The Effect of Changes in Reserve Requirements During the 1930s: The Evidence from Nonmember Banks

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Despite the widespread acceptance of Friedman and Schwartz’s interpretation of the 1936/37 increase in member bank reserve requirements as the major cause of the 1937/38 recession there is surprisingly little straightforward evidence on this issue, perhaps because data limitations and structural instability preclude econometric modeling. We exploit a simple alternative, comparing member banks with non-member banks not subject to changes in reserve requirements. The results support the hypothesis that the increase in reserve requirements reduced the availability of bank credit and contributed to the recession.

The Banking Act of 1935 gave the Federal Reserve the power to double member bank reserve requirements. In 1936 and 1937 it used this power to reduce the extraordinarily high level of excess reserves. It did so not to reduce the then-prevailing level of bank credit or the money supply, but to avoid excessive credit growth in the future. This action has, however, been blamed for generating, or at least exacerbating, the short but sharp recession of 1937/38. It has generated much debate, mainly because of its bearing on the role of monetary policy in the Great Depression.

The main issue in this debate is whether banks held the excess reserves because they lacked profitable lending opportunities, or because they wanted to hold large precautionary balances. The difficulty in distinguishing between these two possibilities is that no adequate measure of the demand for bank credit is available. To avoid this problem we compare the reserve behavior of member and a subset of nonmember banks, which were not subject to the higher reserve requirements. The data are biannual for the period from June 1934 to June 1941. If member banks increased their total reserve ratios because of a decline in the demand for bank credit, then on the reasonable assumption that there...
was no concurrent change in the relative volume of credit demand from member and nonmember banks, the total reserve and loan ratios of member banks and nonmember banks should have behaved in the same way when member bank reserve requirements where raised. By contrast, if member banks held their large excess reserves as precautionary balances, and responded to the increased reserve requirements by restoring their excess reserves, then relative to nonmember banks their cash reserve ratios would have increased and their loan ratios would have decreased.

INSTITUTIONAL BACKGROUND

Prior to the 1935 Banking Act member banks’ required reserve ratios were set by legislation, and differed (as they did for a long time afterwards) depending upon whether a bank was located in one of the two central reserve cities (New York and Chicago), a reserve city (there were about 50 of these with the exact number varying over time), or elsewhere. Reserve requirements for nonmember banks varied from state to state, both in their level and in their composition. For example, some states allowed their banks to hold a certain proportion of their required reserves in U.S. government securities or in securities issued by that state. Others required vault cash and interbank deposits. This makes it impossible to calculate excess reserve ratios for nonmember banks in a manner that would be comparable to the excess reserve ratios for member banks.

As Table 1 shows, in 1936 the Fed raised reserve requirements of member banks on both demand and time deposits by 50 percent. In 1937 it raised the requirements on demand and time deposits by a further 33 percent, thus doubling them from their 1935 level. This still left the banking system as a whole with sufficient reserves to meet its legal requirements, though some banks in large cities had insufficient reserves. But, with a lag of several quarters, member banks sold securities thereby restoring their excess reserves. Then, in April 1938, two months before the trough of the 1937/38 recession, the Fed lowered average reserve requirements on demand deposits by about 13 percent and on time deposits by 17 percent, only to raise them again in November 1941 back to double their 1935 level. This last change is excluded from our regression sample because there is only one subsequent observation (December 1941), and that observation is for just after the Pearl Harbor attack. Excess reserves for reserve city and country banks began to rise in 1934, declined from mid-1936 to

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1 Roos, Economics, p. 104.
TABLE 1
RESERVE REQUIREMENTS FOR MEMBER BANKS

<table>
<thead>
<tr>
<th>Announcement Date</th>
<th>14 July 1936</th>
<th>30 January 1937</th>
<th>15 April 1938</th>
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<tr>
<td>Effective Date</td>
<td>21 June 1917 to 15 August 1936</td>
<td>16 August 1936 to 30 January 1937</td>
<td>1 May 1937 to 15 April 1938</td>
</tr>
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<td></td>
<td>21 June 1937</td>
<td>1 March 1937</td>
<td>16 April 1938 to 31 October 1941</td>
</tr>
<tr>
<td></td>
<td>15 August 1936</td>
<td>30 April 1937</td>
<td>1 November 1941 to 31 December 1941</td>
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<table>
<thead>
<tr>
<th>Net Demand Deposits</th>
<th>Central reserve city banks</th>
<th>Percentage change relative to 1936 requirement</th>
<th>13.00</th>
<th>19.50</th>
<th>22.75</th>
<th>26.00</th>
<th>22.25</th>
<th>26.00</th>
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<tr>
<td>Reserve city banks</td>
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<td>15.00</td>
<td>17.50</td>
<td>20.00</td>
<td>17.50</td>
<td>20.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage change relative to 1936 requirement</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>71</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country banks</td>
<td>7.00</td>
<td>10.50</td>
<td>12.25</td>
<td>14.00</td>
<td>12.00</td>
<td>14.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage change relative to 1936 requirement</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time Deposits</th>
<th>All member banks</th>
<th>Percentage change relative to 1936 requirement</th>
<th>3.00</th>
<th>4.50</th>
<th>5.25</th>
<th>6.00</th>
<th>5.00</th>
<th>6.00</th>
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<td></td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>67</td>
<td>100</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Board of Governors, Banking and Monetary Statistics.

the latter part of 1937, then rose and stayed high for the rest of the decade (See Figure 1).

PREVIOUS LITERATURE

Milton Friedman and Anna Schwartz argued that most of these reserves in excess of the legal requirement were not excess in an economic sense: banks wanted to hold them because they were afraid of further bank runs, having learned from their experience in 1930–1933 that they could not rely on the Fed to act as a lender of last resort. The causes of the large excess reserves were also discussed by other researchers in the 1960s and 1970s (e.g., Karl Brunner and Allan Meltzer; Peter Frost; George Horwich; and George Morrison). In recent years there has been a resurgence of interest in these excess reserves among such scholars as Charles Calomiris and Joseph

2 Friedman and Schwartz, Monetary History.
Among these only Morrison proceeded, in part, by comparing the reserve ratios of member and nonmember banks. He concluded that the difference in their total reserve ratios after the 1936/37 increases was approximately equal to the additional reserves that nonmember banks would have had to hold had their reserve requirements increased as had those of member banks. Hence, he argued, it was the increased reserve requirements that accounted for the higher total reserve ratios (and thus the approximately unchanged excess reserve ratios) of member banks. But Morrison’s results are unconvincing because he did not control for other

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3 For the 1960s and 1970s, see Brunner and Meltzer, “Liquidity Traps”; Frost, “Bank’s Demand”; Horwich, “Effective Reserves”; and Morrison, Liquidity Preferences. For recent works, see Calomiris and Mason, “Consequences”; Graham, “Commercial Bank Reserve Adjustment”; Lindley, Sowell, and Mounts, “Excess Reserves”; Meltzer, History; Mounts, Sowell, and Saxena, “Examination”; Ramos, “Bank Capital Structures”; and Telser, “Higher Member Bank Reserve Ratios.” Roos, (Economics, pp. 302–03) provides a survey of the earlier literature. Hirsch and de Machi (Milton Friedman, pp. 233) referred to Friedman and Schwartz’s discussion of banks’ response to the higher reserve requirements as one of their three “crucial experiments” showing the causal primacy of money. See Temin, Did Monetary Forces; and Mayer, “Money,” for more detail on the debate over the causes of the Great Depression.

4 Morrison, Liquidity Preferences, pp. 45–47.
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variables that could account for the difference and more consequentially he assumed that reserve requirements of nonmember banks were constant. However, in only 17 of the 48 states can one be confident that the state requirements did not change in the 1930s.\(^5\)

The view that the increase in reserve requirements caused the sharp downturn in 1937/38 appears to have become conventional wisdom despite little direct evidence beyond that offered by Friedman and Schwartz and by Morrison. In a recent review of a book on the Great Depression, Alexander Field, in summarizing the discussion of Fed policy in the second half of the 1930s, stated: “The downturn in 1937/38 is attributed conventionally to misguided monetary stringency. . . .”\(^6\) Frederic Mishkin, in the most popular current money and banking textbook discussed the increase in reserve requirements as follows: “So not only does it appear that the Fed was at fault for the severity of the Great Depression contraction in 1929–1933, but to add insult to injury, it appears that it was also responsible for aborting the subsequent recovery.”\(^7\)

It is tempting to view this discussion as part of the Keynesian-monetarist debate, with monetarists claiming that the Fed could have controlled the money supply if it had really tried, and is therefore responsible for the severity of the Great Depression, and some Keynesians arguing that banks would not have turned any additional reserves into earning assets, and deposits. But this simple picture needs qualification. Not all Keynesians confused legally and economically excess reserves. James Tobin noted in his review article of Friedman and Schwartz’s *Monetary History* that most economists (who at the time of Tobin’s review were predominantly Keynesians) believed that the increase in reserve requirements had been “too drastic,” which implies that banks were not in a liquidity trap.\(^8\) Conversely, a monetarist could concede that the excess reserves of the late 1930s resulted primarily from an insufficient demand for bank credit, but could treat it as a special case resulting from the massive bank failures in 1930–1933 and the shock to expectations caused by the restrictive monetary policy of prior years.\(^9\) Moreover, Friedman and Schwartz did not advocate a monocausal explanation for the pile-up of excess reserves, but allowed a role for the demand for credit and low interest rates, and thus a role for a low

\(^5\) The significance of our test does not depend on the size of nonmember bank deposits. Instead, the fulcrum of our test is that the increase in the reserve requirements of one type of bank, and not of the other, provides a natural experiment for seeing how higher reserve requirements affected the banks subjected to them.


\(^7\) Mishkin, *Economics*, p. 422.

\(^8\) Tobin, “Monetary Interpretation,” p. 482.

\(^9\) Morrison, *Liquidity Preferences*, p. 53
marginal efficiency of investment, as part of the explanation. Likewise, Meltzer suggested that certain nonmonetary factors were important.

THE DATA

Because data on the excess reserve ratios of nonmember banks are not available, we instead compare proxies for the total reserve ratios of member banks and the total reserve ratios of nonmember banks. This is feasible because the two traditional hypotheses can be reformulated in terms of total reserves; one asserting that as reserve requirements increased, member banks wanted to increase their total reserve ratios to maintain their excess reserve ratios, and the other asserting that even though reserve requirements were increased, member banks wanted to keep total reserves unchanged, and meet the increased requirement by reducing their excess reserves, but were prevented from doing so by an inadequate demand for bank credit.

The idea of an “inadequate demand for bank credit” is vague and lacks foundation in maximizing behavior, but that is the way in which the Keynesian consensus prior to the publication of Friedman and Schwartz’s Monetary History was formulated. More recently Calomiris and Wilson (forthcoming) have formulated the problem of how banks managed their balance sheets in the 1930s in a much more sophisticated way by treating banks as balancing at the margin the cost of losing deposits if their riskyness increases with the costs of issuing more capital, or switching from risky assets, such as loans, into riskless assets. Although this analysis greatly advances our understanding of bank behavior, it does not address the topic of this article, because Calomiris and Wilson in effect combined all low-risk and riskless assets into a single asset. Their model therefore does not address the question of why banks held such large excess reserves rather than other riskless or low-risk assets.

Testing the two traditional hypotheses by comparing the total reserve ratios of member and nonmember banks is valid only if the reserve requirements of nonmember banks did not change when those of member banks

10 Thus they wrote: “The increased fraction of bank assets held in the form of cash assets . . . can be partially explained by supply considerations. . . . [A] lagged reaction to the gold inflow may have contributed to the increase. More important, because longer lasting, rates of interest in general fell, which made cash assets more attractive compared to other assets. . . . Moreover, the shift in preferences depressed particularly the yields on short-term highly liquid assets. . . . At those yields it was hardly worthwhile to hold bills instead of cash. In consequence . . . the ratio of cash assets to total assets continued to rise until 1940. While supply considerations explain part of the shift into cash assets, they cannot explain the whole of the shift, which was motivated also by the same desire for liquidity as the shift into investments. . . . [After] 1936, the acquisition of cash assets became the most convenient and least costly way to achieve the desired liquidity.” (Friedman and Schwartz, Monetary History, p. 457.

11 Meltzer, History.

12 Calomiris and Wilson, “Bank Capital.”
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did. Compilations of state reserve requirements were published only in 1930, 1937, and 1944. Accordingly, our sample consists of nonmember banks in 17 states that had the same reserve requirements in all three years. This does not guarantee they were unchanged for the entire 1930–1941 period, but it seems highly likely. No information is available on the stringency with which state banking authorities enforced their requirements, but there is no reason to assume that any variation in this stringency is correlated with changes in member bank reserve requirements.

The FDIC provides call-report data for member and nonmember insured banks in each state for 30 June and 31 December. These data can be used to calculate the following three definitions for member and nonmember banks:

\[
\text{Cash reserves} = \text{Vault cash} + \text{Balances with other domestic banks and the Fed} + \text{Cash items in process of collection} \\
(1)
\]

\[
\text{Deposits} = \text{Demand Deposits} + \text{Time Deposits} + \text{Government Deposits} + \text{Interbank Deposits} - \text{Cash items in process of collection} \\
(2)
\]

\[
\text{Cash reserve ratio} = \frac{\text{Cash reserves}}{\text{Deposits}} \\
(3)
\]

The cash reserve ratio (CRR) is the proxy used here for total reserves. The denominator corresponds to the deposit measure against which member and nonmember banks had to hold reserves. The numerator corresponds to

\[13\text{ Board of Governors, “Provisions” 1930, “Provisions” 1937, and “Summary.”}\]

\[14\text{ They are: Alabama, California, Georgia, Iowa, Kentucky, Massachusetts, Missouri, Montana, Nebraska, New Mexico, North Carolina, South Carolina, Tennessee, Utah, Virginia, West Virginia, and Wyoming. This does not necessarily mean that all other states changed their reserve requirements; for some states the information provided was insufficient to decide, and we excluded them from the sample. It is also possible that the total reserve ratios of nonmember banks were affected by the changes in member bank required reserves. Nonmember banks could have felt competitive pressure to raise their total reserves to enhance the safety of their deposits. But it is far from obvious that higher reserve requirements significantly raised the safety of member bank deposits. By reducing potential bank earnings they could also have increased the likelihood of bank failure.}\]

\[15\text{ There is the problem of window dressing in which banks adjust their asset mix just before the call-report dates to improve the appearance of their balance sheets. This problem is likely to have been more severe for nonmember banks because some states may have enforced their reserve requirements only at specific dates, such as the call-report dates.}\]

\[16\text{ Federal Deposit Insurance Corporation, }\textit{Assets}, \text{ various dates.}\]

\[17\text{ Regarding interbank deposits (a component of deposits): For the banking system as a whole, interbank deposits do, of course, equal balances with banks other than the Fed. But that is not so for member banks or nonmember banks taken separately.}\]
neither the definition of reserves applicable to member or nonmember banks. It differs from the former by including interbank deposits, and it differs from the latter by excluding the U.S. government securities and state securities that nonmember banks could count as reserves in some states. It is therefore a compromise measure required by the different ways in which reserves were defined for member and nonmember banks, and by the absence of data that would allow a reconciliation between the two. Figure 2 presents the average computed CRR for member and non-member banks for the 17 states from June 1934 to December 1941. The increased gap between member and nonmember bank ratios is evident after reserve requirements were increased.

Relative shifts in the CRR reflect portfolio adjustments of the type hypothesized by Friedman and Schwartz. A simple model of the demand by banks for cash reserve assets and other assets can be written as

\[
\frac{CRA}{TA} = a + bi_{CRA} + ci_{OA} \text{ if } \frac{CRA}{TA} > \lambda
\]

(4)

\[
\frac{CRA}{TA} = \lambda \text{ if } \frac{CRA}{TA} \leq \lambda
\]

(5)

These states are California, Georgia, Nebraska, and Massachusetts. States generally limited the proportion of reserves that could be held in securities and in interbank deposits.
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where $CRA / TA$ is the ratio of cash assets to total assets, $i_{cra}$ the yield (both monetary and imputed) on cash assets, $i_{oa}$ the yield on other assets, and $\lambda$ the required reserve ratio. Equations 4 and 5 can be written separately for member and nonmember banks. The model cannot be estimated directly because measures of $i_{cra}$ and $i_{oa}$ are not available, and the Treasury bill rate is not an acceptable proxy. And even if such data were available the low frequency of the data and the resulting scarcity of observations, as well as the presumably volatile expectations generated by the uncertainty of the 1930s, would argue against trying to develop an explicit model of bank behavior. The usual procedure of assuming that expectations are rational is not applicable here because it requires assuming either that banks have learned the underlying model, or that their learning process can be specified.

However, this framework can still provide insight into the relative portfolio choices of member and nonmember banks because, for our sample of nonmember banks, $\lambda$ remained constant. Assuming the yield variables and their parameters are the same for member and nonmember banks, one can test whether changes in $\lambda$ for member banks shifted their portfolio choice from the unconstrained state of equation 4 to the constrained state of equation 5 and thus affected their $CRA / TA$ ratios, by seeing if for member banks this ratio changed relative to that for nonmember banks whose $\lambda$ variable did not change. We therefore used as our dependent variable the difference in the cash reserve ratios of member and nonmember banks. Evidence that when the reserve requirements of member banks increased the cash ratio of member banks increased relative to that of nonmember banks is consistent with the hypothesis that the Fed bears significant responsibility for the 1937/38 recession. So too is a showing that the loan ratio (loans to total assets) of member banks declined relative to that of nonmember banks.

THE REGRESSIONS

To determine the impact of reserve requirement increases on the difference in the cash ratios we estimated a regression set combining state cross-

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19 It would not be correct to assume that, because at the margin net expected yields on all assets must be equal, the Treasury bill rate provides an adequate proxy for all yields. Bill rates when compared to loan rates contain large imputed yields in terms of liquidity and safety that may fluctuate. An attempt to estimate a fully specified model would also run into a causality problem; while interest rates affect the excess reserves that banks demand, these excess reserves also affect interest rates.

20 The assumption the yields and their coefficients are the same for member and nonmember banks is actually somewhat stricter than required. If the coefficients are the same, then all that is required is that the ratio of the yields that member banks obtain on earning assets and on excess reserves relative to these yields for nonmember banks remain constant, or conversely, if the yields are not constant, then the ratio of their coefficients is constant.
section and time series data from June 1934 to June 1941, where the variables for member and nonmember banks are denoted by the subscripts “mem” and “non” respectively.

\[
CRR_{mem} - CRR_{non} = b_0 + a_1(\Delta RR) + b_2(S_{mem} - S_{non}) + \\
b_3(TDR_{mem} - TDR_{non}) + b_4(IBDR_{mem} - IBDR_{non}) + \\
b_{5,1...16}(SD) + b_6(IP) \tag{6}
\]

The variable \(\Delta RR\) is the percentage point change in member bank reserve requirements in December 1936, June 1937, and June 1938 over their 1935 level.\(^{21}\) That is, if the reserve requirement was 10 percent in 1935 and increased to 12.6 percent as of December 1936, the variable \(\Delta RR\) is 2.6. Because the reserve requirement ratio for nonmember banks in our sample was constant during this period, \(\Delta RR\) also measures the percentage point change in the difference between the required reserve ratio of member and nonmember banks. Until December 1936 \(\Delta RR\) is zero, then it becomes 2.6 where it stays until June 1937 when it rises to 6.6. It then falls to 4.8 in June 1938, where it remains until the end of the sample period. The other variables are control variables: \(S\) is bank size measured by average assets; \(TDR\) is the ratio of time deposits to total deposits; \(IBDR\) is the ratio of interbank to total deposits; \(SD\) is a state dummy variable; and \(IP\) is a macroeconomic control variable defined as the monthly Index of Industrial Production for a six-month period beginning one month before the call report date. The state dummy variable \(SD\) accounts for differences among the states in the definition of deposits and reserves, as well as the extent to which reserve requirements were enforced.

Any observed changes in the relative size of member bank and nonmember bank reserve ratios could have been the result of deposit shifts between types of banks with different reserve requirements. For member banks shifts of deposits between different types of banks were relatively small. For nonmember banks such data are not available. But, fortunately, in nine of the 17 states in our sample, reserve requirements were the same

\(^{21}\) The reserve-requirement changes were calculated as weighted averages for time deposits and demand deposits in country and reserve city banks. The sample does not include any states with central reserve cities. The weights used are the deposits (Board of Governors, Banking and Money Statistics, pp. 97–103) at the first observation at which the new requirement became effective. We made no adjustments for the changes in the average required reserve ratio that occurred at other times due a shift in the composition of deposits. It would be preferable to compare state banks only with member country banks because nonmember banks were smaller than reserve city banks and functioned more like country banks, but the relevant data for country banks are not available. The date used for the reserve-requirement changes was the first call-report date following the date on which the new requirements became effective. (This is the same as the first call-report date following the announcement of the increase.)
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for all types of nonmember banks. For the other eight states we rely on our control variables (bank size, the time deposit ratio, and the interbank deposit ratio) to pick up the effects of deposit shifts.

In an imperfect capital market bank loans play a special role; it may be much more damaging to economic activity if banks respond to an increase in reserve requirements by reducing bank loans than by reducing their security holdings. To investigate the effect of the reserve requirement changes on the supply of bank loans we used the same set of regressors as before with the ratio of loans to total assets as the dependent variable. That is

\[
\begin{align*}
LOAN_{mem} - LOAN_{non} &= b_0 + a_1(\Delta RR) + b_2(S_{mem} - S_{non}) + \\
b_3(TDR_{mem} - TDR_{non}) + b_4(IBDR_{mem} - IBDR_{non}) + \\
b_5,_{1, \ldots, 16} (SD) + b_6(IP)
\end{align*}
\] (7)

Three additional factors need to be considered: first, the possible asymmetry in the response of banks to increases and decreases in reserve requirements; second, the effect of changing reserve requirements on expectations; and third, the lag in the response of banks to the increase in reserve requirements.

There is no satisfactory way of testing for an asymmetric response with only two increases in reserve requirements interrupted by only one relatively small decrease combined with the small number of data points. Reserve requirements might have affected aggregate demand by changing expectations. Agents might have believed that the 1936/37 increase in reserve requirements would generate a recession, or they might have become more optimistic when they saw the Fed taking action against potential inflation. Similarly, when the Fed lowered reserve requirements in 1938 they might have interpreted that as an indication that the recession would be brief, or as an indication that the Fed feared that the recession would get worse. But a review of news reports and editorials in the Wall Street Journal and the New York Times suggests neither a large negative or positive effect on expectations.22

The variable \(\Delta RR\) incorporates an implicit lag of a month or two because the June and December observations followed the announcement and effective date of the reserve requirement change. An additional, explicit lag may be appropriate, however. Considering the time from when the reserve requirement changes were announced to when they became effective a six months explicit lag—the minimum lag (other than zero) that our data permit—combined with our implicit lag, should provide sufficient time for banks to have adjusted their cash ratios, though not necessarily

22 The review of newspaper articles is available as appendix 1 at tcargill@att.net.
their loan ratios. But we cannot be certain, and therefore we ran regressions with zero, 6-month and 12-month lags, though we consider the 12-month case less plausible than the others. These lags are much shorter than those suggested by Friedman and Schwartz who concluded, apparently from a visual inspection of the data, that:  

\[\text{(1)}\text{It takes some seven months for banks to adjust to an unanticipated discrepancy between their actual and desired reserve positions produced by a change in their actual position, and some three years for banks to carry through a thoroughgoing revision of their reserve position as a result of a change in their desired position.}\]

Friedman and Schwartz, however, did not present independent evidence for such long lags. Their argument is that because lags have to be that long in order to reconcile the data with their interpretation of excess reserves, one must conclude that the lags are that long. But one could equally well conclude that their interpretation of the excess reserves is wrong.

Morrison also found a very long lag in reserve adjustments after financial panics. He attributed this to the difficulty of quickly liquidating enough earning assets, and to the time required for banks to revise their expectations of the volume of earning assets they can reasonably hold. He argued that banks may regard “a large proportion” of a change in potential deposits “as too temporary to warrant a corresponding change in actual deposits,” except if it is necessary to meet higher reserve requirements. Morrison’s argument is applicable at best to the 1936 increase, because following the 1937 increase banks did not have to be concerned about further increases in reserve requirements—the 1937 increase had already brought the required reserve ratio to its statutory maximum. Morrison’s work is, however, a useful warning that different disturbances impinging on bank reserve ratios may generate quite different adjustment lags. Calomiris and Wilson also found a long lag in the portfolio adjustments of banks. But the portfolio adjustments they discussed are adjustments in the ratio of risky to safe assets and in the capital/deposit ratio. One would expect the adjustment between cash assets and other safe assets to be much faster.

23 Friedman and Schwartz, Monetary History, p. 543.
24 Morrison, Liquidity Preferences.
25 Morrison, Liquidity Preferences, p. 59.
26 Tobin, “Monetary Interpretation.”
27 Calomiris and Wilson, “Bank Capital.”
REGRESSION RESULTS

The data set is a nearly balanced panel of cross-section and time-series data with 17 states and 15 time periods for each state. The regression coefficients and standard errors of equations 6 and 7 were estimated by a fixed-effects estimator designed for panel data and a robust errors estimator to adjust the standard errors for nonrandom behavior in the error term. The fixed-effects estimator suppresses the constant term in equations 6 and 7 and does not explicitly provide estimates of the dummy variable coefficients, whereas the robust estimator includes the constant term and the state dummy variables. The regression coefficients for the two estimators are the same; however, the robust errors estimator adjusts the standard errors for a wide range of nonrandom behaviors in the error term. Although we consider them less appropriate given our data set we also present the results for AR1 regressions, both with constant and with varying RHO’s for each state.

Table 2 presents the coefficients and \( t \) values of \( \Delta RR \) and the \( R^2 \) for the four estimators of equations 6 and 7 with no explicit lag, a 6-month lag, and a 12-month lag. The regressions account for a substantial percentage of variation in the dependent variable and the signs and significance of the control variables were not unusual. In general, although the specific control variables were not individually significant they were significant at the 5 percent level as a group. The macro control variable was negative and significant for the 0-month lag regression, but insignificant for the 6- and 12-month lag regressions.

The \( \Delta RR \) variable is positive in all of the reserve ratio regressions and significant at the 5 percent level in all but one regression. In that case it is significant at the 10 percent level. The \( \Delta RR \) variable is negative in all of the loan ratio regressions and significant at the 5 percent level in all but one regression where it just misses significance.

The \( \Delta RR \) variable is not only statistically significant but is also large enough to be economically significant when its impact on the reserve and loan ratio is evaluated at the tails of the distribution. The \( \Delta RR \) variable is measured in percentage point changes of the reserve requirement ratio, so that a coefficient of 0.75 for the cash ratio (Table 2, fixed effects coefficient at 0-months lag) means that the cash ratio increased by 0.75 percentage points.

28 These procedures were run with RATS, version 5 (Estima).
29 The complete set of results is available as appendix 2 at tcargill@att.net.
30 One reader of an earlier version suggested that the change in relative cash ratios might have reflected a shift in holdings of government securities. This is unlikely because the ratio of government securities to assets for member and nonmember banks remained relatively stable after the first reserve requirement increase.
TABLE 2
COEFFICIENT ESTIMATES AND T-VALUES FOR ΔRR AND R² VALUE

<table>
<thead>
<tr>
<th>Explicit Lag on ΔRR</th>
<th>Fixed Effects</th>
<th>Robust Errors</th>
<th>AR1 Constant Rho</th>
<th>AR1 Varying Rho</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Coeff. t-Value</td>
<td>Coeff. t-Value</td>
<td>Coeff. t-Value</td>
<td>Coeff. t-Value</td>
</tr>
<tr>
<td>0 Months</td>
<td>0.75 4.91 0.75 4.51 0.70 3.77</td>
<td>0.68 4.46 0.72 0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.69 0.69 0.69 0.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Months</td>
<td>0.60 4.66 0.60 4.95 0.50 3.23 0.49 3.86</td>
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<tr>
<td>Adjusted R²</td>
<td>0.68 0.68 0.68 0.72</td>
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<tr>
<td>12 Months</td>
<td>0.45 3.64 0.45 4.20 0.28 1.86 0.31 2.51</td>
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<td>Adjusted R²</td>
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<tr>
<td>Dependent Variable Defined as CRRmember – CRRnonmember</td>
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<td>0 Months</td>
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<td>–0.33 –1.89</td>
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<tr>
<td>6 Months</td>
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<td>–0.42 –3.00</td>
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</tr>
<tr>
<td>12 Months</td>
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<td>–0.65 –5.39</td>
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<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
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<tr>
<td>Dependent Variable Defined as LOANmember – LOANnonmember</td>
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</tr>
<tr>
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<td>–0.39 –2.57</td>
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<tr>
<td>6 Months</td>
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<tr>
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<tr>
<td>12 Months</td>
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<td>Adjusted R²</td>
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</tr>
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</table>

Source: Based on results presented in appendix 2 at tcargill@att.net.

points for each 1 percentage point increase in the required reserves ratio.
Focusing on the 1937 increase in reserve requirements as described in note 21, the mean cash reserve ratio increased by 6.6 percentage points over its 1935 level; thus, given a 0.7456 coefficient it raised the mean reserve requirement of member banks by 4.92 percentage points over the 1935 level. Table 3 presents this calculation for the 1937 increase for the entire set of fixed-effects estimates, which we regard as the most reasonable of the four estimators. The calculations for the point estimates of the coefficients suggest a 2.95 to 4.92 percentage point increase in the cash reserves ratio and a 2.55 to 4.07 decrease in the loan ratio of member banks in 1937 over the 1935 level depending upon the lag model used. Table 3 also presents the same calculation for the point coefficient estimate plus and minus one and two standard errors.

CONCLUSION

These results combined with the impressions suggested by Figure 2 do not support the claim that banks responded to the changes in reserve requirements essentially by changing their excess reserves. Instead, they support the hypothesis that member banks met a substantial part of their increased reserve requirements by reducing their earning assets, including
loans. This strongly suggests that the decision to raise reserve requirements in 1936 and 1937 contributed to the 1937/38 recession. This finding does not rule out factors such as fiscal policy and unbalanced inventories that contributed to the recession, but monetary policy was an important contributing factor and perhaps even the most important factor.

REFERENCES


