Did Doubling Reserve Requirements Cause the 1937-38 Recession? New Evidence on the Impact of Reserve Requirements on Bank Reserve Demand and Lending

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Did Doubling Reserve Requirements Cause the 1937-38 Recession? New Evidence on the Impact of Reserve Requirements on Bank Reserve Demand and Lending

Charles W. Calomiris, Joseph R. Mason, and David C. Wheelock

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Abstract

In 1936-37, the Federal Reserve doubled member banks’ reserve requirements. Friedman and Schwartz (1963) famously argued that the doubling increased reserve demand and forced the money supply to contract, which they argued caused the recession of 1937-38. Using a new database on individual banks, we show that higher reserve requirements did not generally increase banks’ reserve demand or contract lending because reserve requirements were not binding for most banks. Aggregate effects on credit supply from reserve requirement increases were therefore economically small and statistically zero.

JEL codes: E51, E58, G21, G28, N12, N22
keywords: reserve requirements, reserve demand, excess reserves, money multiplier

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1. Introduction

Today, U.S. banks have enormous holdings of reserve deposits with the Federal Reserve (Fed), all of which are “excess” reserves in the legal sense following the elimination of reserve requirements in March 2020. The Fed’s large-scale asset purchases during and after the financial crisis of 2007-08, and again during the Covid-19 pandemic in 2020-21, flooded the banking system with reserves. The Fed has sought to manage reserve volumes and implement monetary policy through various means, including the payment of interest on reserve balances and operation of a reverse repo facility.

The potential for excess reserves to fuel an expansion of money and credit, and possibly an acceleration of inflation, has been a concern voiced by many observers, some of whom have argued for raising reserve requirements as a means of responding to inflationary pressures, particularly in light of potential Fed reluctance to sell assets. With required reserve ratios set to zero, the Fed’s asset purchases created a sea of excess reserves and made reserves and Treasuries closer substitutes because reserves, per se, are not needed to satisfy any unique requirement. Some observers have also noted that by making reserves and Treasuries closer substitutes, the payment of interest on reserves has further weakened the power of open market and repo operations to affect money and credit growth at banks. These arguments could potentially justify reimposing reserve requirements as a means of preventing inflation. Furthermore, some

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1 See https://www.federalreserve.gov/monetarypolicy/reservereq.htm
2 Several commentators (e.g., Stella 2009, Calomiris 2010) argue that in a rising interest rate environment, the capital losses suffered by the Fed from sales of longer-term Treasury securities and mortgage-backed securities on its balance sheet could potentially create political problems for the Fed, both through the appearance of contributing to the government deficit (a result of accounting conventions), and through the potential effects on the prices of mortgage-backed securities. If the Fed intends to hold to maturity much of the securities it acquired recently, it could resort to using alternative tools for monetary tightening, such as paying higher interest rates on excess reserves, use of reverse repurchase agreements, or increases in reserve requirements.
observers argue for increasing reserve requirements for prudential reasons as an alternative to the current liquidity requirements on banks which treat holdings of reserves and Treasuries as equivalent (Calomiris, Heider and Hoerova 2017).

Banks’ current disposition toward holding a substantial share of their total assets as excess reserves illustrates a more general phenomenon: banks have always based their balance sheet allocations (including their excess reserves-to-assets ratios) on microeconomic tradeoffs involving risks, expected returns, and liquidity. To implement monetary policy effectively, policymakers must understand those tradeoffs, in particular the preferences that determine the demand for reserves.

An early example of dramatic swings in banks’ reserve holdings was in the 1920s and 1930s. In the 1920s, liquid assets, such as cash, reserve deposits with the Fed, and even Treasury securities, comprised only a small share of total U.S. bank assets. Liquid asset ratios (whether narrowly or broadly defined) grew dramatically after 1929, however, and remained elevated throughout the 1930s. Those changes reflected an increased and persistent preference of banks for holding liquid assets rather than more capital to reduce bank failure risk (Calomiris and Wilson 2004).

In setting monetary policy in the 1930s, the Federal Reserve faced the major challenge of understanding banks’ apparent increased demand for reserves. Fueled by inflows of gold from abroad, U.S. bank reserves grew rapidly in the mid-1930s, and banks accumulated large stocks of reserves in excess of legal requirements. By 1936, Fed officials worried that if banks’ apparent preference for a high level of excess reserves disappeared, they might then grow their deposits and loans dramatically, resulting in higher inflation or financial instability. Fed officials
considered increasing reserve requirements on the System’s member banks to forestall that possibility, but they recognized that an increase in requirements could depress economic activity if it produced an immediate increase in reserve demand and a consequent contraction in money and credit. Officials understood that the impact of higher reserve requirements depended on whether the ongoing surge in excess reserves reflected a stable preference for holding liquid assets. However, after determining that most banks had sufficient excess reserves and other liquid assets to absorb a substantial increase in reserve requirements without reducing their current lending, the Federal Reserve Board decided to increase requirements, which it did in three steps on August 16, 1936, and March 1 and May 1, 1937. In total, the increases doubled the required reserve ratios on the demand and time deposits of member banks (see Table 1).4

Reserve requirements were the Fed’s primary monetary policy tool in the mid-1930s for three main reasons. First, Fed officials believed that raising reserve requirements would lessen the potential for a future surge in money and credit, and hence inflation, but not contract lending or slow the economic recovery.5 Second, the Fed sought to wrest control over monetary policy away from the Treasury, and given the size of Treasury money-creating authority relative to the Fed’s portfolio of Treasury securities, open market sales could easily have been undone by Treasury operations.6 Third, the size of the Fed’s securities portfolio was small compared with the volume of excess reserves, which further limited the scope for open market sales. At the

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4 At the time, the Fed’s reserve requirements applied only to the System’s member banks, which consisted of all banks with federal charters (i.e., national banks) and state-chartered banks that elected to join the System. The Monetary Control Act of 1980 extended the Fed’s requirements to all depository institutions, including state-chartered non-Fed member banks, savings institutions and credit unions.

5 Friedman and Schwartz (1963, p. 526) criticize the Fed for not waiting until the need for tightening was immediate. An argument can be made, however, that by acting in advance, the Fed made its policy more predictable, thereby injecting less uncertainty into the market. Furthermore, acting in advance avoided lags associated with identifying a surge in lending and reacting to it.

6 Meltzer (2003, Chapter 6) discusses the Treasury Department’s influence on monetary policy in the 1930s that resulted from legislative changes and creation of the Exchange Stabilization Fund.
time, the Fed was also not permitted to pay interest on reserve balances. Hence, raising required reserve ratios was the only viable option for significantly reducing excess reserves.7

Many commentators, most notably Friedman and Schwartz (1963), have linked the onset of a recession in May 1937 to the Fed’s doubling of reserve requirements. Friedman and Schwartz contend that the doubling increased reserve demand, thereby reducing the volume of deposits that could be built upon the existing monetary base. The Friedman and Schwartz interpretation has been widely accepted among economists, policymakers, and textbook authors (e.g., Romer, 1992, 2009; Mishkin, 1989, pp. 399-400).

Despite being the dominant view, the impact of higher reserve requirements on the ratio of reserves to deposits is hardly clear in the aggregate data. Friedman and Schwartz (1963, p. 804) focus on the ratio of deposits to reserves, which was generally declining throughout the second half of the 1930s, as shown in Figure 1. The ratio reached a local peak in June 1936, regaining its March 1935 level after having fallen to a local minimum in January 1936. It then declined from June to October 1936 but varied little from October 1936 until November 1937 (ranging between 4.93 and 5.12). The ratio was nearly constant (varying between 4.96 and 4.98) from March through June 1937, despite the reserve requirement increases on March 1 and May 1. In fact, the ratio rose from 4.96 in May 1937 to 5.12 in August 1937. Thus, none of the three hikes was followed by a meaningful drop in the aggregate ratio of deposits to reserves.

Although inspection of the aggregate deposits-to-reserves ratio casts doubt on the Friedman and Schwartz (1963) contention that the doubling of reserve requirements sharply

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7 Banks also rarely borrowed reserves from the Fed so raising the discount rate would have also been ineffective. Friedman and Schwartz (1963, pp. 522-23) point out that several other technical and internal political factors also favored the use of reserve requirements as a tool.
reduced the money multiplier, it is possible that the behavior of the ratio reflected a combination of shocks of which the hike in reserve requirements was just one. Thus, we must look to disaggregated evidence to discern whether higher reserve requirements increased banks’ demand for reserves or reduced their lending.

The influences on reserve demand are many. They reflect liquidity risk, portfolio risk, and the relative cost of managing those risks with increased cash rather than more capital. Friedman and Schwartz (1963) argue that the banking panics of 1930-33 caused banks to demand high levels of excess reserves, and that banks responded to the doubling of reserve requirements by contracting their lending and deposits in an effort to rebuild their excess reserves. By contrast, Fed officials at the time interpreted the high levels of excess reserves as largely idle balances that could be absorbed easily without slowing the economic recovery, let alone causing a recession. Fed officials considered raising requirements as preventative, soaking up balances that could fuel a future rapid increase in lending and inflation without curtailing current lending.

After the first reserve requirement increase in August 1936, Federal Reserve staff studied member banks’ liquid asset holdings to determine how easily banks could absorb additional increases. From the analysis, Fed officials concluded that a prospective credit boom could be averted by raising reserve requirements without causing reserve demand to rise significantly. For example, one internal Fed staff memorandum circulated in January 1937 (Goldenweiser 1937), which served as the basis for the discussion at a January 25, 1937 meeting of the Fed’s governors and Reserve Bank presidents, noted that only 61 member banks (constituting about a fifth of

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8 Others questioned various aspects of this view, including Frost (1971), Wilcox (1984), and Calomiris and Wilson (2004).
member bank assets) would be unable to meet the proposed further increase in requirements
simply by shifting a portion of their assets from deposits held at other banks to deposits held at
the Fed. Moreover, even those potentially constrained banks had additional liquid assets (mainly
Treasuries) from which they could fund an increase in required reserves. The memo (pp. 3-4)
concluded that “[i]n acting at this time the Board can do so with the definite assurance that it will
not arrest recovery which is still far from complete.” The staff’s main concern was that higher
requirements might depress Fed membership in rural areas. The Fed reported some of these same
findings in its 1937 Annual Report (Board of Governors 1938, pp. 4-6).

This paper reports new empirical evidence on the impact of the doubling of reserve
requirements in 1936-37 to test the competing views of the contemporary Fed and Friedman and
Schwartz (1963). We use detailed call report data on individual banks’ reserve requirements and
reserve holdings in 1935 and 1937 to test directly for the first time on a nationwide basis the
determinants of reserve demand in 1935 and whether banks responded to the doubling of reserve
requirements by curtailing their lending. We find that the doubling did not significantly contract
lending among member banks on average, though loan growth was somewhat lower among
banks with greater exposure to the regulatory change. To arrive at these findings, we construct
several nationwide matched samples of Fed member and nonmember banks (based on different
matching criteria) to test for differences in loan growth from 1935 to 1937. We refine those
estimates using additional information to control for bank-specific differences within the
matched samples. Across our various formulations, we find no economically meaningful or
statistically significant differences in lending on average between member banks (which were

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9 In Board of Governors of the Federal Reserve System (1938, p. 6), the Fed also noted that when New York City
banks sold their Treasuries to meet higher reserve requirements, the Fed made open market purchases to offset the
effect on Treasury yields. See also Chandler (1971), pp. 316-17.
subject to the reserve requirements) and nonmember banks (which were not subject to the requirements). We conclude that reserve requirements were not binding on the vast majority of member banks and that the doubling of reserve requirements could not have been an economically significant cause of the recession of 1937-38 – at least not through any effect on the demand for reserves or supply of loans.\textsuperscript{10}

Our paper is most closely related to two recent contributions. First, Calomiris, Mason and Wheelock (2011) examine 26 mutually exclusive subsets of Fed member banks and show that the aggregate rise in the reserve-to-deposit ratio identified by Friedman and Schwartz (1963) did not occur among banks in every Federal Reserve district or class of banks. The ratio rose in some districts but declined or remained constant in others. Calomiris, Mason and Wheelock (2011) suggest that fundamental influences affecting some banks more than others likely produced a rise in aggregate reserve demand in in 1936-37 that was unrelated to the increase in reserve requirements.\textsuperscript{11} Calomiris, Mason and Wheelock (2011) do not investigate reserve demand at the bank level, however, or test whether changes in reserve requirements affected bank lending. By

\textsuperscript{10} The doubling of reserve requirements was not the only monetary policy action taken during 1936-37. As Friedman and Schwartz (1963, p. 544) acknowledge, a Treasury Department policy of sterilizing gold inflows begun in December 1936 substantially slowed the growth of bank reserves. Hanes (2006) and Irwin (2012) contend that gold sterilization was likely more important than the doubling of reserve requirements. Meltzer (2003) also ascribes an important role to gold sterilization. He dismisses the August 1936 increase in reserve requirements as unimportant but does see more impact from the second and third increases in 1937. Similarly, Velde (2009) attributes the monetary contraction to both the doubling of reserve requirements and gold sterilization and finds that monetary contraction was one of multiple causes of the 1937-38 recession. He argues that higher reserve requirements also reduced the demand for government and corporate debt, but had little discernable impact on aggregate bank lending, suggesting that if reserve requirement increases mattered it was not via the money multiplier channel emphasized by Friedman and Schwartz (1963). Eggertsson and Pugsley (2006) also suggest a monetary, but non-Friedman and Schwartz (1963), explanation for the recession focused on Fed and Treasury communications that they argue raised expectations of deflation. In addition to various monetary explanations, several other macroeconomic studies blame the recession on various non-monetary factors, such as tax increases (e.g., Calomiris and Hubbard 1995; McGratton 2012) and supply shocks (e.g., Hausman 2014). The planned wind-down of the Reconstruction Finance Corporation may also have altered bank behavior during the period.

\textsuperscript{11} Cargill and Mayer (2006) found that, in the aggregate, member banks’ reserves rose relative to those of nonmember banks, but Calomiris, Mason and Wheelock (2011) point out that there were important geographic differences between member and nonmember banks on average that can account for the aggregate difference.
contrast, Park and Van Horn (2015) use a difference-in-difference regression approach to compare loan growth among individual Fed member and nonmember banks in New York state. They find that member banks did not reduce their lending in response to higher reserve requirements and conclude that the doubling of reserve requirements likely did not cause the recession of 1937-38.\footnote{Park and Van Horn use quarterly summaries of balance sheet data from Annual Reports of the State of New York Banking Department over 1935-38 for member and nonmember banks in New York state. They focus on the impact on total loan growth, but also test for differential impacts on different types of loans and on the growth of banks’ securities holdings and cash. They differentiate between New York City and other banks, and between small and large banks. They find no impact of changes in reserve requirements on bank lending, and no differential impacts between members and nonmember. However, they do find that in response to changes in reserve requirements, member banks increased their cash holdings and reduced their securities relative to nonmembers.}

Our work builds on the previous studies by examining the impact of reserve requirement changes on bank-level loan growth and reserves throughout the United States and by using an approach that controls for fundamental determinants of reserves demand in our estimation of reserves slack on loan growth. Like Park and Van Horn (2015) we find no evidence that reserve requirement increases affected loan growth, thus casting further doubt on the view that the doubling of reserve requirements was a significant cause of the recession of 1937-38. In addition, we show that the increase in reserve requirements reduced the substitutability of reserve deposits at the Fed and other liquid assets, which likely put the Fed in a better position to implement monetary policy through open market operations as Fed officials had sought. Thus, we conclude that raising reserve requirements was a fundamentally sound policy given the constraints on the Fed at the time.

Section 2 describes the changes in legal reserve requirements and the paths of aggregate measures of required, excess, and total reserves, by bank type and location, for various reserve
concepts. Section 3 explains our methodology for estimating the effect of reserve requirement increases on bank lending growth (and growth in liquid asset holdings) for 1935-1937. Section 4 describes the construction of our nationwide matched samples of member and nonmember banks. Section 5 presents our empirical findings. In Section 6, we present an analysis of narrow and broad reserve demand in 1935 to 1937 to show that the increase in reserve requirements in 1936 and 1937 reduced the substitutability between reserves and Treasuries, and we consider the implications of those findings for monetary policy today.

2. Bank Reserve Measures Disaggregated by Type and Location of Bank

The Banking Act of 1935 required Federal Reserve member banks to hold balances with Federal Reserve Banks to satisfy their legal reserve requirements. Vault cash and other liquid assets such as deposits at other commercial banks (correspondent balances) and Treasury securities could not be used to satisfy reserve requirements. Nonetheless, banks held substantial liquid assets other than deposits with the Fed to meet unexpected payments flows and investment opportunities, and to reduce their asset risk. For example, banks maintained correspondent balances with banks in major cities, especially in central reserve city banks located in New York City and Chicago, to facilitate interregional payments and commercial transactions. The leading correspondent banks in those cities held substantial deposits for banks located throughout the country (indeed throughout the world). The Fed was aware of the substitutability among different categories of reserves and cash assets. As previously noted, Fed officials estimated that most banks had sufficient excess reserves to satisfy an increase in required reserves while others could

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13 Significant statutory changes to reserve requirements were last made under the Monetary Control Act of 1980. Since then, vault cash has counted toward legal reserve requirements. In 2008, the Fed was permitted to pay interest on reserves and has since done so.
shift balances from their correspondents to the Fed. Few, if any, would have to sell securities or contract their lending.

Table 1 lists the prevailing required reserve ratios by bank location and deposit type. Reserve requirements were imposed on net demand deposits and time deposits. As Figure 2 shows, in the aggregate, the ratio of excess reserves to total deposits for Fed member banks fell from levels of 5 to 7 percent of total deposits before the first increase in reserve requirements to 2 and 3 percent in June 1937 and December 1937, respectively. Excess reserves increased after 1937 in part due to a reduction in reserve requirements in April 1938.

Figures 3-5 show semi-annual data on the behavior of three measures of cash assets relative to deposits: reserve deposits at the Fed (the only asset that met statutory reserve requirements), a “Narrow” measure of cash assets, and a “Broad” measure of cash assets. The figures plot aggregates of data for banks in the two central reserve cities (New York City and Chicago), reserve city banks in each Federal Reserve district, and country banks. We review this evidence as background to our empirical analysis and to emphasize the importance of regional heterogeneity and different margins of cash asset substitution that were relevant for different

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14 The National Bank Acts of the 1860s established three tiers of federally-chartered banks, i.e., national banks, based on their location. National banks in central reserve cities, which in the 1930s were Chicago and New York City, were subject to higher reserve requirements than banks in designated reserve cities and all other locations (which were referred to as country banks). The Federal Reserve Act set required reserve ratios for national banks, all of which were required to be Fed members, and state-chartered banks that elected to become members. The Banking Act of 1935 authorized the Federal Reserve Board to adjust require reserve ratios as it deemed appropriate.

15 As of December 1935, net demand deposits were defined to include the demand deposits of individuals, firms, governments, and due to other banks, less deposits due from banks and cash items in the process of collection. The Banking Act of 1935 changed the reserve base were estimated to have reduced required reserves. According to the November 1938 Federal Reserve Bulletin, “the new method of computing net demand deposits [under the Banking Act of 1935] resulted in a reduction of about $35,000,000 in required reserves of all member banks. Requirements of central reserve city banks were increased by $45,000,000, while those of country banks were reduced by $75,000,000 and those of reserve city banks taken as a whole showed a small decline.” (p. 961)
banks. Both considerations show the importance of accounting for legal reserve substitutes and for considering banks from throughout the country, as we do in Section 5.

Figure 3 plots the ratio of reserves held at the Fed divided by total member bank deposits. The “Narrow Cash Assets” measure plotted relative to deposits in Figure 4 equals reserve balances plus vault cash, cash items in the process of collection, and net balances due from other banks. The “Broad Cash Assets” measure shown in Figure 5 equals Narrow Cash Assets plus bank holdings of U.S. Government securities.

As Figure 3 shows, the data for most of the aggregates exhibit a notable increase in reserves-to-deposits after the first increase in reserve requirements in August 1936. However, the ratio fell in some districts after the second and third increases. The variation across bank types and Fed districts make sense when one thinks of the ratios as reflecting fundamental demand driven by differences in local circumstances rather than the Fed’s reserve requirements. Regionally disaggregated measures of economic activity also reveal substantial heterogeneity in economic conditions during the 1937-38 recession which likely contributed to interregional differences in reserve demand (Calomiris, Mason and Wheelock 2011).

The most sustained increases in reserves-to-deposits were among central reserve city banks. Member banks in Chicago and New York City were more likely to have experienced substantial deposit outflows in response to the change in reserve requirements as banks elsewhere moved deposits from correspondent banks to the Fed. New York City banks alone lost some $220 million of interbank deposits between June 1936 and June 1937. At the same time, reserves of New York City banks rose by $643 million and the ratio of reserves to deposits increased substantially. Figure 6 plots the ratio of excess reserves to deposits for the geographic
aggregates and shows that the central reserve city banks in New York and Chicago experienced especially large drops in excess reserve ratios, again reflecting the special liquidity risks that affected the fundamental demand for reserves of banks in those cities.

Overall, the simple pictures shown in Figures 3 and 6 seem to fit broadly with the Friedman and Schwartz narrative, especially for central reserve city banks. However, taking account of banks’ ability to adjust to higher reserve requirements by moving money from correspondents or selling Treasury securities suggests that the economic effect of the doubling of reserve requirements was minimal. Figures 4 and 5 illustrate that the doubling of reserve requirements only weakly and inconsistently affected the demand for broader measures of liquid assets. Again, the data show considerable variation across the geographic aggregates. In Figure 4, New York City banks exhibit a relatively large increase in cash assets-to-deposits, reflecting its special status as correspondent hub, but the picture elsewhere is more mixed. Moreover, Figure 5 shows little clear impact of the changes in reserve requirements on banks in any of the geographic aggregates, including New York City, for the broad liquid assets measure. Some of the aggregates exhibit slight declines in the ratio of broad cash assets to deposits, but others show slight increases or no change. Thus, while the increase in the ratio of reserves to deposits appears generally consistent with the Friedman and Schwartz (1963) narrative, at least after the initial increase and among the central reserve city banks, the evidence from the broader measures of cash assets indicate that most banks responded to the increase in reserve requirements by adjusting the composition of their liquid assets without increasing significantly their total cash assets-to-deposits ratios. The substantial variation across types and districts, and the negative or zero changes observed in many cases, are facts that run counter to the Friedman and Schwartz narrative.
The aggregate evidence, combined with Park and Van Horn’s (2015) microeconomic evidence for New York, is highly suggestive. However, it remains conceivable that the changes in reserve requirements affected lending at the bank level or more generally across the United States. That possibility motivates our analysis in Section 5 of a nationwide sample of individual banks to measure bank-specific reactions to the reserve requirement increases.

3. Empirical Methodology

Our empirical approach employs data on reserve holdings, loans, deposits and other attributes of Fed member and nonmember banks to capture behavior at the individual bank level, using balance sheet data from member bank call reports for 1933-37, and more limited balance sheet data for nonmember banks from Rand McNally Bankers Directory.

Our estimation approach begins with a simple, raw matched-sample calculation that compares loan growth rates from December 1935 to December 1937 for matched pairs of comparable member and nonmember banks. As an estimate of the treatment effect, the calculation implicitly assumes that the difference in observed loan growth rates between member and nonmember banks in the matched sample reflects only the treatment effect of the increase in reserve requirements, which applied only to member banks.

Although our matching criteria guarantee that pairs of banks will be similar in location and size, such matches are never perfect, and remaining differences could affect measured loan growth rate differences between member and nonmember banks. It would be desirable, therefore, to control as much as possible for those remaining differences in bank characteristics when estimating the difference in loan growth due to the reserve requirement increase. We refer to a
matched sample calculation that incorporates those additional controls as a “refined” matched sample calculation.

In addition to the obvious desirability of refining matched sample estimates to control for size and other observable balance sheet differences, controlling for differences in member banks’ exposure to the treatment effect could also be important. We posit that member banks were not identical in their exposure to the treatment effect. As the Fed’s 1936 survey of its members indicated, some banks happened to have high levels of excess reserves when reserve requirements were increased and thus were less exposed to the increase. Ideally, exposure to the regulatory shock should be measured as the quantity of excess reserves the member bank held at the time of the shock less the quantity of excess reserves that the bank’s fundamentals warranted. We find that member banks differed cross-sectionally in their exposure to the hike in reserve requirements, and so we construct refined matched sample comparisons that take those differences (as well as size and other observable characteristic differences) into account. Controlling for those differences should make our estimate of the average treatment effect more accurate. To construct our refined matched sample estimates we use regressions, as explained below, to estimate adjustment factors for each member and nonmember bank that reflect its particular characteristics.

Our refined matched sample calculations combine the advantages of a matched sample with the advantages of a regression. In our application, the information we derive from the matched sample calculations and the information we derive from the regressions are complementary. Our regressions provide useful information for refining the matched sample estimates, but they cannot be used as an alternative means of capturing the average treatment effect. This reflects data limitations for nonmember banks. Our regression analysis is performed
only on member banks, for which we have rich data on which to base estimates of reserve
demand. We employ the matched sample approach to gauge the average treatment effect of the
increase in reserve requirements but use coefficient estimates from regressions estimated using
data for member banks to refine the matched sample calculations of the average treatment effect.
Using the coefficient estimates to make adjustments for both member and nonmember banks
requires us to assume that bank asset size, for example, covaries with loan growth for member
and nonmember banks similarly, ceteris paribus.

Assuming initially, for simplicity, that member and nonmember banks differ in no other
ways, and allowing for the possibility that member bank treatment effects may contain both a
common (average) exposure to the treatment and an idiosyncratic bank-specific exposure, the
matched sample comparison of loan growth can be written as:

\[ \text{ALG(NM)} - \text{ALG(M)} = T + \sum \frac{I_i}{N} \]  

where \( \text{ALG(NM)} \) is the average loan growth rate of nonmember banks from December 1935 to
December 1937, \( \text{ALG(M)} \) is the average loan growth rate of member banks over that same
period, \( T \) is the average treatment effect of the reserve requirement increase on member banks, \( I_i \)
is the idiosyncratic treatment effect component of the reserve requirement increase for each
member bank (after taking into account its average, \( T )^{16} \), \( N \) is the number of member banks, and
\( \Sigma \) is the summation of the \( N \) observations of \( I_i \). We assume that bank-specific variation in
treatment is captured by the following characteristic:

\[ I_i = z [(\text{ER/TR})_{i,1935} - (\text{WER/TR})_{i,1935}], \]

\[ \text{Note that for the entire sample of member banks, } \Sigma I_i / N = 0 \text{ by construction. But for subsamples of matched}
\text{pairs, it can deviate from zero.} \]
where \( z \) is a parameter to be estimated, \( ER/TR \) is observed excess reserves/total reserves in December 1935, and \( WER/TR \) is the “warranted” excess reserves/total reserves ratio as of December 1935. \( WER/TR \) is the predicted value derived from a cross-sectional regression that predicts a bank’s excess reserves ratio from fundamentals. Excess reserves are defined as reserves in excess of the legal requirement just prior to the treatment effect (i.e., in December 1935, reflecting the annual year-end frequency of our data). The coefficient \( z \) is estimated from the following second OLS regression:

\[
LG (M)_i = \alpha + \beta X_i + z \left[ (ER/TR)_{i,1935} - (WER/TR)_{i,1935} \right], \tag{3}
\]

where \( LG (M)_i \) is the loan growth rate of member bank \( (M_i) \) over the period December 1935 to December 1937, \( \alpha \) is the constant term in the regression, \( \beta \) is a vector of coefficient estimates, and \( X_i \) is a vector of exogenous control variables relevant for loan growth over the period December 1935 to December 1937. Note that \( T \) will be present in the estimate of \( \alpha \), but it cannot be derived from an estimate of \( \alpha \). We derive our estimate of \( T \) below.

An estimate of \( T \) can be derived from a refined matched sample calculation by combining the information in equations (1), (2) and (3) as follows:

\[
T = ALG(NM) - ALG(M) - \frac{1}{N} \left\{ \sum z \left[ (ER/TR)_{i,1935} - (WER/TR)_{i,1935} \right] \right\}, \tag{4}
\]

where \( ALG(M) = \frac{1}{N} \sum LG(M)_i \). For simplicity, when writing equation (1), we assumed that the member and nonmember banks’ observable balance sheet characteristics are identical. We now relax that assumption and further refine the matched sample calculation by correcting for any differences in the \( X_i \) observables of member and nonmember banks by rewriting equation (1) as follows:
\[ \text{ALG(NM)} - \text{ALG(M)} = T + \Sigma T_i/N + \beta \Sigma X_j/N - \beta \Sigma X_i/N, \quad (1) \]

where \( j \) indexes nonmember banks and the estimated \( \beta \) is used to adjust for member and nonmember bank characteristics (such as size). The coefficient \( \beta \) is estimated from a loan growth (1935-1937) cross-sectional regression (equation (3)) using the member bank sample. This implies the following reformulation of equation (4), from which we arrive at an estimate of \( T \), the average effect of reserve requirement changes on bank lending:

\[ T = \text{ALG(NM)} - \text{ALG(M)} - \frac{1}{N} \{ \sum z [(ER/TR)_{i,1935} - (WER/TR)_{i,1935}] \}

- \beta \sum X_j/N + \beta \sum X_i/N \quad (4) \]

In our analysis, we construct matched samples of member and nonmember banks in various ways and estimate models of both the demand for reserves in 1935 (WER/TR) and loan growth rates from 1935 to 1937. We report those models in Section 5, where we show that our finding that reserve requirements had no discernible average treatment effect on loan growth is robust to various sample choices and calculation methods. Our estimate of \( T \) is always statistically zero, and in two of three matched comparisons the difference is slightly positive, i.e., that on average member bank loan growth exceeded comparable nonmember bank loan growth, which is contrary to the hypothesis that the doubling of reserve requirements should have reduced member bank loan growth relative to that of nonmember banks. Hence, we conclude that the doubling had no economically or statistically significant effect on aggregate loan growth.

4. Construction of Matched-Pair Samples of Member and Nonmember Banks

This section describes our data and procedures for constructing three nationwide matched-pair samples of member and nonmember banks. The key challenge for constructing a
nationwide sample is in finding plausible matches, given that members and nonmembers were systematically different. Membership was not a random outcome. In particular, larger banks in urban locations were more likely to choose to become members of the Federal Reserve System. At the time, most member and nonmember banks operated as unit (i.e., single location) banks, and banks differed from one another primarily because of their locations (which implied different risk exposures, different business strategies, differences in size, etc.).

Any defensible strategy for constructing a nationwide matched sample of member and nonmembers must find a balance in dealing with two truths: On the one hand, the best matches are of member and nonmember banks located in the same town or city and of roughly similar size (given that size is relevant for the degree of loan portfolio diversification). On the other hand, it can be hard to find matches of similarly-sized banks in the same town or city because member banks tended to be more prevalent in cities while nonmembers were more often located in small towns and rural areas, and because member banks tended to be larger than nonmember banks. Further, many member banks operating in the twelve cities with Federal Reserve Banks had very different business models than nonmember banks in those cities and member banks located elsewhere. In particular, many large member banks in Fed cities operated large correspondent networks, which complicates comparisons of member and nonmember banks of similar size in those cities. For that reason, we exclude banks located in the twelve Federal Reserve Bank cities from all of our matched samples.

We collected balance sheet data from the December 1937 call reports for 500 member banks. We constructed the sample to ensure that both rural and urban areas were properly

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17 Jaremski and Wheelock (2017; 2020) examine the relationship between correspondent banking networks and the location of Federal Reserve Banks.
represented and that banks were drawn from all Federal Reserve districts. After eliminating banks that were not present in 1933 and 1935, we were left with 458 member banks with balance sheet information from the December call reports for 1933, 1935 and 1937. For each country member bank and the remaining reserve city member banks, we then sought to identify a nonmember of similar size and location. Our analysis requires that both the member bank and its match were present in the data throughout 1933-37. We used the Calomiris-Mason (2003a,b) database to identify member banks and obtain their balance sheet information, and Rand McNally Bankers Directories (January 1934, 1936, and 1938) to identify nonmember banks and obtain their balance sheet information as of December 1933, December 1935, and December 1937.

If one requires that member banks and their nonmember matches be located in the same town and be of near identical size, and if one omits the twelve Federal Reserve Bank cities, the remaining matched sample is relatively small and less representative of the entire nation. Alternatively, if one matches banks across similar but not identical locations, or permits matches to occur despite larger differences in size, the matched sample becomes larger and more representative of the nation as a whole. Our solution to this tradeoff is to consider various alternative matched samples (sometimes being relatively restrictive about matching, but other times allowing greater size differences between members and nonmembers or sampling similar but not identical locations). We compare average loan growth rates of member and nonmember banks in the various samples. In addition, we report refined matched-sample comparisons where we use estimates of the regression parameters described in Section 3 to adjust for characteristic differences (such as remaining differences in size and balance sheet ratios) between matched
member and nonmember banks, which is especially useful when there are larger differences in
the sizes of a member and its nonmember match.

When identifying a nonmember bank to match with each member bank we looked first
for the nonmember bank in the same city with total assets in December 1935 closest to that of the
member bank.\textsuperscript{18} In our narrowest sample (labeled Sample 1), we included only country banks in
our search for matches and required that a matching nonmember bank be located in the same
town or city as the member and have total assets within 40 percent of the total assets of the
member bank. Based on that search criteria, we identified a sample consisting of 28 bank-pairs
(i.e., 28 members and 28 nonmembers located in the same town or city with total assets within
40 percent of each other).\textsuperscript{19} Next, we broadened our sample somewhat by allowing banks located
in different towns (but in the same state) to match under the assumption that county banks
located nearby to each other (even if not in the same town) would have similar business models.
However, when looking outside a member bank’s town for a match we required that the
nonmember bank had total assets within 20 percent of the member bank’s total assets. From
those prospective matches, we choose as the match the nonmember country bank located closest
geographically to our member country bank. When expanding the sample to include banks
located in different towns, we focused exclusively on agricultural states to help ensure a
homogeneous sample (i.e., matches with similar business models).\textsuperscript{20} This procedure yielded an
additional 65 matches for a total of 93 matched bank pairs in what we label Sample 2.

\textsuperscript{18} As noted previously, bank branching outside of headquarters cities was prohibited in most states in the 1930s.
\textsuperscript{19} We excluded as potential matches non-corporate, i.e., mutual or privately-owned, banks and savings institutions,
and banks that became members of the Federal Reserve System between 1935 and 1937.
\textsuperscript{20} We define agricultural states as those where earnings from agriculture comprised at least 20 percent of total state
earnings in 1935. The 23 states meeting this criterion are: AL, AR, AZ, GA, IA, ID, KS, KY, LA, MN, MS, MT,
NC, ND, NE, NM, OK, SC, SD, TN, TX, WV, and WY.
Finally for Sample 3 we broadened our sample to include banks located in reserve cities (other than the 12 cities with Federal Reserve Banks). For each reserve city member bank, we searched for the nonmember bank located in the same city with total assets closest to that of the member bank. If there were no nonmember banks in the same city with total assets within 40 percent of the member bank’s total assets, we searched among nonmember banks located elsewhere in the state and selected as the match the nonmember bank located closest geographically to the member bank among those with total assets within 20 percent of the member’s total assets. As before, we restricted ourselves to agricultural states when adding matches that included member and nonmember banks located in different cities. Adding these bank pairs gave us a total of 108 matches.

Table 2 reports characteristics of member and nonmember banks for each of the three samples, and Figures 7-9 provide maps illustrating the locations of the matched pairs for each of the three matched samples. *Rand McNally Bankers Directories* report a smaller set of bank characteristics for nonmember banks than call report data on member banks, so our comparisons reflect its reporting of bank information. Although in Samples 2 and 3 we restricted our additional matches to agricultural states where we believe matched comparisons would be more appropriate due to similarities in bank business models and risk exposures, the figures show that nevertheless we were able to construct a regionally diverse national sample of matched comparisons.

Table 2 shows that on average members and nonmembers differed along several dimensions for all three matched samples. The average loan growth rate from 1933 to 1935 was lower among member banks, but average loan growth from 1935 to 1937 was slightly higher among member banks (except for Sample 2, where the opposite was true). This suggests that
controlling for differences in loan growth from 1933 to 1935 could be important (because of mean reversion) when examining loan growth from 1935 to 1937. Member banks in all three samples were also larger on average but had lower equity-to-asset ratios than their nonmember counterparts. These data all point to potential advantages from refined comparisons of mean loan growth of members and nonmembers that control for differences in average size, loan growth during 1933-35, and equity-to-asset ratios.

5. Estimation Results

We described our method for estimating the average treatment effect (T) of the reserve requirement increases of 1936 and 1937 in Section 3 and explained how we constructed three alternative matched samples of member and nonmember banks in Section 4. Our main variable of interest for gauging the economic consequences of the treatment effect T, i.e., the doubling of reserve requirements, is the difference between the loan growth rates of member and matched nonmember banks from December 1935 to December 1937. We also examine changes in banks’ other cash asset holdings (the buffer of correspondent balances and Treasuries that banks could use to accumulate more reserve deposits at the Fed without having to shrink their lending). We expect this variable to be more responsive than loans to T because it could act as a buffer to avoid having to adjust loan growth.

As described in Section 3, we first use a forecasting model to estimate the “warranted” ratio of excess reserves-to-total reserves in December 1935 for member banks. We use that estimate to measure the degree of “slackness” of the legal reserve constraint, i.e., the difference between actual excess reserves ratio observed in 1935 and the warranted ratio we estimate as a function of bank attributes. We estimate this model because we hypothesize that excess reserves
of a given amount are not equally beneficial to all banks. Desired excess reserve ratios will likely differ across banks because they face different liquidity risks and other attributes. Those with greater liquidity risks, for example, might be relatively reluctant to reduce their excess reserve ratios, and thus more inclined to contract loan supply, in response to a reserve requirement increase. That is why we measure the degree of slackness of excess reserves with \[(ER/TR)_{i,1935} - (WER/TR)_{i,1935}\] rather than simply \((ER/TR)_{i,1935}\).\(^{21}\)

Our forecasting model predicts a bank’s excess reserve ratio in 1935 from its loan growth rate from 1933 to 1935, its asset size (log of total assets), equity-to-assets ratio, ratio of demand deposits to total deposits,\(^{22}\) whether it was a national bank rather than a state-chartered member bank, whether it was a reserve city or central reserve city bank rather than a country bank, and its Federal Reserve district. We take each of these as reflecting fundamental bank attributes that could forecast a higher or lower excess reserves ratio in December 1935. Note that these variables are not all plausibly exogenous to the choice of holding excess reserves but they are still valid as predictors of excess reserve ratios.

Our second regressions include the same variables (except the ratio of demand deposits to total deposits, given the possibility of a mechanical relationship between demand deposits and loans that results from the fact that banks lend by crediting demand deposits to the borrower) plus the residual from the first regression. Table 3a reports summary statistics for the variables in the first regression, which was estimated using data from the Calomiris-Mason (2003a,b).

\(^{21}\) In results not reported here, as an alternative measure of slack in the second-step regression for loan growth from 1935 to 1937, we substituted the ratio of excess reserves to total reserves in 1935 for the difference between actual and warranted reserves. The coefficient estimate was 0.07, which is the same as the coefficient on our preferred measure of slack (the actual less warranted excess reserve ratio) reported in Table 4.

\(^{22}\) Our demand deposits measure (RESBASEDD) is the sum of demand deposits of individuals (i.e., households, firms and state and local governments), net interbank deposits, and U.S. Government deposits, less cash items in the process of collection. It is the net demand deposit aggregate to which the required reserve ratio applied.
database for all 5426 member banks operating in 1933-35, and Table 3b reports statistics for the variables in the second regressions which were estimated using data for the sample of 458 member banks with data for 1933, 1935, and 1937 described previously.

In the first column of Table 4, labeled ER/TR 1935, we report the regression results for the ratio of excess reserves to total reserves in 1935. Many of the variables are highly statistically and economically significant, and adjusted $R^2$ is non-trivial (10.6%). We hesitate to interpret the signs of these coefficients because this is not a structural model and our framework does not depend on any particular interpretation of the coefficients. We offer the following observations, however, with those important caveats in mind. Banks with larger assets should be able to diversify better both portfolio risk and deposit withdrawal risk, implying a negative coefficient, which is what we observe. Our result that deposit mix matters (and that more demand deposits leads to lower excess reserves) can be interpreted in two ways. First, it might be that reserve requirements were set excessively high for demand deposits compared with the true liquidity risk attendant to issuing them, which encouraged banks to hold less excess reserves against them. Alternatively, one could view this result as confirming studies finding that time deposits (which were withdrawable prior to maturity) could be a greater source of liquidity risk than demand deposits. For example, Ramirez and Zandbergen (2014) in their study of Montana banks in the 1890s found that time deposits were a more important source of liquidity risk during bank runs than demand deposits. However, when demand deposits are defined to include interbank deposits, that is unlikely to still be true. Many authors have pointed to interbank deposits (which are part of our demand deposit measure) as particularly important for liquidity risk (e.g., Calomiris and Kahn 1991, Calomiris and Carlson 2017, Calomiris, Jaremski and Wheelock 2021). In Section 6 below, we provide additional evidence in favor of the former interpretation,
i.e., that required reserves on demand deposits may have been higher than warranted by their fundamental liquidity risk.

We also find that national banks and banks in reserve cities had lower excess reserve ratios, ceteris paribus. This suggests that fundamental liquidity risks were lower for those banks or that the requirements they faced were excessive relative their fundamental liquidity risks (when compared to other banks). Reserve ratios also varied significantly across Fed districts, likely reflecting differences in location-specific risks and economic conditions.

The difference between a bank’s actual ER/TR\_35 and its predicted value WER/TR\_35 appears as a regressor in the analysis of loan growth from 1935 to 1937 in the regression labeled LG 1935-37 in the second column of Table 4. Note that the key regressor in the second regression, \((\text{ER/TR})_{i,1935} – (\text{WER/TR})_{i,1935}\), captures differences across banks in their exposure to the treatment. The idiosyncratic component has a zero mean by construction for our entire sample of member banks and is orthogonal to the average treatment effect of the reserve requirement.

Our loan growth model hypothesizes that banks with greater slack (i.e., those with more excess reserves relative to their warranted level of excess reserves) were less affected by the reserve requirement treatment than other banks, and therefore had higher loan growth from 1935 to 1937, ceteris paribus. As shown in Table 4, as expected, the coefficient estimate on \((\text{ER/TR})_{i,1935} – (\text{WER/TR})_{i,1935}\) is positive and statistically significant (as reflected in the fact that the lower bound of the 95 percent confidence interval is greater than zero). The confidence intervals reported for the regressions in the second and third columns of Table 4 are based on bootstrap estimates of the distributions of the covariates, as described in Efron and Tibshirani (1993), to account for the inclusion of the generated regressor (ER/TR) \(– (\text{WER/TR}) 1935\) in those regressions.
deviation of \( [(ER/TR)_{i,1935} - (WER/TR)_{i,1935}] \) is 0.27. Thus, a bank with slack that is one standard deviation above the mean experienced loan growth from 1935 to 1937 that was roughly two percentage points higher (0.078 x 0.27). This produces non-trivial variation in loan growth within our sample, as average loan growth from 1935 to 1937 for our sample was 11 percent with a standard deviation of 17 percent. In results not reported here, we also experimented with additional regressions to test for nonlinearity in the effect of slack on loan growth and found no evidence of nonlinearity.

The third column of Table 4 reports a regression analogous to the loan growth regression but for the growth rate of other cash assets (i.e., liquid assets other than reserves at the Fed) from 1935 to 1937. As we (and Fed officials at the time) hypothesize, other cash assets served as a buffer to insulate bank lending from an increase in required reserves. Consistent with that interpretation, the coefficient on \( [(ER/TR)_{i,1935} - (WER/TR)_{i,1935}] \) in the regression for other cash assets (0.125) is much larger than in the loan growth regression and is also statistically significantly greater than zero.

To derive an aggregate effect from the reserve requirement increases that occurred in 1936 and 1937, we turn to our matched samples. As already noted, the coefficient estimate for \( [(ER/TR)_{i,1935} - (WER/TR)_{i,1935}] \) has no aggregate implication for the effect of reserve requirements on loan growth. However, the coefficient is useful for refining our matched sample estimates of the aggregate treatment effect \( (T) \), as described in equation (4)' of Section 3.

For each of our three matched samples, Table 5 reports raw and refined estimates of loan growth from 1935 to 1937. Mean loan growth during this period was higher among member banks than nonmember banks in Samples 1 and 3. In Sample 2, nonmember banks grew slightly
faster on average (10.3 percent compared with 9.4 percent for member banks), but that difference
is not statistically significant.

As noted in our comparison of member and nonmember bank characteristics, differences
exist in average size, average loan growth from 1933 to 1935, and average equity-to-asset ratios.
Therefore, we produce refined estimates of matched sample differences where we used the
estimated coefficients for the member bank sample in Table 4 to control for differences in
member and nonmember bank characteristics (prior loan growth, equity-to-assets, and size).
Here we assume that coefficient estimates from the member bank sample are similarly useful for
adjusting for cross-sectional differences in the characteristics of both members and nonmembers.
We also allowed member banks’ idiosyncratic differences in excess reserve slack to affect their
loan growth. (Note that although the average of this variable for all member banks is zero by
construction, its average can deviate from zero for subsamples.) These refined matched
comparisons yield the following results: in Samples 1 and 3, member bank loan growth for 1935
to 1937 is higher (by 7.5 percent in Sample 1, and by 2.5 percent in Sample 2), but the loan
growth rates of members and nonmembers are essentially identical in Sample 2. None of the
differences between member and nonmember bank means is close to being statistically
significant. \(^{24}\) We conclude that the reserve requirement increases in 1936 and 1937 had no
significant impact on aggregate bank loan growth from 1935 to 1937. This result aligns with the
simpler and less conclusive comparisons of aggregate liquid asset measures reported in Section
2. \(^{25}\)

\(^{24}\) We note that p-values in the tests reported in of Table 5 are only approximate because of our use of a generated regressor (using the estimated value of \((ER/TR)_{i,1935} - (WER/TR)_{i,1935}\) in the second regression). Correcting degrees of freedom would only further reduce the statistical significance of differences (i.e., increase p-values).

\(^{25}\) We reiterate that, although our analysis omits New York City banks, Park and Van Horn (2015) found that changes in reserve requirements had no significant impact the loan growth rates of New York banks.
6. Restoring Potency to Monetary Policy When Reserves are not Scarce

We conclude that the Fed was correct in believing that raising reserve requirements would reduce excess reserve slack but have little impact on near-term loan growth. Fed officials determined that most banks could meet the new requirements out of their existing excess reserves or by reducing the balances they held with correspondents. Others could sell Treasury securities and thereby obtain some of the excess reserves of other banks. In the event, sales of Treasuries were modest and largely offset by Fed purchases. The Fed purchased approximately $100 million of Treasury securities in April 1937, at least partly in response to pressure from the Treasury Secretary (Calomiris and Wheelock 1998). Yields on Treasury securities rose only modestly, with yields on Treasury bills, for example, rising from around 30 basis points in January 1937 to a peak of 74 basis points in the first week of May before falling back to average some 40-60 basis points over the remainder of 1937. Over the same period, yields on long-term U.S. Government bonds, which were approximately 2.50 percent at the beginning of 1937, rose to 2.80 percent in April and May and ranged between 2.60 and 2.80 percent throughout the remainder of 1937.26

Our paper tests for an effect of raising reserve requirements on bank balance sheets, the mechanism identified by Friedman and Schwartz (1963) and others. Although it is possible that the announcement of higher reserve requirements affected market outcomes in other ways, as we note in the introduction, we find no evidence that the doubling of reserve requirements increased demand for cash assets (relative to deposits) or curtailed lending. We also believe that the logic of the Fed’s increase in reserve requirements – to increase the potency of future monetary policy

by reducing the substitutability between reserves and other cash assets on the margin—was sound. As recent research has argued (e.g., Brauning 2017, Smith 2019, Belongia and Ireland 2021), if Treasuries and reserves are close substitutes on the margin, then the impact of open market operations on Treasury yields, deposit creation, and bank lending may be limited. From that perspective, one can see the Fed’s decision to hike reserve requirements as increasing the power of monetary policy by reducing the substitutability between reserves and other cash assets. Before reserve requirements were raised, banks faced little risk of a shortfall in their required reserves, and so, on the margin, reserves and Treasuries were close substitutes. But after reserve requirements were hiked, and excess reserve ratios fell correspondingly, banks had to be concerned, on the margin, about maintaining their excess reserve balances. This may have made them less willing to supply reserves elastically in exchange for Treasuries.

By reducing the substitutability of reserves and Treasuries, the demand for reserves became more closely linked to bank fundamentals. This can be corroborated by comparing the change in the relative “goodness of fit” of models of reserve demand (i.e., deposits at the Fed) and broad liquid asset demand (which, in addition to reserves, also includes cash assets such as interbank deposits and Treasuries) in 1935 and 1937. We show this in Table 6, using the same determinants of reserve demand as in our excess reserves/total reserves regression in Table 4, for our sample of 458 banks that existed in both 1935 and 1937.

Here our argument is in the spirit of Barnett (1982), which argues that simple sum aggregation (such as creating a measure of M2 that combines deposits and cash) is inferior to weighted sum aggregation (such as a Divisia quantity index) unless the components of the sum are perfect substitutes. Barnett shows that traditional aggregates fail the perfect substitutes test by comparing their performance with Divisia measures for forecasting variables that money should
predict. Our approach argues similarly that when reserves and other cash assets are close
substitutes (as we hypothesize they were in 1935), then broad measures of cash assets should be
more closely related to the determinants of reserve demand than narrower measures. And,
when increases in reserve requirements reduce the substitutability between reserves and other
cash assets, broad measures of liquid assets should become less closely related to the
fundamental determinants of reserve demand while narrower measures should become more
closely related to them.

Our focus is on the change in the relative $R^2$ of regressions of reserves and broad cash
assets. Changes in the variance of the error term can cause $R^2$ to rise or fall over time, but not
cause a change in relative $R^2$. In 1935, the adjusted $R^2$ was only 0.169 for the reserve demand
regression (with bank reserves held at the Fed relative to total bank assets as the dependent
variable), but in 1937, the adjusted $R^2$ for reserves/assets rises to 0.506. In 1935, the adjusted $R^2$
for a broad cash assets/total assets regression is 0.408, but in 1937, the adjusted $R^2$ falls to 0.305.
Similar patterns are apparent if we use total deposits rather than total assets in the denominators
of the dependent variables. Thus, the relative goodness of fit between fundamental variables
and the demand for reserves at the Fed increased both absolutely and relative to the fit for broad
cash assets, suggesting that reserves and other cash assets, such as Treasuries, were less
substitutable after the doubling of reserve requirements.

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27 We do not follow Barnett (1982) by constructing an alternative Divisia index of bank liquid assets both because we lack the data to do so (e.g., interest rates on interbank deposits) and because it is not obvious that it would be appropriate to use Barnett’s method of constructing an ideal index to weight components of cash assets held by banks using their yields. Reserves are held only by banks but Treasuries are held by the public and the banks. It is not clear that banks are the marginal investor in Treasuries. They could be at a corner solution, where the relative yields are not equal to their relative value to bank holders.

28 In 1935, the $R^2$ was only 0.132 for a narrow reserve demand regression (with bank reserves held at the Fed relative to total bank deposits as the dependent variable), but in 1937, the $R^2$ for reserves at the Fed/deposits rises to 0.419. In 1935, the $R^2$ for a broad cash assets/deposits regression is 0.218, but in 1937, the $R^2$ falls to 0.175.
From a similar perspective, it is also interesting to examine the magnitude and precision of the coefficient estimates in the four regressions reported in Table 6. The variables that are associated only with fundamental (rather than regulatory) influences on the demand for cash assets, i.e., equity-to-assets, loan growth from 1933 to 1935, and asset size tend to be statistically significant more often in the broad cash asset regressions (for both 1935 and 1937). For example, the coefficient on the ratio of equity to assets (which many authors have found to negatively covary with the cash-to-assets ratio) is negative and significant in the broad cash asset regressions but is not significant in the reserves regressions for either 1935 or 1937. Similarly, loan growth from 1933 to 1935 enters negatively in both broad cash asset regressions. It enters in the 1935 reserves regression (but not the 1937 regression) with a much smaller and less statistically significant coefficient than in the broad cash asset regression for 1935. Bank size enters positively only in the two broad cash asset regressions. Federal Reserve district location did not affect a bank’s regulatory requirements but could have been correlated with local economic conditions that should matter for risk. Federal Reserve district dummies are much more significant in the broad cash asset regressions, and to the extent that a few of them are statistically significant in the reserves regression, it is only the case for the reserves regression for 1937.

By contrast, variables such as whether the bank is a national bank, whether it is a reserve center bank (i.e., a reserve city or central reserve city bank), and the bank’s ratio of demand deposits to total deposits – the list of characteristics that can be interpreted as reflecting regulatory requirement treatment differences or fundamental influences correlated with those

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29 We expected size to enter negatively, given the economies of scale in managing liquidity and portfolio risk. We interpret our contrary finding as reflecting systematic differences in bank business models (and therefore higher risks) that are positively correlated with size.
regulatory treatment differences – enter significantly in the reserves regressions (and sometimes in both the reserves and broader cash assets regressions).

Interestingly, the coefficient on demand deposit share is positive and highly statistically significant in all four regressions. The fact that it is significant in the reserves regressions is not surprising given that reserve requirements were higher for demand deposits than time deposits. But the variable has a similar magnitude and statistical significance for the broad cash assets regressions. Indeed, for 1935, the coefficient estimate is a bit larger (0.19) than in the reserve regression (0.13). This suggests that liquidity risk from demand deposits of individuals was relatively high. This fact also informs our prior discussion of excess reserve ratios (column one of Table 4), where we found a significant negative effect on excess reserves from the demand deposit share. The evidence here indicates that the reserve requirement on demand deposits was likely higher than what was warranted by their relative liquidity.

In summary, our regression findings for cash asset demand are consistent with the view that banks were mainly targeting broad liquidity in 1935 and viewed cash and Treasuries as close substitutes. After the Fed had increased reserve requirements, however, reserves became more closely reflective of regulatory and other factors, implying that the Fed apparently was correct to believe that the increases would leave it better positioned to influence bank balance sheets by varying the supply of reserves than it had been before.

Today, banks face no reserve requirements and possess large amounts of reserves and Treasuries, and those assets are close substitutes. The close substitutability of reserves and Treasuries could hamper monetary policy implementation to control inflation, requiring a larger open market sale to have a desired policy impact than in an environment where the
substitutability of reserves and Treasuries was less. As reserves are withdrawn, banks will hold more Treasuries with relatively little effect on Treasury yields or potentially on deposit creation and lending. This implies that a massive amount of open market sales (or repo lending) might be required to deal with a surge in inflation. Some observers note that the Fed could raise the rate of interest paid on reserves substantially as an alternative means of combatting inflation. However, doing so could significantly reduce the Fed’s remittances to the Treasury, and perhaps even result in accounting losses that would erode the Fed’s capital and cause it political difficulties.

There are also inherent limitations to using high interest rates on reserves to contract lending. For example, if the Fed raised interest rates on reserves to very high levels, banks might substitute entirely away from Treasuries, and at this corner solution, the interest rate paid to banks on reserves could substantially exceed market interest rates paid to holders of Treasuries, which is not allowed under the statute that authorized the payment of interest on reserves.

Still another approach that is not being discussed (so far) is for the Fed to restore the scarcity of reserves by reimposing reserve requirements. The analysis in Table 6 suggests that raising reserve requirements in the mid-1930s reduced the substitutability between reserves and Treasuries. This likely enhanced the Fed’s ability to implement monetary policy using conventional tools, i.e., open market operations, by substantially increasing the impact of a given volume of open market operations on Treasury yields, bank deposit creation and lending. Conceivably, reserve requirements could be reinstated today while continuing to pay interest on reserves to avoid creating a new tax on banks (say, by paying at a constant difference of a few basis points below the repo rate). The experience of the 1930s suggests that at least in some circumstances, reserve requirements can be used effectively in the implementation of monetary policy.
References


Notes: Money Stock is the sum of currency held by the public and deposits (demand and time) at commercial banks; Deposits/Reserves is the ratio of deposits at commercial banks to bank reserves; Deposits/Currency is the ratio of deposits at commercial banks to currency held by the public; and Base is the sum of vault cash and bank reserves (referred to as “High-Powered Money” by Friedman and Schwartz (1963)).

Source: Friedman and Schwartz (1963, Tables A-1 and B-3).
Figure 2: Excess Reserves/Deposits, All Member Banks

Notes: Excess reserves are reserves of all member banks at the Federal Reserve less required reserves. Deposits are total member bank deposits. Vertical lines identify the months in which reserve requirements were raised, i.e., August 1936, March 1937 and May 1937.

Source: Board of Governors of the Federal Reserve System (1943).
Figure 3: Total Reserves at Federal Reserve Banks Divided by Total Deposits for Aggregates of Member Banks

Note: Vertical lines indicate August 1936, March 1937, and May 1937.

Source: Board of Governors of the Federal Reserve System (1943, volume 2)
Figure 4: Narrow Cash Assets Divided by Total Deposits for Aggregates of Member Banks

Note: Narrow cash assets equals the sum of member bank holdings of reserve deposits with the Fed, vault cash, cash items in the process of collection and net deposits due from correspondents. Vertical lines indicate August 1936, March 1937, and May 1937.

Source: Board of Governors of the Federal Reserve System (1943, volume 2)
Figure 5: Broad Cash Assets Divided by Total Deposits for Aggregates of Member Banks

Note: Broad cash assets equals the sum of member bank holdings of reserve deposits with the Fed, vault cash, cash items in the process of collection, net deposits due from correspondents, and government securities. Vertical lines indicate August 1936, March 1937, and May 1937.

Source: Board of Governors of the Federal Reserve System (1943, volume 2)
Figure 6: Excess Reserves Divided by Total Deposits for Aggregates of Member Banks

Notes: Excess reserves are reserves deposits of member banks at the Federal Reserve less required reserves. Deposits are total member bank deposits. Vertical lines indicate August 1936, March 1937 and May 1937.

Source: Board of Governors of the Federal Reserve System (1943, volume 2)
Note: Stars indicate the locations of member banks and their nonmember bank matches, Sample 1.

Source: See text.
Figure 8: Locations of Member and NonMember Bank Matches, Sample 2

Note: Blue stars indicate locations of member bank and nonmember matches when both banks were located in the same city or town. Red stars and blue dots indicate the locations of member banks and nonmember banks when members and nonmember matches were not located in the same city or town.

Source: See text.
Figure 9: Locations of Member and NonMember Bank Matches, Sample 3

Note: Blue stars indicate locations of member bank and nonmember matches when both banks were located in the same city or town. Red stars and blue dots indicate the locations of member banks and nonmember banks when members and nonmember matches were not located in the same city or town.

Source: See text.
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<td>Reserve city</td>
<td>10</td>
<td>15.00</td>
<td>17.50</td>
<td>20.00</td>
<td>17.50</td>
<td>20.00</td>
</tr>
<tr>
<td>Country</td>
<td>7</td>
<td>10.50</td>
<td>12.25</td>
<td>14.00</td>
<td>12.00</td>
<td>14.00</td>
</tr>
<tr>
<td><strong>On time deposits:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All member banks</td>
<td>3</td>
<td>4.50</td>
<td>5.25</td>
<td>6.00</td>
<td>5.00</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Source: Board of Governors of the Federal Reserve System (1943).
Table 2: Sample Statistics, Member (M) and Nonmember (NM) Banks in Matched Pair Samples

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG(M) 1933-35</td>
<td>1</td>
<td>-0.055</td>
<td>0.129</td>
<td>-0.042</td>
<td>0.184</td>
<td>-0.313</td>
</tr>
<tr>
<td>LG(M) 1933-35</td>
<td>2</td>
<td>-0.006</td>
<td>0.203</td>
<td>-0.009</td>
<td>0.859</td>
<td>-0.450</td>
</tr>
<tr>
<td>LG(M) 1933-35</td>
<td>3</td>
<td>0.002</td>
<td>0.206</td>
<td>-0.007</td>
<td>0.859</td>
<td>-0.450</td>
</tr>
<tr>
<td>LG(NM) 1933-35</td>
<td>1</td>
<td>0.039</td>
<td>0.315</td>
<td>-0.049</td>
<td>1.156</td>
<td>-0.357</td>
</tr>
<tr>
<td>LG(NM) 1933-35</td>
<td>2</td>
<td>0.005</td>
<td>0.219</td>
<td>-0.040</td>
<td>1.156</td>
<td>-0.420</td>
</tr>
<tr>
<td>LG(NM) 1933-35</td>
<td>3</td>
<td>0.012</td>
<td>0.217</td>
<td>-0.034</td>
<td>1.156</td>
<td>-0.420</td>
</tr>
<tr>
<td>LG(M) 1935-37</td>
<td>1</td>
<td>0.099</td>
<td>0.184</td>
<td>0.076</td>
<td>0.495</td>
<td>-0.312</td>
</tr>
<tr>
<td>LG(M) 1935-37</td>
<td>2</td>
<td>0.094</td>
<td>0.175</td>
<td>0.060</td>
<td>0.601</td>
<td>-0.312</td>
</tr>
<tr>
<td>LG(M) 1935-37</td>
<td>3</td>
<td>0.107</td>
<td>0.173</td>
<td>0.074</td>
<td>0.601</td>
<td>-0.312</td>
</tr>
<tr>
<td>LG(NM) 1935-37</td>
<td>1</td>
<td>0.065</td>
<td>0.146</td>
<td>0.049</td>
<td>0.422</td>
<td>-0.185</td>
</tr>
<tr>
<td>LG(NM) 1935-37</td>
<td>2</td>
<td>0.103</td>
<td>0.169</td>
<td>0.070</td>
<td>0.703</td>
<td>-0.280</td>
</tr>
<tr>
<td>LG(NM) 1935-37</td>
<td>3</td>
<td>0.089</td>
<td>0.173</td>
<td>0.069</td>
<td>0.703</td>
<td>-0.491</td>
</tr>
<tr>
<td>EQ/TA (M) 1</td>
<td>1</td>
<td>0.140</td>
<td>0.050</td>
<td>0.142</td>
<td>0.273</td>
<td>0.066</td>
</tr>
<tr>
<td>EQ/TA (M) 1</td>
<td>2</td>
<td>0.153</td>
<td>0.066</td>
<td>0.144</td>
<td>0.371</td>
<td>0.046</td>
</tr>
<tr>
<td>EQ/TA (M) 1</td>
<td>3</td>
<td>0.148</td>
<td>0.064</td>
<td>0.138</td>
<td>0.371</td>
<td>0.046</td>
</tr>
<tr>
<td>EQ/TA (NM) 1</td>
<td>1</td>
<td>0.160</td>
<td>0.048</td>
<td>0.170</td>
<td>0.248</td>
<td>0.071</td>
</tr>
<tr>
<td>EQ/TA (NM) 1</td>
<td>2</td>
<td>0.162</td>
<td>0.063</td>
<td>0.153</td>
<td>0.391</td>
<td>0.050</td>
</tr>
<tr>
<td>EQ/TA (NM) 1</td>
<td>3</td>
<td>0.161</td>
<td>0.066</td>
<td>0.150</td>
<td>0.391</td>
<td>0.050</td>
</tr>
<tr>
<td>TA(M) 1935</td>
<td>1</td>
<td>4553.495</td>
<td>12987.976</td>
<td>1379.443</td>
<td>69126.691</td>
<td>340.433</td>
</tr>
<tr>
<td>TA(M) 1935</td>
<td>2</td>
<td>2099.923</td>
<td>7284.369</td>
<td>845.416</td>
<td>69126.691</td>
<td>81.399</td>
</tr>
<tr>
<td>TA(M) 1935</td>
<td>3</td>
<td>3559.841</td>
<td>8616.534</td>
<td>968.823</td>
<td>69126.691</td>
<td>81.399</td>
</tr>
<tr>
<td>TA(NM) 1935</td>
<td>1</td>
<td>3424.286</td>
<td>9011.586</td>
<td>1150.000</td>
<td>48257.000</td>
<td>309.000</td>
</tr>
<tr>
<td>TA(NM) 1935</td>
<td>2</td>
<td>1719.183</td>
<td>5084.996</td>
<td>770.000</td>
<td>48257.000</td>
<td>66.000</td>
</tr>
<tr>
<td>TA(NM) 1935</td>
<td>3</td>
<td>3069.620</td>
<td>6782.053</td>
<td>1000.500</td>
<td>48257.000</td>
<td>66.000</td>
</tr>
</tbody>
</table>

Variable Definitions: LG is annual percentage growth rate of total loans (divided by 100); EQ/TA is equity (sum of capital, surplus and undivided profits) divided by total assets; TA is total assets (in $ thousands); M and NM refer to Federal Reserve member (M) and nonmember (NM) banks.

Data Sources: For member banks: Reports of Condition and Income (call reports); for nonmember banks: *Rand McNally Banker Directory* (January 1934, 1936, and 1938).
Table 3a: Summary statistics for the 5426 banks used in the first-stage regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>St.Dev.</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER/TR 1935</td>
<td>0.422</td>
<td>0.276</td>
<td>0.422</td>
<td>1.076</td>
<td>-2.414</td>
</tr>
<tr>
<td>OCA/TA 1935</td>
<td>0.191</td>
<td>0.115</td>
<td>0.171</td>
<td>0.762</td>
<td>0.000</td>
</tr>
<tr>
<td>LOANS/TA 1935</td>
<td>0.320</td>
<td>0.131</td>
<td>0.309</td>
<td>0.954</td>
<td>0.005</td>
</tr>
<tr>
<td>LG 1933-35</td>
<td>-0.009</td>
<td>0.192</td>
<td>-0.042</td>
<td>2.798</td>
<td>-0.715</td>
</tr>
<tr>
<td>Natl Bank 1935</td>
<td>0.872</td>
<td>0.334</td>
<td>1.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Res City Bank 1935</td>
<td>0.068</td>
<td>0.251</td>
<td>0.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>RESBASEDD/TD 1935</td>
<td>0.388</td>
<td>0.181</td>
<td>0.375</td>
<td>0.967</td>
<td>0.000</td>
</tr>
<tr>
<td>EQ/TA 1935</td>
<td>0.150</td>
<td>0.060</td>
<td>0.138</td>
<td>0.816</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Variable Definitions: ER/TR is the ratio of excess reserves to total reserves; OCA/TA is the ratio of cash assets other than reserves to total assets, where other cash assets is the sum of vault cash, cash items in the process of collection, net deposits due from banks, and government securities held by banks; LOANS/TA is the ratio of total loans to total assets; LG is the annual percentage growth rate of total loans; lnTA is the log of total assets; Natl Bank is an indicator equal to 1 for national banks; Res City Bank is an indicator equal to 1 for banks located in reserve or central reserve cities; RESBASEDD/TD is the ratio of (demand deposits + US Government deposits + net deposits due to banks – cash items in the process of collection) to total deposits; and EQ/TA is the ratio of total equity to total assets.

Data Source: Reports of Condition and Income (call reports). See Calomiris and Mason (2003 a,b).
### Table 3b: Summary statistics for the 458 banks used in the second-stage regressions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>St.Dev.</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG 1935-37</td>
<td>0.108</td>
<td>0.175</td>
<td>0.086</td>
<td>1.389</td>
<td>−0.609</td>
</tr>
<tr>
<td>LG 1933-35</td>
<td>0.016</td>
<td>0.208</td>
<td>−0.018</td>
<td>1.813</td>
<td>−0.450</td>
</tr>
<tr>
<td>Natl Bank 1935</td>
<td>0.895</td>
<td>0.307</td>
<td>1.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Res City Bank 1935</td>
<td>0.472</td>
<td>0.500</td>
<td>0.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>(ER/TR)−(WER/TR) 1935</td>
<td>0.019</td>
<td>0.274</td>
<td>0.014</td>
<td>0.537</td>
<td>−2.539</td>
</tr>
<tr>
<td>EQ/TA 1935</td>
<td>0.133</td>
<td>0.056</td>
<td>0.121</td>
<td>0.386</td>
<td>0.045</td>
</tr>
<tr>
<td>lnTA 1935</td>
<td>15.539</td>
<td>2.085</td>
<td>15.390</td>
<td>21.545</td>
<td>11.307</td>
</tr>
<tr>
<td>OCA/TA 1935</td>
<td>0.236</td>
<td>0.125</td>
<td>0.229</td>
<td>0.700</td>
<td>0.013</td>
</tr>
<tr>
<td>OCAGr 1935-37</td>
<td>0.018</td>
<td>0.248</td>
<td>−0.021</td>
<td>1.586</td>
<td>−0.601</td>
</tr>
</tbody>
</table>

**Variable Definitions:** LG is the annual percentage growth rate of total loans; Natl Bank is an indicator equal to 1 for national banks; Res City Bank is an indicator equal to 1 for banks located in reserve or central reserve cities; (ER/TR) – (WER/TR) is the ratio of excess reserves to total reserves minus the ratio of “warranted” excess reserves to total reserves; EQ/TA is the ratio of total equity to total assets; lnTA is the log of total assets; OCA/TA is the ratio of other cash assets to total assets, where other cash assets is the sum of vault cash, cash items in the process of collection, net deposits due from banks, and government securities held by banks; and OCAGr is the annual percentage growth rate of OCA.

**Data Source:** Reports of Condition and Income (call reports). See Calomiris and Mason (2003 a,b).
Table 4: Regressions for Excess Reserves/Total Reserves in 1935 (Col. 1), Growth Rate of Total Loans 1935-37 (Col. 2), and Growth Rate of Other Cash Assets 1935-37 (Col. 3)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LG 1933-35</td>
<td>0.255</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.075)</td>
</tr>
<tr>
<td>InTA 1935</td>
<td>-0.023</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(-0.004)</td>
<td>(-0.035, -0.011)</td>
</tr>
<tr>
<td>RESBASEDD/TD 1935</td>
<td>-0.219***</td>
<td>-0.019***</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>EQ/TA 1935</td>
<td>0.162**</td>
<td>0.223</td>
</tr>
<tr>
<td></td>
<td>(0.075)</td>
<td>(-0.740, -0.091)</td>
</tr>
<tr>
<td>(ER/TR)–(WER/TR) 1935</td>
<td>0.079</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022, 0.135)</td>
</tr>
<tr>
<td>Natl Bank 1935</td>
<td>0.06</td>
<td>0.037</td>
</tr>
<tr>
<td></td>
<td>(-0.049, 0.060)</td>
<td>(-0.040, 0.104)</td>
</tr>
<tr>
<td>Res City Bank 1935</td>
<td>0.047</td>
<td>-0.068</td>
</tr>
<tr>
<td></td>
<td>(0.002, 0.091)</td>
<td>(-0.132, 0.001)</td>
</tr>
<tr>
<td>FRDIST01</td>
<td>0.015</td>
<td>-0.057</td>
</tr>
<tr>
<td></td>
<td>(-0.052, 0.085)</td>
<td>(-0.151, 0.047)</td>
</tr>
<tr>
<td>FRDIST03</td>
<td>-0.013</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(-0.083, 0.055)</td>
<td>(-0.113, 0.090)</td>
</tr>
<tr>
<td>FRDIST04</td>
<td>0.026</td>
<td>-0.046</td>
</tr>
<tr>
<td></td>
<td>(-0.044, 0.091)</td>
<td>(-0.142, 0.055)</td>
</tr>
<tr>
<td>FRDIST05</td>
<td>-0.007</td>
<td>-0.071</td>
</tr>
<tr>
<td></td>
<td>(-0.074, 0.057)</td>
<td>(-0.164, 0.026)</td>
</tr>
<tr>
<td>FRDIST06</td>
<td>0.074</td>
<td>0.046</td>
</tr>
<tr>
<td></td>
<td>(0.004, 0.143)</td>
<td>(-0.204, -0.003)</td>
</tr>
<tr>
<td>FRDIST07</td>
<td>0.078</td>
<td>-0.110</td>
</tr>
<tr>
<td></td>
<td>(0.013, 0.142)</td>
<td>(-0.185, 0.010)</td>
</tr>
<tr>
<td>FRDIST08</td>
<td>0.035</td>
<td>-0.150</td>
</tr>
<tr>
<td></td>
<td>(-0.040, 0.108)</td>
<td>(-0.243, -0.021)</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Standard Error</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>FRDIST09</td>
<td>0.073</td>
<td>0.018</td>
</tr>
<tr>
<td>FRDIST10</td>
<td>0.181</td>
<td>0.015</td>
</tr>
<tr>
<td>FRDIST11</td>
<td>0.159</td>
<td>0.016</td>
</tr>
<tr>
<td>FRDIST12</td>
<td>-0.000</td>
<td>0.018</td>
</tr>
<tr>
<td>Constant</td>
<td>0.737</td>
<td>0.067</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors in parentheses in Column 1 (); * p < .10, ** p < .05, *** p < .01. Values in parentheses in columns 2 and 3 indicate the lower and upper bounds of 95% confidence intervals, as estimated by applying a bootstrapping procedure described in Efron and Tibshirani (1993) to estimate distributions of the estimators.

Variable definitions: FRDIST01 is an indicator equal to 1 if the bank resides in the First Federal Reserve District, etc.; see the notes to Tables 3a and 3b for other definitions.

Data Source: Reports of Condition and Income (call reports). See Calomiris and Mason (2003 a,b).
Table 5: Member and Nonmember Bank Mean Refined Loan Growth Rate, 1935-37

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample 1 Mean</th>
<th>Sample 2 Mean</th>
<th>Sample 3 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG(M)</td>
<td>0.099</td>
<td>0.094</td>
<td>0.107</td>
</tr>
<tr>
<td>LG(NM)</td>
<td>0.065</td>
<td>0.103</td>
<td>0.089</td>
</tr>
<tr>
<td>p-value</td>
<td><strong>0.444</strong></td>
<td><strong>0.721</strong></td>
<td><strong>0.439</strong></td>
</tr>
<tr>
<td>ALGM</td>
<td>0.352</td>
<td>0.322</td>
<td>0.338</td>
</tr>
<tr>
<td>ALGNM</td>
<td>0.287</td>
<td>0.323</td>
<td>0.313</td>
</tr>
<tr>
<td>p-value</td>
<td><strong>0.166</strong></td>
<td><strong>0.982</strong></td>
<td><strong>0.317</strong></td>
</tr>
<tr>
<td>Obs</td>
<td>28</td>
<td>93</td>
<td>108</td>
</tr>
</tbody>
</table>

Notes:

ALGNM = LG(NM) 1935-37 – (-0.0228 x lnTA 1935) – (0.255 x LG (NM) 1933-35) – (-0.423 x EQ/TA 1935)

ALGM = LG(M) 1935-37 – (-0.0228 x lnTA 1935) – (0.0789 x ((ER/TR)−(WER/TR) 1935)) – (0.255 x LG(M) 1933-35) – (-0.423 x EQ/TA 1935) - (-0.0060 x Natl Bank 1935)

p-values are for t-tests of equality of ALGMN and ALGM means for indicated sample.

Variable definitions: LG is annual percentage growth rate of total loans; ALG is defined above; M and NM refer to member and nonmember banks. See notes to Tables 3a and 3b for definitions of variables appearing in the formulae for ALGNM and ALGM.

Data Sources: For member banks: Reports of Condition and Income (call reports); for nonmember banks: Rand McNally Banker Directory (January 1934, 1936, and 1938).
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LG 1933-35</strong></td>
<td>-0.029** (0.014)</td>
<td>0.002 (0.009)</td>
<td>-0.045 (0.035)</td>
</tr>
<tr>
<td><strong>LG 1935-37</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>lnTA 1935</strong></td>
<td>-0.001 (0.002)</td>
<td>0.001 (0.001)</td>
<td>0.021*** (0.005)</td>
</tr>
<tr>
<td><strong>RESBASEDD/TD 1935</strong></td>
<td>0.130*** (0.018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RESBASEDD/TD 1937</strong></td>
<td></td>
<td>0.130*** (0.010)</td>
<td>0.092** (0.039)</td>
</tr>
<tr>
<td><strong>EQ/TA 1935</strong></td>
<td>-0.114* (0.061)</td>
<td>-0.076* (0.040)</td>
<td>-0.411*** (0.150)</td>
</tr>
<tr>
<td><strong>Natl Bank 1935</strong></td>
<td>-0.012 (0.010)</td>
<td>-0.013** (0.006)</td>
<td>0.038* (0.022)</td>
</tr>
<tr>
<td><strong>Res City Bank 1935</strong></td>
<td>-0.004 (0.008)</td>
<td>0.016*** (0.005)</td>
<td>0.015 (0.018)</td>
</tr>
<tr>
<td><strong>FRDIST01</strong></td>
<td>-0.006 (0.013)</td>
<td>-0.017** (0.007)</td>
<td>-0.043 (0.028)</td>
</tr>
<tr>
<td><strong>FRDIST03</strong></td>
<td>-0.025* (0.013)</td>
<td>-0.057** (0.030)</td>
<td>-0.026*** (0.008)</td>
</tr>
<tr>
<td><strong>FRDIST04</strong></td>
<td>-0.015 (0.013)</td>
<td>-0.022*** (0.008)</td>
<td>0.023 (0.023)</td>
</tr>
<tr>
<td><strong>FRDIST05</strong></td>
<td>0.006 (0.012)</td>
<td>-0.010 (0.007)</td>
<td>0.014 (0.028)</td>
</tr>
<tr>
<td><strong>FRDIST06</strong></td>
<td>-0.020 (0.012)</td>
<td>0.072** (0.029)</td>
<td>-0.031*** (0.007)</td>
</tr>
<tr>
<td><strong>FRDIST07</strong></td>
<td>0.013 (0.012)</td>
<td>0.143*** (0.028)</td>
<td>-0.013* (0.007)</td>
</tr>
<tr>
<td><strong>FRDIST08</strong></td>
<td>-0.014 (0.013)</td>
<td>0.060* (0.031)</td>
<td>-0.031*** (0.008)</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient 1</td>
<td>Coefficient 2</td>
<td>Coefficient 3</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>FRDIST09</td>
<td>-0.011</td>
<td>0.091***</td>
<td>-0.020**</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.032)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>FRDIST10</td>
<td>-0.000</td>
<td>0.137***</td>
<td>-0.027***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.030)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>FRDIST11</td>
<td>-0.002</td>
<td>0.136***</td>
<td>-0.027***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.030)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>FRDIST12</td>
<td>-0.012</td>
<td>0.055**</td>
<td>-0.030***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.028)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.076*</td>
<td>0.180*</td>
<td>0.073***</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.092)</td>
<td>(0.023)</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Observations</th>
<th>458</th>
<th>458</th>
<th>472</th>
<th>472</th>
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<tbody>
<tr>
<td>R²</td>
<td>0.200</td>
<td>0.430</td>
<td>0.524</td>
<td>0.330</td>
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<tr>
<td>Adjusted R²</td>
<td>0.169</td>
<td>0.408</td>
<td>0.506</td>
<td>0.305</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors in parentheses; * p < .10, ** p < .05, *** p < .01.

Variable Definitions: See Tables 3a, 3b, and 4.

Data Source: Reports of Condition and Income (call reports). See Calomiris and Mason (2003 a,b).