2008). However, the historical record indicates that reserve requirements may lead other institutions, not subject to the requirements, to opt to rely more on the banks as a source of liquidity. This tendency could put additional pressure on the banks during a crisis.

Another lesson is that the liquidity of assets being used in the reserve can change during a crisis. Moreover, if the same assets are used as a store of liquidity by both regulated and non-regulated institutions, shifts in asset liquidity can transmit financial pressures from one group to the other.

The paper also reviews the compliance of banks with the reserve requirement. Compliance was generally high, but it was regularly the case that a notable number of banks were deficient. The historical

experience illustrates how compliance can be related to the discipline provided by the bank examiners.

Many of these lessons were discussed by policymakers as they debated the creation of the Federal Reserve. This paper reviews the debates and describes how policymakers expected a central bank to address some of the inadequacies of reserve requirements in mitigating panics. These discussions provide insights into how the founders of the Federal Reserve expected it to act in response to a financial crisis. Fairly soon after the founding of the Federal Reserve, reserve requirements ceased to be viewed as a tool to manage individual bank liquidity and instead were seen as a tool for managing overall credit conditions and financial market liquidity. This shift in thinking is also discussed.

This paper is organized as follows. Section 2 reviews the introduction of reserve requirements and some alternative ways they were constructed. The purpose of the reserve requirements is discussed in section 3. Section 4 describes historical lessons regarding the use of reserve requirements as liquidity-management regulation, in normal times and especially during panics. Section 5 presents the arguments made for establishing a central bank and indicates how these arguments stemmed from some of the issues raised in previous sections. This section also notes the decline in the use of reserve requirements as a tool for regulating liquidity following the establishment of the Federal Reserve. Section 6 concludes.

2. Introduction and Calculation of Historical Reserve Requirements

The first reserve requirements were introduced in the United States shortly following the Panic of 1837 by the states of Virginia, Georgia, and New York (Rodkey 1934). These requirements were generally intended to ensure that banks had ready access to resources that would enable them to meet their liability obligations. (When reserve requirements were first adopted, banks were chartered exclusively by the states, so it was state laws that mattered.) The adoption of reserve requirements by other states occurred slowly; only ten states had such laws by 1860. However, after the Panic of 1857 there

were a number of journal articles and pamphlets advocating reserve requirements.³

When reserve requirements were first enacted, the main bank liability was bank notes, privately issued currency that banks promised to redeem for specie (gold or silver coin), and state laws referred to those liabilities as the base for determining the appropriate reserve. As the liability base of banks shifted toward deposits, the reference point for the reserve requirements shifted as well. In 1842, Louisiana passed a law requiring banks to maintain a reserve in specie equal to one-third of their total liabilities to the public, which included both notes and deposits (White 1893). By 1895, twenty-one states had reserve requirements for commercial banks; at this time, all such laws included deposits in liability base (Comptroller 1895). For states that enacted reserve requirements, the laws regarding the ratio of reserves that had to be held relative to the liability base ranged from between 10 percent to 33 percent.

There was some variation in the types of deposits included in the base of the reserve. By the end of the 1800s, a majority of states required the reserve to be calculated against all deposits. However, some policymakers argued that banks ought to maintain a greater reserve only against more volatile deposits, and a few states just required a reserve against demand deposits (Comptroller 1895, Welldon 1910). A handful of states mandated reserves against both demand and time deposits, but specified that the amount of liquid resources that needed to be held against each dollar of time deposits was smaller than that required for demand deposits.

State laws also differed with respect to what assets could be included in the reserve held against liabilities. Some states allowed deposits in other banks to count; this feature was likely due to the fact that many banks in smaller communities maintained balances at banks in larger cities to clear payments. As many bank notes, and later checks, were redeemed at these clearing banks, interbank deposits played an important part in a bank's liquidity profile (James 1978, White 1983). A few states required that the entire reserve be carried as specie in the bank's vault. A handful of states allowed short-term loans to count as part of the reserve.

³See also Miller (1927) for discussion of shifts in thinking around this time.

When the U.S. Congress passed the National Banking Acts in the early 1860s and provided for national bank charters, the legislation included reserve requirements for national banks. These reserve requirements were tiered and depended on the location of the banks. For much of the National Banking Era, banks located outside major cities—referred to as “country banks”—were required to hold reserves equal to 15 percent of deposits, three-fifths of which could be held as deposits in banks located in reserve cities while the rest was required to be held as vault cash.⁴ Banks in reserve cities—generally larger cities—were required to hold reserves equal to 25 percent of deposits, half of which could be carried as balances in central reserve cities. Banks in central reserve cities—at first just New York but later Chicago and St. Louis as well—held significant amounts of interbank deposits. These banks were required to maintain a reserve equal to 25 percent of deposits which needed to be held in gold or in legal tender.⁵ One reason that banks in reserve and central reserve cities were expected to hold a higher portion of their assets as reserves was that they held more interbank deposits; these deposits were seen as more volatile and, in particular, more likely to be withdrawn during banking panics (Federal Reserve 1927).

Although it was typical for interbank deposits to be included in the reserve, this choice was subject to some criticism, as it was understood that these assets were generally not an effective source of liquidity during banking panics. Noyes (1894) noted that when demand during a panic was for physical currency, reserves held elsewhere were not particularly useful. More fundamentally, allowing interbank deposits to count as reserves created a pyramid structure. A bank could deposit cash in another bank and count that deposit in its reserve while the second bank counted the cash in its reserve. The second bank could then deposit the cash in a third bank and compound the process. A withdrawal of reserves by the bottom of the pyramid during a panic would thus result in a rapid depletion of reserves within the banking system (*Bankers Magazine* 1907a).

⁴Prior to 1874, national banks had to hold reserves against both notes and deposits.

⁵A number of states also adopted a tiered system in which state-chartered banks in larger cities faced more stringent reserve requirements.

The Comptroller of the Currency (Comptroller)—the chief regulator of national banks—argued that reserves held in other banks had been ineffective in protecting depositors during the panics of 1873 and 1893 and encouraged Congress to increase the portion of the reserve that banks had to carry in their vaults (Comptroller 1900, pp. 25–27).

3. The Purpose of the Reserve

Reserve requirements were implemented as a prudential requirement meant to ensure that banks maintained the resources to meet their obligations. This goal is very broad and has both solvency and liquidity attributes. Indeed, proponents of reserve requirements often blended the two or spoke of the benefits in terms of both the safety of the banks and the promptness with which banks could meet withdrawals.

An example of arguments framing the reserve as a tool for supplying liquidity comes from the 1873 report of the Comptroller, where it was noted that “the question is not whether a reserve shall be held which shall insure the *payment*, merely, of the note, for that is unnecessary, but what amount of reserve shall be held by the banks to insure the *prompt* payment of all their liabilities?” (p. 19). With respect to solvency benefits, Tucker (1858) suggested that bank failures, such as during the Panic of 1857, were the result of “imprudence” as banks over-extended themselves and did not maintain a reserve of at least one-third of their liabilities.⁶ Most advocates tended to blend these ideas. Hooper (1860) provided one of the most interesting blends. He argued that a bank could reduce its riskiness by increasing either its capital or its reserve, and institutions with a greater fraction of their assets as reserves could sustain a higher

⁶Capital also played an important role in prudential regulation, and it was well understood that an adequate capital base was necessary to establish the safety of the bank. Tucker (1839) maintained that “to secure the requisite solidity, two things seem essential. One is that the bank should have a sufficient amount of capital; and the other is, that such capital should be real, not nominal or borrowed [i.e., paid in installments or with borrowed funds]” (p. 192). Interestingly, and in contrast to the reserve requirements, capital requirements were often expressed in terms of a fixed dollar amount rather than as a ratio. Nevertheless, a few states in the early 1800s did limit the amount of loans that could be extended to some multiple of capital.

leverage ratio.⁷ Having a strong reserve meant that the bank would be able to avoid being forced to access emergency funds from other banks or rapidly call in their loans (or presumably be forced to sell assets in fire sales) and thus be stronger overall.

Commentators also noted that the reserve was important in promoting confidence and could prevent troubles from starting. Hooper (1860) suggested that confidence about the reserve likely affected banks' willingness to use it. In particular, he argued that banks in New Orleans were required by law to maintain a higher reserve than those in other large cities (Boston in particular) and that the populace of New Orleans, knowing the strength of the reserve, had greater confidence in their banks and thus the New Orleans banks were better able to use their reserve times of financial trouble. Westerfield (1921) summarizes this debate regarding a minimum reserve requirement succinctly: "The psychological effect of the known large reserve is undoubtedly good, allaying the depositor's fears as to the bank's ability to pay on demand; but if the depositor also realized that this reserve could not be actually used when required, his faith would be less strong" (p. 146).

While much of the discussion focused on the micro-prudential benefits to the individual banks of requiring a minimum level of reserves, some commentators did suggest that there were systemic benefits of ensuring banks retained sufficient liquid resources on hand. Opdyke (1858) argued that excessive credit growth led to a boom-and-bust cycle and that a reserve requirement could be useful in restraining credit growth.⁸

⁷While he does not use these terms, Hooper appears to argue that banks should target a particular overall level of risk and can hit that risk target by adjusting either their capital-to-asset ratio (leverage) or the balance between riskless cash and risky loans. Calomiris (2011) makes a fairly similar point.

⁸Opdyke advocated limiting loans to one and a half times capital plus specie, which also suggests that reserves blended solvency and liquidity benefits. He further argued that the importance of restraining credit growth, and hence of a reserve requirement, had more than an economic motivation. "Whenever our currency is thrown into one of its paroxysms of extreme expansion, by the undue enlargement of bank loans, it literally intoxicates commerce, and drives it into all kinds of excesses. The desire of gain is stimulated to an unwonted degree, and manifests itself in over-trading, imprudent credits, reckless speculations, and numerous enterprises of questionable utility and still more questionable morality" (p. 8).

Other systemic benefits were described by Coe (1873) and Hooper (1860), who suggested that there were collective-action reasons to mandate minimum reserves, especially for banks in the main money center of New York City. Hooper noted that the reserve of banks in New York was a common good benefiting all the banks in the city as well as the rest of the country.⁹ He further argued that the managers of those banks might not internalize the social benefit they provided and, as a consequence, the law needed to require them to hold a larger reserve than the banks would otherwise have chosen.

It is out of the question for the banks of the city of New York to hold that relation of the entire confidence through the country, so long as the action of each bank, in regard to the amount of its reserve of specie, is dependent upon the peculiar views or character of its board of managers. The *law* must secure the uniform ability of the banks to meet their engagements by making it imperative upon each one of them to hold the requisite amount of specie as a condition of their power to discount. (Hooper 1860, p. 44)

Coe noted that banks in New York City were linked through their mutual dependence on the call loan market for liquidity and that interior banks tended to react to troubles at one bank in New York as a signal of troubles at all the banks. (The call loan market was a money market in which banks and others would provide short-term loans to brokers secured by equity collateral. As equities were liquid, when a bank needed to call in a loan, the broker was assumed to be able to sell the collateral to repay the loan. However, if all the banks called these loans at the same time, the brokers would be forced to liquidate their collateral at fire-sale prices and might be unable to repay the loans.) Thus, during a panic the strong banks needed to support the weak institutions to contain liquidity drains and prevent problems from cascading. This linkage, Coe argued, was a reason that all banks needed to hold a strong reserve and was a

⁹The centrality of banks in New York City reflected their place in the payment system, as a typical source of liquidity through the provision of discounting, and as an access point to the New York money markets. This importance was enhanced when New York City was designated as a central reserve city at the top of the reserve pyramid in the National Banking Era (see also James 1978).

motivation for the New York Clearinghouse to establish a reserve requirement in 1857.

4. Lessons from History Regarding Reserve Requirements

This section reviews four lessons regarding reserve requirements. The lessons concern the enforcement of the requirement during normal times, use of the reserve during panics, the complexities of moral hazard issues, and the changing liquidity of assets during panics.

4.1 Enforcing the Reserve Requirement

Modern discussions about enforcing the reserve requirement involve efforts to balance the need to ensure that banks meet the requirement with the desire not to push banks to maintain too substantial a buffer. Goodhart (2008) favors a tiered structure based on the severity of the violation. The Basel Committee on Banking Supervision (2010) lists extensive considerations regarding enforcement rules.

The historical debate about how to ensure that banks met the reserve requirement started soon after the first requirements were introduced. Tucker (1839) advocated enforcing the requirement using a moderate penalty proportional to any deficiency of the reserve. He maintained that the penalty should be high enough to dissuade banks from running below the reserve in good times but not so high that banks were unwilling to use the reserve during a crisis.¹⁰

In the National Banking Era, the law provided that in the event the Comptroller found that a national bank was deficient in its reserve, the bank could be required to cease making loans and stop paying dividends until the reserve was restored.¹¹ If the reserve was

¹⁰Opdyke (1858) argued for requiring a minimum reserve somewhat below what was desired, as he maintained that banks would hold a buffer stock above the requirement and that the buffer could then be used: “A legal minimum of 20 per cent. will, it is believed, give a practical minimum of not less than 25 to 30 per cent., for no prudent bank will voluntarily occupy a position on the verge of legal death” (pp. 15–16).

¹¹The Comptroller (1893) stated that in the event that the bank had loaned out too great a portion of its funds or depositors had withdrawn a significant

not restored within thirty days, the Comptroller could, with the concurrence of the Secretary of the Treasury, appoint a receiver for the bank. It was well noted that both the finding by the Comptroller that the bank was deficient and the decision to seek a receiver were discretionary on the part of the Comptroller. Moreover, the Comptroller stated that he only had the opportunity to learn about the bank's balance sheet from one of the biannual bank examinations or the report of condition filed five times a year (1893). The actual ability to monitor was slightly more complicated. In their examination reports, examiners were asked to review the bank's books and comment on the adequacy of the bank's reserve for the past thirty days (or more if deemed appropriate). Thus the examination reports allowed the Comptroller more than just a single day's observation.

Carter Glass (1913) asserted that this particular penalty regime was not very successful. In the debates related to the Federal Reserve Act, he maintained that the penalties for holding inadequate reserves for an extended period were so severe that they were not applied and that in some cases banks had been allowed by regulators to have deficient reserves for several years. Examination reports for a sample of banks indicate that the examiners took note of the condition of the bank's reserves and used this information, along with other aspects of the bank's condition, to make recommendations about whether the bank should be required to suspend dividend payments or take other remedial actions. An inadequate reserve alone may have resulted in some scolding by the examiner but does not appear to have been sufficient to cause the examiner to recommend strong corrective action. However, if the bank had other problems, such as too many large loans or a rising number of overdue loans, then a deficient reserve was used by the examiners as an additional lever to push the bank to take remedial actions.

Information from Welldon (1910) suggests that, as of 1909, many states had similar, though slightly less severe, penalties for banks falling short of their reserve requirement. Out of the thirty-nine states that had reserve requirements at that time, Welldon mentions

amount of funds, the only "safe and prudent course for the bank to pursue is to cease paying out money in any direction except to depositors until either through the collection of demand or maturing loans on the one hand, or the receipt of deposits on the other, the required portion has been restored" (p. 18).

a penalty for failing to meet that reserve for twenty-five states. In every case, that penalty involved a prohibition on extending new loans. In fifteen cases, there was also a prohibition on issuing dividends. For only one state, Arizona, does Welldon mention an explicit provision that failure to restore the reserve could result in a bank being declared insolvent.

Looking at the status of reserves for a sample of 208 national banks in both reserve cities (82 banks) and larger country towns (126 banks) using data from the September 1892 Call Report provides some further information about the level of bank reserves.¹² Most banks appear to have held reserve in excess of the required reserve; the average reserve ratio was around 31 percent and quite similar for both country banks and those in reserve cities (table 1).¹³ (These ratios are similar to those reported by the Comptroller in 1887.) Moreover, the ratio of reserves to deposits exceeded the legal requirement (15 percent for country banks and 25 percent for reserve city banks) by 10 or more percentage points for two-thirds of country banks and one-fifth of reserve city banks. Banks may have preferred

¹²The sample used here consists of 208 national banks from cities located predominantly in the West and South; these parts of the country were most affected by the Panic of 1893, a fact that will become useful below. The sample was limited in size in order to allow for more in-depth analysis of these banks. Importantly, the examiner reports used in the paper are also from this group of institutions. The sample includes most of the banks in this part of the country that would have stood between the country banks and the banks in the money centers and thus the banks most affected by developments in interbank markets during the panic. The particular cities used are Birmingham and Mobile, Alabama; Los Angeles and San Diego, California; Denver and Pueblo, Colorado; Indianapolis, Indiana; Des Moines and Dubuque, Iowa; Lexington and Louisville, Kentucky; New Orleans, Louisiana; Minneapolis, Rochester, St. Paul, and Stillwater, Minnesota; Kansas City and St. Joseph, Missouri; Helena, Montana; Lincoln and Omaha, Nebraska; Fargo, North Dakota; Cincinnati, Ohio; Portland, Oregon; Knoxville, Memphis, and Nashville, Tennessee; Dallas, El Paso, and San Antonio, Texas; Salt Lake City, Utah; Spokane and Tacoma, Washington; Milwaukee and Racine, Wisconsin; and Cheyenne, Wyoming. Data are from Comptroller (1892).

¹³While the reserve ratio was roughly cash and due from reserve agents divided by net due to banks and individual deposits, the precise calculation includes various offsets and adjustments such as for cash items in the process of collection, clearinghouse exchange, and unpaid dividends. These adjustments increased the reserve ratio by 2 percentage points on average for the banks in sample. The calculation here follows the procedure used by the national bank examiners and described in Coffin (1896).

Table 1. Reserve Ratios in 1892 (actual reserves as a percent of reservable liabilities)

	Country Banks			Reserve City Banks		
	Reserve in Bank	Held at Reserve Agents	Total Reserve Ratio	Reserve in Bank	Held at Reserve Agents	Total Reserve Ratio
Mean	15.5	16.6	32.1	15.0	15.2	30.2
75th Percentile	18.7	20.5	38.4	19.0	18.3	35.1
Median	14.0	14.5	29.3	14.0	14.4	27.8
25th Percentile	9.2	8.9	20.8	11.6	9.9	24.6
Standard Deviation	9.7	12.8	9.6	5.6	7.6	8.5
Observations	126			82		
Source: Call Report for September 30, 1892 (Comptroller 1892).						

to hold reserve ratios in excess of what was required simply because they preferred being more liquid, as is suggested by *Bankers Magazine* (1908), or because they viewed the required reserve ratio as a minimum they did not want to breach and desired to maintain a buffer.¹⁴

Reserves held in the bank (as opposed to with reserve agents) accounted for about half the total reserve. Relative to deposits, reserves at the bank averaged about 14 percent for both groups, also well above the legal requirements of 6 percent for country banks and 12.5 percent for reserve city banks. The finding that about half the reserve was held in cash matches similar findings by the Comptroller a decade or so later (Comptroller 1907).

While many banks appear to have preferred to hold reserves well in excess of what was legally required, some banks had deficiencies in their reserve ratios. Of the banks in the sample, 10 percent of the country banks and 25 percent of reserve city banks had a deficient

¹⁴Baer and McElravey (1993) provide (and test) a model of a bank's optimal capital stock that illustrates how the presence of asymmetric information that raises the costs of issuing equity could prompt banks to maintain a capital ratio in excess of the regulatory requirement. Similar arguments could apply to the excess reserve ratios found here.

reserve. The fact that banks had deficient reserves suggests that they did not see the reserve ratio as something that had to be met at all times (perhaps especially because they had thirty days to restore it upon notice by the Comptroller). Nevertheless, most of these banks did not sink too far below the legal limit—many of them being within 3 percentage points of the requirement.¹⁵

4.2 *Use of the Reserve Requirements during Panics*

Whether the banks would actually use the reserve is very important. As noted earlier, a key motivation for the historical reserve requirements was to have a store of liquid assets that could be used during a panic. Modern liquidity regulations also presume that the reserve will be used (Basel Committee on Banking Supervision 2010, Stein 2013). This section describes the legal ability of banks to use their reserves, the alternatives they had, and some evidence on actual use. Banks appear to have been quite reluctant to use their reserve, and this section discusses a particular feature of the banking system during the National Banking Era that may have contributed to this reluctance.

It should be noted that some recent work suggests that reserves may be beneficial if they are *not* usable. For instance, Calomiris (2011) and Calomiris, Heider, and Hoerova (2012) argue that an unusable reserve limits liability holder losses in the event of default, as more safe assets put a floor on possible losses. Moreover, an unusable reserve may also reduce risk shifting. As both modern and historical rules intend(ed) the reserve to be used, I focus here on lessons regarding usability.

4.2.1 *Legal Ability of Banks to Use Their Reserve*

The concern that legally required reserves held by banks would not be helpful if the banks had to maintain these reserves at all times

¹⁵Comparing reserve deficiencies over time suggests only limited persistence. Looking at banks with Call Report data for both 1892 and 1894, of the ten banks with the lowest reserve ratios in 1892, only one was still in the ten with the lowest reserve ratios in 1894 and only three were in the bottom thirty banks.

and could not use them was stated clearly early on. In 1848, Kettell argued that “This *keeping* of 15 per cent. of specie on *hand* has been tried in New York, in Alabama, and elsewhere, and its gross absurdity always made manifest. Of what use is it that a bank has the gold and silver, if the law forbids it to part with it?”

The debate about whether banks could legally use their reserves continued during the National Banking Era. In his annual report for 1894, the Secretary of the Treasury argued against the reserve requirement, saying that, as the law was silent on when the national banks could use their reserves, it created a situation in which they were unusable: “Among these are the requirements . . . that a fixed reserve, which cannot be lawfully diminished, shall be held on account of deposits. The consequence of this last requirement is that when a bank stands most in need of all its resources it cannot use them without violating the law” (p. LXXIX).

Proponents of reserve requirements responded that the reserve was established with the intent that it be used during stress periods. As noted above, the decision to find a bank deficient in its reserve was discretionary on the part of the Comptroller. This discretion allowed the Comptroller to effectively waive the requirement during a panic and allow banks time to rebuild their reserves subsequently (Comptroller 1893).¹⁶

Others viewed the vagueness of the law regarding the use of the reserve to be a notable impediment to banks’ willingness to use the reserve.¹⁷ *Bankers Magazine* (1907b) argued that the vagueness of the law regarding when the reserve could be drawn down meant that many bankers felt that the reserve could not be used during a crisis. The president of the American Bankers Association expressed similar sentiments in 1908 (see *Bankers Magazine* 1908).

¹⁶It is unknown whether the examiners were given explicit instructions to waive the requirement. No mention of any changes in standards appear in the Comptroller’s annual reports in which responses to panics are discussed, nor is anything apparent from the examiner reports reviewed.

¹⁷Providing certainty about when the reserve could be used was seen as inherently difficult. Coe (1873) argued that it is very challenging to prescribe rules regarding the circumstances or timing in which the reserve should be allowed to be used or rebuilt.

4.2.2 Alternative Options for Banks

Banks during this period had some alternatives to running down their reserve during a crisis. One option was to try to expand the supply of liquid assets. Banks in New York and other large cities formed clearinghouses to facilitate the settlement of payments between members. These clearinghouses also provided a way to supply liquidity to member banks during a panic by allowing banks to deposit securities with the clearinghouse and receive clearinghouse loan certificates that could be used to make payments to other members of the clearinghouse. Using clearinghouse notes allowed specie or other forms of cash to be used to satisfy the heightened demand from others for liquid assets (Comptroller 1873 and 1890, Nash 1908). Clearinghouse notes were issued extensively in the Panic of 1907. In New York, these notes continued to be large-denomination notes, but in many smaller cities small-denomination notes were issued and circulated with other currency in the general public market. The clearinghouse notes worked for interbank and sometimes local transactions, but were not well suited for interregional payments and were thus an imperfect remedy.

Another alternative to using the reserve during this period was for the bank to suspend convertibility of deposits or to completely suspend operations. If a single national bank in the town closed its doors, it would be reviewed by the bank examiners before being allowed to reopen. Examiner reports indicate the examiners would require actions on the part of both owners and depositors (such as capital injections and agreements to refrain from large withdrawals, respectively) before the bank would be reopened. Moreover, when only one bank in the town suspended, there were often notable reputational consequences for that institution. In a severe situation, the clearinghouse might coordinate the closing of all the banks in the community. In these cases, the clearinghouse might be able to coordinate a reopening without all banks needing to be examined.

4.2.3 Evidence on Use of the Reserve during a Panic

Evidence on use of the reserve during panic situations suggests some reluctance to do so. Of the banks in the sample described in section 4.1, forty-eight closed temporarily or permanently during the Panic

of 1893, and the examiner reports conducted when these institutions were closed provide useful information about the willingness of banks to utilize their reserve when under pressure.¹⁸ Among the banks that closed, either permanently or temporarily, the median cash reserve ratio was about 2 percent, well below the legal requirement. Nevertheless, the median cash ratio was still decidedly positive, and fourteen institutions had cash ratios of 6 percent or more. (Balances due from reserve agents represented about 60 percent of the total reserve for banks on the day they were closed. Such balances were notably higher at banks that suspended but were allowed to reopen, which suggests that an inability to access these funds in a timely fashion may have contributed to the suspensions of some banks during the panic.)

As their reserves were depleted during banking panics, banks in the central reserve city of New York would suspend or curtail shipments of currency to other parts of the country.¹⁹ Sprague (1913) argued that the New York banks tended to do so well before they had exhausted their reserve. In 1907, the *Wall Street Journal* noted that reserves were about 21 percent of deposits around the time of suspension, below the legal requirement but still fairly high.²⁰ It was noted in the *Journal* that use of the reserve during the panic was appropriate:

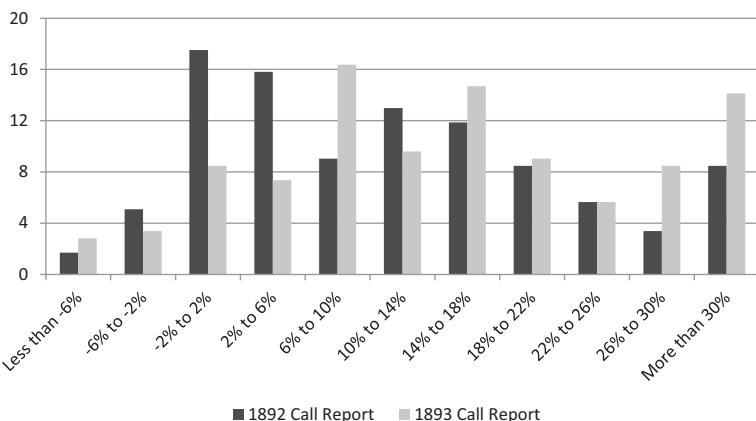
[T]here is a deficit of the bank reserve of \$38,838,825. It should be remembered, however, that a reserve is for use. There is no wisdom in locking up immense sums of money in bank vaults

¹⁸For the histories of the Panic of 1893, as well as other panics of the National Banking Era, see Sprague (1910) and Wicker (2000).

¹⁹Banks in reserve cities would in turn suspend payments to country banks. A lack of available currency gave rise to the use of scrip and other currency substitutes (see Andrew 1908 and Warner 1895).

²⁰Typically, all the banks in the clearinghouse would publish their individual balance sheets each week. During the periods when currency shipments were suspended, it was common for the clearinghouse association to provide a common balance sheet. Doing so avoided revealing whether a particular institution was deficient in its reserve and may have reflected concerns about revealing a deficiency. However, such periods also corresponded to periods in which clearinghouse loan certificates were being issued and it may have been more appropriate to consider the collective liquidity position of the clearinghouse members rather than looking at them individually.

Figure 1. Distribution of Total Reserve Ratios in Excess of Legal Requirement

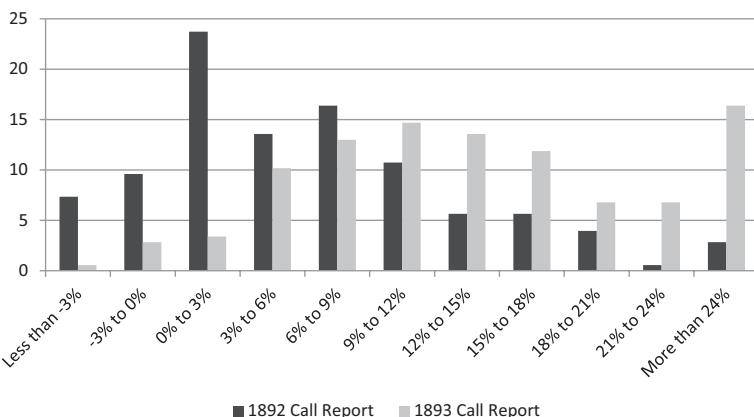


Source: Call Report for September 30, 1892 and October 3, 1893 (Comptroller 1892, 1893).

unless they can be employed in times of emergency. (*Wall Street Journal*, Nov. 4, 1907)

Detailed information on bank balance sheets and reserves is available at a time shortly after the panic from the October 3, 1893 Call Report. Comparing reserve ratios in excess of the legal requirement in 1893 to such ratios in 1892 for national banks operating in both periods (using the same cities as before) suggests that reserve ratios rose at both country banks and reserve city banks (figure 1). The change in the composition of the reserves is even more dramatic as banks shifted from holding their reserve with agents to holding it as cash. The average ratio of cash to liabilities subject to the reserve rose by nearly 10 percentage points; for many banks, cash holdings alone became enough to satisfy the reserve requirement (figure 2). By contrast, average reserves held at agent banks relative to reservable liabilities fell by 5 percentage points. As might be expected, when faced with the possibility of deposit runs and large-scale withdrawals, banks preferred to hold more liquid assets and, in particular, to have cash on hand. Given the pyramiding of reserves that occurred through interbank deposits, this shift to holding reserve in

Figure 2. Distribution of Cash Reserve Ratios in Excess of Legal Requirement



Source: Call Report for September 30, 1892 and October 3, 1893 (Comptroller 1892, 1893).

cash at the bank would have contracted the supply of reserves for the banking system as a whole.

The increase in the cash reserve ratio is due largely to a drop in the liability base. Individual deposits declined 28 percent between 1892 and 1893 at the median bank while net due to banks dropped more than 50 percent. By contrast, cash balances decreased only a little (about 5 percent). Cash balances may have been maintained in part as banks called in funds from their reserve agents; such balances also decreased more than 50 percent. The declines in the various measures of interbank activity again illustrate the collapse in the general liquidity of the financial system as banks pulled back from each other. Loans contracted 17 percent, possibly as banks raised cash by calling in loans (of course, loans may have declined for other reasons such as lack of demand).

Comparing reserves in 1894 to those in 1892 provides some information about longer-term changes to reserve holdings following a panic. It appears that for country banks there was little persistent impact on the reserve ratios, either in the overall ratio or in the composition of the reserve. For reserve city banks, there may have been somewhat more persistence in the effect of the panic, as these

institutions continued to maintain slightly higher reserve ratios a year later (33 percent in 1894 versus 30 percent in 1892). That increase appears evenly split between cash and deposits with reserve agents.

4.2.4 Importance of the Liquidity Backstop

Banks in New York City were vital liquidity providers to the financial system (James 1978). Balances held at these institutions were key for processing payments and could be drawn down if banks needed currency at home. As banks in different parts of the country ran currency surpluses or deficits, specie would be shipped in or out of New York and redistributed around the country. Moreover, New York City banks were important providers of short-term interbank funds through the practice of rediscounting bills.

The centrality of New York City banks to the system had serious repercussions during panics. When New York City suspended convertibility, banks around the country lost access to their typical liquidity backstop. During a panic, individual banks sought to pull their funds out of the banks in the reserve cities and bolster their liquid resources (*Bankers Magazine* 1908); several observers, such as the Comptroller (1907) and Herrick (1908), reported that declines in interbank deposits contributed at least as much to the panic as the actions of individual depositors.²¹ Knowing that banks in New York had suspended payments to out-of-town banks during prior banking panics, by the Panic of 1907, banks were reported to be preemptively trying to pull their funds out of New York City before the banks there could suspend. The country banks were viewed as acting out of self-preservation because there was no guarantee that their regular source of liquidity would be able to furnish that liquidity should the crisis intensify (Roberts 1908, Sprague 1913). Thus, the uncertainty about the dependability of the typical source of liquidity appears to have exacerbated the panic dynamics (such run dynamics are also described in Allen and Gale 2007).

²¹Stickney (1901) makes a similar point comparing the U.S. experience during panics with that of England. He argues that during times of stress, the U.S. system resulted in banks having to compete for reserves, which increased their scarcity, while in England the Bank of England faced no competition and could thus act to make reserves more readily available.

4.3 Moral Hazard Issues

One of the typical motivations for reserve requirements in modern literature is that it reduces the moral hazard concerns associated with a lender-of-last-resort backstop (Cao and Illing 2011, Ratnovski 2009, Rochet 2008). The historical record indicates that the moral hazard issue is more complicated; it suggests that when some institutions are subject to reserve requirements, other institutions may reduce their reserves and depend on liquidity being provided by those institutions subject to the requirement.

Following the Panic of 1893, there were discussions about whether some state banks were free-riding on the national banks. *Bankers Magazine* (1894) indicated that there was an expectation by some state banks that the national banks would use their reserves to provide liquidity and support to state banks and trust companies not subject to the reserve requirements, even if this support was only provided by the national banks to stem local unrest and thus protect themselves. The article indicated that this expectation was the source of some tension among bankers and resulted in some lack of cooperation during the panic.

Another example comes from the trust companies in New York, which played a key role in the Panic of 1907. These institutions took deposits and were similar to banks, but the state laws allowed them to operate with smaller reserve requirements; indeed, these institutions established themselves as trust companies partly to avoid capital and reserve requirements. Reportedly, the trust companies operated with cash on hand of only about 2 percent of their deposits, much less than the banks (Noyes 1901). Instead, as their store of liquidity, the trust companies held deposits at the commercial banks that earned interest and could be drawn upon in the event there were withdrawals. Noyes argues that the trust companies did so in part because the reserves maintained by the banks gave the trust companies confidence that the banks would be liquid in a crisis. Consequently, during the panic, the withdrawals by the trust companies became a serious drain on the banks (Sprague 1908).

4.4 Lessons Regarding the Assets Selected to Serve as the Reserve

As noted extensively above, the interbank deposits that were often included as part of the reserve tended to become illiquid during

crises. This is a useful reminder that the liquidity properties of some assets are not the same in normal times as in stress episodes.²²

A related point is also demonstrated by the dynamics of the call loan market. As noted above, call loans were short-term loans to stockbrokers to finance stock purchases and were collateralized by stocks. These loans could be called by the bank when funds were needed, and it was assumed the stockbrokers would be easily able to sell the stock to repay the loan. While not technically part of the reserve, these loans were viewed as highly liquid and served as a secondary reserve for both banks and trust companies. Moreover, a significant portion of the funding for the call loan market came from the banks and trusts.

The Panic of 1907 involved both runs on the trust companies and the banks and a plunge in the stock market. The call loan market quickly came under immense pressure as both banks and trust companies sought to utilize this secondary reserve and borrowers in that market that were unable to find alternative funding faced the prospect of selling their stocks in a fire sale and possibly defaulting. Consequently, institutions were not able to tap the call loan market as a secondary source of liquidity as they might normally do, and the functioning of that market deteriorated significantly.²³

As noted by Moulton (1918) and highlighted by the call loan market example, securities holdings did not function well as a secondary reserve during a crisis in this period, as banks could often only sell their securities to other banks or similar institutions. If all banks were seeking to sell their securities holdings at the same

²²Given the biases against interbank transactions and in favor of assets associated with safe-haven demands, modern liquidity requirements may be less subject to some of the concerns identified here.

²³This dynamic was well known. In discussing the use of call loans as stores of short-term liquidity, Dwight (1858) noted that “the causes which alarm one bank alarm the whole. Upon any shock to confidence, they all call in at once. The stock collaterals are forced upon the market at the same moment that its ability to take them is almost destroyed by the total cessation of new loans” (p. 159). The argument was repeated following the panic of 1893, where it was noted that when all institutions used the same market as a source of liquidity, that market would be unable to provide liquidity during a panic (*Bankers Magazine* 1894). This dynamic is also the one warned against by Coe (1873) when he indicated that the size of banks’ reserves had systemic implications and warned that strong banks would need to support weaker institutions.

time, those securities would not function as a source of liquidity. For a security to function as a source of liquidity during a crisis, ready purchasers from outside the banking system are needed (similar ideas also appear in Allen and Gale 2007 and Brunnermeier 2009).²⁴

5. Reserve Requirements and the Federal Reserve

As it became clear that reserve requirements were not successful in preventing panics or in keeping banks liquid during panics, discussions turned to the need for a central bank. Many of the associated debates dealt with the issues raised in section 4. Subsequent to the establishment of the Federal Reserve, the purpose of reserve requirements shifted from being used to maintain individual bank liquidity to providing a tool for the central bank to control the cost of liquidity and credit.

5.1 *Discussions Regarding the Establishment of a Central Bank*

There were several lessons that policymakers took from the Panic of 1907 that prompted them to work toward establishing a central bank. One lesson was that when the instrument used as a reserve and primary source of liquidity—in this case, the supply of gold and Treasury notes—was fairly inelastic in the short run, demand for that instrument would exceed the available supply during a panic.²⁵ Banks would compete for these funds and withdraw funding from each other; the competition triggered some of the negative dynamics discussion in section 4.2.3. If banks used other markets as secondary reserves, the associated scramble for liquidity during panics would impair functioning in these other markets, as was the case in the call loan market noted in section 4.4.

²⁴Around this time there was a broader debate about what it meant for assets and for banks to be liquid. Traditionally the self-liquidating nature of short-term loans had been emphasized as a source of liquidity, and banks were more liquid when they had more of these loans. This view was in the process of being challenged. See Suviranta (1933) for a more in-depth discussion.

²⁵Gold could, and did, flow into the United States from abroad in response to rising interest rates. These inflows boosted liquidity but did take some time to arrive in quantities sufficient to meet demand.

To address these issues, many policymakers concluded that an “elastic” currency that could increase in quantity was required (Vanderlip 1908). The notion that an elastic currency was needed was not new.²⁶ However, following the Panic of 1907, legislative action seemed considerably more likely. Some proposals provided for an emergency currency that could be issued by a central authority only during a crisis; as a temporary palliative, such a currency was included in the Aldrich-Vreeland Act of 1908. Under this Act the Secretary of the Treasury could, during a crisis, authorize the issuance of currency backed by any securities held by banks instead of the usual requirement that the currency be backed by U.S. government bonds.²⁷ Ultimately, policymakers chose instead to create the Federal Reserve as a permanent solution where the discount window could be used to turn bank assets into central bank reserves and would thus provide an elastic currency that could be used to respond to changing stringencies in money markets more flexibly and continuously than could the issuance of emergency currency.

A closely related argument made by advocates of a central bank was that only central bank notes or reserves are certain to be liquid during a financial crisis (Sprague 1911).²⁸ Other assets were argued to be liquid only to the extent that they could be converted into central bank reserves:

In countries where these notes of the central banks are generally accepted in settlement of debts by business men and banks,

²⁶As early as 1868, the Comptroller argued in favor of providing some elasticity to the currency for use during times of stress, and at various times bankers had also argued for an elastic currency (Hamilton 1906 and Pugsley 1902), but these prior efforts had not resulted in any significant changes. White (1983) describes these and other initiatives.

²⁷Some, such as Silber (2007), have argued that the issuance of Aldrich-Vreeland currency in 1914 helped prevent a panic in U.S. financial markets associated with the onset of World War I.

²⁸In particular, Sprague (1911) and Warburg (1916) argued against thinking of interbank deposits as reserves even though these assets had traditionally been a part of banking reserves. They argued that interbank deposits tended to concentrate risk in a few large institutions, so that the entire system was affected if issues arose at those institutions and that there was no guarantee that those institutions in which the interbank deposits were vested would themselves remain liquid. Vanderlip (1908) noted that the interbank deposits created interdependence among financial centers and that once New York closed, other centers were compelled to suspend payments to out-of-town banks.

the “banking reserves” of the stock banks may safely consist of the central bank currency, or of a balance kept with the central bank, convertible into such currency. These form the first line of banking reserves. The second line consists of those assets which, with certainty and promptness, may be converted into credit balances with the central bank. (Warburg 1916, p. 9)

Central bank reserves can also be expanded rapidly by the central bank during a stress episode. Moulton (1918) noted that the expansion of liquidity is essential during a crisis, as banks are expected to be the source of liquidity for their non-financial customers during a crisis, and if banks are required to bolster their own liquidity to support their reserve by demanding repayment of, or even refusing to renew, loans during a crisis, then financial strains can be significantly exacerbated.

As a central bank would be able to provide a guaranteed liquidity backstop, individual banks would not need to hoard liquidity at the first sign of stress because they would know that the backstop would still be available in a crisis (again addressing the negative dynamics discussed in section 4.2.3). Warburg (1914) goes a bit further and argues that, in order to prevent hoarding, the backstop and ability to supply cash must have the absolute credibility that only a central bank can provide.²⁹ It was expected that the existence of the central bank would prompt a change in behavior during a panic and would stop minor stresses from escalating into full blown crises (Warburg 1916).

A third lesson was that the liquidity requirements that tried to strike a balance between ensuring that the liquidity of the banking system was maintained yet not hampering banks in providing credit were likely to be overwhelmed during a panic. Even critics of central banks sought ways to allow private market participants to expand the supply of liquid assets during a panic.

One other aspect of the Panic of 1907 that was not lost on policymakers was that institutions outside the normal banking system

²⁹However, it should be noted that the Federal Reserve was subject to a reserve requirement of its own in that each Reserve Bank had to maintain a gold reserve equal to 40 percent of its note issue and reserves in the form of gold or other eligible securities equal to the remaining 60 percent. Bordo and Wheelock (2010) argue that this requirement restrained the Federal Reserve actions at some times.

that were not required to maintain a reserve, in this case the trust companies, could precipitate a drain on the liquidity of the banking system (the moral hazard issue from section 4.3). The realization that these outside institutions could threaten the stability of the system may have prompted some large, influential New York Clearinghouse Association members to support a central bank (see Moen and Tallman 1999, White 1983).

5.2 Reserve Requirements after the Founding of the Federal Reserve

With the establishment of the Federal Reserve, required reserves were reduced, as it was expected that the liquidity backstop from the central bank provided individual commercial banks with a ready means of meeting extraordinary liquidity demands.³⁰ As noted by Rodkey (1934, p. 64):

With the advent of the Federal Reserve System in 1914, we entered upon an era of central banking . . . It is clear that the presence of a central bank, prepared to make advances on eligible assets, places the individual bank in a less vulnerable position with respect to demands of its depositors. It tends to lessen the need for primary reserves. The Federal Reserve Act recognized this fact by reducing materially the percentage of required reserves.

Westerfield (1921) noted that the reduction in reserves was appropriate for several reasons, including because the reserves were concentrated (as opposed to dispersed across banks throughout the system), because the reserves were “located in a central bank which feels its responsibility,” and because their “availability is now unquestioned.”³¹ Lunt (1922), who provided instructions to insurers on how to assess the quality of a bank from its balance sheet, noted that prior to the founding of the Federal Reserve, the statement of cash and cash items “was regarded as extremely important, and

³⁰See also Feinman (1993), who provides more detail on reserve requirements from the founding of the Federal Reserve until the 1990s.

³¹White (1983) suggests that further lowering the reserve requirements also enhanced the attractiveness of joining the Federal Reserve System.

banks that habitually carried larger reserves than those required by law were thought to be exceptionally safe" (p. 217). However, with the Federal Reserve, the "point seems far less important now, since any bank that has a proper loan account can replenish its reserve at will by the simple process of rediscounting."

While reserve requirements continued to be viewed as a tool to promote bank liquidity for some time, there was a gradual shift away from this view. Indeed, by the late 1930s, reserve requirements were no longer seen as playing an important role in providing liquidity:

The committee [Federal Reserve System Committee on Bank Reserves] takes the position that it is no longer the case that the primary function of legal reserve requirements is to assure or preserve the liquidity of the individual member bank. The maintenance of liquidity is necessarily the responsibility of bank management and is achieved by the individual bank when an adequate proportion of its portfolio consists of assets that can be readily converted into cash. Since the establishment of the Federal Reserve System, the liquidity of an individual bank is more adequately safeguarded by the presence of the Federal Reserve banks, which were organized for the purpose, among others, of increasing the liquidity of member banks by providing for the rediscount of their eligible paper, than by the possession of legal reserves. (Federal Reserve 1938)

It is useful to note that during this period, the Federal Reserve was a regular lender to the banking system. Burgess (1936) notes that in a typical month during the mid-1920s, about one-third of member banks obtained at least one loan or advance from their Reserve Bank. As a regular lender, it would be fairly easy for the Federal Reserve to provide additional liquidity to individual banks. The discount window was seen by Federal Reserve staff as the primary source of emergency liquidity for the banking system, especially after the range of eligible collateral was significantly expanded in 1932.

Rather than promoting individual bank liquidity, reserve requirements became seen as a tool to manage credit growth and facilitate the use of monetary policy. This development occurred as the Federal Reserve began to use open-market operations to adjust available reserves in the banking system as its primary monetary policy tool;

it was seen as impractical to have reserves both serve as a source of liquidity and be manipulated for monetary policy purposes.

The two main functions of legal requirements for member bank reserves under our present banking structure are, first, to operate in the direction of sound credit conditions by exerting an influence on changes in the volume of bank credit, and secondly, to provide the Federal Reserve banks with sufficient resources to enable them to pursue an effective banking and credit policy. (Federal Reserve 1938)

6. Lessons and Concluding Remarks

From the late 1830s until 1913, regulatory efforts aimed at promoting bank liquidity consisted primarily of reserve requirements that mandated that individual institutions hold liquid assets. However, these requirements were not sufficient to provide liquidity and prevent banks from suspending deposit withdrawals during banking panics. It became clear to many observers that the reserve requirements created, at best, a static pool of liquidity that banks would compete over during a crisis. To enable the expansion of that pool of liquid assets to meet the extraordinary liquidity demands experienced during a crisis, the Federal Reserve was established.

Policymakers today are considering various liquidity requirements for banks. For instance, under the Basel III requirements, banks will be subject to a liquidity coverage ratio (LCR). Under this requirement, banks will be required to maintain a stock of high-quality and liquid assets as a buffer that is sufficient to cover potential net cumulative cash outflows at all times during a thirty-day period. The LCR is similar to a reserve requirement in that it effectively requires liquid assets to be held against certain classes of liabilities (and lines of credit).

Several lessons from the historical reserve requirements for liquidity regulation today are apparent. One lesson is that it is extremely challenging to convince institutions to switch from maintaining a reserve to drawing down that reserve, especially during a period when their inclination is to take steps to bolster their liquidity situation. The historical experience highlights how the tendency to hoard liquidity can be heightened by uncertainty about when it is

appropriate to use the reserve and by uncertainties regarding the availability of other liquidity backstops. These uncertainties may in fact contribute to the strength and speed of the run and point to the importance of implementing modern regulations in ways that minimize these uncertainties.

The historical experience also shows that requiring some institutions to carry a reserve can cause other institutions to reduce their own reserves and rely instead on the institution subject to the requirement. Such responses have important implications for who benefits from and who bears the burdens of the liquidity requirements. In several historical episodes, other institutions put additional pressures on banks subject to reserve requirements to support them during panics. In at least one case, institutions not subject to the reserve appear to have made a conscious choice to reduce their own liquidity buffer because they believed the banks would need to use theirs.

References

- Allen, F., and D. Gale. 2007. *Understanding Financial Crises*. Oxford: Oxford University Press.
- Andrew, A. P. 1908. "Substitutes for Cash in the Panic of 1907." *Quarterly Journal of Economics* 22 (4): 497–516.
- Baer, H., and J. McElravey. 1993. "Capital Shocks and Bank Growth—1973–1991." *Economic Perspectives* (Federal Reserve Bank of Chicago) 17 (4): 2–21.
- Bankers Magazine*. 1894 (April). New York: Homans Publishing.
- . 1907a (July). New York: The Bankers Publishing Company.
- . 1907b (August). New York: The Bankers Publishing Company.
- . 1908 (November). New York: The Bankers Publishing Company.
- Basel Committee on Banking Supervision. 2010. *Basel III: International Framework for Liquidity Risk Management, Standards and Monitoring*. Bank for International Settlements.
- Bordo, M., A. Redish, and H. Rockoff. 1993. "A Comparison of the United States and Canadian Banking Systems in the Twentieth Century: Stability vs. Efficiency." NBER Working Paper No. 4546.

- Bordo, M., and D. Wheelock. 2010. "The Promise and Performance of the Federal Reserve as Lender of Last Resort 1914–1933." Working Paper No. 2010-036A, Federal Reserve Bank of St. Louis.
- Brunnermeier, M. 2009. "Deciphering the Liquidity and Credit Crunch 2007–2008." *Journal of Economic Perspectives* 23 (1): 77–100.
- Buiter, W. 2009. "Central Banks and Financial Crises." In *Maintaining Stability in a Changing Financial System*. Proceedings from an Economic Policy Symposium sponsored by the Federal Reserve Bank of Kansas City, held in Jackson Hole, Wyoming, August 21–23, 2008.
- Burgess, W. R. 1936. *The Reserve Banks and the Money Market*. New York: Harper and Brothers Publishers.
- Calomiris, C. 2009. "Banking Crises and the Rules of the Game." NBER Working Paper No. 15403.
- . 2011. "Identifying the Right Mix of Capital and Cash Requirements in Prudential Bank Regulation." Mimeo, Columbia University.
- Calomiris, C., and G. Gorton. 1991. "The Origins of Banking Panics: Models, Facts, and Bank Regulation." In *Financial Markets and Financial Crises*, ed. G. Hubbard, 109–75. Chicago: University of Chicago Press.
- Calomiris, C., F. Heider, and M. Hoerova. 2012. "A Theory of Bank Liquidity Requirements." Mimeo, Columbia University.
- Cao, J., and G. Illing. 2011. "Endogenous Exposure to Systemic Liquidity Risk." *International Journal of Central Banking* 7 (2): 173–216.
- Coe, G. 1873. *Report to the New York Clearing House Association*. New York: W. H. Arthur & Company.
- Coffin, G. 1896. *Handbook for Bank Officers*. Washington, DC: McGill and Wallace.
- Comptroller of the Currency. Various years. *Annual Report*. Washington, DC: U.S. Government Printing Office.
- Dwight, E. 1858. "The Financial Revulsion and the New York Banking System." *Hunt's Merchants Magazine and Commercial Review* 38 (February): 157–63.
- Federal Reserve. 1927. *Report on Member Bank Reserve Requirements*. Memorandum prepared by Mr. Smead of the Division of Bank Operations.

- . 1938. *Member Bank Reserve Requirements – Analysis of Committee Proposal*. Memorandum prepared by Woodlief Thomas.
- Feinman, J. 1993. “Reserve Requirements: History, Current Practice, and Potential Reform.” *Federal Reserve Bulletin* (June): 569–89.
- Friedman, M., and A. Schwartz. 1963. *A Monetary History of the United States, 1867–1960*. Princeton, NJ: Princeton University Press.
- Glass, C. 1913. Speech in the House of Representatives on September 10.
- Goodhart, C. 2008. “Liquidity Risk Management.” *Financial Stability Review* (Banque de France) 11 (February): 39–44.
- Hamilton, J. 1906. “Currency Reform.” Address before the Michigan Bankers Association in Grand Rapids, Michigan, June. Reprinted in *Practical Problems in Banking and Currency*, ed. W. Hull. New York: Macmillan Company, 1907.
- Herrick, M. 1908. “The Panic of 1907 and Some of Its Lessons.” *Lessons of the Financial Crisis, Annals of the American Academy of Political and Social Science* 31 (2): 8–25.
- Hooper, S. 1860. *An Examination of the Theory and the Effects of Laws Regulating the Amount of Specie in Banks*. Boston: Little, Brown and Company.
- James, J. 1978. *Money and Capital Markets in Postbellum America*. Princeton, NJ: Princeton University Press.
- James, J., D. Weiman, and J. McAndrews. 2013. “Wall Street and Main Street: The Macroeconomic Consequences of New York Bank Suspensions 1866–1914.” *Cliometrica* 7 (2): 99–130.
- Kettell, T. P. 1848. “The Money of Commerce.” *De Bow’s Review* 6 (October): 243–64.
- Kroszner, R. 1995. “Free Banking: The Scottish Experience as a Model for Emerging Economies.” Policy Research Working Paper No. 1536, World Bank.
- Lunt, E. 1922. *Surety Bonds*. New York: The Ronald Press Company.
- MacKenzie, K. 1932. *The Banking Systems of Great Britain, France, Germany, and the United States of America*. London: McMillan and Company.
- Miller, H. 1927. *Banking Theories in the United States Before 1860*. Cambridge, MA: Harvard University Press.

- Moen, J., and E. Tallman. 1999. "Why Didn't the United States Establish a Central Bank Until After the Panic of 1907?" Working Paper No. 99-16, Federal Reserve Bank of Atlanta.
- Moulton, H. G. 1918. "Commercial Banking and Capital Formation, part III." *Journal of Political Economy* 26 (7): 705–31.
- Nash, W. 1908. "Clearing-House Certificates and the Need for a Central Bank." In *Lessons of the Financial Crisis, Annals of the American Academy of Political and Social Science* 31 (2): 61–66.
- Noyes, A. 1894. "The Banks and the Panic of 1893." *Political Science Quarterly* 9 (1): 12–30.
- . 1901. "The Trust Companies: Is There Danger in the System?" *Political Science Quarterly* 16 (2): 248–61.
- Opdyke, G. 1858. *A Report on the Currency*. New York: John Trow, Printer.
- Perotti, E., and J. Suarez. 2011. "A Pigovian Approach to Liquidity Regulation." *International Journal of Central Banking* 7 (4): 3–41.
- Pugsley, C. 1902. "Emergency Circulation." Address to the American Bankers Association in New Orleans, Louisiana, November. Reprinted in *Practical Problems in Banking and Currency*, ed. W. Hull. New York: Macmillan Company, 1907.
- Ratnovski, L. 2009. "Bank Liquidity Regulation and the Lender of Last Resort." *Journal of Financial Intermediation* 18 (4): 541–58.
- Roberts, G. 1908. "The Need of a Central Bank." In *Lessons of the Financial Crisis, Annals of the American Academy of Political and Social Science* 31 (2): 45–54.
- Rochet, J.-C. 2008. "Liquidity Regulation and the Lender of Last Resort." *Financial Stability Review* (Banque de France) 11 (February): 45–51.
- Rodkey, R. 1934. *Legal Reserves in American Banking*. Ann Arbor, MI: University of Michigan, School of Business Administration, Bureau of Business Research.
- Secretary of the Treasury. 1894. *Report of the Secretary of the Treasury*. Washington, DC: U.S. Government Printing Office.
- Silber, W. 2007. "The Great Financial Crisis of 1914: What Can We Learn from Aldrich-Vreeland Emergency Currency?" *American Economic Review: Papers and Proceedings* (May): 285–89.

- Sprague, O. M. W. 1908. "The American Crisis of 1907." *Economic Journal* 18 (71): 353–72.
- . 1910. *History of Crises Under the National Banking System*. Washington, DC: National Monetary Commission.
- . 1911. "The Aldrich Plan for Monetary Legislation." *American Economic Review* 1 (2): 262–71.
- . 1913. *Banking Reform in the United States*. Cambridge, MA: Harvard University Press.
- Stein, J. 2013. "Liquidity Regulation and Central Banking." Address at the Credit Markets Symposium sponsored by the Federal Reserve Bank of Richmond, held in Charlotte, North Carolina, April 19. Available at <http://www.federalreserve.gov/newsevents/speech/stein20130419a.htm>.
- Stickney, A. B. 1901. "The Medium of Exchange and the Banking Function." Address to the American Bankers Association in Milwaukee, Wisconsin, October. Reprinted in *Practical Problems in Banking and Currency*, ed. W. Hull. New York: Macmillan Company, 1907.
- Suviranta, B. 1933. "The Shiftability Theory of Bank Liquidity." In *Economic Essays in Honour of Gustav Cassel*. London: G. Allen & Unwin.
- Tucker, G. 1839. *The Theory of Money and Banks Investigated*. Boston: Charles Little and James Brown.
- . 1858. "Banks or No Banks." *Hunt's Merchants Magazine and Commercial Review* 38 (February): 147–57.
- Vanderlip, F. 1908. "The Panic as a World Phenomenon." In *Lessons of the Financial Crisis, Annals of the American Academy of Political and Social Science* 31 (2): 2–7.
- Wall Street Journal*. 1907. Various issues.
- Warburg, P. 1914. "A United Reserve Bank of the United States." *Proceedings of the Academy of Political Science in the City of New York* 4 (4): 75–115.
- . 1916. "The Reserve Problem and the Future of the Federal Reserve." Speech before the Convention of the American Bankers Association, Kansas City, Missouri, September 29.
- Warner, J. D. 1895. "The Currency Famine of 1893." *Sound Currency* 2 (6): 337–56.
- Welldon, S. 1910. *Digest of State Banking Statutes*. Washington, DC: National Monetary Commission.

- Westerfield, R. 1921. *Banking Principles and Practice*, Vol. I and II. New York: The Roland Press Company.
- White, E. 1983. *The Regulation and Reform of the American Banking System, 1900–1929.* Princeton, NJ: Princeton University Press.
- White, H. 1893. “National and State Banks.” *Annals of the American Academy of Political and Social Science* 3 (May): 1–30.
- Wicker, E. 2000. *Banking Panics of the Gilded Age*. New York and Melbourne: Cambridge University Press.