

Why Was There No Banking Panic in 1920-1921? The Federal Reserve Banks and the Recession

Abstract

Prior to the formation of the Federal Reserve's Open Market Investment Committee in 1923, the Federal Reserve banks enjoyed considerable discretion in discounting and open market operations. During the 1920-1921 recession that followed the Fed's sharp increase in discount rates, we show with new data that Federal Reserve banks in hardest-hit districts expanded rather than contracted credit to their member banks in the early stage of recession. To prevent widespread bank runs within their Districts, this group of Federal Reserve banks sought to mitigate the effects of the recession. Although they were individually constrained by gold reserve requirements, as was the System as a whole, the expansionary Reserve banks were able to borrow excess gold reserves from the other Reserve banks and continue or expand lending. While they were ultimately compelled to implement the contractionary policy dictated by the Board, these Federal Reserve banks sustained lending for a prolonged period to their member banks who took their additional credit primarily in the form of currency. Buffered by increased liquidity, these banks were able to meet withdrawals by customers, preventing a banking panic, allowing the record number of suspended banks to pursue an orderly liquidation.

Ellis Tallman
Federal Reserve Bank of Cleveland

and

Eugene N. White
Rutgers University and NBER

Preliminary—Not for Citation
December 20, 2019

I. Introduction

This paper asks why there was no banking panic associated with the severe economic contraction of 1920-21 in the U.S.. Prior to that contraction, deeper recessions were associated with banking panics. National Banking Era panics typically began with a bank run at a major financial institution, which then spread throughout the banking system--the Banking Panic of 1907 being a prime example. These events took place in a setting without a central bank and the aftermath of the 1907 panic gave momentum for the establishment of the Federal Reserve System. However, the Great Depression and the associated banking panics during the period 1929-33 took place despite the presence of the Federal Reserve System, so the existence of a central bank was not the cure all for banking panics. The absence of a banking panic in 1920-21 remains a conundrum because the severe macroeconomic contraction tracks closely to the trajectory of the first years of the Great Depression. Furthermore, the observed distress in the banking sector revealed by both the contraction in deposits relative to currency and the increase in bank suspensions also mimics the disruptions in both the National Banking Era crises and the banking panics of the Great Depression. In a largely ignored episode of Federal Reserve history, this paper highlights the policies implemented by the Federal Reserve System in 1920-21 that may explain the puzzling absence of a panic.

We argue that during the severe recession of 1920-1921, the individual Federal Reserve banks pursued substantially different policies, responding to the disparate conditions of member banks in their districts. The more industrial and urbanized Federal Reserve districts followed contractionary policies, seeking to restore a price level and interest rates consistent with the gold standard, following the lead set by the Federal Reserve Board and the Federal Reserve Bank of New York. The commodity price collapse that followed the end of World War I was a huge economic shock that affected agricultural and rural districts much harder than industrialized districts leading their Federal Reserve banks to expand credit and to provide the liquidity needed to offset conditions that might have ignited a banking panic. While these Southern and Western Federal Reserve banks were criticized for bailing out speculators and protecting imprudent bankers, their region-driven policies may have prevented a financial panic, on the scale of the 1907 panic, and perhaps a much worse contraction. The independent role that the Districts banks played in managing the first big recession that the Fed faced has been overlooked because the standard histories of the Federal Reserve (Friedman, 1963; Meltzer, 2003) focused on policy making by the Federal Reserve Board and the Federal Reserve Bank of New York.

Our analysis highlights the role played by temporary transfers of lending capacity between Federal Reserve district banks in the form of inter-district loans of gold reserves. At the time, Federal Reserve System district banks were required to hold minimum gold reserves of no less than 40 percent of their outstanding currency and 35 percent of their member bank deposits (the two largest components of Federal Reserve credit), which at times imposed a binding constraint on Federal Reserve credit. In no instance did any Federal Reserve District bank violate the gold reserve requirement when expanding its balance sheet to extend credit. We use this observation to justify the identification strategy to consider gold reserve borrowings to be exogenous to Federal Reserve credit within the same month. Then, we demonstrate how credit extensions by the Federal Reserve banks in the agricultural Districts relied upon their ability to borrow gold reserves from other district banks with excess gold reserves.

By reallocating gold reserves across Districts, these loans facilitated a credit expansion that would have occurred naturally in a branch banking system, whose development in the U.S. had been thwarted by nineteenth century anti-branching laws. Although correspondent banking

had served as a partial substitute for branching for the inter-regional allocation of funds in the pre-Federal Reserve era, it only worked well in periods of moderate economic fluctuations. It failed to deliver funds to the least liquid banks in 1907, after a series of large shocks ignited a panic. Again in 1920-21, a sharp contraction, magnified the risk of offering credit, especially for correspondent banks that operated across the nation. In this the first downturn, when the Federal Reserve System was fully-operational, we see the inter-district lending of gold reserves as a reasonably effective conduit for cross-district—interregional---‘emergency’ liquidity provision.

A significant literature argues that during the National Banking Era (NBE, 1864-1913), clearing houses were capable of acting as lenders of last resort.¹ Our analysis highlights how inter-district gold reserve lending extended crisis liquidity provision powers beyond the pre-existing clearing house system. In cities, where there was a clearing house, the total emergency liquidity provision was limited to the capital capacity its constituent member banks. Although the Federal Reserve System was largely based on the clearing house system, the Federal Reserve Act of 1913 made an explicit provision for the lending of gold reserves between District Reserve banks. This mechanism for the interregional transfer of reserves was absent in the pre-Fed era, as city-based clearing houses had no means to provide mutual assistance. That provision was the essential element that allowed the Fed to reallocate credit capacity across regions in ways that were unavailable to clearing houses during the NBE.

We assert that inter-district gold reserve lending provided the liquidity that diminished the threat of a banking panic during the 1920-21 contraction. In its absence, the limited reserves of Federal Reserve district banks in agricultural areas would have prevented them from issuing needed liquidity to their member banks. The dearth of liquidity might have forced these member bank to adopt a tactic common in the NBE of suspending convertibility to halt a panic. Yet the suspension of convertibility of deposits into cash in NBE panics was unpopular and costly and was a last-resort action taken by banks to preserve their liquidity. In the NBE, those panics associated with suspensions were also associated with the most severe real output contractions.

The independence of the regional Federal Reserve banks in this period (the very early years of the System) is central to understanding the conduct of Fed policy. Richardson and Troost (2009) and Carlson, Mitchener and Richardson (2011) have shown that the Reserve banks had enough discretionary authority to contain a panic and moderate contractionary forces in the Great Depression before the reform of the System’s governance by the Banking Act of 1935 that centralized authority for monetary policy in the Federal Open Market Committee. However, the period we consider preceded the Federal Reserve Board’s famous Tenth Annual Report (1923). That report recognized the need to coordinate discounting and open market operations for a consistent general credit policy and led to the formation in the Spring of 1923 of the Open Market Investment Committee and a system-wide account that pro-rata allocations to the Reserve banks of centrally determined open market operations (Friedman and Schwartz, 1963, p. 251). Thus, we examine the pre-1923 period when the Reserve banks had the greatest latitude for pursuing their own policies, even resisting directions from the Board of Governors and pressure from other Reserve banks.

While the Federal Reserve Board initially deplored their divergent policies, it eventually conceded the success of the dissenting Reserve banks efforts in 1920 to mitigate the effects of the recession in their districts. In spite of this recognition, the inter-Federal Reserve bank lending that had channeled credit to the harder hit districts was terminated in 1922. Official contemporary

¹ See Gorton (1985), Timberlake (1984 and 1993), and Hoag (2018). See also Tallman and Moen (2012) and Moen and Tallman (2015).

documents tend to minimize the battle within the Fed, leaving the impression for modern researchers (Eichengreen, et al., 2015) that there was seamless cooperation within the System. Yet, internal archival documents, such as the boards of directors' minutes of the Federal Reserve District banks and the correspondence between banks and the Board (White, 2017) reveal an intense struggle over a regionalized monetary policy.

In the second section of this paper, we describe the origin and characteristics of 1920-1921 recession; and in the third, the susceptibility of the economy to panics when markets – especially, financial markets -- were less than fully integrated. In the fourth, we document the divergence of policy among the Federal Reserve banks, while in the fifth, we examine the debate among the Federal Reserve banks and members of the Federal Reserve Board over what might be termed, member banks' dissenting policies. In the sixth section, we provide some econometric evidence that inter-district lending of gold reserves permitted Federal Reserve banks in the districts most exposed to the post World War I agricultural price shocks to provide an exceptional increase in credit to their member banks. In turn, these member banks primarily took their credit in the form of currency rather than deposits at their Federal Reserve banks. Liquidity for banks in districts hardest hit by the recession increased substantially when conditions for a banking panic—a decline in economic activity and a massive increase in the number of bank suspensions---ripened. Ordinarily, in such circumstances, panics had erupted; but not this time.

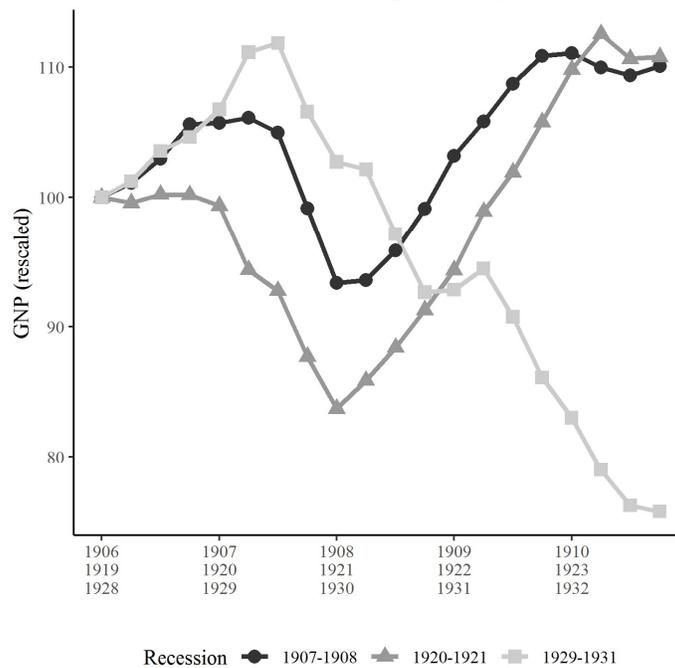
I. The Panic-Less Recession of 1920-1921

The conventional view of the 1920-1921 recession is that it was severe but relatively brief. Figure 1 compares this recession with those of 1907-1908 recession and the initial years of the Great Depression. The speed and depth of the post-World War I recession is strikingly similar but was unaccompanied by a banking panic. The 1907-1908 exhibits the same V-shape as 1920-1921, with a sharp four-quarter drop in GNP of 9.8 percent and a four-quarter bounce back of 13.4 percent. For 1920-1921, there was a 16.5 percent decline and a 12.4 percent recovery for the same time spans. From the peak in 1929, GNP fell 12.6 percent in a year; and rather than recovering plunged a further 11.2 percent in the next four quarters. The contracting years 1907-1908 and 1929-1930 both saw major banking panics but not 1920-1921; and in 1931 two more panics magnified further the plunge of GNP.

In this paper, we define banking panics as events in which there is a shut-down response within the banking system when it is faced with a risk of widespread disintermediation. These disintermediation risks rise when one observes one or more of the following characteristics: an increase in the currency to deposits ratio, a measurable signal of banking distress like a sharp increase in short-term liquidity borrowing, or an upward spike in the number of bank suspensions. Any or all of these characteristics may arise for only a short duration of time, and still create an increase in the costs of intermediation. Actions like a suspension of convertibility of deposits into cash or restrictions on the payment of cash are examples of the “shut-down” response that was endemic to the NBE banking panics.²

² In the NBE panics, the issuance of clearing house loan certificates, a temporary form of additional liquidity, would also be a signal of panic. However, discount window loans from the Federal Reserve System were aimed to improve on that facility, and we would not want to imply that large-scale liquidity borrowing was sufficient for a banking panic akin to those of the NBE. See Gorton and Tallman (2018) for a definition of banking panics during the NBE.

Figure 1
Three Recessions---Quarterly GNP



Source: Robert J. Gordon, ed., *The American Business Cycle: Continuity and Change* (Chicago: Chicago University Press, 1986), Appendix B and <http://www.nber.org/data/abc/> Note: Quarterly GDP is rescaled to 100 = first observation.

Empirically, Jalil (2015) provides the first comprehensive survey of measures of panics and identifies 7 major panics and 20 non-major panics in the United States between 1825 and 1929. The last major panic before the establishment of the Fed was during October-November 1907 and then there were non-until October-December 1930. However there were “non-major” (Jalil’s phrase) panics in Boston (August-September 1920), North Dakota (November 1920-February 1921), Florida and Georgia (July 1926), Florida (March 1927) and Florida (July-August 1929). The Boston and North Dakota events fall within the recession months of 1920-21. They are worth examining in detail even though they were minor and did not pose a threat of broader contagion, highlighting the absence of a major panic.

Mentioned in the *Commercial and Financial Chronicle* and catalogued by Jalil as “bank disturbance,” the Boston event was not a run or a panic set off by recession but was the result of the collapse of Charles Ponzi’s scheme.³ Ponzi used the Hanover Trust Company to cloak his transactions; and when Ponzi was arrested, the state bank examiner took control of the bank on August 11, 1920.⁴ Apparently unconnected to Ponzi, three more trust companies suspended payment in September 1920 when rumors of their poor condition sparked large withdrawals. This action combined with statements from the Boston Clearing House that it stood ready to provide assistance calmed depositors.⁵ None of these state-chartered trust companies had become

³ (Jalil 2015, appendix; *Commercial and Financial Chronicle* (October 2, 1920, p. 1327)

⁴ *Commercial and Financial Chronicle* (August 14, 1920), p. 644 and 661,

⁵ Massachusetts Trust Companies were allowed to cease payment for 90 days in extraordinary circumstances.

members of the Federal Reserve; consequently, the Federal Reserve Bank of Boston left matters to the bank commissioner and the clearing house, while pursuing a contractionary policy that pressured businesses and banks in its district. (Federal Reserve Bank of Boston, 1920. In its Annual Report for 1920, the Boston Fed acknowledged the drastic decline in the region's economy, viewing it as necessary to halt the expansion of credit that had fueled a speculation-driven inflation. It is worth quoting the section of the reviewing banking condition:

There have been no failures among member banks during 1920 and, while a few banks have at times become somewhat over-extended in their loans, liquidation of these to proper limitations have been gradually brought about through the help and co-operation of the Federal Reserve Bank. The failure of several of the smaller Boston trust companies in the early Fall caused but temporary disturbance to other banking institutions. These trust companies had large savings deposits and handled a character of business peculiar to themselves and, therefore, their closing was little felt by other institutions. (Federal Reserve Bank of Boston, 1920, p. 13)

Disturbance is certainly the correct term the Boston event, not panic or even minor panic.

In contrast to Boston, the twenty-three North Dakota bank failures, in the district of the Federal Reserve Bank of Minneapolis formed a minor panic. Expansionary operations by a group of Federal Reserve banks, including the Minneapolis Fed, ended in September 1920 when they were forced to abide by the Board's contractionary directives. In the face of tighter credit, it is not surprising that some banks began to weaken. The underlying cause of the closing in North Dakota was the decline in the price of wheat. The Commercial and Financial Chronicle (November 27, 1920, p. 2101) reported a cluster of thirteen bank closings where farmers drew down their deposits holding back their crops, waiting for higher prices. These and additional closings that occurred through February 1921 were expected to be temporary and some banks reopened once conditions improved; although ultimately some failed. The state commissioner of agriculture and labor blamed the Federal Reserve for failing to provide banks with enough credit to tide them over. The Minneapolis Fed seemed unconcerned, as it did not mention bank runs in its Annual Reports for 1920 and 1921. It simply reported that out of approximately 1,000 member banks in the district 7 were in liquidation in 1920 and 16 in 1921. In summary, there was no contagion to the other banks in the district much less to other districts. These isolated instances in Massachusetts and North Dakota thus do not remotely approach the magnitude of nationwide bank runs of 1907 and 1930 and may even not deserve the name of "minor panics."

Thus, in the face of a huge economic shock, the question for the country as a whole remains, what would account for the absence of a major panic in 1920-21? Table 1 reports the number of bank failures for the same years covered in Figure 1. The condition of banks in the years just before a recession would likely determine to a considerable degree their susceptibility to insolvency [the banking sector being weaker in each successive episode], so the number and the percentage change in failures are displayed as a rough adjustment for any trend factors. Again, the recession of 1920-1921 was no less severe than the 1907-1908 and 1929-1930 recessions on the banks, with the number of suspensions rising more sharply. The similarity of circumstances would seem to have presaged a major banking panic in 1920 or 1921; but none occurred and the economy experienced a bounce-back recovery.

Table 1
Bank Suspensions in Three Recessions

Year	Number of Suspensions	Percentage Change from Previous Year	Year	Number of Suspensions	Percentage Change from Previous Year	Year	Number of Suspensions	Percentage Change from Previous Year
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1906	53	-33.8	1919	62	31.9	1928	498	-25.6
1907	90	69.8	1920	167	169.4	1929	659	32.3
1908	153	70.0	1921	505	202.4	1930	1350	104.9
1909	78	-49.0	1922	366	-27.5	1931	2293	69.9

Source: Board of Governors of the Federal Reserve System, Banking and Monetary Statistics (Washington, D.C., 1943), Table No. 66.

Both the absence of a central bank in 1907 and the absence of an appropriate policy by the Federal Reserve in 1930-1933 contributed to the rise in bank failures and the outbreak of panics. The contractionary actions of the Fed during 1920-1921 would seem to have set up the right conditions for a panic to erupt. We suggest that this “puzzle” is answered in part by the fact that monetary policy was decentralized. Like the city-based clearing houses of the NBE, the Federal Reserve banks served their members by clearing and collecting checks and providing temporary credit, with one crucial difference. The clearing houses were not interconnected and could not quickly and efficiently transfer gold reserves amongst themselves. As long as there was extra liquidity in the Federal Reserve System as a whole, reserves could be shuffled among the banks. While the Federal Reserve System was imposing a contractionary policy in the aggregate, the expansionary policies of the individual Federal Reserve banks in the districts most exposed to agricultural price shocks caused a reallocation of liquidity to those regions, even as total liquidity shrank. The result was to mitigate the effects of the shocks to the weakest districts, reducing the likelihood of a panic, even as banks closed their doors in record numbers.

The absence of a panic in 1920-1921 is remarkable. Not only did GDP decline more than in 1907-1908, but deposits at banks shrank significantly by similar magnitudes. Comparing the two events is somewhat difficult because deposits were measured differently. Ideally one would like to have all deposits for all depository institutions at a relatively high frequency. While this is not possible for reasons that will be explained, all the available evidence show an unmistakably larger decline in deposits in 1920-1921---something that in the past would have been indicative of a panic. The only comprehensive data for the pre-Federal Reserve and Federal Reserve eras is total deposits for national and state banks on June 30 of each year, which is shown in Table 2 for 1907-1909 and 1919-1922. Having only the June 30th data misses the October 1907 panic but is close to the July 1921 bottom of the recession. Although an imperfect measure, the shrinkage of deposits in 1920-1921 is much greater 8.86 percent compared to 2.38 percent. There is one caveat, which is that between 1907 and 1908, state banks fall by 6.77 percent while national banks rise by 2.26 percent, offsetting part of the fall and attributable to the flight to quality banks as highlighted in Moen and Tallman (1992). Both categories of banks show major declines in 1920-1921, with national banks’ deposits dropping 11.75 percent and state banks by 6.32 percent.

Table 2
Deposits of National and State Banks
(June 30, \$1000s)

	National Banks	State Banks	Total	Percentage Change
1907	6,188	6,539	12,727	
1908	6,328	6,096	12,424	-2.38
1909	6,932	6,857	13,789	
1920	17,159	19,523	36,682	
1921	15,142	18,289	33,431	-8.86
1922	16,323	19,210	35,533	

Source: Historical Statistics, Series Cj225 and Cj170

Call report data provides us with a more accurate picture of deposit behavior over time, but only for the national banks in this era and it is measured differently in the years before and after 1914. In Table 3, total deposits from the call reports for 1907-1909 are measured as individual deposits plus interbank deposits (due to national banks, state banks, and trust companies). For the years 1920-1922, total deposits are the sum of demand deposits and time deposits. Measuring the decline is a bit tricky, given that the total decline in deposits occurred over different periods of time. The call dates with the lowest reported deposits columns 2 and 6 are highlighted: December 3, 1907 and September 6, 1921. Columns 3 and 7 show the days that will elapse from one of three high points to the lowest point. The largest fall in deposits for 1907-1907 occurs over the shortest interval: 7.39 percent; for the same number of days for 1920-1921, the drop is slightly smaller, 5.05 percent. However, the total drop of 12.3 percent from the peak in 1920 to September 6, 1921 that took 295 days is larger than the 3.95 percent drop that occurred over a very similar interval for 1907-1908. While one might argue that a panic erupted in 1907 with the rapid drop of 7.39 percent of deposits compared to 5.05 percent in 1921, it is hard to image that the much larger total magnitude of 12.3 percent could not also have produced a panic.

Table 3
Deposits of National Banks
(in thousands of dollars)

Call Date	Deposits	Days from [1] to 12/3/1907	Percentage Change in Deposits	Call Date	Deposits	Days from [5] to 9/6/1921	Percentage Change in Deposits
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
11/12/1906	5,844			11/15/1920	13,719	295	-12.30
1/26/1907	5,752	311	-3.95	12/29/1920	13,136	251	-8.40
3/22/1907	5,866	256	-5.81	2/21/1921	12,672		
5/20/1907	5,966	197	-7.39	4/28/1921	12,299	197	-5.05
8/22/1907	5,874			6/30/1921	12,404		
12/3/1907	5,525			9/6/1921	12,032		
2/14/1908	5,655			3/10/1922	12,283		
5/14/1908	5,967			5/5/1922	12,625		

Source: U.S. Comptroller of the Currency, Annual Reports, various years.

Table 4 contains information that allows a comparison of business cycles from the early 20th century, those associated with panics (like 1907 and the Great Depression) as well as those not associated with panics. We employ this selection of business cycles along with important measures of business cycle characteristics – a proxy measures for the severity of the real output contraction in each business cycle along with a proxy measure to indicate the degree of cash hoarding, in other words a sign of a liquidity crisis in the banking system. For the real output proxy measure, we use the percentage change in Industrial Production as estimated by Miron and Romer (1990). For the liquidity proxy, we use the maximum percentage change in the currency deposits ratio (measured by Friedman and Schwartz 1970) observed during the contraction under examination. We emphasize the maximum percentage change because panics may begin after the start of the economic downturn and end prior to the end of the economic contraction and as a result using measures from the business cycle peak to trough may understate the degree of the liquidity crisis as experienced when it took hold.

Table 4
Business Cycles With and Without Panics

Table 10: Business Cycles with and without Panics			
NBER Business Cycle Dates Peak – Trough	Panic Date	Maximum percentage change observed in $\Delta(C/D)$, and timing in contraction	Percentage change in real output proxy peak to trough
May 1907 – Jun. 1908	Oct. 1907	25.7 from July to Dec. 1907	-16.6
Jan. 1910 – Jan. 1912	No Panic	3.4 From March to Oct. 1910	-2.3
Jan. 1913 – Dec. 1914	Aug. 1914	12.9 From July to Oct. 1914	-11.0
Jan. 1920-July 1921	No panic	9.6 From Jan. to Oct. 1290	-25.4
May 1923-July 1924	No panic	-2.1 Jun to July 1924	-17.6
Oct. 1926 – Nov. 1927	No panic	-8.8 From Oct. 1926 – Nov. 1927	-2.0
Aug. 1929 – Mar. 1933	Nov. 1930, April 1931, Aug.- Nov 1931 Jan-Mar. 1933	1.3 From Oct. 1929 to Sep. 1930 35.1 From Oct. 1930 to Sep. 1931 72.6 From Oct. 1931 to Mar 1933	-32.8

Source: NBER Business Cycle Dates, <https://www.nber.org/cycles/cyclesmain.html>. Currency to Deposits ratio taken from Friedman and Schwartz 1970, Industrial production (real output proxy) from Miron and Romer 1990: <https://www.nber.org/databases/macroeconomy/data/01/m01130aa.db> panic dates from Gorton 1988, Jalil 2015 and Wicker 1996.

Table 4 highlights the fact that the contraction of 1920-21 is associated with a sharp increase in the currency to deposits ratio, comparable to the one experienced in 1914 that is associated with a banking panic. Note that the rise in the currency to deposits ratio in 1907 is virtually double that in 1914. For 1907, the cash hoarding reflects a full-blown panic unmitigated by either the interventions of the Aldrich-Vreeland associations in 1914 or discount window lending by the Federal Reserve System in 1920-21. The business cycles in 1923-24 and 1926-27 are less severe with respect to the magnitude of the real contraction, and are not associated with a sharp increase in the currency to deposits ratio. In fact, the 1926-27 recession is associated with a significant decline in the currency to deposits ratio, which was continuous throughout that recession. In 1920-21, the shock to output, measured by the IP measure in the last column, is of a magnitude that would have destabilized the banking system in periods prior to the Federal Reserve System. We emphasize that the output contraction was larger in 1920-1921 than for any other recession in Table 4 with the exception of the Great Depression.

Instead of examining panics in the presence of output shocks or business cycles, other scholars have focused on aggregate price shocks as a key determinant of financial booms and busts. Using this criteria, a panic in 1920-1921 should have occurred because the deflation that followed World War I constituted the most serious price shock that the U.S. would experience during the whole gold standard era (1790-1933), with the exception of the Great Depression. Bordo, Dueker, and Wheelock (2002) investigated the effects of aggregate price shocks on financial stability. Rather than model panics, they measure financial distress, forming indexes based on quantitative and qualitative measures, the former composed of standardized distances from the median values of the business failure rate, the bank failure rate, and the real interest rate spread and the latter on Thorp's (1926) narrative of financial conditions extended by descriptions found in the Annual Reports of the Board of Governors of the Federal Reserve. The indexes had values of 1 to 5, representing "extreme distress," "moderate distress," "normal," "moderate expansion," and "euphoria." It should be noted that a period of extreme distress will not necessarily include a panic.

Table 5 attempts to reconcile this work on banking distress with banking panics. As can be seen immediately, the dates for major and non-major panics do not line up with the dates for severe and moderate distress. Part of the problem is due to the artificial division of banking distress into calendar years that tend to mismeasure both the indexes of stress and the explanatory variable that Bordo et. al. focus upon. Their article highlights the role played by unexpected price shocks, positive shocks creating financial "euphoria" and negative shocks creating financial distress. There are three big unexpected negative price shocks associated with a panic or distress. The first are shocks in 1893 and 1894 measured as -1.7 and -5.2 percent and are associated with a Jalil banking panic in 1893 and BDW qualitative severe banking distress but only quantitative moderate distress in 1893. The next is 1907-1908, where the price shocks are 3.0 and -4.3 percent that probably blur the shock by using yearly changes and yield the panic of 1907 and minor troubles in 1908 and very oddly only moderate banking distress for 1907-1908. The giant annual price shock falls within 1920-1921 recession, where price shocks for the full years are 10.6 and -15.3 percent. This annual shock for 1921 is more than twice the next largest for this 45 year period, but Jalil identifies no major panic and only the minor disturbances discussed above, with Bordo et. A. finding moderate qualitative and quantitative banking distress.

Table 5
Banking Panics and Banking Distress
1870-1929

Jalil Major	Jalil Non Major	BDW Severe Distress	BDW Moderate Distress	BDW Severe Distress	BDW Moderate Distress	BDW
Banking Panic	Banking Panic	Qualitative Index	Qualitative Index	Quantitative Index	Quantitative Index	Unexpected Aggregate Price Shock (Percent)
1873		1873			1873-77	-1.1
		1874				-3.7
			1875			-0.5
		1876				-1.7
			1877			-1.0
				1878		-0.6
	1884		1883-85		1884	-2.2
	1890					-1.4
1893		1893			1893	-1.7
		1894				-5.2
			1895			
	1896	1896				-0.1
	1899					-1.1
	1901					-0.5
	1903		1903			1.4
	1905					-2.3
1907			1907-08			3.0 (1907)
	1908					-4.3(1908)
			1914			-0.3
	1920-21					10.6(1920)
			1921		1921-22	-15.3 (1921)
	1926					1.3
	1927					0.3
	1929					2.5

Whether measured by the magnitude of the shock to the real economy, the sharp increase in liquidity demands, or the deflationary surprise, the absence of a banking panic during the 1920-21 recession seems an anomaly. We believe that a general panic was avoided because the District banks, whose member banks had the greatest need for liquidity, were able to borrow gold reserves via the mechanism created by the Federal Reserve Act to facilitate the lending of gold reserves across District banks. Thus, during the first phase of the 1920-21 recession, the Federal Reserve banks in predominantly agricultural regions tapped into the large excess reserves of the Boston, Cleveland, New York and Philadelphia Reserve Banks, enabling them expand the credit offered to their member banks who took it primarily in the form of currency. Once the Federal Reserve

System as a whole approached the legal gold reserve ratio, the expansionary. District banks had to follow the contractionary lead of the Board and the four Northeastern banks. However, having blunted the initial shock of the recession, the threat of a banking panic receded

To set the stage for analyzing Fed policy, we review the background of the 1920-1921 recession, beginning with the end of World War I and illustrated with some selected statistics in Table 5. Moving from a wartime to peacetime economy presented major challenges and the Fed committed “several mistakes, some avoidable, some unavoidable in the circumstances” (Meltzer, 2003, p. 90). These policy choices first accelerated the postwar boom and then magnified the bust.

Table 6
Selected Economic Statistics, 1913-1929

Year	Manufacturing Production	Consumer Price Index	Manufacturing Wholesale Price Index	Wholesale Farm Products Price Index	Unemployment	Gold Stock	New York Federal Reserve Bank Discount Rate
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
1913	100	100.0	100.0	100.0	5.7	na	
1914	91.9	100.9	95.0	100.0	8.5	1,526	5.0
1915	102.7	101.5	97.5	100.0	9.0	2,025	4.0
1916	122.4	110.8	126.1	118.3	6.5	2,556	3.0
1917	123.4	133.5	163.9	181.1	5.2	2,868	3.5
1918	121.3	156.9	177.3	207.8	1.2	2,873	4.0
1919	118.5	180.2	184.9	221.1	2.3	2,707	4.75
1920	125.7	208.8	230.3	211.7	5.2	2,639	7.0
1921	97.3	186.5	149.6	123.9	11.3	3,373	4.5
1922	128.8	174.7	146.2	131.7	8.6	3,642	4.0
1923	152.8	177.8	149.6	138.3	4.3	3,957	4.5
1924	140.8	178.1	142.9	140.0	5.3	4,212	3.0
1925	157.6	182.6	147.1	153.9	4.7	4,112	3.5
1926	160.8	184.4	142.9	140.6	2.9	4,205	4.0
1927	156.5	180.9	134.5	139.4	3.9	4,092	3.5
1928	163.4	178.4	132.8	148.3	4.7	3,854	5.0
1929	173.6	178.4	131.1	146.7	2.9	3,997	4.5

Sources: U.S. Index of Manufacturing Production 1863-1930, NBER Macrohistory, <http://www.nber.org/databases/macroeconomy/contents/chapter01.html>, U.S. Consumer Price Index, <https://www.measuringworth.com/usdpi/result.php>, Carter, et. al., *Historical Statistics*, Wholesale prices Industrial commodities Series Cc67, Wholesale prices Farm Products Series Cc68, Unemployment, Series Ba745, Governors of the Federal Reserve System, *Banking and Monetary Statistics* (1943), Gold Stock, p. 536, Table No. 156 and New York Federal Reserve Bank discount rate, pp. 439-440, Table No. 115.

First, there was a fiscal shock. Following the armistice in 1918, the federal government slashed its expenditures and quickly shrank the size of the military. This action contributed to the brief recession of August 1918-March 1919; however, it was partly offset by the low interest rate

policy of the Fed that continued to assist the Treasury with the sales of the Victory Bond issue. Desirous of maintaining bond prices, the Treasury favored a low interest policy (Friedman and Schwartz, 1963). In April 1918, the New York Fed had set its rates for discounts and advances on eligible paper at 4 percent, well below the market rates and maintained this rate until November 1919. All the other Reserve banks adhered to this policy and none set a rate higher than 4 ½ percent. The upsurge in discounts to member banks that had been rising quickly paused during the 1918-1919 recession and then continued.

This Fed policy to maintain discount rates ‘lower than the market interest rate’ contributed to a commodities and general economic boom, beginning in early 1919 and peaking in January 1920. As seen in Table 6, prices, whether measured by the consumer price index or the manufacturing or farm products wholesale price indexes increased sharply, with manufacturing output also rising quickly. Many of the Federal Reserve banks were alarmed by the rapid decline in their gold reserves, as expansionary policy combined with the end of the Gold Export Embargo in June 1919 had led to a drop in the gold stock for the first time in years, with gold flowing out of the United States (Column 7 in Table 6). As a whole, the Federal Reserve System’s gold reserve ratio fell from 50.6 percent in June 1919 to 42.7 percent in January 1920. Under pressure from the Treasury, the Federal Reserve Board exercised its authority to veto requests from the Federal Reserve Banks of New York and Boston to raise their rates. But, when several Reserve banks neared their 40 percent gold reserve minimum, the Board allowed the New York bank to raise its rate to 4 ¾ percent in December 1919. The other Reserve banks followed suit and rates rose to 5 and eventually 6 percent. Yet, the upward swing of commodities prices meant that member banks that could charge 10 percent or more on their loans still found it profitable to borrow at the increased Reserve bank discount rates. In an attempt to discourage borrowing, Congress passed the Phelan Act of 1920 that permitted the Federal Reserve to set progressively higher rates for member banks that borrowed heavily. Although the Board retained its authority to veto any basic rate changes, it delegated the power to determine progressive rates to the district banks.

The boom collapsed in January 1920 just as many reserve banks’ discount rates reached 6 percent, leading Friedman and Schwartz (1963, p. 231) to comment that “The rise in the discount rates in January was not only too late but also probably too much.” In June 1920, the Federal Reserve Bank of New York raised its discount rate to 7 percent. The recession, beginning in January 1920 and reaching a trough in July 1921, became a severe one. Although the annual statistics Table 6 partly mask the full extent of the economic decline, manufacturing output declined 23 percent, while consumer, manufacturing and farm prices plunged by 11, 35 and 41 percent, with unemployment rising to 11.3 percent. Distress on the farm and in the factory led to an unparalleled uptick in bank suspensions from 62 in 1919 to 167 in 1920, and then 505 in 1921, as seen in Table 1.

Yet, many in the Fed were not keen to cut rates quickly. The desire was not only to terminate inflation but to bring prices down to a level that would be consistent across countries when the international Gold Standard was resumed. However, prices stubbornly remained well above any of the prewar price level measures seen in Table 6. The Governor of the Federal Reserve Bank of New York, Benjamin Strong, was opposed to any discount rates cuts so long as market interest rates were higher. In his words, the Fed should be following “Bagehot’s golden rule” (Chandler, 1958, p. 173-4) and make the discount rate a penalty rate to deter any inflationary impulse. This expression was an apparent misinterpretation of Bagehot, whose rule was aimed at temporary provision of credit during financial crises. Strong was applying the rule to a year of actively contracting credit. He wanted to see member bank borrowing reduced by 20 percent.

Although the Federal Reserve Bank of New York steadily cut its bills purchased, its member banks' level of discounts scarcely dropped, leading the bank to raise its discount rate to 7 percent in June 1920, in the midst of the recession. Boston had raised its rate to 7 percent in May 1920; but though other Federal Reserve banks like Cleveland and Philadelphia followed this "austerity" program, they kept their rates at 6 percent. While the Board and Benjamin Strong pushed this policy favored by some banks, those banks in agricultural regions where the collapse of the commodities boom threatened the existence of their member banks resisted it.

The demise of the commodities boom created a severe inter-regional balance of payments imbalance between Districts whose economies were primarily agricultural and those that were primarily manufacturing. Wallace (1956) describes the situation faced by banks in agricultural districts, where farmers unable to sell their products at a high enough price to liquidate their bank loans, drew down their bank deposits to pay debts to merchants and factors. Those merchants and factors who received payments from the farmers then paid wholesalers or manufacturers in the cities who in turn liquidated their bank loans. In every such transaction, an equivalent amount of reserves was transferred from the bank in the agricultural area to the bank in the non-agricultural area, thereby forcing the former (agricultural area bank) to borrow heavily at their Federal Reserve banks. This problem was exacerbated by the Phelan Act of 1920, which permitted heavily borrowing member banks to be charged progressively higher interest rates. Although the Act's intention was to restrain those banks that expanded their loans most rapidly during the postwar boom and inflation, the progressive discount rates had a perverse effect during the recession that began in 1920. Banks (in the Atlanta and Kansas City Districts, specifically) paid the announced discount rate so long as their borrowings did not exceed their "basic" line set equal to $2\frac{1}{2}$ times the sum of 65 percent of their average monthly reserve banks and the paid-in capital stock of the borrowing bank.⁶ Above this threshold, borrowing member banks paid an extra $\frac{1}{2}$ percentage point on the additional amount borrowed, which was increased by $\frac{1}{2}$ percentage point and applied to that additional borrowing every time the borrowing bank borrowed an additional 25 percent more than their basic line. The problem was compounded further because the substantial inter-regional balance of payments movements drained reserves from the member banks in agricultural districts, reducing their average monthly reserve balances, thereby reducing the basic line thresholds and automatically hiking their marginal and average borrowing costs. The member banks of the Atlanta and Kansas City districts were especially hard hit by this factor, yet member banks in the Dallas and St. Louis districts also faced challenges from inter-regional payment imbalances. Thus, the Phelan Act amplified already powerful forces that in past circumstances had induced banking panics.

In this specific instance, the Phelan Act and its implementation made a bad situation worse. For example, as the recession progressed, the agricultural district member banks held on average a smaller volume of reserves, thereby reducing the "base line" borrowing level amounts for member banks. In situations when banks need additional reserves, like when member banks face depositor withdrawals that reduce cash balances, borrowing from the Federal Reserve district bank should be an attractive option. Situations like short-term liquidity provision were what motivated

⁶ The quantity 2.5 reflects the inverse of the gold reserve requirement (.40) that applied to Federal Reserve District banks issues of currency. The .65 reflects the fact that District Reserve Banks would have to hold .35 gold reserve against reserve balances held at the Federal Reserve Bank by member banks. Formulas for calculating the base line borrowing limit were different for the Dallas and St. Louis Districts. Dallas used a calculation dependent only upon paid in capital and surplus, whereas the St. Louis calculation of base line depended upon required reserve balances rather than reserve balances held by the member bank. Wallace (1956: 61) that cites Congressional Record, Senate, LXIV, 1923, 2557.

the establishment of the Federal Reserve System, so it is not surprising that member banks would want to exercise that option. But the Phelan Act made borrowing from the Fed more expensive for those banks facing the largest need for additional reserves or currency for depositor withdrawals.

II. Susceptibility to Regional and National Financial Crises

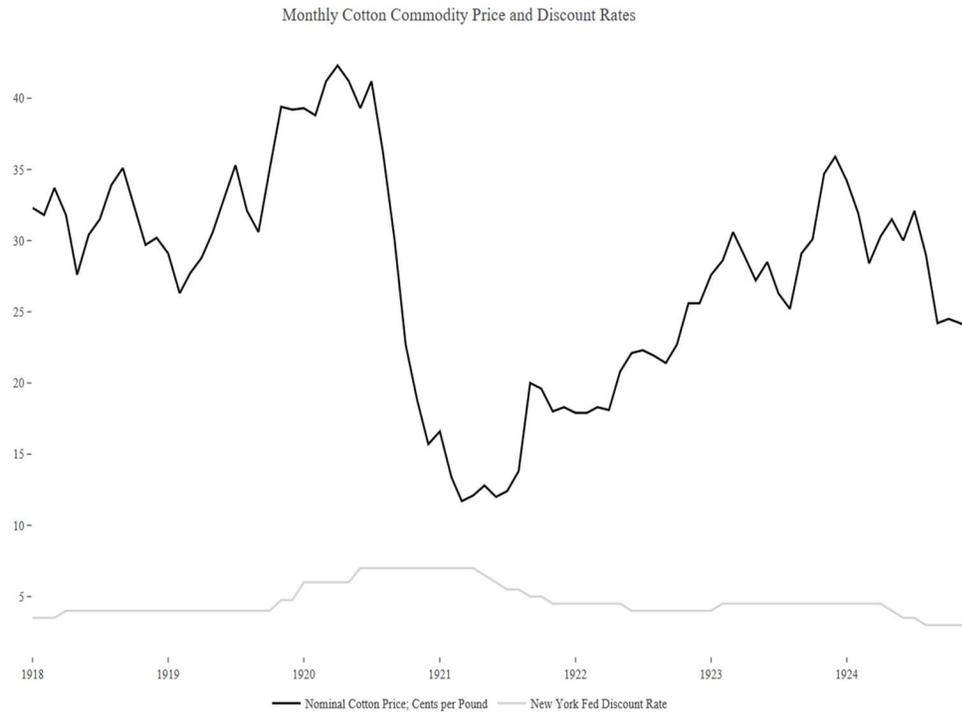
While some might object that we only consider the ability of the Federal Reserve to allocate liquidity inter-regionally, there is evidence the inter-bank market was not sufficiently integrated to obviate a need for central bank intervention; nor did the labor market or other markets provide a mechanism to adjust to asymmetric regional shocks. Theoretically, Freixas, Parigi, and Rochet (2000) and Allen and Gale (2009) show that in models of a multi-region economy with systemic risk that liquidity surplus regions can supply liquidity short regions. If there is a shortage of aggregate liquidity, a shock may be transmitted from the weaker regions to the stronger regions by unexpected forced liquidations, which may then yield a general banking and economic crisis. The possibility of a shock producing a regional or general crisis is greater if money markets are not fully integrated and/or if interbank market for liquidity is characterized by information asymmetries that may be exacerbated by shocks. Both of these conditions appear to have been present in the early 1920s, leaving the twelve Federal Reserve banks facing very different regional conditions during the recession of 1920-21.

In the early twentieth century, the U.S. economy was far less integrated than it is today. One way to look at market integration and the issue of how to structure monetary policy is through the lens of the optimal currency literature. If U.S. regions—or Federal Reserve districts---may be viewed as separate currency areas, there may be a case for differential monetary policy or in the extreme, which is what the literature focuses on, different currencies. To be a candidate for a separate currency/monetary area (Rockoff, 2010), a region should have several attributes: (1) it should be a large area, (2) its specialized goods should be subject to shocks that are not symmetric to other regions, (3) labor mobility between regions is limited, (4) capital mobility between regions is limited, and (5) fiscal transfers between regions are limited.

Although there were no legal impediments in the United States to the movement of goods, money/capital, and, to a lesser degree, labor, these conditions were at least in part fulfilled. The Federal Reserve districts were approximately as large in size and income as many European countries, and there was a high degree of specialization. The specialized regions may not have conformed exactly to the boundaries of the Fed districts, but their output was distinctive. Most significantly, the Southern and Western regions were heavily dependent on agriculture, much more so than even the Midwest. The most distinctive region was the South. Before the Civil War, sugar, tobacco, rice and cotton were its dominant crops for market; but in the second half of the nineteenth century, cotton absorbed an even larger share of resources than it had before the war. At the time of the 1920-21 recession, cotton was a leading economic sector in the Atlanta, Dallas, Richmond, and St. Louis districts. It was most important in the Sixth District (White, 2017), Atlanta, where the mid-1920 fall in cotton prices caused acute distress for the region's banks whose loans were heavily collateralized by cotton.

The wild gyrations of the price of cotton relative to the discount rates that regulated the flow of credit to cotton growers is seen in Figure 2. While credit was cheap when cotton prices rocketed upwards, the collapse during the recession drastically raised the cost of repayment.

Figure 2



Source: U.S. Wholesale Price of Cotton, New York; 10 Markets 09/1870-12/1945, NBER Macrohistory

Left scale is cents per pound for cotton price, and percent for Discount rate.

The desperate state of cotton was described by one of the directors of the Federal Reserve Bank of Richmond's Board, D. R. Coker

It appears to me that the worst trouble with the whole situation in the country is unequal deflation. The cost of living in our section has not gone down more than a small fraction as much as the deflation of cotton. In less than a year, cotton has declined approximately 80 percent and cottonseed approximately 80 percent in value; that is, the two products of the cotton fields have gone down and are bringing in today about one fifth of that they were bringing a year ago. I know of no other agricultural product that has declined so much. (Fifteenth Conference of Federal Reserve Banks, 1921, p. 562).

Coker spoke sympathetically of the "thousands of our desperately poor and ignorant tenants in the South" and gave a painful example: "I know a negro who owned 500 acres of land; he bought 500 acres next to him and paid \$250.00 an acre for it. Unless he is helped for five or six years he will probably lose both farms." Facing the same dilemma was the plantation owner "who bought 15,000 acres for \$50,000 and borrowed but now he is losing money on his crops, cant' make payments" (Fifteenth Conference of Federal Reserve Banks, 1921, p. 598).

In terms of the labor market, the South was the most distinctive region, having limited labor mobility with the rest of the American economy until after World War I (Wright, 1996, Collins, 1997). In terms of the money market, Landon-Lane and Rockoff (2004) found that for the pre-Depression era, “monetary shocks were communicated to all parts of the United States by financial markets, but that the level and timing of the responses was erratic.” There was less than complete integration for the Plains, the West and the South. For example, the vector auto-regression results in Landon-Lane and Rockoff showed that most of the variance in the forecast errors in the Western, Plains and Southern rates are not explained by the national rate. In the South, shocks to the national rate accounted for only 10 percent of the variance of the forecast errors for 1880-1913 and 20 percent for 1914-1943. They concluded: “In the nineteenth century, perhaps until World War II, the peripheral regions of the United States did not simply import interest rate shocks from other regions. They generated their own....This lack of synchronicity set a difficult problem for a potential monetary authority.”⁷

Part of this lack of integration was certainly a result of the prohibition on branching by national banks and most state banks (White, 1983) that created an industry populated almost exclusively by unit banks. Consequently, there were 20,000 commercial banks in the United States in 1920. However, American banks were imperfectly tied together through correspondent banking networks that facilitated the holding of reserves and movement of funds for investment around the country.

Branching restrictions also limited the distribution of bank capital across regions, effectively enforcing capital barriers across regions. Different regions had banks of various capital levels. New York City and the northeast had the banks with the largest capitalization, followed by the industrial centers of Chicago and Cleveland. Because of branching restrictions, banks with higher capital levels could not expand outside its region.

Complicating matters further was the dual banking system where banks could be chartered by the federal government via the Office of the Comptroller of the Currency or by the states through their state banking agencies. Only national banks and state banks that met most of the qualifications for national banks could be member of the Federal Reserve System. These member banks could receive direct injections of liquidity from a Federal Reserve Bank that discounted their paper; but for the greater number of state non-member banks that had not joined the system; liquidity would then have to be obtained indirectly through the intermediation of member banks.

The success of these banking networks in transferring funds and arbitraging interest differentials relied on limited published information---that did not fully capture the condition of banks’ balance sheets or underlying loan collateral. The only consistent information on another bank could publicly obtain was from the short balance sheets of national banks in the Call Reports published three to five times a year or from the four or five item weekly data published for members of clearing houses. Loan quality was practically invisible. This information asymmetry was partly bridged by reputation but that might easily vanish in the wake of a severe shock. In the Sixth District, for example (White, 2017) a substantial portion of member and non-member bank loans were collateralized by cotton and other commodities that rendered their balance sheets opaque to other banks, especially those outside of the region who were less familiar with its specialized activity. Thus, illiquid banks could find it difficult to access the regional and national intermarket market for liquidity because of the heightened information asymmetries.

⁷ It should be noted that these tests for market integration all rely on annual data that sometimes may smooth over shocks---booms and busts---and hence may not fully capture the moments of crisis.

To shore up their own liquidity in a crisis, banks refused to renew loans, which were typically short-term, forcing their customers to quickly dump their stocks of commodities on the market. In a process theoretically described by Shleifer and Vishy (1992), Diamond and Rajan (2009), and Caballero and Simsek (2009), fire sales for commodities and commodity-backed bills could break out and send prices for the commodities as well as bills backed by them below their fundamental prices. The rapid descent of prices could then produce a cascade of bank failures and possibly a full-fledged bank panic in which regions may have imposed a suspension of convertibility or an extended bank holiday.

Given the regional economic differences in the United States and the less than perfect integration of many markets, shocks could affect regions asymmetrically and lead to very different regional economic outcomes. There were no significant fiscal stabilizers to transfer purchasing power to offset the asymmetric effects of negative shocks in the 1920s. Thus, regional conditions perceived by twelve Federal Reserve banks could be quite different, leading to divergent policy efforts. The decentralized and distributed structure of the Fed was in no small part a reflection of the concerns by local bankers and businesses that a centralized authority would not serve them well and hence the Federal Reserve banks were delegated a relative degree of autonomy, which would be pushed to near its limits during the recession of 1920-21.

III. Inter-Federal Reserve Bank Lending

In contrast to the pre-1914 clearing house assistance to banks, where resources were limited to the city or local area, a Reserve bank could expand its discounts because it could borrow gold reserves from other Reserve banks with ample reserves in the 1920-1921 slump. That is, the powers of the Federal Reserve System allowed it to circumvent the capital barriers that prevented clearing houses from reallocating credit across regions during the NBE. Although guided by the Federal Reserve Board, the Federal Reserve District banks had a relatively high degree of autonomy. Even though they were established by the Federal Reserve Act of 1913, the district banks were not government agencies but were owned by their member banks—all the national banks that were required to join and all state banks that voluntarily joined. District reserve banks were governed by their member-elected boards of directors who closely guided the day-to-day activities of the Reserve banks, meeting either as a whole or as an executive committee once or more a week. Their design resembled the clearing houses that had been established in every major city in the nineteenth century to assist with the clearing and collection of checks and that had provided emergency liquidity in the form of clearing house loan certificates to their members during financial crises. The value of this liquidity provision during the Panic of 1907 led Congress to provide for similar federally established association under the Aldrich-Vreeland Act of 1908, while it considered broader banking reform. Thus, the Federal Reserve banks could be viewed as an evolutionary extension of the clearing houses and Aldrich-Vreeland associations.

A signal difference, however, was that the twelve Federal Reserve banks provided not just emergency liquidity but regular liquidity to ease the sharp seasonal demands that were thought to be the primary contributors to financial panics. In accordance with this objective and the real bills doctrine's framework, loans were intended to be short-term. Section 14 of the Federal Reserve Act specified that the Reserve banks could "discount notes, drafts, and bills of exchange arising out of actual commercial transactions" "for agricultural, industrial or commercial purposes." Except for U.S. government securities, they were prohibited from providing credit collateralized by stocks or bonds. The portfolio of the Reserve banks was dominated by discounts, which were

provided “passively,” to member banks who applied to the discount window depending on the posted discount rates. The maturity of discounts was limited to 90 days, except for agricultural and livestock paper and bills of exchange that had a maximum permissible maturity of six months. In addition, the Reserve banks could discount trade acceptances with maturity up to three months. Open market operations---“active” policy---were secondary to discounting and were conducted by the purchase of specified types of bills and securities.

Subject to the approval of the Federal Reserve Board, each Reserve bank could set its discount rates. Rates were not uniform and within each instrument-specific rate, they diverged as much as one percent. The Board exercised its authority by frequently denying Reserve bank requests for discount rate changes or permission to use a new type of collateral. Discounting and open market operations of the Reserve banks were then constrained by their individual reserve requirements. The Federal Reserve Act set these reserve requirements in lawful money---primarily gold and certificates for gold held by the Treasury---at 40 percent for a bank’s Federal Reserve notes and 35 percent for member bank deposits held as reserves at the District Federal Reserve Bank. (McCalmont, 1963, p. 12). In practice, the gold reserve ratio of a Bank was calculated as equal to total gold reserves divided by the sum of its notes outstanding plus net deposits (excluding the float).⁸ A Federal Reserve Bank could violate this requirement if the Federal Reserve Board authorized a suspension, which could be for up to 30 days, renewable for another 15 days.⁹ However, the Board had to impose a graduated tax on the shortfall.¹⁰ Yet, penalties actually imposed were trivial because a Federal Reserve Bank with deficient reserves could call upon other Banks to lend it reserves.

By forming a decentralized central bank where each Federal Reserve Bank had to maintain its own reserve ratio, the Federal Reserve Act of 1913 created a problem where regionalized shocks would create major problems for individual Banks. This inherent problem was recognized by Benjamin Strong, when the Act was being debated. He wrote:

the establishment of twelve regional institutions is dangerous...Entire freedom of interchange of discount should exist. Otherwise, when the burden of one district becomes too heavy for the local institution to carry....the other eleven....would endeavor to strengthen their own resources rather than discount for the institution requiring such accommodation. (Chandler, 1958, p. 34).

To manage this potential problem, the Federal Reserve Act gave the Board the power, upon affirmative vote of a minimum of five members, to require Federal Reserve Banks to rediscount the discounted paper of other Federal Reserve Banks at a rate of interest fixed by the Board. To manage the regular inter-Reserve bank lending, a “Gold Settlement Fund” was created in

⁸This accepted method was conveniently calculated on a daily basis, although it is a slightly higher ratio than that called for by the Act of 1913. McCalmont (1963, p. 17) reports that requirements were later calculated as total (gold) reserves less forty percent of notes divided by net deposits. The two measures are only equal if the reserve ratio is forty percent.

⁹ This permission to violate the reserve requirements parallels the power of the British Chancellor of the Exchequer to issue a “chancellor’s letter” promising to indemnify the Bank of England if it violated its legal minimum reserves under the Bank Act of 1844.

¹⁰ The 1913 Act set the rates against the shortfall for Federal Reserve notes but left the Board free to set the tax rate on deposit deficiencies (McCalmont 1963, p. 25). For example, the Board’s 1920 Annual Report (p. 46-48) shows that Boston paid \$239, New York \$23,301, Atlanta \$181, Chicago \$147, Minneapolis, \$78, Kansas City \$96, Dallas \$74 and San Francisco, \$547.

Washington, D.C. If a Federal Reserve Bank saw its gold reserves dropping and approaching the legal minimum, it could sell bills and securities and discourage use of the discount window or it could rediscount bills with another Reserve bank in exchange for gold. The rediscounting bank would then wire the Gold Settlement Fund to transfer gold certificates between the accounts of the two banks. The official gold reserve ratio of the borrowing bank was then raised and for the lending bank it was lowered. Most of these transfers were voluntary though the Board ultimately could compel assistance.

Rediscounting was one method to transfer reserves temporarily from a surplus Bank to a deficit Bank, but there were two other methods that were also employed. Federal Reserve Banks also bought bankers acceptances from each other to replenish reserves, and a Federal Reserve Bank could request an alteration in its share of bankers acceptances offered to the System. From the opening of the Fed in 1914 to 1922, “re-rediscounts” were the principal form of interbank assistance, although Reserve banks also bought acceptances from each other; but from 1923 to 1933, there were no re-rediscounts and Reserve banks bought acceptances and government securities from each other to provide reserve assistance. (McCalmont, 1963, p. i).

Although the Reserve Banks initiated re-rediscounts and trading in acceptances, the Board tried to emphasize the importance of its role in the inter-District transfers, as it was anxious “that the men conducting the actual day-to-day operations of the Reserve Banks should not relegate it [the Board] to a minor role.” In its Annual Report of 1918 (p. 3) the Board trumpeted that “Discount transactions between the banks have not, as a rule, been negotiated by the banks themselves, but through the medium of the Federal Reserve Board, instructions being given by telegraph.” In its 1919 Annual Report (pp. 5-6), it reported “There has been such a spontaneous spirit of cooperation between the Federal Reserve Banks that all transactions suggested by the Federal Reserve Board have been made voluntarily, and in no case has the Board found it necessary to exercise its statutory power to require such operations.” This public posture may have obscured the fact that the Reserve Banks, not the Board, were the driving force in the shifting of reserves because their relative needs to provide credit to their districts.

What the Federal Reserve Board could influence were the rates for re-discounts. On March 15, 1915, the Board fixed the rate of re-rediscount at 3 ½ percent for all classes of paper under 30 days maturity and 4 percent for over 30 but less than 90 days. On May 29, 1917, the Board set a rate of 3 percent for all paper maturing up to 90 days, but there were no re-rediscounts until December 1917 when it appears that transactions went through at individually negotiated but apparently unreported rates (McCalmont, 1963, p. 31). The Board faced a difficult problem in setting this rate, as Reserve Banks could be charging different rates to their member banks in their respective districts and consequently a fixed rate could result in one Reserve Bank subsidizing another or enforcing losses on a borrowing Bank. Discontent over this issue was raised in the September 1920 meeting of the Federal Advisory Council. The discussion was summarized:

The question now arises, however, whether a Federal Reserve Bank which has been able to maintain a high [gold (added)] reserve by reducing the demands for accommodation from its own member banks, which are its depositors, should be required to extend accommodation to member banks in other districts through the medium of their Federal Reserve Bank at the same rates as are established for their own members. (quoted in McCalmont, 1963, p. 32-33).

Acknowledging this problem, the Board raised the interbank rate to 7 percent on September 7, 1920 for paper discounted by the Federal Reserve Bank of Cleveland, and then extended the rate to all inter-Federal Reserve Bank discounts on September 13, 1920. The rate was lowered to 6.5 percent on May 13, 1921, 6 percent on June 23, 1921, and 5.5 percent on November 3, 1921. As economic conditions eased, the concerns about re-rediscunts diminished and there were no longer any re-rediscunts outstanding by March 22 1922. After this date, there were no new re-rediscunts until 1933. Instead, the Banks pooled open market operations through the System Account,¹¹ though discounting remained under the authority of the Reserve Banks.

V Divergent Federal Reserve Bank Policies

Although it was originally intended to assist with very brief gold reserve shortages, inter-Federal Reserve bank lending also eased the medium-term constraint on any Federal Reserve Bank. If each of the Federal Reserve banks had been legally obliged to maintain their reserve ratios independently in 1920-1921, those in agricultural districts would have been constrained to follow the contractionary policies initiated in Washington, D.C. Instead, the district banks in areas exposed to the dramatic commodity price shocks resisted demands that they adhere to a policy of austerity until the middle of the recession.

This divergence can be seen in Table 6, which depicts the changes in the credit volumes (discounts to member banks and bills purchased) supplied by the Reserve banks to their member banks. The data presented is new, culled from the Annual Reports of the individual Federal Reserve Banks and other sources and the data permit a window onto the diverging policies of the Federal Reserve Banks. To provide a sense of the relative size of each banks' operations the outstanding credit at the end of December 1919 is given in Column 3. New York is obviously the giant, with Chicago and Cleveland a distant second and third. The change in each Reserve bank's discount rate from December 1919 to February 1920, the outset of the recession, is shown in Column 4. Column 5 displays the actual reserve ratio for the Reserve banks and in parentheses the adjusted reserve ratio, that is, the ratio that would have resulted if the bank had not borrowed or lent reserves from other Reserve banks. It should be noted that the adjusted reserve ratio was in the original reports so that each bank was aware of all twelve banks' borrowing-supported reserve position. Columns 6 and 7 display the percent change in the volume of credit from the beginning of the recession to mid-recession in September 1920 and the prevailing rates at the end of that month. Column 8 presents the reserve and adjusted reserve ratios for November 1920. The decline of credit during the recession is provided in Column 9 and the discount rates prevailing for the end of the recession, July 1921, in Column 10.

¹¹“Once a week each Reserve Bank's proportion of the aggregate purchases of the System would be figured on the basis of its reserve percentage at the close of the preceding week and the distribution would be effected accordingly. Such Banks as may have purchased more than their portion would be requested to make sales from their portfolio to such other Bank or Banks as the secretary of the Open Market Investment Committee might indicate” (McCalmont, 1963, p. 50).

Table 7
Hawks and Doves:
Federal Reserve Banks' Credit Policies 1919-1921

No.	District	Credit Outstanding 12/1919	Discount Rates 12/1919-2/1920	Gold Reserve (Adjusted) Ratios 1/1920	Percent Change in Credit (With Adjusted Ratio of Column 8) 12/1919 to 9/1920	Discount Rate 9/1920	Gold Reserve (Adjusted) Ratios 9/1920	Percent Change in Credit 12/1919 to 7/1921	Discount Rate 7/1921
1	2	3	4	5	6	7	8	9	10
1	Boston	211,342	4.75-6.00	42.6 (42.3)	-27.4 (-6.48)	7	51.4 (66.2)	-68.3	6.00
2	New York	1,028,991	4.75-6.00	40.3 (39.3)	-2.5 (-4.26)	7	43.7 (42.9)	-62.5	5.50
3	Philadelphia	212,838	4.75-6.00	40.6 (35.4)	-23.1 (-7.75)	6	48.5 (58.2)	-43.5	6.00
4	Cleveland	281,423	4.75-6.00	48.3 (49.0)	-55.1 (-26.94)	6	48.3 (78.6)	-50.7	6.00
5	Richmond	119,963	4.75-6.00	44.6 (41.9)	19.5 (-17.61)	6	42.5 (29.3)	5.1	6.00
6	Atlanta	106,453	4.75-6.00	48.5 (50.6)	59.6 (-33.01)	6	40.5 (17)	-1.2	6.00
7	Chicago	349,009	4.75-6.00	50.3 (57.3)	44.1 (30.06)	7	39.1 (35.3)	-18.9	6.00
8	St. Louis	115,171	4.75-6.00	48.9 (48.9)	38.9 (-27.43)	6	40.2 (21)	-26.4	6.00
9	Minneapolis	84,458	4.75-6.00	50.2 (50.2)	26.7 (-28.08)	7	39.1 (22.2)	-16.3	6.50
10	Kansas City	131,530	5.00-6.00	49.6 (49.6)	43.8 (-35.93)	6	41.3 (18.4)	-29.2	6.00
11	Dallas	61,795	5.00-6.00	62.0 (62.0)	85.4 (-53.41)	6	39.8 (10)	24.4	5.50
12	San Francisco	165,300	4.75-6.00	40.3 (41.3)	34.9 (42.29)	6	40.3 (42.5)	-14.7	5.50

Source: Annual Reports of the individual Federal Reserve banks.

Note: "Adjusted" is the counter-factual gold reserve ratio that would have existed in the absence of gold reserve lending across Federal Reserve District banks.

The table is shaded to contrast districts 1 through 4 and districts 5 through 12, roughly the divide between more industrial and more agricultural districts—termed Hawks and Doves to reflect their divergent efforts to contract or expand credit. The latter covered the regions particularly hit by the commodities price collapse and neatly identifies the policy split within the Fed. At the beginning of the recession, the more industrialized districts had much lower reserves generally than the more agricultural districts, though Cleveland, Richmond and San Francisco had somewhat different positions. It is notable that both New York and Philadelphia had borrowed reserves via the Gold Settlement Fund; if they had not they would have, at 39.3 and 35.4 percent, fallen below the 40 percent required reserve ratio. These Reserve banks would have been desirous to have their member banks repay their loans and thereby replenish their reserves and provide them with a sufficient gold cushion. In contrast, the more agricultural districts were flush with reserves in January 1920 and even provided some reserves to New York and Philadelphia.

For the Federal Reserve System as a whole, the need to halt inflation and ensure that aggregate gold reserves were sufficient dictated that all the banks raise their discount rates. While they quickly raised their discount rates to 6 percent by February 1920, only Districts 1 through 4

saw declines in the credit to their member banks, large percentage changes, ranging from -23.1 to -55.1 percent, except for New York, which had a small decline. Member banks in the agricultural districts, Districts 5 through 12 had dramatic increases in credit, ranging from 19.5 percent in Richmond to 85.4 percent in Dallas. In both industrial and agricultural regions, these credit movements were generated by changes in discounts to member banks rather than changes in bills purchased. Member banks in Districts 5 to 12 were not discouraged from borrowing.

Expanding discounts to member banks caused the gold reserves of District banks 5 to 11 to drop as seen by comparing columns 5 and 8. These Reserve Banks now had to replenish their reserves temporarily by borrowing from Boston, Philadelphia and Cleveland. Without these borrowed gold reserves, these seven Reserve Banks would have theoretically had reserve ratios, indicated by the adjusted reserve ratios (in parentheses in column 8), of 18.0 to 39.4 percent, in several cases substantially below the 40 percent requirement.

In Table 8, we calculate the associated percentage change in Federal Reserve credit that would have been extended under the counter-factual assumption implied by the gold reserve ratio that would have been observed in the absence of gold reserve lending across districts. Large contractions in credit would have been occurred in the districts of Richmond, Atlanta, St. Louis, Minneapolis, Kansas City, and most notably in Dallas. In each instance, the absence of borrowed gold reserves would have forced double digit contractions in the level of credit extended by these district banks to their member banks. Recognizing that gold reserve borrowing allowed these same banks to increase their lending to member banks by double digit percentages over the 12/1919 to 9/1920 period, the counter-factual exercise highlights the degree of accommodation that the gold reserve lending enabled.

Table 8
Counterfactual Federal Reserve Credit with no Inter-Reserve Bank Lending
December 1919 to September 1920

No.	District	Percent Change in Credit	Percent Change in Credit Derived from the Adjusted Reserve Ratio 9/1920
1	2	6	6A
1	Boston	-27.4	-6.48
2	New York	-2.5	-4.3
3	Philadelphia	-23.1	-7.8
4	Cleveland	-55.1	-26.9
5	Richmond	19.5	-17.6
6	Atlanta	59.6	-33.0
7	Chicago	44.1	30.1
8	St. Louis	38.9	-27.4
9	Minneapolis	26.7	-28.1
10	Kansas City	43.8	-35.9
11	Dallas	85.4	-53.4

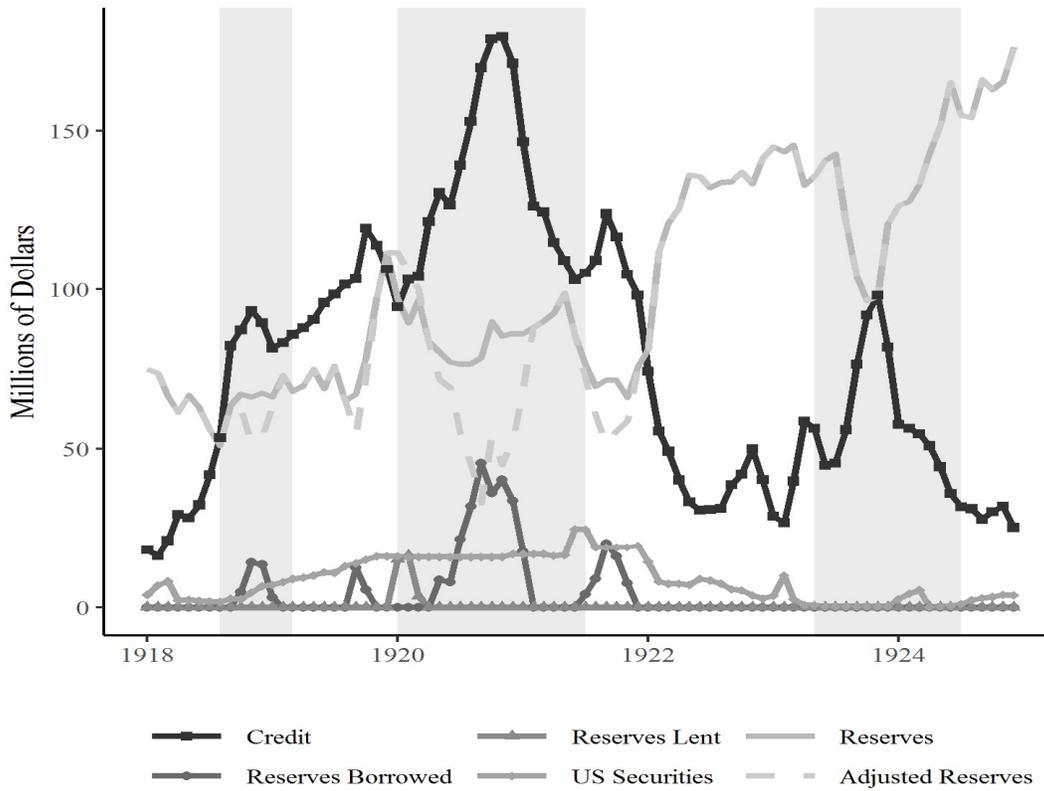
12	San Francisco	34.9	42.3
----	---------------	------	------

The largest interbank lender, the Federal Reserve Bank of Cleveland was particularly upset with the expansion of credit to what it deemed to be failing banks in the South on collateral that was regarded as “weak.” Up until this point, inter-Reserve Bank lending had occurred at negotiated rates (for which we have no data). Unhappy about this arrangement, the Cleveland Fed persuaded the Federal Reserve Board to raise its interbank lending rate to 7 percent on September 7, 1920. While discount rates of 6 percent were sufficient in some districts to discourage member bank discounting, several districts raised them to 7 percent by November 1920, the highest level for the period. The result was a decline in demand for discounts by member banks, which subsequently fell precipitously across the agricultural districts.

Column 9 in Table 7 records the total decline in member bank credit for the whole of the 1920-1921 recession. For the industrialized districts, total credit fell between 43.5 and 68.3 percent. The total decline in the agricultural districts was far less. Thus, it appears that the Federal Reserve Banks in these areas buffered their member banks from the full shock of the commodity price collapse and may also have buffered businesses in their areas.

To see the divergence of Federal Reserve Bank policy over the whole period, Figures 3 and 4 display key variables for the Federal Reserve Banks of Atlanta and Cleveland who were the leading adversaries in the internal debate over policy during the recession. Covering the years 1918 to 1924, there were three recessions, shaded in blue. During the 1920-1921 recession, the Atlanta Bank rapidly expanded credit, primarily discounts, to its member banks, nearly doubling the dollar value. This increase would have led to a sharp drop in its reserves, as indicated by its adjusted reserves (dashed grey line). However, it was able to borrow gold from other District Banks. The spike in borrowed reserves coincides with the sharp upward movement in Federal Reserve Credit issued. These borrowings constituted approximately half of its gold reserves at the peak of its expansion of credit. Discounts were then curtailed in the middle of the recession under pressure from the Board and especially the Cleveland Bank, which pursued a strictly contractionary policy from the outset of the recession, cutting credit and increasing its reserves. While it eventually accumulated \$300 million of reserves, Cleveland lent \$150 million to other Reserve Banks, including Atlanta. When the System forced Atlanta and other agricultural Reserve Banks to reduce discounts, credit to member banks from the Cleveland Bank leveled off.

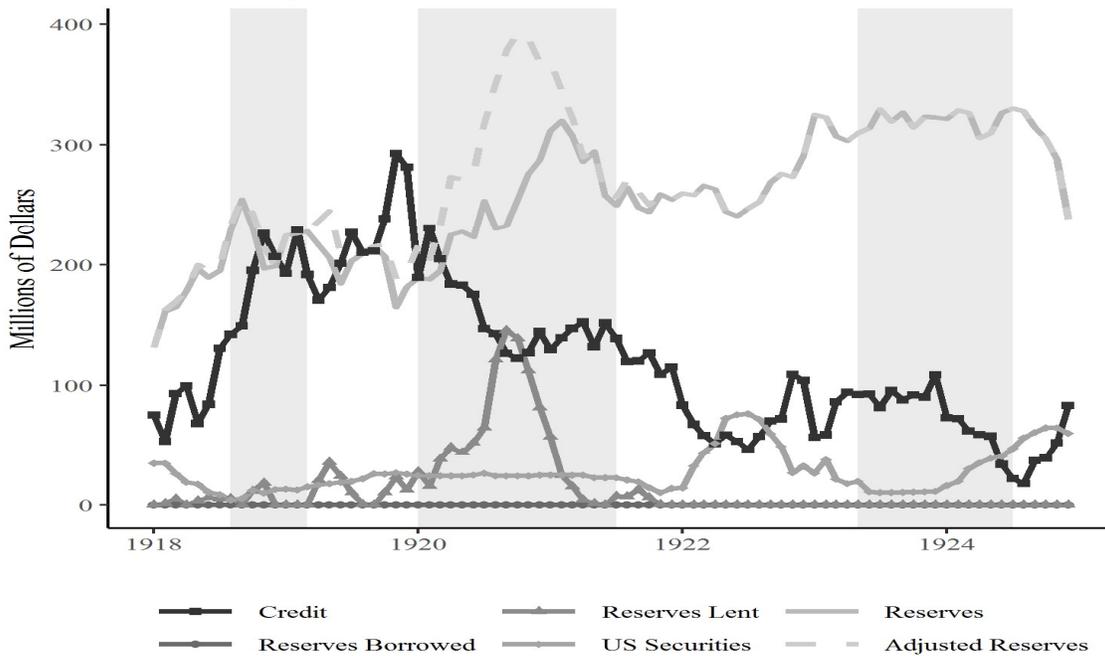
Figure 3: Federal Reserve Bank of Atlanta



Shaded gray areas indicate recessions.

Source: Federal Reserve Bank of Atlanta, [Annual Reports](#) (1918-1924).

Figure 4: Federal Reserve Bank of Cleveland



Shaded gray areas indicate recessions.

Source: Federal Reserve Bank of Cleveland, [Annual Reports](#) (1918-1924).

As seen in Table 6, these characterizations do not hold for the years before the recession. In summary, during 1918-1919, the system-wide gold reserve ratio fell from a high of 66.0 percent in February 1918 to 44.8 percent in December 1919; but it was still well above the 40 percent minimum. During much of this period the “dovish” agricultural districts had greater reserves than the “hawkish” industrial districts. In fact, for a good portion of 1919, the Doves lent reserves to the Hawks, notably the last months of 1919 when without inter-Reserve bank lending the reserves of Districts 1 through 4 would have at times fallen below 40 percent. During the recession of January 1920-July 1921, the System’s reserves hovered just above 40 percent and the roles of borrower and lender abruptly and dramatically flipped. Owing to their willingness to allow their member banks to obtain more discounts during the downturn, the Doves’ reserves plummeted, as indicated by their adjusted reserve ratio. Only borrowing from the Hawks permitted the Doves to maintain reserve ratios just above their 40 percent minimum. The lending was substantial as indicated by the difference between the actual reserve ratio and the adjusted reserve ratio of the Hawks. Even though the Hawks were contracting, the System as a whole was perilously close to the minimum of 40 percent---and thus there were fewer and fewer reserves to reallocate among the Reserve banks. After prolonged behind closed doors squabbling over the Doves increased borrowing, the sharp uptick in inter-Reserve Bank borrowing in August-September 1920 enabled the Cleveland bank to persuade the Federal Reserve Board to set a 7 percent rate for all interbank borrowing, a rate that was higher or equal to all Reserve banks’ basic discount rates. From this point onward, the Doves began to contract their lending to member banks and consequently their borrowing from the Hawks, as seen in the rapid ascent of the adjusted reserve ratio for the Doves. By the time that all inter-Reserve bank lending halted in 1921, all Reserve banks had moved through a contractionary phase and they had bolstered their reserve ratios well above 60 percent.

While our study is essentially macroeconomic, focusing on the total expansion of credit provided to member banks and the liquidity they were then able to obtain, Rieder (2019) has provided a microeconomic analysis focusing on the use of the Phelan Act that permitted Federal Reserve banks to charge higher discount rates to the member banks that were perceived to be taking on too much risk, over-expanding their loans. We view our study, focused on the volume of Federal Reserve Credit and his study, focused on interest rates, as complementary, illuminating further the divergent Federal Reserve bank policies. Identifying banks 25 kilometers along the borders of Federal Reserve districts that employed different mixes of raising the basic discount rate and imposing higher marginal rates on suspected member banks, he found in the short-run (4 months) the bank loan growth and the leverage of the Phelan Act-treated banks compared to the control banks was up to 21 percent lower; in the medium run (16 months) it was up to 34 percent lower, furthermore it significantly reduced the probability of bank failures. It is difficult to map his results into our findings given our aggregate focus on district-wide lending to member banks and his border region banks’ expansion of loans to their customers; however they complement each other and reinforce our interpretation. In the meetings of the Board and the Reserve banks described elsewhere in the paper, the dovish Reserve banks were often viewed by their hawkish opponents as expanding their credit to reckless banks. Rieder’s results show that those dovish banks—including the leader of the doves, Atlanta---that combined an expansion of Federal Reserve credit to member banks with a Phelan Act regime of higher marginal rates of discount controlled for moral hazard.

To see this more clearly, Table 9 combines Rieder’s policy characterization with ours. As seen in Table 6, we divided banks into two categories---hawks that pursued a contractionary policy in the first phase of the recession from December 1919 to September 1920 and doves that engaged

in expansionary policies. Rieder divides the Federal Reserve banks into three categories: four that adopted used the authority granted in the Phelan Act (Atlanta, Dallas, Kansas, and St. Louis), those that raised their basic rate to 7 percent by June 1920 (Boston, Chicago, New York, and Minneapolis) and the four (Cleveland, Philadelphia, Richmond, and San Francisco), which did neither. Clearly his basic-rate-increasing banks that indicates a tougher general policy are split between our contractionary and expansionary banks. Does this present a problem? One feature that might resolve this seeming problem is collateral, which neither Rieder nor we have attempted to categorize as it was a discretionary. However the crucial question is which Federal Reserve banks used and which did not use the Phelan Act. Atlanta, Dallas, Kansas and St. Louis were the 2nd, 1st, 4th and 5th most expansionary banks in Table 6, depending heavily on borrowing gold reserves from other Federal Reserve banks. Yet, none of them experienced a bank crisis---emphasizing the probable role of the use of the Phelan Act to restrain risky expansion by some banks. Richmond did not use the Phelan Act but then it was the least expansionary of all the doves, with none of its expanded borrowing driven by borrowed reserves, while not raising its basic rate. A deficiency in district liquidity may measured by the difference between a Federal Reserve bank's actual gold reserve ratio and the ratio that would have existed without borrowing for November 1920 in Column 8 of Table 6. Among the doves, Richmond, San Francisco and Chicago were the strongest by this measure, with San Francisco actually being in the position of a lender not a borrower. None of these Federal Reserve districts experienced any banking crisis. But, Minneapolis, which was weak by this reserve measure, and had raised its basic rate to 7 percent and did not use the Phelan Act, was the second least expansionary district----and in its district, North Dakota experienced the only recognized localized banking runs, suggesting perhaps, that it would have been better to adopt a more expansionary policy coupled with use of the Phelan Act. However, an careful identification of policy choices by Federal Reserve banks awaits an examination an of the archival records of their Boards of directors, of which only Atlanta and Cleveland have provided access to date.

An expansion of Federal Reserve credit during the early phase of the recession, coupled with use of the Phelan Act appears to have been the best policy mix, providing loans to member banks in the critical months, thereby preventing a collapse of banks, while preventing an excessive increase in credit that would produce failed banks among the riskiest borrowers.

Table 9: Characterizing Federal Reserve Bank Policy

	Contractionary	Expansionary
Phelan Act Not Used	Boston* Cleveland New York* Philadelphia	Chicago* Minneapolis* Richmond San Francisco
Phelan Act Used		Atlanta Dallas Kansas St. Louis

*The Federal Reserve banks that Rieder points to as increasing their basic discount rate by June 1920 are indicated by an asterisk.

VI Analysis of the Impact of Divergent Federal Reserve Bank Policies

A key question is to what extent inter-District lending permitted dovish Reserve Banks to expand credit to their member banks, while the transfer of gold reserves may have influenced hawkish Reserve Banks to contract credit to their member banks. The new data that we have collected from publications of the Reserve Banks for the years 1918-1924 allows us to offer estimates of (1) how Reserve Bank credit to member banks responded to inter-District lending and (2) how increased credit augmented the liquidity of member banks. In the depths of a severe recession, increased liquidity in the form of Federal Reserve notes would have enabled banks meet withdrawals more easily and reduce the likelihood of a panic.¹²

To begin, we have modeled the effects of both borrowing and lending of gold reserves on the credit provided by Federal Reserve banks to their member banks by examining only those periods when gold reserves were borrowed and only those banks that were lending or borrowing. We imposed this limitation because the borrowing of gold reserves reveals the need (or perceived need) on the part of the borrowing District banks for additional lending capacity to extend credit to their member banks. Observations in periods during which there was no borrowing of gold reserves could be ones in which District banks were not able to meet demands for liquidity from member banks. But, without borrowed reserves, District banks facing a demand for loans from member banks would be unable to extend credit to them, given the required gold reserve ratio as a binding constraint. This condition would hinder finding any potential influence of borrowed gold reserves on the extension of Federal Reserve Credit to member banks. We look at net lending and net borrowing because, although there were clearly defined Reserve banks that were primarily lenders or borrowers in the 1920-1921 recession, there were occasionally a few months when banks both lent and borrowed funds. Notably, the Federal Reserve Bank of New York was often simultaneously borrowing and lending; and measuring the net activity of this largest of the District Reserve banks is essential. The primary lending banks were Boston, Chicago, Cleveland, Philadelphia, and New York. We include Chicago in this group because even though it expanded its operations like the dovish banks, it lent like the hawks. The primary borrowing banks were Atlanta, Dallas, Kansas City Minneapolis, Richmond, St. Louis, and San Francisco.

In our first stage, we specify a model of the Federal Reserve bank credit ($FedCredit_i$) provided by each District bank to their member banks to determine the impact of net reserves borrowed ($NetBorrowed_i$) from other District banks (equation 1) and net reserves lent ($NetLent_i$) by the District bank (equation 2) on credit. We add bank fixed effects ($District_i$), adjusted reserves ($AdjustedReserves_i$), an indicator for periods during the recession ($Recession$), and an interactive term between the recession indicator and net borrowing or net lending. The adjusted reserves level measures the credit extension capacity of a District Bank in the absence of borrowing or lending gold reserves from other District Banks. Credit, borrowing, lending, and reserves are in levels, measured in millions of dollars

The econometric estimation is not strictly a time-series regression because we drop observations between time-periods when there was no borrowing and lending of gold reserves between District Banks. The individual District Banks are pooled together. All variables in the

¹² The next logical step would be to determine if the divergent Reserve Bank policies mitigated the effects of the recession in the hardest hit regions. However, we do not attempt this last exercise, owing to a lack of data on economic activity, including almost any possible measure of unemployment and output by District in the Federal Reserve's early years.

regression are contemporaneous. Our identification strategy is that the gold reserve borrowing by District Banks reflects the perceived need for additional credit capacity and that it is predetermined relative to Federal Reserve Credit extended to a District Bank's member banks. In other words, district banks only borrow gold reserves if they anticipate the need to expand credit beyond the capacity implied by their existing gold reserves.

$$(1) \text{ FedCredit}_{i,t} = \beta_0 + \beta_1 \text{NetBorrowed}_{i,t} + \beta_2 \text{Adjusted Reserves}_{i,t} + \beta_3 \text{Recession} + \beta_4 \text{Recession} \times \text{NetBorrowed}_{i,t} + \beta_5 \text{District}_i + \varepsilon_{i,t}$$

$$(2) \text{ FedCredit}_{i,t} = \beta_0 + \beta_1 \text{NetLent}_{i,t} + \beta_2 \text{Adjusted Reserves}_{i,t} + \beta_3 \text{Recession} + \beta_4 \text{Recession} \times \text{NetLent}_{i,t} + \beta_5 \text{District}_i + \varepsilon_{i,t}$$

Table 10 captures some of the essential effects that inter-Federal Reserve District borrowing and lending had on the provision of credit by the District Banks to their member banks.¹³ For the borrowing banks' periods of net borrowing, the intercept of \$61.9 million identifies Atlanta's average level of Federal Reserve bank credit and the fixed effects for the other district banks pick up their average differences with Atlanta. The three variables of particular interest are significant. By itself, a recession added \$19.5 million dollars in lending to the member banks of these Reserve banks. The coefficient on Net Borrowed indicates that every dollar of inter-Reserve bank borrowing led to \$1.11 cents of additional credit to member banks---roughly a dollar for a dollar---so that in September 1920 when the Atlanta Fed borrowed \$45.5 million, it led to \$50.5 million in Federal Credit to member banks. To this increase should be added the effect of the interaction term of Borrowing in the Recession, whose coefficient is 0.613. Thus, for the Recession of 1920-1921, the total effect of a dollar borrowed is the sum of the coefficients or 1.723, which implies that for every dollar of borrowed reserves, the Federal Reserve banks in this group provided just under two dollars of additional Federal Reserve Credit to their member banks. For the Atlanta Fed, borrowed reserves provided approximately \$78 million out of a total \$170 million loaned. If the pure recession effect is added, then Atlanta bank provide another \$19.5 million for a total of nearly \$100 million out of its total Federal Reserve credit \$170 million.

For borrowing Federal Reserve banks when they were net lenders, the most interesting feature of this regression is that while the coefficient on net lending is indistinguishable from zero, the coefficient on lending during the recession was -1.795, essentially a symmetric value for the combined effects of borrowing funds, reducing credit in lending districts during a recession. Thus, it appears that lending---perhaps in small amounts since they rarely lent---had no effect outside of recessions on Federal Reserve Credit. However, during a recession, lending a dollar of reserves caused a shrinkage of Credit equal to borrowing a dollar of reserves. For the Atlanta Fed, during the recession year of 1920, it lent \$15.0 million, \$11.1 million and \$2.7 million in January, February and March. For January 1920, the coefficients suggest that lending would have caused a contraction of Federal Credit of \$26.9 million.

¹³ The Federal Reserve Bank of Cleveland is absent from the regressions for equation 1 because there are no periods in which it borrowed gold reserves from another district bank.

Table 10

Provision of Federal Reserve Credit and Inter-Reserve Bank Borrowing and Lending

	Borrowing FRBs Atlanta, Dallas, KC, Minneapolis, Richmond, St. Louis, San Francisco,		Lending FRBs Boston, Philadelphia, New York, Chicago, Cleveland	
	(1)	(2)	(1)	(2)
Net Gold Reserves Borrowed _t	1.110*** (0.207)		1.429* (0.802)	
Net Gold Reserves Lent _t		0.630 (0.400)		4.934*** (0.629)
Adj. Reserves _t	0.481*** (0.141)	0.492*** (0.170)	-0.982*** (0.263)	-1.157*** (0.090)
I _{Recession} × Net Gold Reserves Borrowed _t	0.613*** (0.210)		-1.583* (0.948)	
I _{Recession} × Net Gold Reserves Lent _t		-1.795** (0.875)		-4.116*** (0.676)
I _{Recession}	19.534*** (4.417)	61.334*** (9.713)	194.674*** (34.559)	140.642*** (22.842)
α _{Dallas}	-33.496*** (6.102)	-14.191 (17.523)		
α _{Kansas City}	-12.151** (4.646)	14.493 (17.117)		
α _{Minneapolis}	-32.711*** (5.549)	-19.609 (16.353)		
α _{Richmond}	-14.507*** (3.630)	47.111** (20.887)		
α _{San Francisco}	54.478*** (15.988)	46.763** (18.816)		
α _{St. Louis}	-15.969*** (5.053)	11.826 (16.651)		
α _{Chicago}			353.047*** (72.436)	268.886*** (26.527)
α _{Cleveland}				68.195*** (20.624)
α _{New York}			1,128.884*** (144.852)	1,176.913*** (59.414)
α _{Philadelphia}			20.743 (35.680)	-29.869 (28.337)
Constant	61.934*** (10.706)	0.596 (21.380)	217.948*** (47.433)	277.650*** (29.606)
Bank FE?	Yes	Yes	Yes	Yes
Observations	124	78	73	106
R ²	0.877	0.867	0.919	0.875
Adjusted R ²	0.867	0.847	0.910	0.865
Residual Std. Error	12.502 (df = 113)	23.537 (df = 67)	100.661 (df = 65)	69.395 (df = 97)
F Statistic	80.848*** (df = 10; 113)	43.518*** (df = 10; 67)	104.957*** (df = 7; 65)	85.019*** (df = 8; 97)

Note:

* ** *** p < 0.01

Net lending and borrowing both enter regressions as positive.

For the hawkish Federal Reserve banks, the typical lenders, Federal Reserve Credit increased by \$194.7 million in recessions, suggestive of leaning into the wind. The coefficient on

net borrowing of 1.429 indicates that every borrowed dollar of gold reserves led to an increase of credit by \$1.43. However, during a recession the combined effects adding in the interaction term of net borrowing and the recession of -1.583 reveals that they behaved quite differently than the dovish banks and there was scant if any effect on credit to member banks. Cleveland, the Atlanta Fed's adversary never borrowed, which is why it does not appear in the third column regression. Instead we examine the Philadelphia Fed's and the Boston Fed's net borrowing behavior. We see that Philadelphia borrowed continuously from November 1918 to April 1920, and during recession months its Federal Credit supplied plunged as it wound down its borrowing. The Boston Fed's peak of borrowing--\$69.9 million—in December 1919 occurred when its Federal Reserve Credit hit a peak high of \$210 million, just before the recession of 1920-1921. A \$100 million of this sum can be explained by the borrowing coefficient. Yet, when the recession hit, the Boston Fed ceased to borrow and became a large lender to the dovish Reserve banks.

Lastly, Table 10 reports the effects of hawkish banks' net lending on their supply of Federal Reserve Credit to their member banks. The coefficient of 4.934 on lending suggests that, even as they lent their reserves, to dovish banks, they continued to expand. When a recession hit, they provided \$140.6 million more of credit, but the coefficient of the interaction term of -4.116 when combined with the coefficient on net lending reveals that lending to other Reserve Banks had little effect on their provision of credit to their own member banks. These coefficients capture the visual in Figure 3 of the Cleveland bank where the enormous surge in lending occurred while Federal Reserve credit, though fluctuating, is essentially flat. This result suggests that while Cleveland may have complained that it was unable to give credit to its member banks in 1920-1921 it did not cut it off because of its lending to dovish Reserve banks---even when lending to Reserve banks surpassed lending to its member banks.

For the dovish Reserve banks, an aggregated measure of the estimated effects of interbank borrowing of reserves, measured by the combined coefficients on net borrowing and the recession indicator interacted with net borrowing times the amount borrowed, is shown in Table 8, where the recession is split into its two policy phases. For the borrowing banks, the total effect of borrowing was to increase their supply credit by \$261.5 million during the first phase of the recession. This figure is lower than their actual increase in Federal Reserve Credit of \$332.6 million. The implication is that in the absence of borrowing there would have been a much smaller expansion of credit for the Doves---essentially they would have marched in step with the Hawks. However, when the system's minimum gold reserve ratio was nearly breached, these Federal Reserve banks were compelled to shrink their credit, as borrowing wound down, and the withdrawal of funds caused an estimated decrease in credit of \$251.0 million, accounting for nearly all of their actual decrease of \$306.6 million.

Table 11: Two Phases of the 1920-1921 Recession: Effects of Borrowing on a Federal Reserve Bank's Credit to its Member Banks (\$ millions)

	9/19 to 9/20	9/20 to 7/21
Bank	Total Borrowing Effect	Total Borrowing Effect
Atlanta	57.26	-71.5
Dallas	33.46	-31.5
Kansas City	70.94	-70.9
Minneapolis	36.78	-12.9
Richmond	-0.65	-0.3
St. Louis	63.74	-63.7
Estimated Increased from Borrowing	261.52	-251.0
Actual Total Increase in Credit	332.60	-306.6

The next question is what did the national and state member banks in the dovish Districts do with the additional credit that they were supplied with by the borrowed inter-Federal Reserve bank reserves. Equations 3 and 4 represent two of the key choices, taking additional Federal Reserve Credit in the form of Currency---Federal Reserve notes----or holding them as Deposits at the Federal Reserve banks. If the banks were concerned about widespread withdrawals by their customers and the potential for a banking panic to arise, then the primary choice should have been currency, which would have supplied them with vital liquidity. Both choices are driven by models similar in structure for those estimating the effects of interbank borrowing on Federal Reserve Credit, but here it is Federal Reserve Credit (fitted value taken from estimates of equations 1 and 2 in Table 7) is the key variable, not interbank gold reserves borrowing.

$$(3) \text{ Currency}_{i,t} = \beta_0 + \beta_1 \text{FedCreditFitted}_{i,t} + \beta_2 \text{Recession} \times \text{FedCreditFitted}_{i,t} + \beta_3 \text{Recession} + \beta_4 \text{District}_i + \varepsilon_{i,t}$$

$$(4) \text{ Member_Bank_Deposits_at_FRBanks}_{i,t} = \beta_0 + \beta_1 \text{FedCreditFitted}_{i,t} + \beta_2 \text{Recession} \times \text{FedCreditFitted}_{i,t} + \beta_3 \text{Recession} + \beta_4 \text{District}_i + \varepsilon_{i,t}$$

Table 12: Provision of Currency and Deposits and Federal Reserve Credit

	Currency _t		Federal Reserve Deposits _t	
	Borrowing FRBs	Lending FRBs	Borrowing FRBs	Lending FRBs
	(3)	(4)	(3)	(4)
Fed CreditFitted _t	0.545*** (0.080)	0.568*** (0.045)	0.148*** (0.042)	0.087* (0.043)
I _{Recession} × Fed CreditFitted _t	-0.014 (0.085)	-0.058* (0.031)	-0.114** (0.044)	-0.075** (0.030)
I _{Recession}	4.603 (8.806)	56.476*** (20.876)	11.003** (4.573)	10.588 (20.220)
α _{Dallas}	-51.929*** (4.723)		2.921 (2.453)	
α _{Kansas City}	-37.898*** (4.388)		29.862*** (2.279)	
α _{Minneapolis}	-44.216*** (4.973)		3.917 (2.582)	
α _{Richmond}	-12.744*** (3.446)		6.877*** (1.789)	
α _{San Francisco}	40.581*** (13.168)		63.496*** (6.838)	
α _{St. Louis}	-19.098*** (4.724)		17.419*** (2.453)	
α _{Chicago}		157.003*** (21.054)		127.257*** (20.393)
α _{New York}		195.565*** (27.787)		589.150*** (26.914)
α _{Philadelphia}		15.188 (13.457)		-7.910 (13.035)
Constant	68.619*** (8.323)	78.569*** (12.678)	27.857*** (4.322)	94.476*** (12.280)
Bank FE?	Yes	Yes	Yes	Yes
Observations	124	73	124	73
R ²	0.904	0.982	0.775	0.986
Adjusted R ²	0.896	0.981	0.758	0.985
Residual Std. Error	11.699 (df = 114)	38.164 (df = 66)	6.075 (df = 114)	36.965 (df = 66)
F Statistic	118.725*** (df = 9; 114)	606.358*** (df = 6; 66)	43.701*** (df = 9; 114)	794.366*** (df = 6; 66)

Note: *p<0.10, **p<0.05, ***p<0.01
Net lending and borrowing both enter regressions as positive.

Table 12 reports the regression results for equations 3 and 4. These estimations seem to indicate that the behavior of the national and state member banks in both dovish and hawkish Federal Reserve Districts exhibited similar behavior. The extension of one dollar of Federal Reserve Credit by District Banks that borrowed heavily in the 1920-1921 recession to their

member banks led to them holding \$0.54 of additional currency (the effects of the sum of the Fed Credit coefficient and the coefficient on the interaction term for the Recession and Fed Credit). For member banks in the hawkish lending Districts, an increase in one dollar of Federal Reserve Credit led to \$0.51 of additional currency. Federal Reserve deposits of banks in both hawkish and dovish Districts barely changed when Federal Reserve Credit increased during the recession, rising by only \$0.01 and \$0.03 respectively.

Table 13
Two Phases of the 1920-1921 Recession: Effect of Increases in
(Fitted) Credit on Federal Reserve Banks Supply of Currency

	9/19 to 9/20	9/20 to 7/21
Bank	Total Effect of Federal Reserve Credit	Total Effect of Federal Reserve Credit
Atlanta	43.16	-30.82
Dallas	35.30	-17.32
Kansas City	38.75	-28.99
Minneapolis	16.30	-8.23
Richmond	21.68	-1.74
St. Louis	36.83	-23.99
Estimated Increase in Currency	192.02	-111.08
Actual Total Increase in Currency	119.35	-178.83

Table 13 presents the aggregate effects of increasing and then contracting Federal Reserve Credit on the supply of Currency for the two policy phases of the recession. Note that the level of currency among the borrowing District reserve banks rises along with the predicted level of Federal Reserve Credit. The six Dovish districts would have increased currency supply by \$192.0 million over the year from September 1919 to September 1920. The actual increase was somewhat smaller, around \$120 million, and took place when the total aggregate currency supply in the US increased by over \$400 million over the same time-period. Inter-District lending of gold reserves provided the capacity for the additional Federal Reserve Credit (fitted values from Table 12 used in estimates of Equation 3) and hence more currency. However, once the Dovish districts lost their borrowed gold reserves and the associated credit capacity, the resulting contraction in (predicted) Federal Reserve Credit caused an estimated drop in currency of \$111.1 million that is nearly two thirds of the actual decline of \$178.8 million.

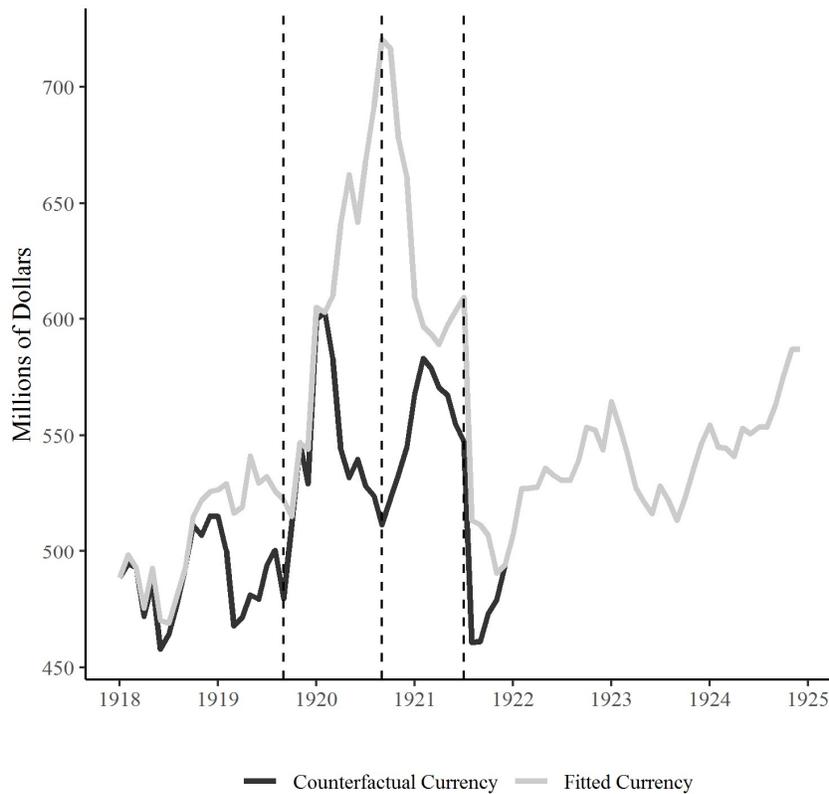
Table 14
Counter-Factual Exercise:
Effect of Restricting Gold Reserve Borrowing on
Federal Reserve Credit and Federal Reserve Banks Supply of Currency

	9/19 to 9/20	9/20 to 7/21
Bank	Total Effect of Federal Reserve Credit	Total Effect of Federal Reserve Credit
Atlanta	5.28	11.01
Dallas	9.30	1.10
Kansas City	-2.73	12.48
Minneapolis	-5.20	-0.67
Richmond	13.11	-1.55
St. Louis	-0.43	13.28
Estimated Increase in Currency	19.32	35.65
Actual Total Increase in Currency	119.35	-178.83

In Table 14, we perform a separate counter-factual exercise in which we eliminate gold reserve borrowing for the District Banks thereby shutting down the expansionary impact of borrowed reserves on Federal Reserve Credit. Firstly, the exercise employs the estimated relationship in column 1 of Table 10 and isolates the resulting contractionary effect on Federal Reserve Credit estimates found using the counter-factual restrictions on gold reserves borrowing. We then introduce that fitted counter-factual Federal Reserve Credit estimate into equation 3 (first column in Table 11). We find that, in the absence of gold reserve lending, the time series path for Federal Reserve Credit starts at a lower level and, along with the inability to borrow gold reserves, the findings imply that the currency supplied by these Reserve banks to its member banks would have been lower than observed by over \$100 million. This prediction contrast notably to the predicted over-estimate of about \$70 million from Table 12. Thus, in the early and perhaps panic-threatening phase of the recession, there was a notable increase in the capacity of member banks in these Districts to meet their customers' demands for cash arising from the ability to borrow gold reserve from Districts with surpluses.

Figure 4 displays estimates for both the fitted and counter-factual currency time-series paths from which the changes listed in Table 10 are taken. The nearly \$200 million difference between the fitted and the counter-factual at September 1920 highlights the additional currency supply arising from the gold reserve borrowing available to the District Federal Reserve Banks under consideration. This stark difference in the predictions for September 1920 highlights the contribution from gold reserve borrowing to the increase the liquidity available at these District Banks for loans to their member banks during the downturn.

**Figure 4: Federal Reserve Notes in Six Districts:
Fitted Estimates versus Counter-factual Predictions**



Note: Dashed lines indicate September 1919, September 1920, and July 1921.

Conclusion

The absence of a panic in 1920-21 is important because the prevention of panics was a central reason for the establishment of the Federal Reserve System. The Fed was able to prevent a panic in 1920-21 by allowing the re-allocation of excess reserves and hence credit capacity from Federal Reserve banks that substantially exceeded their gold reserve requirements to those Federal Reserve banks that had exhausted their excess reserves by increasing credit to their member banks who in turn obtained currency that their customers demanded.

During the early years of the Federal Reserve System, there is a paucity of data on economic activity by district. Its absence prevents us from determining whether the expansion first of Federal Reserve credit and secondly member bank lending served to prevent an even harsher down turn and perhaps a banking panic in the agricultural districts. However, what is clear is that several Federal Reserve banks located in districts where agricultural prices had plummeted initially resisted the call for a sharp contraction of Federal Reserve credit. Instead, concerned about the health of their member banks and the economies of their respective regions, these District banks expanded credit to member banks. To facilitate expanding credit, these District banks borrowed gold reserves heavily from those District Reserve banks with gold reserves in ample supply and in regions less affected by the economic contraction. The additional credit capacity at Reserve banks enabled their member banks to borrow from the District banks and maintain loans

to their customers, while at the same time enduring deposit withdrawals in the form of currency. In prior periods without central bank liquidity provision (e.g. the National Banking Era 1863-1913), such depositor withdrawals would cause a liquidity crisis and perhaps a banking panic. When the Federal Reserve System as a whole neared its 40 percent minimum reserve ratio, the restrictive policies advocated by the Federal Reserve Board and the calls by the more hawkish Federal Reserve banks were heeded and all of the Federal Reserve banks contracted credit. Nevertheless, by the end of the recession, bank credit in Southern and Western district of the Federal Reserve did not contract as severely as in the Northeast. Their early-to-middle-of-recession expansion of credit substantially increased their member banks holdings of Federal Reserve notes, thereby providing the latter with additional liquidity to ward off bank runs that in previous recessions had morphed into banking panics. These Federal Reserve banks that had dissented from the Board contractionary policy may thus be seen as fulfilling the central reason for establishing the Fed---the prevention of devastating banking panics.

Bibliography

Allen, Franklin and Douglas Gale, "Interbank Market Liquidity and Central Bank Intervention," Journal of Monetary Economics 56 (2009), pp. 639-652.

Board of Governors of the Federal Reserve System, Banking and Monetary Statistics (Washington, D.C., 1943), Table No. 66.

Bodenhorn, Howard, "A More Perfect Union: Regional Interest Rates in the United States, 1880-1960," in Michael D. Bordo and Richard Sylla, eds., Anglo-American Financial Systems: Institutions and Markets in the Twentieth Century (New York: Irwin, 1995), pp. 415-453.

Bodenhorn, Howard and Hugh Rockoff, "Regional Interest Rates in Antebellum America," in Claudia Goldin and Hugh Rockoff, eds., Strategic Factors in American Economic History: A Volume to Honor Robert W. Fogel (Chicago: Chicago, University Press, 1992).

Bordo, Michael D., Michael J. Dueker & David C. Wheelock, 2002. "[Aggregate Price Shocks and Financial Instability: A Historical Analysis](#)," Economic Inquiry, 40(4), pages 521-538, (October 2002).

Caballero, Ricardo J. and Alp Simsek, "Fire Sales in a Model of Complexity," Journal of Finance 68 (December 2013), pp. 2549-87.

Carlson, Mark, Kris James Mitchener, and Gary Richardson, "Arresting Banking Panics: Federal Reserve Liquidity Provision and the Forgotten Panic of 1929," Journal of Political Economy Vol 119, No. 51 (2011), pp. 889-924.

Carter, et. Al., Historical Statistics of the United States,

Chandler, Lester V., Benjamin Strong, Central Banker (Washington, D.C., 1958).

Collins, William J., "When the Tide Turned: Immigration and the Delay of the Great Black Migration," Journal of Economic History, Vol. 57, No. 3 (September 1997), pp. 607-632.

Diamond, Douglas W. and Raghuram G. Rajan, "Fear of Fire Sales, Illiquidity Seeking and Credit Freezes," Quarterly Journal of Economics (2011) 126:2, pp. 557-591.

Eichengreen, Barry, Arnaud J. Mehl, Livia Chitu, and Gary Richardson, "Mutual Assistance between Federal Reserve Banks: 1913-1960 as Prolegomena to the TARGET2 Debate," Journal of Economic History Vol. 75, No. 3 (September 2015). Pp. 621-659.

Federal Reserve Bank of Atlanta, Annual Reports, 1918-1924

Federal Reserve Bank of Boston, Annual Reports, 1918-1924

Federal Reserve Bank of Chicago, Annual Reports, 1918-1924

Federal Reserve Bank of Cleveland, Annual Reports, 1918-1924

Federal Reserve Bank of Dallas, Annual Reports, 1918-1924

Federal Reserve Bank of Kansas City, Annual Reports, 1918-1924

Federal Reserve Bank of Minneapolis, Annual Reports, 1918-1924

Federal Reserve Bank of New York, Annual Reports, 1918-1924

Federal Reserve Bank of Philadelphia, Annual Reports, 1918-1924

Federal Reserve Bank of Richmond, Annual Reports, 1918-1924

Federal Reserve Bank of St. Louis, Annual Reports, 1918-1924

Federal Reserve Bank of San Francisco, Annual Reports, 1918-1924

Federal Reserve Board, Annual Reports (Washington, D.C., 1918-1924).

Fifteenth Conference of Federal Reserve Banks and Joint Conference with Federal Reserve Board and Class B Directors, April 12-15, 1921.

Freixas, Xavier and Bruno M. Parigi and Jean-Charles Rochet, “Systemic Risk, Interbank Relations and Liquidity Provision by the Central Bank,” Journal of Money, Credit and Banking 32:2 (2000), pp. 611-638.

Friedman, Milton and Anna J. Schwartz, Monetary Statistics of the United States. (Princeton: Princeton University Press, 1970).

Friedman, Milton and Anna J. Schwartz, A Monetary History of the United States 1867-1960 (Princeton: Princeton University Press, 1963).

Gordon, Robert J., ed., The American Business Cycle: Continuity and Change (Chicago: Chicago University Press, 1986), Appendix B.

Gorton, G. (1985). Clearinghouses and the origin of central banking in the United States. Journal of Economic History 45, 277–83.

Gorton, Gary B. and Ellis Tallman, Fighting Financial Crises: Learning from the Past (Chicago: University of Chicago Press, 2018).

Governors of the Federal Reserve System, Banking and Monetary Statistics (1943),

Hoag, Chris 2018 “Clearinghouse Loan Certificates as a Lender of Last Resort.” The North American Journal of Economics and Finance, Volume 45, July 2018, Pages 215-229.

- Landon-Lane John and Hugh Rockoff, “Monetary Policy and Regional Interest Rates in the United States, 1880-2002,” NBER Working Paper No. 10924 (November 2004).
- McCalmont, David B., “The Sharing of Gold Reserves Among Federal Reserve Banks,” (Ohio State University, typescript, 1963).
- Meltzer, Allan H., A History of the Federal Reserve Vol. 1: 1913-1951, (Chicago: Chicago University Press, 2003)
- Miron, Jeffrey A. and Christina D. Romer. “A New Monthly Index of Industrial Production, 1884-1940.” *Journal of Economic History* 50 (June 1990): 321-337.
- National Bureau of Economic Research, Macrohistory database, <http://www.nber.org/databases/macrohistory/contents/chapter01.html>,
- MeasuringWorth. U.S. Consumer Price Index, <https://www.measuringworth.com/usecpi/result.php>,
- Moen, Jon R. and E. W. Tallman. “Close but Not a Central Bank: The New York Clearing House and Issues of Clearing House Loan Certificates.” In Current Policy Under the Lens of Economic History, edited by Owen F.Humpage, Chapter 5, 102–125. Cambridge University Press: New York, 2015.
- Richardson, Gary and William Troost, “Monetary Intervention Mitigated Banking Panics during the Great Depression: Quasi-Experimental Evidence from a Federal Reserve District Border, 1929-1933,” Journal of Political Economy Vol. 117, No. 6 (2009) pp. 1031-1073.
- Rieder, Kilian. “Should Monetary Policy Lean Against the Wind? Quasi-experimental Evidence from the Federal Reserve Policies in 1920-21.” Unpublished manuscript, April 29, 2019.
- Riefler, Winfield, Money Rates and Money Markets in the United States (Harper and Brothers, 1930).
- Rockoff, Hugh, “How Long did it take the United States to become an optimal currency area?” in Forrest H. Capie and Geoffrey E. Wood, Monetary Unions: Theory, history, public choice (London: Routledge, 2003), pp. 76-103.
- Shleifer, Andrei and Robert W. Vishny, “Fire Sales in Finance and Macroeconomics,” Journal of Economic Perspectives 25(1), pp. 29-40.
- Tallman, E.W, and J.R. Moen “Liquidity Creation without a Central Bank: Clearing House Loan Certificates in the Banking Panic of 1907.” Journal of Financial Stability, 2012, 8(4): 277–291.
- Thorp, William Long. *Business Annals*. New York: National Bureau of Economic Research, 1926.

Timberlake, R. H. (1993) Monetary Policy in the United States. Chicago: University of Chicago Press and the Cato Institute.

Timberlake, R.H. (1984). The central banking role of clearinghouse associations. Journal of Money, Credit, and Banking 16, 1–15.

Wallace, Robert F., “The Use of Progressive Discount Rate by the Federal Reserve System.” Journal of Political Economy. Vol. 64, No. 1 (1956), pp. 59-68.

Wheelock, David, “Member Bank Borrowing and the Fed’s Contractionary Monetary Policy during the Great Depression,” Journal of Money, Credit and Banking 22 (4), November 1990, pp. 409-426.

White, Eugene N., The Regulation and Reform of the American Banking System 1900-1929 (Princeton: Princeton University Press, 1983).

White, Eugene N., “Protecting Financial Stability in the Aftermath of World War I: the Federal Reserve Bank of Atlanta’s Dissenting Policy,” in. Peter L. Rousseau and Paul Wachtel, eds., Financial Systems and Economic Growth: Credit, Crises and Regulations from the Nineteenth Century to the Present (Cambridge: Cambridge University Press, 2017), pp. 201-231.

Wright, Gavin, Old South, New South: Revolutions in the Southern Economy Since the Civil War (Baton Rouge: Louisiana State University Press, 1996).