Do changes in reserve requirement affect bank lending and economic growth? Evidence from US microdata

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Abstract

Whether and how monetary expansion affects the real economy is an issue that is well studied but still triggers dissent and debates. This paper utilizes the adjustment of reserve requirements due to the phase-in program of the 1980 Monetary Control Act and annual updates of reserve regulations as a natural experiment to study the local economic consequences of changes in monetary supply. These changes to reserve requirement by the Federal Reserve were motivated by aggregate (national level) trends and set at the national level, with no specific consideration of local needs. Depending on the membership status with the Federal Reserve and the composition of deposits, the policy changes the amount of reserve requirement to different degrees for individual banks, and hence for different counties on the regional-aggregate level. Using 1982-1992 data, I show that reduction in the reserve requirement increases new loans extended by banks. Moreover, the reduction in required reserve leads to employment growth at the county level. Consistent with the expectation that the reserve changes would matter more for firms and industries more reliant on bank financing, I find that this growth effect is stronger for smaller firms (defined as 1-19 employees) than larger firms (100+ employees) and more significant for industries with a higher level of dependence on external finance.

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1. Introduction

Whether and how much monetary policy can lead to real economic consequences is a long-lasting debate in macroeconomics and a question that attracted significant scholastic attentions. Some earlier papers, such as Gurley and Shaw (1955) and Kormendi and Meguire (1985), use macro time-series data to study the links between monetary supply and economic growth. However, empirical results based on macro data entail some potential issues: first, there is endogeneity issue since there might be common components behind monetary supply and growth; second, establishing causality can be difficult. The limitation of macro-data based research suggests that we turn to micro data for solutions instead. Moving away from aggregate data, a series of studies have used micro-data to delve into the transmission mechanism and the effect of monetary policy, such as Kashyap and Stein (1995), Kashyap and Stein (2000) (Fed fund rate and bank lending), Jiménez, Ongena, Peydró and Saurina (2014) (Spanish overnight rate and loan composition), and Liebig, Porath, Weder and Wedow (2007) (bank capital adequacy). In recent years, another stream of literature, represented by Ivashina and Scharfstein (2010), Khwaja and Mian (2008), Rodnyansky and Darmouni (2017), Chodorow-Reich and Falato (2017), and Carpinelli and Crosignani (2017), utilizes micro-level shocks to banks and unconventional monetary policy after the Great Recession, such as quantitative easing and bank assistance programs, to study the economic consequences of monetary policy. While a large body of research has attempted to estimate the growth effect of monetary expansion using aggregate data and to analyze the effect of monetary policy on bank lending during the crisis, little work has been done to study how reserve requirements affect lending and local economic growth using microdata. The goal of the paper is to fill this gap by evaluating the effectiveness of a conventional monetary policy that has once again begun to play a vital role, the reserve requirement, and by documenting the real economic effect it generates.

This paper exploits regional variations in changes to reserve requirements induced by the Monetary Control act of 1980, coupled with detailed county-level micro-data, to provide a novel evidence on the whether and how relaxation of monetary policy impacts real economic activity. The milestone Monetary Control Act of 1980 (henceforth MCA 1980) provides us with a good natural experiment. In MCA 1980, non-member banks, defined as banks that are not members of the Federal Reserve System, and thus were not bound by the Federal reserve requirements, are required to increase their reserves within a specific time frame. Meanwhile, member banks can gradually reduce their reserve burdens. MCA 1980 also allows the Federal Reserve to adjust the required reserve criteria annually. Since banks in different places have different capital structures and deposit compositions, their available liquidity is reduced/increased to different degrees when reserve requirement regulations are updated. I address the institutional changes in detail in Section 2.1.

In Section 3, I propose a theoretical framework to justify the use of the natural experiment. I demonstrate that relaxing reserve requirement has stronger local effect when banks operate locally and face liquidity constraint, which were true for the period of time when the natural experiment took place. Also, the model suggests that relaxation of reserve requirement leads to greater expansion of smaller firms and firms that are more dependent on external finance, suggesting that regressions should be ran separately for firms of different size and different level of external-finance dependence.

The empirical analysis in this paper is undertaken in two stages. In the first stage, I calculate annual reserve changes for individual banks and link them to other bank traits to construct a bank-level panel dataset. I use this panel data to examine whether banks extend more (less) loans when relaxing the reserve requirement are relaxed (tightened). I find that indeed there is a significant impact of changes in reserve requirement on loans extended, with relaxation of reserves leading to more loans. In the second stage, I explore whether reserve requirements impacted local economic outcomes. In the baseline analysis, I regress local employment growth on a measure of local changes in reserve requirement. I find that a decrease in the required level of reserves is associated with greater local employment growth. This finding is robust to plausible variations in methodology, such as adding more control variables, including fixed effects, weighting by county size and adding lag terms at the county level. Additional robustness checks are done to eliminate concerns that (1) the estimates could be polluted by 1982-1984 data with a large employment fluctuation; (2) Employment growth was resulted from contemporaneous financial deregulations. Based on the average level of employment and monetary statistics in this period, my baseline estimates suggest that a 1% reduction in required reserve as percentage of total deposit increases job growth by 1.09%.

This paper contributes to three strands of literature. First, it contributes to the monetary policy literature by providing evidence for one of the most frequently discussed questions in macroeconomics - whether and how monetary policy affects real economic outcomes. Second, the paper contributes to the recent research on shocks and financial sufficiency of banks after the Great Recession. Although the paper uses a different setting, it shares common theoretical support and channeling mechanisms between banks and the real economy. Last, this paper also complements the ongoing pool of literature studying the synergy between finance and development. While geographical expansion of financial institutions (Burgess, Pande and Wong (2005) and Kendall (2012)), the increased value of real estate as mortgages to obtain higher ceiling loans (Flannery and Lin (2015)), the legal and financial system (DemirgüçKunt and Maksimovic (1998)), financial deregulation (Aghion, Fally and Scarpetta (2007)), and small business lending programs (Nguyen, Greenstone and Mas (2015) and Keeton (2009)) are shown to significantly impact economic growth, less progress has been made in understanding how reserve requirement as a monetary policy tool translates to local economic outcomes.

Moreover, the results provide useful information to policymakers. Internationally, many countries, such as China and India (Liu and Spiegel (2017)), still use reserve requirement as a basic monetary tool. The evidence on the relationship between the amount of loanable money in the banking sector and regional economic growth suggests that changing reserve requirements could indeed be effective as a monetary policy tool. In the US, in the wake of the surge of excess reserves after the Federal Reserve began paying interest on excess reserves following the 2008 financial crisis and possible future policy revamps (Taylor (2017)), the role of required and excess reserve as a monetary policy tool became more substantial. Moreover, the paper shows that the effect of monetary policy varies across firm size and external finance dependency. Confirming related findings in the literature, this paper suggests that policies impacting the bank credit channel could be used specifically to encourage the development of small businesses or finance-dependent industries.

The remainder of the paper is organized as follows. Section 2 introduces background information pertaining to the expansion of the paper and clarifies some points made in Section 1. Section 3 proposes a theoretical framework to discuss and justify the empirical strategy that I use in Section 4. Section 4 discusses the econometric methodology. Section 5 presents the construction of the data and summary statistics. Section 6.1 presents the main results. Section 6.2 shows robustness checks to supplement the results in Section 6.1. Section 7 offers some final thoughts on the ramifications of my findings.

2. Background

2.1. Localness of Banking

A sizable body of previous research concludes that credit supply and demand has strong localness, viz., most firms obtain loans from local banks. Because this paper primarily examines the regional employment effect, this kind of localness is important. If any firm can borrow money from any bank at any location, associating the local variations in loanable credit with regional growth will not be feasible. Previous research shows that credit and banking have strong locality, especially for small businesses that rely heavily on bank lending. For example, using data from the 1993 Survey of Small Business Finances, Kwast, Starr-McCluer and Wolken (1997) find that 92.4% of small businesses use a depository institution within 30 miles of their main office. Data from the 2001 Credit, Banks, and Small Business Survey, conducted by the National Federation of Independent Businesses indicate that the average travel time between a small business and its primary financial institution was 9.5 minutes and 90% of small businesses look for banking services within 14.8 miles of a firm's location (Brevoort, Wolken and Holmes (2010)). DeYoung, Frame, Glennon, McMillen and Nigro (2008) finds that the median borrower-lender distance is approximately 17 miles for medium-upper income tracts, and 35 miles for low-moderate income tracts. Petersen and Rajan (2002) documents that even in the United States, the distance between small business borrowers and their banks is less than 20 miles (35 km) for over 75% of loans made to these firms. Such localness of banking, plus the fact that US banks are often scattered geographically because of banking regulations, create variation that we can utilize to test if changes in reserve requirements could lead to different local development outcomes, if such an effect does not extend beyond a certain radius. It is expected that localness of banking is more acute for smaller firms and less so for larger firms, which suggests the importance of running separate regressions for different size groups.

2.2. The US Reserve Requirement Regulations

As discussed in Section 1, utilizing reserve requirement changes is the essence of this paper. Therefore, understanding the US reserve system, especially how it works after MCA 1980, is essential. To be specific, in my research design, there are three sources of reserve requirement changes.

(1) Variation across "member" and "non-member" banks. By membership at the Federal Reserve, banks can be classified into two broad categories – member banks (including past member banks that abandoned membership before a certain date), and non-members (including non-member banks that acquired membership before a certain date). Before the MCA of 1980, the former were subject to the Federal Reserve requirements, which were generally more stringent than the new rules stipulated in the MCA of 1980. The percentage reserve requirement for each type of deposit was much lower, and banks could exempt the reserve requirement using certain types of asset. For the latter, they only needed to comply with state reserve requirements prior to the MCA of 1980, which were much more lenient than Federal requirements (Gilbert and Lovati (1978)). Some states required banks to maintain reserve at a very low percentage of deposit. Most states allowed banks to satisfy reserve requirements using demand balance dues and securities they held[1]. This situation had led to dismissal of membership from the Federal Reserve to eliminate the burden. By the end of 1976, the percentage of commercial banks belonging to the Federal Reserve System had declined to 39 percent, from 45 percent at the end of 1966

[1] Some states were particularly lenient, e.g., Illinois did not have any reserve requirement.

(Gilbert and Lovati (1978)). To stop the divestiture of membership and to harmonize regulation, the Monetary Control Act of 1980 came to place. When the Monetary Control Act went into effect, it put all banks under uniform regulation: non-member banks were asked to maintain higher level of reserves, while member banks faced reduced reserve obligations in most cases. To ensure a smooth transition, a phase-in program was designed to give non-member banks additional time to meet the revised requirements and for member banks to reduce the excessive reserves of the past. Under this program, past member banks were given six years to gradually reduce the excess between the old and the new requirements, while non-member banks had to raise their reserve level to meet the new regulations within eight years (transition period was twelve years for foreign banks). Thus this policy generates a natural experiment: throughout the transition period, the amount of loanable money becomes smaller for past non-member banks and larger for member banks. Because extent of membership varied across regions, this difference translates into variations in geographical dimension if we aggregate the reserve changes to the regional level.

(2) Annual change of reserve low-reserve tranche and exemption amount. The Federal Reserve sets three amounts that together determine a bank's total reserve requirement: (i) “low-exemption amount”, below which banks do not need to maintain reserve; (ii) “low reserve tranche”, such that for transaction deposits between this cutoff amount and the low exemption amount banks only need to maintain a discounted (i.e., lower) reserve ratio; (iii) and reserve ratio, which is a percentage that banks need to maintain for deposits beyond the “low reserve tranche amount. If there has been a decrease in the total transaction accounts of all depository institutions, the Federal Reserve will adjust the low reserve tranche and exemption value to relax the reserve requirement.[2] At the same time, time

[2] The Monetary Control Act of 1980 stated that the increase in transaction accounts (subject to reserve requirements) is determined by subtracting the amount of such accounts on June 30 of the preceding calendar year from the amount of such accounts on June 30 of the calendar year involved (Reserve Maintenance Manual, Federal Reserve Board).

deposit is subject to a uniform 3% reserve ratio (0% after 1990). The calculation of the reserve requirement is summarized by the formula below:

$$RequiredReserve = \begin{cases} (TD - L) \times RR + (L - E) \times LR + TM \times TR, & \text{for } TD \geq L \\ (TD - E) \times LR + TM \times TR, & \text{for } TD < L \text{ and } TD > E \end{cases}$$

Where:

$TD = Transaction\ deposit$

$TM = Time\ deposit$

$L = Low\ reserve\ tranche$

$RR = Regular\ reserve\ ratio$

$E = Exemption\ amount$

$LR = Low\ reserve\ ratio$

$TR = Time\ deposit\ reserve\ ratio$

From the description above, it is clear that the amount of released liquidity is determined by the total amount of deposits at an individual bank (with no consideration for any regional aggregates). However, because the distribution of banks is not uniform cross regions, and because banks have different deposit compositions, the consequence of such adjustment is not evenly distributed at all locations. This kind of unevenness creates utilizable variation.

(3) Changes in bank branch locations. Besides the above two factors, changes in the distribution of bank branch locations also contribute to the pattern of changes in required reserve. When banks begin to operate new branches or close old branches, the availability of the loanable amount of credit in corresponding regions will be affected. When calculating the required level of reserves at the bank level and attributing the changes to local regions, the computation process also captures this type of variation.[3]

[3]This also raises a potential concern that growth might be attributed to bank consolidation instead of to the reserve requirement. To eliminate this possibility, subsample regressions are conducted to eliminate this concern. The details are presented in Section 6.2.3 .

For the time span of this research, I choose the years between 1982 and 1992. The year 1981 marks the first year that MCA went into effect and the onset of phase-in program stipulated in the MCA. Therefore, 1982 is the first year for which I can calculate “clean” reserve changes. Another reason for choosing 1992 as the terminal point is that the Federal Reserve allowed so-called “sweeping” of transaction deposits, i.e., transferring money from transaction accounts that are subject to Federal Reserve requirements to nontransaction accounts for which a reserve was no longer required after 1992. Banks have incentive to maintain as little reserve as possible to maximize profit. To this end, banks usually manage to circumvent the reserve requirement, which is mainly imposed on more “liquid” transaction accounts after 1990. Bennett, Peristiani et al. (2002) concludes that the reserve requirement was no longer binding after sweeping was no longer prohibited. The actual level of reserves became so low that adjusting low reserve tranche and exemption amounts does not significantly changes banks' loanable liquidity.[4]

3. Theoretical Framework

In this section, a theoretical framework is constructed to illustrate the impact of the above-mentioned regulatory changes and to discuss other variables at work. This also helps to justify the use of the policy of the natural experiment that serves as the core of the paper.

Views about the effect of monetary policy on economic outcomes can be sum-

[4]For banks, deciding the size of sweeping is purely technical– it is an optimization problem in which banks trade off revenue from investments and potential cost, such as management cost and overdue penalties imposed by the Federal Reserve. Tracing the size of sweeping and using it as a source of variation in liquidity injection is possible; however it is not practically feasible because of data limitations (the size of sweeping for each individual bank is confidential) and is outside the scope of this paper.

marized under two heads: the money view and the credit view. If the "money view" is correct and monetary policy only works by changing the aggregate demand and supply of money to shift the user cost of capital, it is not possible to attribute the regional variation of growth to the policy change. In contrast, the credit view holds that monetary policy shifts the assets and liabilities of banks to change the supply of bank loans extended to firms which could vary across banks and hence across regions. In Kashyap and Stein (1994), the two authors summarize the two conditions for the bank lending view requires to hold: (a) banks cannot shield their loan portfolios from changes in monetary policy; and (b) borrowers cannot fully isolate their real spending from changes in the availability of bank credit. In the later part of this section, I show that the bank lending view is the functioning mechanism when (1) firms bank locally, and (2) banks face liquidity constraints and (3) firms are not fully funded until the marginal benefit of lending equals the marginal cost. The intuition here is quite straightforward: when banks already have enough money to well fund firms to the point where the marginal benefit of lending equals the marginal cost of lending , additional liquidity will not encourage banks to extend more lending. They will instead allocate this additional liquidity to other investment channels, such as equity or bond markets. In contrast, if banks are short of liquidity to make the optimal level of loans, creating additional liquidity will shift the level of lending closer to the optimal point.

Another purpose of the theoretical framework is to show that changes in loanable funds have an uneven impact on firms at different positions on the size spectrum, due to the differences in funding sources, the size of demand for funding, and funding cost. The inflow into banks' loanable fund reservoir mostly affects smaller firms who find it hard to access non-local sources; in contrast, larger firms that can access national-wide finance markets, such as by issuing corporate bonds, are less affected by this inflow.

Several assumptions are made to construct the theoretical framework, described below.

Production

(1) There are N regions in the country. N is sufficiently large such that no one single region is big enough to impact aggregate variables significantly (i.e., banks/firms in each region take aggregate variables as given).

(2) There are two types of firms, small firms and large firms. Each region has a representative large firm and a representative small firm. Large firms can fund their investments through either bank loans or issuing bonds in the bond market after paying a fixed entry cost γ. Small firms can only fund their projects through bank lending.

(3) There are two inputs (labor and capital) and one output. The labor market is fully competitive and is mobile, so wages equated cross regions. The output market is fully competitive and transportation cost is zero. Products are exchanged in a nation-wide market and the law of one price is achieved.

(4) Cobb-Douglas production function, with decreasing return to scale, i.e. $F(K, L) = (p + \eta_e)K^{\alpha_i}L^{\beta_i}$, with $\alpha_i + \beta_i < 1$ and $i \in \{s, l\}$, represents small and large firms respectively.p denotes price level and η_e denotes price adjustment.

(5) Assume $\dfrac{\partial F}{\partial E} > r_B$. The marginal product of new capital ∂E is higher than the Fed fund rate. This condition guarantees that the Fed rate is not prohibitively high so that firms will always have the incentive to invest.

Financial sector

(6) There is one bank in each region and firms cannot borrow from outside of the region in which they are located in. Banks serve as the rational, profit-maximizing intermediary between depositors and financial markets. Banks distribute loans to large firms (E_l) and small firms (E_s), at interest rates of r_l and r_s respectively.

Banks can also invest money in the bond market at a risk-free rate r_B. This rate is set up by the Federal Reserve.

(7) Banks' expected probability of default for each type of firm are functions $\theta_l(.)$ and $\theta_s(.)$ of the volume of loan E_i, the firms' own capital $\overline{W}$, and the amount of deposit S. Ceteris paribus, the chance of default increases when the firm borrows more, owns less capital, and the bank has less liquidity, i.e. $\frac{\partial\theta(E,\overline{W},S)}{\partial E} > 0$, $\frac{\partial\theta(.)}{\partial S} < 0$, $\frac{\partial\theta(.)}{\partial\overline{W}} < 0$.

(8) Banks' loss function is convex. $\frac{\partial^2\theta(.)}{\partial E^2} > 0$.. This can be explained from the perspective of banks' risk preference. Risk-averse banks' disinclination to risk increases with the amount of loans lent to firms.

(9) The rate of change in risk increases at a faster pace when the borrowing firm has less owned-capital and the bank has fewer deposits. $\frac{\partial^2\theta(.)}{\partial E\partial\overline{W}} < 0$, $\frac{\partial^2\theta(.)}{\partial E\partial S} < 0$

Aggregate variables

(10) The price adjustment η_e is set at the aggregate level.

(11) The bond rate is determined by a nation-wide bond market. For simplicity, I assume the interest rate of corporate bond is equal to the treasury bond rate (r_B). The central bank (the Federal Reserve) can intervene by conducting open-market operations to withdraw or inject money into the market.

Given these assumptions, in the later part of this section, I will prove two arguments: (1) regional effects exist (bank lending channel argument) when bank credit is tight and firms are not fully-funded. (2) Larger firms, defined as firms with more self-owned capital, are less likely to be affected by relaxation of liquidity constraints.

To do so, we need to examine the optimization conditions of the bank and the firms. The sequence of action is as follows: the large firm and the small firm decide their optimal levels of investment at each interest rate, $E_l(i_l)$ and $E_s(i_s)$.

The banks then observe $E_l(i_l)$ and $E_s(i_s)$ to determine the supply of bank loans. Based on this timing assumption, we can set out the the maximization problem of a small firm in a representative region j and solve for the small firm's demand for bank loans. To keep notations succinct, I omit the region subscript j for all agents in the representative region. The profit function is defined as:

$$\pi_s = (p + \eta_e)K_{t,s}^{\alpha_s} L_s^{\beta_s} - i_s E_s - wL_s$$

where $K_{t,s} = (1 - \delta)K_{t-1,s} + E_s$, δ is the depreciation rate.
Take derivate w.r.t to E and L in both sides:

$$\frac{\partial \pi_s}{\partial E_s} = (p + \eta_e)\alpha_s[(1 - \delta)K_{t-1,s} + E_s]^{\alpha_s - 1} L_s^{\beta_s} - i_s = 0 \tag{1a}$$

$$\frac{\partial \pi_s}{\partial L_s} = (p + \eta_e)(\beta_s)L_s^{\beta_s - 1} K_{t,s}^{\alpha_s} - w = 0 \tag{1b}$$

Solving the optimization problem gives us the demand function for bank loans for the small firm:

$$E_s^* = (\frac{(p + \eta_e)\alpha_s}{i_s})^{\frac{1 - \beta_s}{1 - \alpha_s - \beta_s}} (\frac{(p + \eta_e)\beta_s}{w})^{\frac{\beta_s}{1 - \alpha_s - \beta_s}} - (1 - \delta)K_{t-1,s} \tag{2a}$$

$$L_s^* = (\frac{(p + \eta_e)\alpha_s}{i_s})^{\frac{\alpha_s}{1 - \alpha_s - \beta_s}} (\frac{(p + \eta_e)\beta_s}{w})^{\frac{1 - \alpha_s}{1 - \alpha_s - \beta_s}} \tag{2b}$$

Next, let us consider the large firm's problem. As mentioned above, large firms can choose between bank lending or bond market financing, depending on which one is cheaper at the desired investment level. So the profit function is set up as:

$$\pi_l = (p + \eta_e)K_{t,l}^{\alpha_l} L_l^{\beta_l} - i_l E_l - wL_l - (r_B B + \gamma) * I(B > 0)$$

where $K_{t,l} = (1-\delta)K_{t-1,l} + E_l + I(B > 0)B$ and $I(B > 0)$ is a binary indicator function. $I(B > 0) = 1$ when $B > 0$ and $I(B > 0) = 0$ when $B = 0$.
Because there is a cost associated with bond issuance, the large firm will choose bond financing only when the investment level is large enough. The cut-off point of bond issuance, E^c , is marked by:

$$[(p+\eta_e)\alpha_l((1-\delta)K_{t-1,l} + E^c)^{\alpha_l - 1}L_l^{*\beta_l}]K_{t,l} = r_B B + \gamma \tag{3a}$$

$$B = E^c \tag{3b}$$

Contingent on the cost of financing, there are two possible scenarios:
(1) When $i_l E_l < r_B B + \gamma$, i.e. $E_l < E^c = \dfrac{\gamma}{i_l - r_B}$, financing with bank loans is cheaper than issuing corporate bonds. Now the optimal choice of E_l^* of large firms is governed by the follwing first order conditions:

$$\frac{\partial \pi_l}{\partial E_l} = (p+\eta_e)\alpha_l[(1-\delta)K_{t-1,l} + E_l]^{\alpha_l - 1}L_l^{\beta_l} - i_l = 0 \tag{4a}$$

$$\frac{\partial \pi_l}{\partial L_l} = (p+\eta_e)\beta_l L_l^{\beta_l - 1}[(1-\delta)K_{t-1,l} + E_l]^{\alpha_l} - w = 0 \tag{4b}$$

Solve the equations:

$$E_l = \left(\frac{(p+\eta_e)\alpha_l}{i_l}\right)^{\dfrac{1-\beta_l}{1-\alpha_l-\beta_l}}\left(\frac{(p+\eta_e)\beta_l}{w}\right)^{\dfrac{\beta_l}{1-\alpha_l-\beta_l}} \tag{5a}$$

$$L_l = \left(\frac{(p+\eta_e)\alpha_l}{i_l}\right)^{\dfrac{\alpha_l}{1-\alpha_l-\beta_l}}\left(\frac{(p+\eta_e)\beta_l}{w}\right)^{\dfrac{1-\alpha_l}{1-\alpha_l-\beta_l}} \tag{5b}$$

(5a) can be also written as:

$$i_l = (p+\eta_e)^{\frac{1}{1-\beta_l}} \alpha_l \beta_l^{\frac{\beta_l}{1-\beta_l}} w^{\frac{-\beta_l}{1-\beta_l}} E_l^{\frac{-(1-\alpha_l-\beta_l)}{1-\beta_l}} \tag{6a}$$

These can be shown to yield:

$$(p+\eta_e)^{\frac{1}{1-\beta}} \alpha_l \beta_l^{\frac{\beta_l}{1-\beta_l}} w^{\frac{-\beta_l}{1-\beta_l}} E_l^{\frac{1}{1-\beta_l}} = r_B E_l + \gamma \tag{7a}$$

(2) When $i_l E_l > r_B B + \gamma$, it is more economical to finance from the bond market. Firm will invest until marginal return to capital equals to the corporate bond rate r_B:

$$E_l = \left(\frac{(p+\eta_e)\alpha_l}{r_B}\right)^{\frac{1-\beta_l}{1-\alpha_l-\beta_l}} \left(\frac{(p+\eta_e)\beta_l}{w}\right)^{\frac{\beta_l}{1-\alpha_l-\beta_l}} - (1-\delta_l)K_{t-1,l} \tag{8a}$$

$$L_l = \left(\frac{(p+\eta_e)\alpha_l}{r_B}\right)^{\frac{\alpha_l}{1-\alpha_l-\beta_l}} \left(\frac{(p+\eta_e)\beta_l}{w}\right)^{\frac{1-\alpha_l}{1-\alpha_l-\beta_l}} \tag{8b}$$

Therefore, large firms' demand for bank loan is:

$$E_l = \begin{cases} 0, & \text{if } E_l > E^c \\ \left(\frac{(p+\eta_e)\alpha_l}{i_s}\right)^{\frac{1-\beta_l}{1-\alpha_l-\beta_l}} \left(\frac{(p+\eta)\beta_l}{w}\right)^{\frac{\beta_l}{1-\alpha_l-\beta_l}} - (1-\delta)K_{t-1,l}, & \text{if } 0 < E_l < E^c \end{cases} \tag{9}$$

The two "global" variables, bond market rate and expected price change, are determined by general equilibrium conditions marked by the summation of all regional markets. The price level is determined by the gap between saving and investment. Here we assume that the expected price change is proportional to the investment/saving gap (Takahashi (1971)), i.e.

$$\eta = \Omega(I - S)/K$$

where I, S, K are aggregate investment, savings, and capital stock of all regions.

$$I = \sum_j (E_{s,i} + E_{l,i}), S = \sum_j [(1 - \delta_1) - (1 - \delta_2)]S_j, K = \sum_j (K_{l,t-1} + K_{s,t-1})$$

The bond market rate is determined by:

$$\frac{B_c}{r_B} + \sum_j Q_j(r_B, \bar{W}) = \sum_j \Lambda_j(r_B)$$

where B_c is the amount of treasury bonds issued by the Federal Reserve, $\sum_j Q_j$ is the aggregate demand for corporate bond by all large firms, and $\sum_j \Lambda_j$ is the amount invested in the bond market by all banks.

Now consider banks' optimization problem. By assumption, the bank is a monopoly supplier of loans. Thus, it will observe firms' demand functions for credit at each interest rate level and decide the amount of lending to large firms and small firms accordingly. The profit maximization problem can be written as:

$$\pi = i_s E_s + i_l E_l - \theta_s(E_s, \overline{W}, S)E_s - \theta_l(E_l, \overline{W}, S)E_l + r_B B$$

s.t. $E_s + E_l + B \leq (1 - \sigma)\overline{S_{t-1}}$, where σ is the required reserve ratio.

Substitute the large firm's and the small firm's demand functions for bank credit into the profit function, and the bank's optimization problem becomes a piece-wise function. To ease the discussion, I first consider the optimal solution when $E_l < E^c$ and $\tilde{S} > E_l + E_s$, and then later discuss other scenarios.

Set up Lagrangian:

$\mathcal{L} = i_s^*(E_s)E_s + i_l^*(E_l)E_l - \theta_s(E_s, \overline{W}, S)E_s - \theta_l(E_l, \overline{W}, S)E_l + r_B B - \lambda[E_s + E_l + B - \tilde{S}]$
For banks, the marginal revenue of lending (MRL) is:

$$MRL_i = (p + \eta_e)^{\frac{1}{1-\beta_i}} \alpha \beta_i^{\frac{\beta_i}{1-\beta}} w^{\frac{-\beta_i}{1-\beta_i}} (\frac{\alpha_i}{1-\beta_i}) E_i^{\frac{\alpha_i+\beta_i-1}{1-\beta_i}}, i \in \{s, l\}$$

Intuitively, banks will lend until the “net” marginal revenue of lending (NMRL, which is the marginal revenue of lending minus risk and opportunity cost of investing in the bond market), i.e.,

$$NMRL_i = MRL_i - \frac{\partial \theta_i}{\partial E_i} * E_i - \theta_i - r_B = 0, i \in \{s, l\}$$

Now consider what would happen when the required reserve ratio is relaxed. Differentiate E_s^* and E_l^*:

$$\Delta E_s^* = \frac{\partial E_s^*}{\partial r_B} \Delta r_B + \frac{\partial E_s^*}{\partial \eta_e} \Delta \eta_e + \frac{\partial E_s^*}{\partial \tilde{S}} \Delta \tilde{S}$$

$$\Delta E_l^* = \frac{\partial E_l^*}{\partial r_B} \Delta r_B + \frac{\partial E_l^*}{\partial \eta} \Delta \eta + \frac{\partial E_l^*}{\partial \tilde{S}} \Delta \tilde{S}$$

Since the price level change is determined by the aggregation of all regions and any single region is small enough compared to the national market by assumption, the price level and the bond market rate changes can be approximately assumed to be zero, i.e., $\Delta \eta_e \approx 0$ and $\Delta r_B \approx 0$. Therefore, the changes in commercial loans only depend on $\Delta \tilde{S}$. Four possible scenarios may emerge and will be discussed one by one.
(1) When $S > E_s^* + E_l^*$ and $E_l^* < E'^*$, the constraint is now not binding and the loan demand of the large firm does not exceed the break-even point of issuing bond E'^*. Because the function of marginal revenue of loan is a decreasing function, the marginal revenue of loan is higher than purchasing bonds for $E < E_s^*$

and $E < E_l^*$. Now the bank will keep lending until the marginal revenue of commercial loan equals the cost of risk plus the bond market rate. Now the amount of loans lending to large firms and to small firms are functions of the levels of firm owned capital and price level change, i.e. $E_s = E_s^*(\eta, \overline{W_s}, r_B)$ and $E_l = E_l^*$, and the rest can be invested into the bond market, i.e., $B^* = S - E_s^* - E_l^*(\eta, \overline{W_l}, r_B)$. Now, if the reserve requirement is relaxed, the bank will not lend the newly available money to firms, since the marginal benefit of lending will be smaller than the marginal cost. This implies that $\frac{\partial E_s^*}{\partial \tilde{S}} = 0$, $\frac{\partial E_l^*}{\partial \tilde{S}} = 0$, therefore now E_s^* and E_l^* are only shifted by the changes in equilibrium inflation and bond rate, $\Delta \partial E_s^* \approx 0$ and $\Delta \partial E_l^* \approx 0$. Graphical illustration is shown in Figure 1.

(2) When $S > E_s^*$ and $E_l^* > E^{'*}$, it is now more economical for large firms to finance from the bond market. Now large firms will choose zero bank lending, $E_l^* = 0$, while small firms are still well-funded by banks. Also, as $E^{'*} = \frac{\gamma}{i_l - r_B}$ is not a function of $\tilde{S}$, relaxing the reserve requirement does not change the cut-off scale of bond-financing, we have $\frac{\partial E_l^*}{\partial \tilde{S}} = 0$, and the large firm still does not borrow from the bank. It is the same with the scenario in (1): since the bank already funds the small firm until MRL equals to the marginal cost, the bank will not further extend small firm lending. Graphical illustration is shown in Figure 2.

(3) When $S < E_s^*$ and $E_l^* > E^{'*}$, the bank is now facing liquidity constraints and large firms finance investment from the bond market. Because the function of marginal revenue of loan is decreasing in E, for the bank, the marginal revenue of lending is higher than investing in the bond market. Therefore, the bank will grant all loanable money to small firms. When the reserve requirement is relaxed, and the liquidity constraint is lifted, the bank will first allocate the additional liquidity to commercial loans to small firms and not to buying bonds until $E_s = E_s^*$. By the same logic in (2) , the large firm will still finance from the bond market, $\frac{\partial E_l^*}{\partial \tilde{S}} = 0$. A graphical illustration is shown in Figure 3.

(4) When $S < E_s^* + E_l^*$ and $E_l^* > E^{'*}$, the bank is now facing credit constraint and the large firm will finance from bank loans because the investment is not large enough to offset the cost of bond issuing fees. Now, since the marginal revenues of loans for both large and small firms are higher than the bond rate, the bank will prioritize commercial lending and again equalize net MRL of large firms and MRL of small firms, i.e., NMRL$_s$ =NMRL$_l$. In this case, the bank invests zero in the bond market, $B = 0$. It is easy to prove that E_s and E_l under this new equilibrium are larger: see Figure 4.

In the case when firms are facing credit constraint ((3) and (4)), if the reserve ratio is relaxed, banks will extend commercial lending. Therefore, this verifies the claim about the bank credit channel raised at the beginning of this section. Putting this conclusion into context, a remarkable feature associated with the period of 1982-1992 (which is during Paul Volcker's tenure as Chairman of the Federal Reserve and the first a few years of Alan Greenspan's tenure under the George HW Bush administration) is the very low level of excess reserve held by banks (less than 1/10000 of total deposit), banks' unwillingness to make new loans (Figure 6) and high interest rates (Figure 5). These three factors combined suggest that banks were liquidity-constrained and firms were more likely to be underfunded. In this context, the relaxation of the reserve policy is more likely to impact the real economy.

Now, I show that firms with more owned capital tend to finance from the bond market and are therefore less likely to benefit from banks' liquidity expansion, as they might be already funding their investments from the bond market. For this purpose I show (see Appendix (A) for the detailed proof), that the cut-off point E^c is an increasing function of the firm's own capital $\overline{W}$.

To test this prediction, regressions will be run separately for firms of different size categories in the next part of the paper. If the prediction is true, relaxation of the reserve requirement will lead to greater expansion of smaller firms relative to larger firms. If we replace the large/small firm distinction with the level of dependence on external finance, we can reach a similar conclusion: high external finance dependent firms are more likely to benefit from liquidity expansion than are low external finance-dependent firms.

4. Methodology

4.1. Main Regression

The econometric strategy in this paper has two scaffolding steps. First, I regress the size of new bank loans on the increment of unleashed reserves to confirm that additional liquidity does lead to additional credit supply. This regression is performed at the bank-year level. The regression equation is:

$$\Delta log(TotLoan_{i,t}) = \beta_0+\beta_1\Delta log(Reserve_{i,t})+\beta_2\frac{TotLoan_{i,t}}{TotAsset_{i,t}}+\beta_3\Delta log(Dep.)+I(InterStBk)_{i,t}+ I(IntraStBk)_{i,t} + I(Year)_t + \epsilon_{i,t}$$

where i, t denote bank i in year t. $\Delta log(TotLoan_{i,t})$ is the log difference of the previous year loan and the current year loan, i.e., $\Delta log(TotLoan_{i,t}) = log(TotLoan_{i,t}) - log(TotLoan_{i,t-1})$. $\Delta \log(Reserve_{i,t}) = \log(Reserve_{i,t}) - \log(Reserve_{i,t-1})$, calculated from a bank's balance sheet as of Dec 31 of year (t-1). $\Delta log(Dep.)$ is the log difference of deposit. $\frac{TotLoan_{i,t}}{TotAsset_{i,t}}$ is the ratio of a bank's total loan versus total assets. It measures bank's capacity to extend more lending. A higher loan/asset ratio indicates that the ability to extend new loans is limited. $I(InterStBk)_{i,t}$ is the dummy variable indicating whether the state where the bank is located allowed interstate banking in that year. $I(IntraStBk)_{i,t}$ is the dummy variable indicating whether the state where the bank is located allowed intrastate banking in year t.

The second set of regressions attempts to establish a link between regional employment growth by industry and credit supply. If the relationship established in the first regression is substantive, new investment owing to the relaxation of the reserve requirement should also generate growth in employment. In the second set of regressions, the scope of analysis is on the county level (using County Business Pattern data). The reason behind choosing the county as our analytic unit is twofold. Aside from the fact that the county is usually the smallest unit measured by government-published economic statistics, the average size of a US county is approximately 1200 square miles: if a county were circular, it would have a 34-mile radius, which would serve most of a bank branch's clients if it were located in the county's geographical center.

First I provide some simple non-parametric evidence. I group counties by the extent of decrease in reserve requirements. In Figure 8, I document the year-by-year employment growth of the top 25% of areas and the bottom 25% of areas. This non-parametric evidence is consistent with the main proposed idea that areas with more reduction in required reserve saw greater employment growth. To confirm the result parametrically, I conduct the regression below. Starting from the generic production function (the derivation process is shown in Appendix C), the regression equation is set as:

$$log(REmpChg_{i,t}+1) = \beta_0 + \beta_1 log(RResChg_{i,t}+1) + \beta_2 log(\frac{TotLoan}{TotDep}_{i,t}) + \beta_3 \overrightarrow{X}_{i,t} + I(Year_t) + I(County_i) + \epsilon_{i,t}$$

i, t denote county i in year t. $REmpChg_{i,t}$ is the relative change of employment, defined as $\frac{Emp_{i,t} - Emp_{i,t-1}}{0.5Emp_{i,t} + 0.5Emp_{i,t-1}}$. $\frac{TotLoan}{TotDep}_{i,t}$ is the total loan/deposit ratio of all banks in county i and year t. $\overrightarrow{X}$ is the set of control variables. Referring to regional growth literature, such as Carlino and Mills (1987), county typology (urban/rural classification, dominant industry), crime rate, and population density are added as additional controls. $RResChg_{i,t}$ is the ratio of change in reserves as the fraction of total deposits in the area, defined as required reserve in year t minus required reserve in year (t-1) divided by $TotDep_{i,t}$, i.e., $\frac{Reserve_{i,t} - Reserve_{i,t-1}}{TotDep_{i,t}}$. $I(Year_t)$ and $I(County_i)$ denote year and county fixed effects.

Because growth rate regressions are often plagued by autocorrelation problems, and because my data are a dynamic panel with a short time horizon (T) and a large number of counties (N) (Nickell (1981)), the Wooldridge test for autocorrelation in panel data is conducted to determine an appropriate estimation strategy. From Table 1, the Wooldridge test confirms that the data are immune to this autocorrelation problem. To be on the safe side, I report first-differencing (FD) and fixed effect (FE) results and FE estimator with Driscoll-Kraay standard errors to allow for potential cross-sectional heteroskedasticity.

4.2. Heterogeneity by firm and industry characteristics: Firm Size and External Finance Dependence

My theoretical model suggests heterogeneous effects by firm size. To test this, I undertake a third set of regressions to test whether the effect of changes in required reserves varies by firm size as predicted by the model. Therefore, I break down establishments into three categories: 1-19 employees, 20-100, and 100 or more.

Consistent with the assumptions in the model, data suggests smaller firms are more reliant on bank finance: In particular, according to the Quarterly Financial

Report, bank debt composes 82.9% of a firm's total assets among small companies, while for large companies, that number is 22.8% (see Table 3). Similarly, it is reasonable to expect that firms in industries more dependent on external finance will benefit the most from financial expansion. To examine whether credit availability affects different industries, I generate an external finance dependence index for SIC-4 industries following the method proposed by Rajan and Zingales (2001) using Compustat.[5] Then I run the following specification for the industries for top and bottom 25% of industry groups (by index of external finance dependence) separately:

$$log(REmpChg_{i,t,j}+1) = \beta_0 + \beta_1 log(RResChg_{i,t}+1) + \beta_2 log(\frac{TotLoan}{TotDep}_{i,t}) + \\ + \beta_3 \overrightarrow{X}_{i,t} + I(Year_t) + I(County_i) + \epsilon_{i,j,t}$$

where i,t denote county i of year t. j=0 indicates summation of employment changes of the bottom 25% industry group, j=1 indicates summation of employment changes of the top 25% industry group. Financial sector is excluded from the sample.

4.3. Other Institutional Changes in This Period

In the wake of the 1973 oil crisis and the 1979 energy crisis, high inflation began to distress the economy. Per Meltzer (2014), public concerns about the inflation exceeded concerns about unemployment during this period. As a response, Paul Volcker initiated an aggressive anti-inflation monetary policy. The contrac-

[5] Per Rajan and Zingales (2001), a firm's dependence on external finance is defined as capital expenditures (Compustat# 128) minus cash flow from operations (broadly defined as the sum of cash flow from operations plus decreases in inventories, decreases in receivables, and increases in payables) divided by capital expenditure. After aggregating capital expenditure and cash flow from operations for each company for the period from 1982-1992, I then take the median of all firms in the same industry to avoid over-representation of large firms. To exclude extreme values and industries with too few firms, I drop top 1% and bottom 1% of observations that are not comparable to the indices in the original paper in magnitude from the data.

tionary monetary policy is said to be one of the causes of the short early 1980s recession. US unemployment spiked in 1980, and gradually returned to the pre-recession level by 1984. Since the root of the recession was monetary, to ensure the cleanness of the experiment, I exclude the disinflation and subsequent recovery period between 1982-1984. The results are presented in Section 6.2.1.

Another important regulatory change during this period is the deregulation of depository institutions. Besides the regulatory changes in reserve requirements, another purpose of the reform in 1980 was to gradually remove the interest rate ceiling, stipulated in Regulation Q of the Glass-Steagall Act, in the period between 1980 and 1986. The reform also allowed banks to operate new depository businesses, such as creating negotiable order of withdrawal (NOW) accounts. These concurrent institutional changes could impact our analysis in three ways: (1) It was possible that the deregulation created changes that could impact the availability of liquidity in the market. However, because the variation utilized in this paper is regional, as discussed in the theoretical analysis in Section 3, the changes in general equilibrium variables are unlikely to affect the validity. (2) The financial deregulation may also have affected member and non-member banks differently and resulted in gains and losses of jobs in the financial sector at the same time. I undertake two robustness checks to address this concern. First, I exclude states in the northeast region and Illinois, which have higher percentages of employment in the financial sector than national average, and I run a sub-sample analysis. Second, the financial sector is excluded in the financial dependence and growth regressions in Section 4.2 to check if employment still grows. Results are discussed in Section 6.1. (3) One of the initial intentions of Regulation Q was to prevent small banks from depositing into big banks, instead of lending more locally (Gilbert, 1986). If the legislators' worries were true, small banks would withdraw money from big banks and extend more lending. However, as illustrated in Gilbert (1986), the percentage of deposits at large commercial banks from other banks was not changed due to the passing of Regulation Q, and there was also no abrupt growth in the level of inter-bank loans after the interest rate deregulation.

Finally, during this period, many states began relaxing bank branching restrictions. It has been documented in Jayaratne and Strahan (1996) that bank branch deregulation resulted in growth. Two robustness checks are performed to rule out the alternative explanation. First, I add the interaction term between state ID and year fixed effect. Because deregulation of branching is a decision made on the state-level, this term absorbs potential effects of state-level deregulation. Second, I run a sub-sample analysis using only county-year pairs with no new bank branch entry. The result is presented in Section 6.2.3.

5. Data and Summary Statistics

5.1. Bank Balance Sheet Data

The balance sheet data of banks are taken from the quarterly Consolidated Report of Condition and Income filed by individual banks (rather than bank holding companies), often referred to as "call reports". Banks are required to file and submit call report forms four times each year : on 03/31, 06/30, 09/30, and 12/31. Because this paper examines the effect taking place across the year, I use 12/31 data of year (t-1) to calculate deposits, loans and reserve level for year t. Call reports contain detailed on- and off-balance sheet information, such as assets and liabilities, deposits by categories, amount of loans committed, income from each line of business, and costs incurred. Due to changes in reporting regulations, there are inconsistencies in definitions of some variables; what comprises variable name A in some years may be referred to as variable B in others.

Some standardization is required to ensure consistency. The methodology used to standardize the data is presented in Appendix C. Table 2 shows descriptive statistics of some variables to be used in the first regression.

My analysis examines banks that existed for at least two years during the 1982 to 1992 sample period. The decline in the number of banks during this period was due mainly to bank consolidation and bank failures. To ensure the cleanness of the analysis, I exclude the bank-year pairs impacted by mergers or acquisitions in the previous year. After cleaning, the sample includes 157,896 bank-year observations for 18,539 unique banks.

5.2. Bank Location Data

Bank location information is taken from yearly Institution Directory data provided by the FDIC (Federal Deposit Insurance Corporation). The dataset includes geographical information for individual banks' affiliated branches (identified by RSSD ID) such as city, state, county, zip code, and GPS coordinates. The FDIC website provides available-to-download datasets starting in 1994. I obtained 1987-1993 datasets through an FOIA request directed to the FDIC. Since the data also record the dates of establishment and acquisition, I can infer the prior distribution of each banks' branches for covering the entire period of our interest by matching the dataset for year 1987 with bank mergers and acquisitions and failure data obtained from the Federal Reserve Bank of Chicago.

5.3. County-level Data

To focus on the impact of real estate market shocks, I control for local social and economic conditions in our estimations. County typology codes compiled and

maintained by the USDA capture a range of economic and social characteristics. These codes include the following classifications: farming, mining, manufacturing, federal/state government, recreation, retirement destinations, high poverty and nonspecialized. I also introduce two control variables that potentially affect county development– crime rate and population density– from the Census Bureau USA Counties database. The descriptive statistics are shown in Table 4.
County level employment data with industry breakdowns are obtained from the County Business Patterns (CBP) released by the Census Bureau. The original CBP data contain the number of establishments by establishment size and industry. One issue with the CBP data is that, to protect the rights of employers to confidentiality, the U.S. Census Bureau has not disclosed the number of employees when identifying individual firms. Instead, it places a suppression flag, with each letter representing an employment range. In my estimation of employment size change, I employ the method of imputation in Autor, Dorn and Hanson (2013) to generate the size of employment at the country-SIC 4 code level [6].

6. Results

6.1. Baseline Results

This section applies the methodology discussed above and presents results for each part. First, I present the estimates of how changes in reserve requirement affect growth in loans at the individual bank level. I then estimate the impact of reserve requirement changes on local employment growth. Next, I examine the

[6] A fixed point algorithm is implemented to estimate employment numbers within the indicated brackets. The algorithm also imputes employment which is only reported at aggregate industry levels to 4-digit SIC industries.

effects of changes in reserve requirements separately for subsamples that differ on firm size and industry finance dependence level.

Table 5 reports the first regression in the twofold analysis, identifying whether changes in the required reserve affected new loans extended. Column (1) reports the baseline specification. Reserve change receives a negative and significant sign, implying that banks lend more when the obligation of keeping a reserve relaxes. The 0.306 coefficient suggests that banks lend out 30.6% of the reduced reserve. Column (2) controls a county fixed effect. Column (3) adds state*year FEs to the regression. The result remains stable and statistically significant. These results are supportive of the existence of the lending channel that bridges reserve requirement changes and local economic growth.

In Table 6, I link reserve requirement changes with local employment data to examine whether changes in the required reserve have an impact on the local real economy. The first 2 columns in Table 6 report first-differencing estimates, before and after adding more local characteristics such as demographic controls. Column (3) reports estimates after including county fixed effects. The coefficient is larger than in Column (1) but the sign and significance level remain the same. Column (4) reports results using the Driscoll-Kraay standard error (Driscoll and Kraay (1998)). The sign and the magnitude are in tandem with FD and FE estimates. All four estimation methods obtain estimates in support of the argument that relaxing the reserve requirement boosts local employment growth: the results are invariant to the estimation strategies selected, as reported in the last row of the table, and are also robust after adding county characteristics as control variables.

One concern could be that the employment growth might be mainly driven by small counties. To address this, I run a population-weighted regression in Column (5). The coefficient shrinks slightly but not too much, implying that small counties are not over-weighted in the results. I add region*year and state*year fixed effects in Column (6) and Column (7). The interaction terms help to control region-year and state-year specific unobservables. Adding state*year fixed effects also helps to control the effect of intrastate banking deregulation. The addition reduces the magnitude of the coefficient, but the direction and significance are still preserved. Based on the coefficient of the last column, 1% of reduction in required reserve as a percentage of total deposit increases employment growth by 1.03%.

Table 7 summarizes the coefficients obtained from the same regression strategy as in Table 6 separately by firm size groups. To keep the output succinct, I only report coefficients for the main independent variable of interest in the table. The coefficient for reserve level change becomes insignificant for the firm group with more than 100 employees (which represents the top 0.75% in US firm size distribution according to Axtell (2001)). The results suggest that large firms with over 100 employees tend to benefit less from banks' credit expansion, which is consistent with my model and the fact that larger firms have more diversified ways to finance themselves other than obtaining bank credit (Hancock, Peek and Wilcox (2007)).

Table 8 reports the results after partitioning industries by dependence on external finance. Column (1) and (2) show the top 25% and bottom 25% of industry groups by external finance dependence index. Column (1) and (3) report the specification with region*year fixed effect. Column (2) and (4) report the specification with state*year fixed effect. The comparison suggests that the impact of reserve changes is stronger for firms that are more dependent on external finance.

6.2. Robustness Checks

6.2.1. Subsample Analysis: Excluding 1982-1984

The study period of the natural experiment covers the year of 1982, which is the peak of the recession that began in 1981, and subsequent recovery until 1984, as shown by Figure 7. To ensure the cleanness of the experiment, I excluded this time period and reran the regressions in the previous section. The results are presented in Table 9. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. The estimates are slightly larger than the baseline, but remain negative and significant. The results show that the baseline results are robust in this sub-sample.

6.2.2. Excluding Northeastern US and Illinois

As argued in Section 4.3, one concern is that the financial deregulation that occurred at the same time as the natural experiment created new jobs in financial sector. Although regression in Table 8 which excludes finance sector shows that sectors other than financial service (SIC 6000-6799) also grow in employment, to further eliminate this concern, I removed northeastern states and Illinois, which have larger percentages of employment in the financial sector, and re-conducted the regressions specified in Table 6 in the subsample analysis. In Table 10, Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. As shown in Table 10, the main results still hold, suggesting that the job gains due to the financial deregulation did not account for the employment changes during this period.

6.2.3. Including Only County-year with No New Bank Branch

As mentioned in Section 4.3, one important institutional change that occurred during the period of interest is bank branch deregulation. As documented in Jayaratne and Strahan (1996), the relaxation of bank branch restrictions led to observed changes in growth. Also, since the methodology used in this paper allocates reserve change to all branches of multi-branch banks when they enter a new location, the county-level reserve changes too. It is of concern that the employment growth might attribute to new bank entry after the deregulation, rather than reserve changes. Although Column (7) in Table 6 confirms that the result is still significant after adding state*Year fixed effects, which controls for state-level deregulation effects. To further address this the concern, I check robustness using a sub-sample where I retain only county-year pairs with no new bank branches established. The results are presented in Table 11. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. Again, the significance and sign of point estimates are not drastically changed, suggesting that bank branch deregulation does not account for all employment growth.

6.2.4. Addressing Spillover Effects on Neighboring Counties

In this section, I create an index to capture possible spillover effects from adjacent regions. The index weights reserve change from all proximate counties with their pairwise distances. Based on the evidence that 90% of firms are located within 100 miles of banks with which they do business, I first set this radius at 100 miles, and then at 150 miles. Assuming that impact decays exponentially with distance, the index of credit expansion, total deposit and reserve change is defined as:

$$\Delta ReserveIndex_{i,t} = \sum_k \Delta ReserveChg_{i,t} e^{\frac{-D}{D-Distance_{i,k}}}$$

$$TotDepositIndex_{i,t} = \sum_k TotDeposit_{i,t} e^{\frac{-D}{D-Distance_{i,k}}}$$

$$TotLoanIndex_{i,t} = \sum_k TotLoan_{i,t} e^{\frac{-D}{D-Distance_{i,k}}}$$

$$RWtdResChg_{i,t} = \frac{\Delta ReserveIndex_{i,t}}{TotDepositIndex_{i,t-1}}$$

$$WtdLoanDepoRatio_{i,t} = \frac{TotLoanIndex_{i,t}}{TotDepositIndex_{i,t}}$$

Where D=100 or 150. i,k,t denote zip code i, bank k, and year t. $Distance_{i,k}$ is the distance between zip code i and bank k.

After constructing the index, I then regress:

$log(REmpChg_{i,t}+1) = \beta_0+\beta_1 log(RWtdResChg_{i,t}+1)+\beta_2 log(WtdLoanDepoRatio_{i,t})+ \beta_3 \overrightarrow{X}_{i,t} + I(Year_t) + I(County_i) + \epsilon_{i,j,t}$

The results are presented in Table 12. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. The coefficients have the same sign as the baseline results, suggesting that the growth effect is significant even after considering neighboring counties. Because the reserve and deposit indexes are artificially weighted numbers, here the magnitude of coefficients does not indicate the size of the employment growth effect.

7. Conclusion

The relationship between monetary policy and economic growth is a long-standing topic of interest in finance and macroeconomics, with important policy implications. Potential neutrality of money, and hence effectiveness of monetary policy in affecting real outcomes, is a topic of ongoing debate among macro-economists. From the micro perspective, the interaction between development and finance represents a research area that continues to draw great deal of research interest. Utilizing reserve requirement changes as a natural experiment, I conduct regression analyses to examine whether changes in loanable money affect bank lending and have an impact on local growth. The results suggest that banks increase lending when the reserve requirement is relaxed and that lowering the required reserve also boosts local employment growth. Robustness checks suggest that the employment growth was not caused by contemporaneous financial deregulations. Additional analyses are conducted for different employee size brackets and for industries with different levels of dependence on external finance. The results suggest that the reduction in required reserve leads to a higher growth rate for smaller firms than for larger (100+ employees) firms, and for high external-finance-dependent industries than low external-finance-dependent sectors.

This paper's findings impact on three different areas of current research. First, it explores the real economic consequences of a conventional monetary policy tool, reserve requirement, using a natural experiment and micro-level data. This approach avoids endogeneity concerns in previous macro-data based papers and contributes to literature that uses micro data to study the effect of monetary policy and recent research on the effect of non-conventional monetary policy after the Great Recession. Second, in the context of the literature on financial constraints, this paper provides new evidence that an increase in loanable money generates business growth. Finally, although the study was established using data from an earlier time period, because many countries still use the reserve requirement as a major monetary policy tool, the methodology and the conclusions still carry lessons for researchers and policy makers in these countries. In the wake of the surge of excess reserve after 2008 and possible future regulatory revisions, this research could also contribute to future research about the reserve requirement as a monetary policy tool in the US.

A Appendix: Proofs and Graphs in Section 3

Proof (1): The purpose of the proof is to show that when firms are not well-funded, i.e. $E_s^1 < E_s^*$ and $E_l^1 < E_l^*$, relaxing reserve requirement ($\tilde{S}$ increasing from $\tilde{S}_1$ to $\tilde{S}_2$) will lead to an increase in equilibrium amount of commercial loans, i.e. $E_s^2 > E_s^1$ and $E_l^2 > E_l^1$.
Now the equilibrium condition is marked by:

$$MRL_s - \frac{\partial \theta_s}{\partial E_s} * E_s - \theta_s - r_B = MRL_l - \frac{\partial \theta_l}{\partial E_l} * E_l - \theta_l - r_B \tag{10a}$$

$$E_s + E_l = \tilde{S} \tag{10b}$$

Prove by contradiction. Let $f_i = MRL_i - \frac{\partial \theta_i}{\partial E_i} * E_i - \theta_i - r_B$, $i \in \{s, l\}$. Take derivative w.r.t E_s and E_l:

$$\frac{\partial f}{\partial E_i} = (p+\eta_e)^{\frac{1}{1-\beta_i}} \alpha_i \beta_i^{\frac{\beta_i}{1-\beta_i}} w^{\frac{-\beta_i}{1-\beta_i}} (\frac{\alpha_i}{1-\beta_i})(\frac{\alpha_i+\beta_i-1}{1-\beta_i}) E_i^{\frac{\alpha_i+2\beta_i-2}{1-\beta_i}} - 2\frac{\partial \theta_i}{\partial E_i} - \frac{\partial^2 \theta_i}{\partial E_i^2} * E_i < 0$$

Suppose $E_s^2 < E_s^1$, since $\tilde{S}_1 < \tilde{S}_2$, so $E_l^2 = \tilde{S}_2 - E_s^2 > E_l^1 = \tilde{S}_1 - E_s^1$. Since f is an increasing function in E and by (10a), $f_l(E_l^2) = f_s(E_s^2) > f_l(E_l^2) = f_s(E_s^1)$, contracting with $E_s^2 < E_s^1$, therefore $E_s^2 > E_s^1$ must be held true. Similarly, it can be proved that $E_l^2 > E_l^1$.

Proof (2): The purpose of the proof is to show that firms with more owned capital are less likely to benefit from relaxation of reserve requirement when the bank does not have enough liquidity . It is needed to prove that the equilibrium desired amount of bank loan E_l^* is more likely to go over the cut-off point E^c when $\overline{W}$ gets larger, i.e. to show that E_l^* is increasing in $\overline{W}$.
Prove by contradiction. Suppose $\overline{W}$ increases from $\overline{W}_1$ to $\overline{W}_2$, the equilibrium levels of lending are E_1^c and E_1^l at $\overline{W}_1$ and E_2^c and E_2^l at $\overline{W}_2$. Assume $E_2^l \leq E_1^l$.

Take derivative of f_l w.r.t $\overline{W}$:

$$\frac{\partial f_l}{\partial \overline{W}} = -2E_l \frac{\partial^2 \theta_l}{\partial E_i \partial \overline{W}} - \frac{\partial \theta_l}{\partial \overline{W}} < 0$$

f_l is a decreasing function in $\overline{W}$, $f_l(\overline{W}_2) < f_l(\overline{W}_2)$. By (10a), it implies that now f_s at $\overline{W} = \overline{W}_2$ is smaller than f_s at $\overline{W} = \overline{W}_1$. Since f_s is increasing in E_s, it means $E_2^s < E_1^s$ and further $E_2^l = \tilde{S} - E_1^s > E_1^l = \tilde{S} - E_1^s$, contradicting with the assumption $E_2^l \leq E_1^l$. Therefore, E_l^* is increasing in $\overline{W}$.

Proof (3): The purpose of the proof is to show that the equilibrium level of investment when the large firm chooses bond financing is larger than the cut-off E^c. Let $f = MRL_l - \frac{\partial \theta_s}{\partial E_s} * E_s - \theta_s - r_B$, then $E_l = E_{l1}^*$ when $f = 0$ and $S = S_1$ is the equilibrium before bank's liquidity easing. Take derivative of f with respect to S:
$\frac{\partial f}{\partial S} = \frac{\partial^2 \theta_s}{\partial E_s \partial S} E - \frac{\partial \theta_s}{\partial S} < 0$, since $\frac{\partial^2 \theta_s}{\partial E_s \partial S} < 0$ and $\frac{\partial \theta}{\partial S} < 0$.
So for $S_2 > S_1$, $f(S_2, E_1^*) < f(S_1, E_1^*) = 0$, therefore, the solution E_{s2}^* for $f = 0$ when $S = S_2$ is larger than E_{s1}^*. The second order derivatives suggest:

$$\frac{\partial^2 (i_s E_s)}{\partial E_s^2} = (p+\eta_e)^{\frac{1}{1-\beta_s}} \alpha_s \beta_s^{\frac{\beta_s}{1-\beta_s}} w^{\frac{-\beta_s}{1-\beta_s}} (\frac{\alpha_s}{1-\beta_s})(\frac{\alpha_s + \beta_s - 1}{1-\beta_s}) E_s^{\frac{\alpha_s + 2\beta_s - 2}{1-\beta_s}} - 2\frac{\partial \theta_s}{\partial E_s} - \frac{\partial^2 \theta_s}{\partial E_s^2} * E_s < 0$$

$$\frac{\partial^2 (i_l E_l)}{\partial E_l^2} = (p+\eta)^{\frac{1}{1-\beta_l}} \alpha_l \beta_l^{\frac{\beta_l}{1-\beta_l}} w^{\frac{-\beta_l}{1-\beta_l}} (\frac{\alpha_l}{1-\beta_l})(\frac{\alpha_l + \beta_l - 1}{1-\beta_l}) E_l^{\frac{\alpha_l + 2\beta_l - 2}{1-\beta_l}} - 2\frac{\partial \theta_l}{\partial E_l} - \frac{\partial^2 \theta_l}{\partial E_l^2} * E_l < 0$$

$\frac{\partial (i_l E_l)}{\partial E_l}$ is a decreasing function. By Assumption (5), the marginal revenue of lending is larger than the Fed fund rate, i.e. $\frac{\partial (iE)}{\partial E} >> r_B$ at $E = 0$. So the marginal revenue intersects with $i = r_B$ at some point $E^* > 0$, i.e. $\frac{\partial(iE)}{\partial E} = r_B$ at $E = E_B^*$

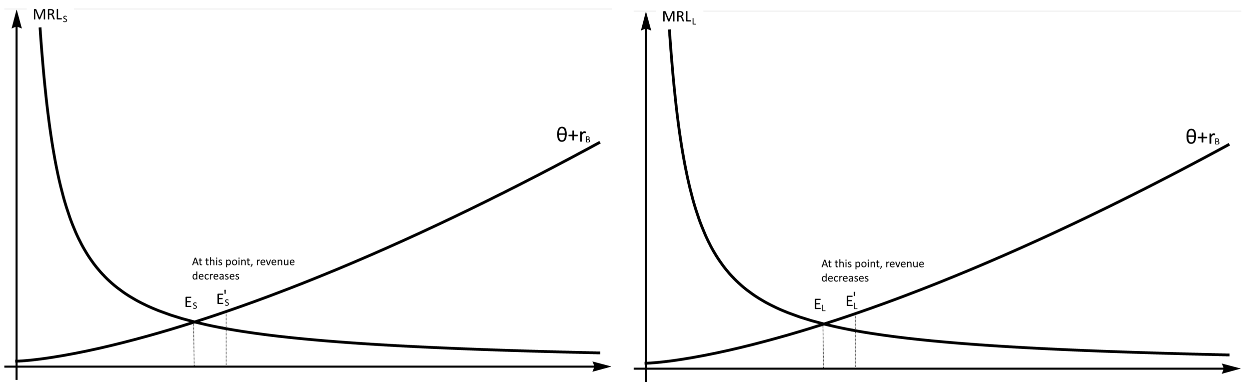

Figure 1: Scenario (1)

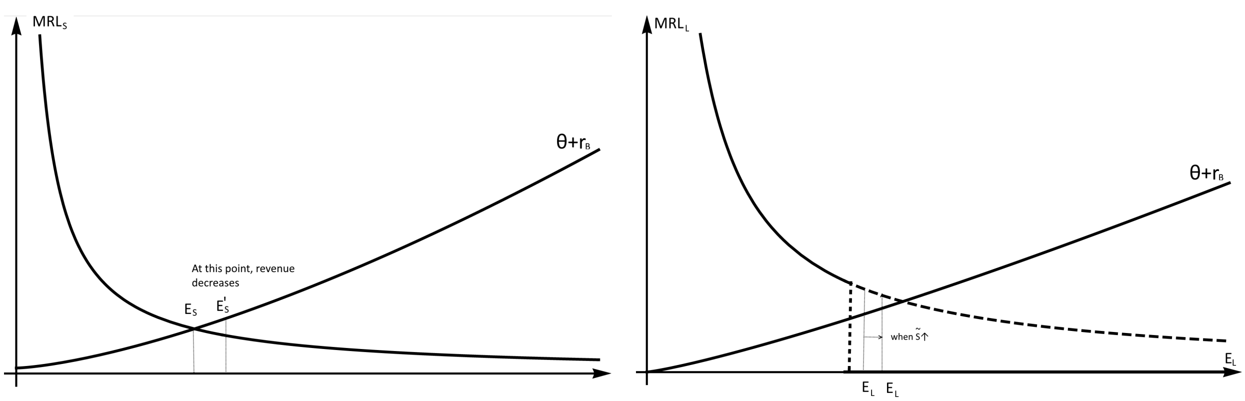

Figure 2: Scenario (2)

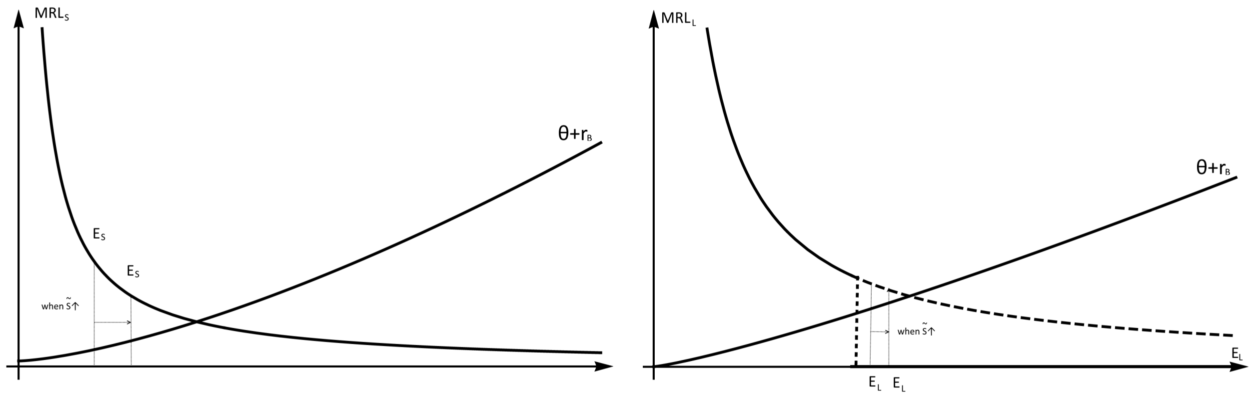

Figure 3: Scenario (3)

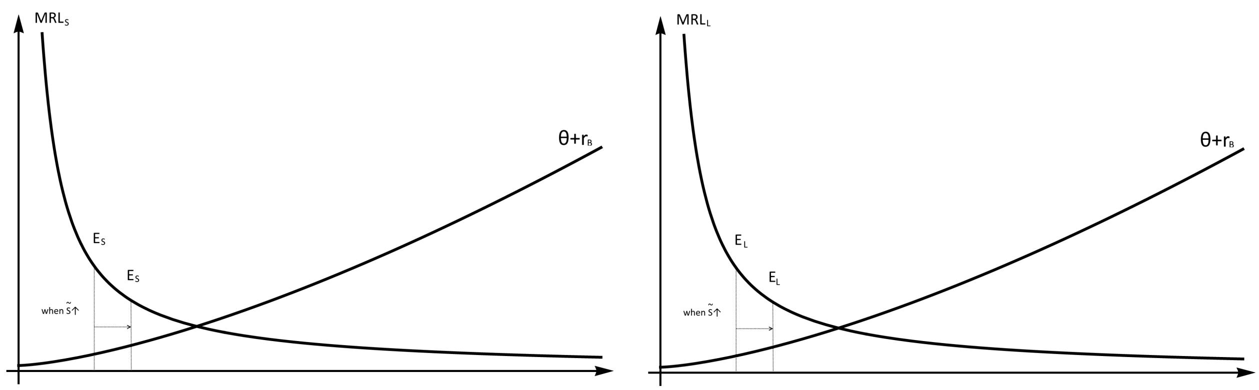

Figure 4: Scenario (4)

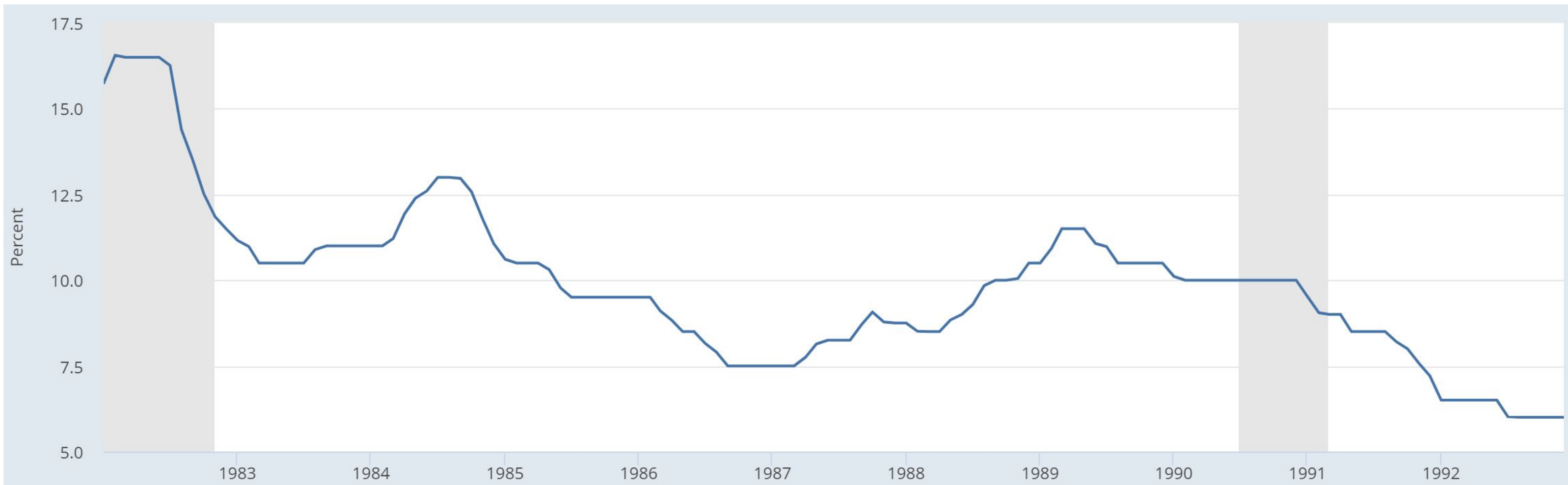

Figure 5: Prime loan rate 1982-1992. Source: FRED, St. Louis Fed

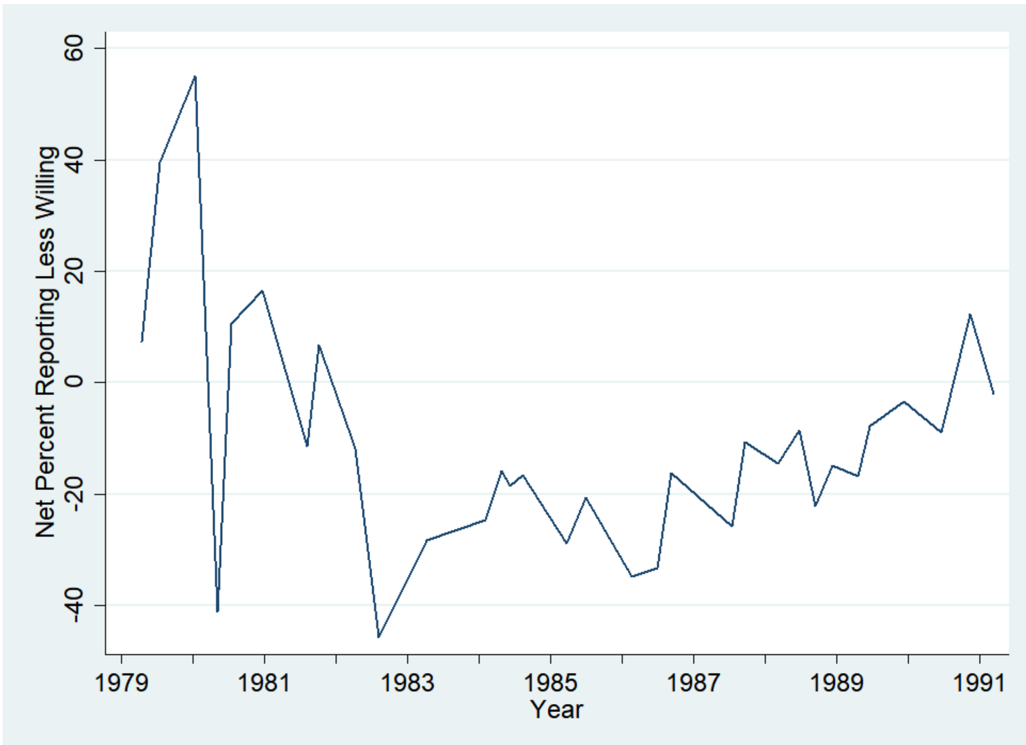

Figure 6: Net percent of loan officers reporting less willing to lend

Source: Federal Reserve Board Senior Loan Officer Opinion Survey. Surveys were conducted in February, May, August and November of each year. Figure replicated from Schreft and Owens (1991).

Figure 7: Unemployment rate 1982-1992. Source: Bureau of Labor Statistics

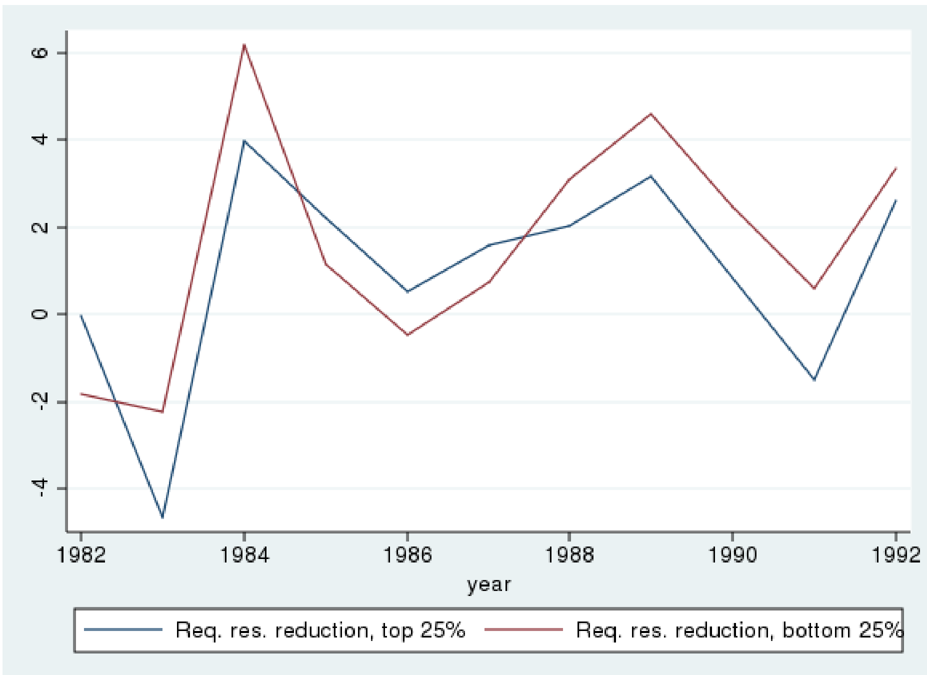

Figure 8: Nonparametric evidence, employment growth in top 25% and bottom 25% reserve reduction regions. Percentage employment growth is on the y-axis.

A Appendix: Definition of Variables

The table below explains how variables are defined and data sources.

Varible name	Description	Source
totloan	Amount of loan extended by the bank	Bank call report. =RCON1400+RCON2165, if YEAR<=1983, =RCON1400 IF YEAR>=1984
totasset	Amount of total asset owned by the bank.	Bank call report. =RCFD2170
totdepo	Yearly average of total deposit of the bank.	Bank call report. =RCON3360
empgrowth	Employment growth rate.	County Business Pattern. = $(Emp_{\cdot i,t} - Emp_{\cdot i,t-1})$ $/(0.5Emp_{\cdot i,t} + 0.5Emp_{\cdot i,t-1})$
reschg	Required reserve change compared to last year. Calculated from bank balance sheet of 12/31 of the previous year.	Imputed from individual bank data.

popdensity	Population density of the county.	Census Bureau US Counties
dist	Distance between two jurisdictions (county or zipcode)	NBER, County Distance Database
totinc	Total personal income of the county (proxy of GDP)	Census Bureau US Counties
ruralcont	Urban-Rural Continuum from 1-9, defined in 1983. The larger the number is, the more rural the county is. >=4 Rural areas.	USDA County Typology Codes
agtp79r	Value=1 Agriculture Dependent County	USDA County Typology Codes
mfgtp79r	Value=1 Manufacturing Dependent County	USDA County Typology Codes
mintp79r	Value=1 Mining Dependent County	USDA County Typology Codes
gvttp79r	Value=1 Government Funding Dependent County	USDA County Typology Codes
rettp79	Value=1 Retirement County	USDA County Typology Codes
povtp79	Value=1 High Poverty County	USDA County Typology Codes

B Appendix: Projected Aggregate Reserve Requirement Based on Individual Level Data vs Publicized Aggregate Required Reserve

Information on reserve requirements for individual banks are not publicly available. So the calculation of the required reserve for each bank is based on bank call report data, reserve laws and regulations. Table 11 and Figure 9 below benchmarks aggregate required reserve level publicized by the Federal Reserve and my calculation.

Table 13: Comparing Actual and Imputed Required Reserve

Year	Publicized Aggregate Required Reserve			Imputed Aggregate
	Year Mean	Year Max	Year Min	
1982	40.1494	42.784	38.866	40.56859
1983	38.3228	41.315	37.418	37.6517
1984	37.2363	39.858	35.423	39.77005
1985	42.2505	47.058	39.358	47.41582
1986	50.3549	58.196	45.601	51.63509
1987	58.2969	61.109	55.842	54.80413
1988	60.8003	62.616	58.868	61.71139
1989	59.6767	62.242	57.824	60.97431
1990	60.1418	61.878	57.457	62.94424
1991	49.6899	54.555	46.709	56.88
1992	51.6408	55.423	47.838	57.89611

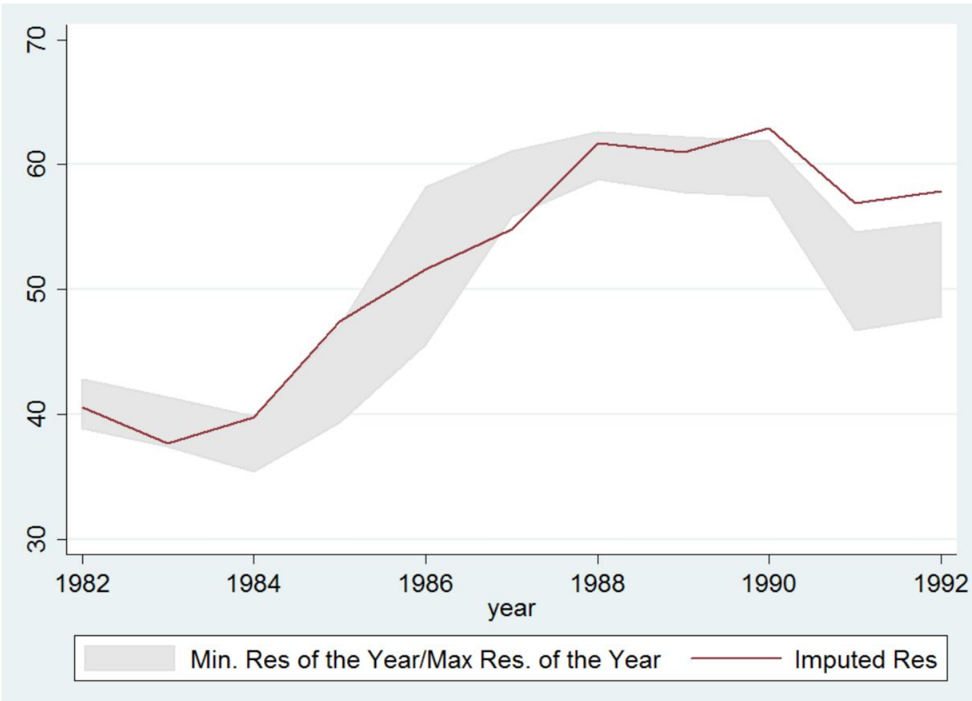

Figure 9: Imputed Required Reserve and Actual Reserve

C Derivation of the Reserve Change-Employment Change Regression Equation

K_t and L_t are the capital stock and labor input of time t. D_{t-1} is the amount of loanable money at time t-1. c is the marginal rate of investment. ΔRes_t is the change of required reserve at the beginning of time t (so it only depends on the amount of deposit at time t-1). For example, $Res_{Year1990}$=Reserve requirement for deposit on 89/12/31 calculated by 1990 new rates-Reserve requirement for deposit on 89/12/31 calculated by 1989 old rates.
At time t, we have:
$K_t = K_{t-1} + c(D_{t-1} + \Delta Res_t)$, i.e. $K_{t-1} * K_t\% = K_{t-1} + c(D_{t-1} + \Delta Res_t)$
Where $K_t\%$ is the growth rate of K from (t-1) to t, i.e., $K_t = (1 + K_t\%)K_{t-1}$ Add one and take log of both sides:

$$log(K_t\% + 1) = log(cD_{t-1} + c\Delta Res_t + 1) - logK_{t-1} \tag{11}$$

Also, starting from the identify below ($L_t\%$ is the growth rate of L from (t-1) to t) :

$$\frac{K_{t-1} * (1 + K_t\%)}{L_{t-1} * (1 + L_t\%)} = \frac{K_t}{L_t} \tag{12}$$

Take log of both sides:

$$log(1 + L_t\%) = log(1 + K_t\%) + log(K_{t-1}) - log(L_{t-1}) - log(\frac{K_t}{L_t}) \tag{13}$$

Substitute (13) into (11):
$log(1 + L_t\%) = log(cD_{t-1} + c\Delta Res_t + 1) - log(K_{t-1}) + (log(\frac{K_{t-1}}{L_{t-1}}) - log(\frac{K_t}{L_t}))$
$\Longrightarrow \ log(1 + L_t\%) = log[(1 + c\frac{\Delta Res_t}{D_{t-1}} + \frac{1}{cD_{t-1}})cD_{t-1}] - log(K_{t-1}) + (log(\frac{K_{t-1}}{L_{t-1}}) -$

$log(\frac{K_t}{L_t}))$

$\implies log(1 + L_t\%) = log(1 + \frac{\Delta Res_t}{D_{t-1}} + \frac{1}{cD_{t-1}}) + log(c) + log(D_{t-1}) - log(K_{t-1}) + (log(\frac{K_{t-1}}{L_{t-1}}) - log(\frac{K_t}{L_t}))$

Since $\frac{1}{cD_{t-1}}$ is a very small number, $log(1+\frac{\Delta Res_t}{D_{t-1}} + \frac{1}{cD_{t-1}})$ can be approximated with $log(1 + \frac{\Delta Res_t}{D_{t-1}})$

Therefore we have

$log(1 + L_t\%) = log(1 + \frac{\Delta Res_t}{D_{t-1}}) + log(\frac{D_{t-1}}{K_{t-1}}) + (log(\frac{K_{t-1}}{L_{t-1}}) - log(\frac{K_t}{L_t}))$

If we assume that capital-labor ratio in one region is stable over time and does not vary too much across regions, we can omit $(log(\frac{K_{t-1}}{L_{t-1}}) - log(\frac{K_t}{L_t}))$ in the regression. So the regression equation can be set up as:

log(1+employment growth rate at time t)=β_0+$\beta_1$log(1+Reserve change at time t as percentage of loanable money of (t-1))+log(total deposit of t-1/Capital stock of t-1)+$\epsilon_{i,t}$.

Since it is difficult to find data for capital stock, I use the total amount of loan instead.

Table 1: Wooldridge Test for Autocorrelation in Panel Data

VARIABLES	Dep. Var. and Explanatory Vars. Only	With Control Vars.
F Value	0.136	0.01
P-Value	0.7121	0.9719

H0: no first-order autocorrelation

Table 2: Summary Statistics, Bank-level regression

Variable	Obs.	Mean	Std. dev	10%	25%	50%	75%	90%
$\Delta Log(Res.)$	149,167	0.026	0.678	-0.523	-0.105	0.154	0.287	0.693
$\Delta Log(Loan)$	160,213	0.086	0.923	-0.104	-0.014	0.066	0.154	0.279
$\Delta Log(Depo.)$	164,792	0.090	0.378	-0.039	0.014	0.065	0.126	0.224
Loan/Depo ratio	166,713	0.618	0.560	0.370	0.481	0.594	0.692	0.770
Intra. Banking	188,197	0.455	0.498	0	0	0	1	1
Inter. Banking	188,197	0.269	0.444	0	0	0	1	1

This table describes the variables in the first regression (reserve change-new bank loan). $\Delta Log(Res.)$ is the log difference of required reserves of time t from (t-1), i.e. $Log(Reserve_t) - Log(Reserve_{t-1})$. $\Delta Log(Loan)$ denotes the log difference of loans. $\Delta Log(Depo.)$ denotes the log difference of deposits. Intra. Banking denotes whether the state relaxed intra-state banking regulation (=1 regulation relaxed). Inter. Banking denotes whether the state relaxed inter-state banking regulation.

Table 3: Bank and Nonbank Sources of Debt for Manufacturing Corporations

	1973:4				1991:4			
	Total	Large	Medium	Small	Total	Large	Medium	Small
Bank debt/Total debt								
Short-term	78.8%	64.9%	93.1%	84.0%	44.9%	22.8%	77.0%	82.9%
Long-term	24.6%	17.1%	36.1%	43.3%	31.2%	21.1%	51.7%	59.3%
Total	34.4%	23.4%	49.8%	55.3%	33.0%	21.3%	54.9%	65.5%
Commercial paper as % of								
Short-term debt	12.7%	26.1%	2.1%	1.7%	N.A.	62.8%	6.9%	N.A.
Non-bank short-term debt	59.7%	74.3%	31.0%	10.4%	N.A	81.3%	30.1%	N.A.
Total debt	2.3%	3.4%	0.5%	0.5%	N.A.	7.5%	0.9%	N.A.
Total nonbank debt	3.5%	4.5%	1.0%	1.1%	N.A.	9.6%	1.9%	N.A.

Source: Quarterly Financial Report. Replicated from Kashyap and Stein (1994). This table shows the sources of debt for manufacturing corporations. Medium and small firms have higher reliance on nonbank financing sources than large firms.

Table 4: County-level Summary Statistics: the Second Sets of Regressions

Statistics	Ratio Res. Chg.	Ratio Emp. Chg.	Pop. Density	Crime rate	Rural-Urban Contin.
Mean	-.007008	.041	223.731	.00232	5.836
Standard Derivation	.0844	0.183	1603.553	.00289	2.538
p10	-.0497	-0.218	4.621	.0000426	2
p25	-.00744	-0.133	16.481	.00059	4
p75	.0034	0.194	92.063	.0031	8
p90	.019	0.246	278.947	.0055	9

Statistics	Agri. Dep.	Manufact Dep.	Mining Dep.	Govt Dep.	Retire. County	High Poverty
Mean	.232	.194	.051	.073	.157	.078
Standard Derivation	.422	.395	.219	.260	.363	.268
p10	0	0	0	0	0	0
p25	0	0	0	0	0	0
p75	0	0	0	0	0	0
p90	1	1	0	0	1	0

This table describes the variables in the second set of regressions (reserve change-employment change). Ratio Res. Chg. denotes the ratio of change in required reserve as total deposit of the county. and Ratio Emp. Chg. denotes the ratio of employment change from the last year. Urban-Rural Contin. denotes urban-rural continuum. A higher value means the county is more rural. FarmingDep, ManufactDep, MiningDep, GovDep denote whether the county is farming, manufacturing, mining, or government dependent. Retire denotes whether the county is a retirement county. High poverty denotes that the county has a high poverty rate.

Table 5: Response of Bank Loans to Reserve Change

	(1)	(2)	(3)
Dep. Var	$\Delta Log(Loan)$	$\Delta Log(Loan)$	$\Delta Log(Loan)$
$\Delta Log(Res.)$	-0.306***	-0.304***	-0.368***
	(0.0219)	(0.0222)	(0.0223)
Intra-state Banking	0.0873***	0.0342	0.415
	(0.0191)	(0.0269)	(0.826)
Inter-state Banking	0.0309**	0.0201	0.207
	(0.0155)	(0.0258)	(0.398)
$\Delta Log(Deposit)$	0.401***	0.387***	0.434***
	(0.0273)	(0.0278)	(0.0273)
Loan/Depo Ratio	-5.50e-05	-0.000101	-0.000114
	(8.47e-05)	(8.40e-05)	(7.94e-05)
Year FE	X	X	X
County FE		X	X
State*Year FE			X
Constant	0.0505**	0.119***	-0.214
	(0.0239)	(0.0263)	(0.815)
Observations	129,336	129,336	129,336
R-squared	0.353	0.378	0.447

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the response of bank lending to reserve changes.$\Delta Log(Loan)$ denotes the log difference of total loans between year t and year (t-1). $\Delta Log(Deposit)$ denotes the log difference of total deposit between year t and year (t-1). Intra-state Banking denotes whether the state relaxed intra-state banking regulation (=1 regulation relaxed). Inter-state Banking denotes whether the state relaxed inter-state banking regulation. $\Delta Log(Res)$ denotes the log difference of total required reserve between year t and year (t-1). A minus sign on $\Delta Log(Res)$ indicates that the reserve requirement of the bank decreases compared to last year.

Table 6: The Effect of Reserve Changes on Local Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)
log(RResChg+1)	-1.097***	-0.996***	-2.142***	-2.262*	−1.878***	-2.467***	-1.216**	-1.24**	-1.09**
	(0.278)	(0.278)	(0.463)	(1.048)	(0.426)	(0.466)	(0.537)	(0.528)	(0.519)
log(REmpChg+1), Lag=1					-0.0113**		-0.129***	-0.161***	-0.186***
					(0.00553)		(0.00555)	(0.00592)	(0.00596)
log(REmpChg+1), Lag=2									-0.127***
									(0.00580)
Log(Depo./Loan)	0.00764	0.00819	0.0100	0.00989***	0.0111*	0.0160**	0.00365	0.00490	0.00542
	(0.00651)	(0.00650)	(0.00686)	(0.00101)	(0.00501)	(0.00703)	(0.00747)	(0.00727)	(0.00727)
Crime Rate	-0.257	-0.0829	-0.793*	-0.872*	-0.101	-0.389	0.182	0.688	0.540
	(0.649)	(0.655)	(0.473)	(0.419)	(0.162)	(0.477)	(0.508)	(0.474)	(0.496)
Pop. Density	-6.74e-06	-4.16e-05	-0.000106***	-8.33e-05***	-2.81e-05***	-7.77e-05***	-3.76e-05**	-4.00e-05***	-4.84e-05***
	(5.78e-05)	(6.66e-05)	(2.00e-05)	(2.20e-05)	(2.68e-06)	(1.76e-05)	(1.77e-05)	(1.52e-05)	(1.72e-05)
Urban-Rural Cont.		0.000235							
		(0.000387)							
FarmingDep = 1		0.000873							
		(0.00228)							
ManufactDep = 1		0.00162							
		(0.00208)							
MiningDep = 1		-0.00485							
		(0.00364)							
GovtDep = 1		0.000764							
		(0.00302)							
Retire = 1		-0.000597							
		(0.00219)							
HighPoverty = 1		0.000330							
		(0.00288)							
Constant	-0.00936***	-0.00974***	14.42***	14.96**	13.27***	15.92***	10.15***	8.771***	11.55***
	(0.00261)	(0.00319)	(2.129)	(4.821)	(1.965)	(2.145)	(2.474)	(1.338)	(2.409)
Region*Year						X			
State*Year							X	X	X
FIPS FE			X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X	X
Method	FD	FD	FE	FE, D-K s.e.	Pop. Weighted	FE	FE	FE	FE
Observations	33,672	33,189	33,310	33,310	33,310	33,310	33,310	33,310	33,310
R-squared	0.054	0.054	0.139		0.331	0.146	0.152	0.197	0.218

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the effect of reserve requirement reduction on employment growth. log(REmpChg+1) denotes the growth of employment. log(RResChg+1) denotes the change of required reserve as the ratio of local total deposit. Negative sign before log(RResChg+1) indicates that reserve reduction leads to employment growth. Urban-Rural Cont. denotes urban-rural continuum. A higher value means the county is more rural. FarmingDep, ManufactDep, MiningDep, GovDep denote whether the county is farming, manufacturing, mining, or government dependent. Retire denotes whether the county is a retirement county. Column (1)-(4) use different estimation method. Column (5) is weighted by population. Column (6)-(7) add region*year and state*year fixed effects. Column (8)-(9) add lag terms of employment growth.

Table 7: The Effect of Reserve Changes by Size

Size Category	1-19	1-19	20-100	20-100	100+	100+
log(RResChg+1)	-3.283***	-0.627*	–5.444***	-2.282**	4.245**	4.813**
	(0.309)	(0.352)	(0.993)	(1.166)	(1.685)	(2.086)
Region*Year	X		X		X	
State*Year		X		X		X
Year FE	X	X	X	X	X	X
County FE	X	X	X	X	X	X

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

This table reports the effect of reserve requirement reduction on employment growth by firm size (number of employees). The regression equation is the same with Table 6. I only report coefficient before Log(RResChg+1).

Table 8: The Effect of Reserve Changes by Dependence on External Finance. Top 25% vs Bottom 25%

Size Category	Bottom 25%	Bottom 25%	Top25%	Top25%
log(RResChg+1)	-2.481	0.523	-1.799**	-2.859**
	(1.787)	(2.103)	(0.872)	(1.164)
Region*Year	X		X	
State*Year		X		X
Year FE	X	X	X	X
County FE	X	X	X	X

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

This table reports the effect of reserve requirement reduction on employment growth by the level of dependence on external finance (top 25% industries vs bottom 25% industries). The regression equation is the same with Table 6. Column (1) and (3) report the specification with region*year fixed effect. Column (2) and (4) report the specification with state*year fixed effect. To be succinct, I only report coefficient before Log(RResChg+1).

Table 9: Robustness Test: Excluding 1982-1984

	(1)	(2)	(3)	(4)
Dep. Var	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)
log(RResChg+1)	-5.816***	-5.439***	-1.873*	-1.639*
	(0.924)	(0.936)	(0.986)	(0.965)
log(REmpChg+1), Lag=1				-0.166***
				(0.00601)
log(REmpChg+1), Lag=2,				-0.0854***
				(0.00567)
Log(Depo./Loan)	0.382*	0.370*	-0.343	-0.550**
	(0.209)	(0.214)	(0.233)	(0.229)
Crime Rate	-0.0668	0.262	0.848*	0.961**
	(0.413)	(0.419)	(0.448)	(0.440)
Pop. Density	-0.000138***	-0.000141***	-7.43e-05***	-8.81e-05***
	(2.30e-05)	(2.29e-05)	(2.30e-05)	(2.24e-05)
Region*Year		X		
State*Year			X	X
Year FE	X	X	X	X
County FE	X	X	X	X
Observations	24,271	24,271	24,271	24,175

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

This table reports the estimates after excluding observations between 1982-1984, as discussed in Section 6.2.1. In this period, there was a large fluctuation in employment rate due to the aggressive anti-inflationary monetary policy. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment.

Table 10: Robustness test: Excluding Northeast US and Illinois

	(1)	(2)	(3)	(4)
Dep. Var	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)
log(RResChg+1)	-2.382***	-2.254***	-1.212**	-1.253**
	(0.492)	(0.492)	(0.567)	(0.558)
log(REmpChg+1), Lag=1				-0.185***
				(0.0063)
log(REmpChg+1), Lag=2,				-0.132***
				(0.0061)
Region*Year		X		
State*Year			X	X
Year FE	X	X	X	X
County FE	X	X	X	X
Observations	24,271	24,271	24,271	24,175

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the estimates after excluding northeastern US and Illinois, which are states that have larger percentages of employment in the financial sector, as discussed in Section 6.2.2. The table confirms that the job gains due to the financial deregulation did not account for the employment changes during this period. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. To keep the output succinct, some control variables are not reported.

Table 11: Robustness Test: Only Include County-year with No New Bank Entry

	(1)	(2)	(3)	(4)
Dep. Var	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)	log(REmpChg+1)
log(RResChg+1)	-2.204***	-2.485***	-2.485***	-1.157*
	(0.591)	(0.594)	(0.594)	(0.670)
log(REmpChg+1), Lag=1				-0.197***
				(0.00726)
log(REmpChg+1), Lag=2				-0.139***
				(0.00709)
Log(Depo./Loan)	0.00941	0.0173**	0.0173**	0.00402
	(0.00818)	(0.00843)	(0.00843)	(0.00926)
Crime Rate	-1.338**	-0.692	-0.692	0.284
	(0.679)	(0.688)	(0.688)	(0.705)
Pop. Density	-3.99e-05	-1.43e-05	-1.43e-05	8.16e-05
	(7.03e-05)	(7.03e-05)	(7.03e-05)	(6.87e-05)
Region*Year		X		
State*Year			X	X
Year FE	X	X	X	X
County FE	X	X	X	X
Observations	23,913	23,913	23,913	23,808

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports estimates after excluding counties with new bank entry in that year. It addresses the concern that the employment growth might attribute to new bank entry after the deregulation, rather than reserve changes, as discussed in Section 6.2.3. Column (1) reports fixed effect model estimates. Column (2) and (3) add region*year and state*year fixed effects. Column (4) adds lag terms of employment. To keep the output succinct, some control variables are not reported.

Table 12: Robustness Check- Using Distance-weighted Reserve Change Index

	(1)	(2)	(3)	(4)
Distance	100 miles	100 miles	150 miles	150 miles
Log(RWtdResChg+1)	-3.670***	-4.117***	-7.910***	-10.21***
	(0.717)	(0.728)	(1.313)	(1.368)
Region*Year	X		X	
State*Year		X		X
Year FE	X	X	X	X
County FE	X	X	X	X
Observations	24,271	24,271	24,271	24,175

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

This table reports results after replacing the local required reserve change in the second set of regressions with an index that weights in the required reserve changes of neighboring counties defined in Section 6.2.4. This modification captures possible spillover effects from adjacent regions. For brevity, I only report coefficients of the weighted reserve change.

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