Monetary Policy, Bank Competition and Regional Credit Cycles: Evidence from a Quasi-Natural Experiment

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Abstract

This paper examines how competition in the banking sector affects the transmission of monetary policy and the variation of credit expansion across regions in the United States. Using the U.S. branching deregulation between 1994 to 2008 as an exogenous change in banks' competition, we analyze how bank competition affects monetary policy transmission through the bank lending channel. The results show that competition strengthens the impact of monetary policy on bank loan supply. We then show that states with a more deregulated banking sector were more affected by monetary conditions in the years leading to the Great Recession. Specifically, the effect of loose monetary conditions on the expansion of households' debt was stronger in states that had fewer bank branching restrictions. The results suggest that variations in the level of bank competition may have amplified regional asymmetries in the years leading to the Great Recession.

Keywords: Monetary policy, Bank competition, Deregulation, Credit cycle.

JEL Classification code: E32, E44, E52, G21, G28.

1 Introduction

Should policymakers consider bank competition when assessing monetary policy? From a policy perspective, answering this question is becoming increasingly relevant, as there is growing evidence for an increase in consolidation and a decline in the intensity of bank competition worldwide and particularly in the U.S. (Claessens 2009; Clerides, Delis, and Kokas 2015). For example, Figure 1 presents the annual average for the Lerner index and the 5-Bank concentration ratio (CR5) for the U.S. in the past two decades.[1] The figure documents the increase in consolidation and the general failure of perfect competition in the banking sector in the United States in recent years. This paper documents the importance of bank competition in the pass-through of monetary policy. Additionally, we provide evidence that heterogeneous financial markets may induce asymmetric monetary transmission and contribute to local credit booms.

The recent crisis gave way to a new macroprudential approach to regulation which focuses on mitigating financial vulnerability or systemic risk. However, nearly a decade after the landmark Dodd-Frank Act there is still a substantial debate over the proper scope and conduct of financial regulation. In the academic literature, there is an ongoing discussion over the optimal balance between monetary and macroprudential policies in achieving financial stability. Namely, is excess credit growth best counteracted by macrorprudential policy, such as loan-to-value ratios, or by "lean against the wind" monetary policy?[2] Additionally, there is still no consensus over the level (regional or national) at which macroprudential policies should be conducted. In light of these ongoing academic and public policy debates, there is an increasing need to understand the relationship between bank competition and monetary policy transmission. Specifically, if the impact of monetary policy on local financial conditions varies with the degree of local bank competition there is a stronger argument for implementing macroprudential policies which can be targeted at a local level, and a weaker argument for relying on one-size-fits-all "lean against the wind" monetary policy.

A first obvious question is, therefore: How might bank competition affect monetary policy effectiveness? The literature typically explains the connection using the "lending channel" of monetary transmission. According to the theory of the lending channel, monetary policy

[1] The Lerner index ranges between 0 and 1, where larger values are interpreted as indicating more market power (less competition). The CR5 ratio is the assets of five largest banks as a share of total commercial banking assets.

[2] See Stein (2014), Svensson (2017), and Adrian, Liang, et al. (2018) among others.

can impact the supply of credit by affecting banks' balance sheets and the cost of credit. By impacting banks' reserves, monetary policy can influence banks' access to loanable funds and thus their ability to supply credit. Banks with less access to alternative funding sources (other than deposits) will, in this case, be more sensitive to changes in monetary policy (Bernanke and Blinder 1988; Bernanke and Blinder 1992). Recent research has indicated that competition may play an important role in determining the strength of the lending channel, however theoretical considerations suggest the effect may work in opposite directions. For instance, greater competitive pressure following the removal of barriers to entry may push relatively weaker banks - i.e., those most reliant on deposit finance - out of the market, resulting in a general weakening of the bank lending channel. On the other hand, the federal funds rate influences the marginal cost of issuing new loans and one would expect lending to respond more strongly to marginal cost in relatively more competitive markets. If this channel dominates, increased competition would strengthen the bank lending channel. Furthermore, banks in more competitive environments tend to have less market power. Everything else equal, a bank with higher maker power is likely to have superior access to alternative sources of funds. Therefore, an increase in competition and corresponding decrease in market power can strengthen the lending channel.

Bank competition may also play an important role in monetary transmission through the more recently suggested "risk-taking channel". According to the risk-taking channel, monetary policy may impact banks' risk-taking behavior, specifically willingness to supply riskier loans (Borio and Zhu 2012). For example, low policy rates may induce banks to "reach for yield" and supply riskier loans to meet high expected rates of return. However, a less competitive banking system may lead to greater bank profits which will reduce incentives to engage in hazardous activities. Thus, an increase in banks' market power may also mitigate the impact of monetary policy through the risk-taking channel.

Given these conflicting channels and theoretical predictions, there is a need for clear empirical evidence about how competitive conditions in the banking sector influence monetary policy transmission. A major challenge when empirically investigating the connection between bank competition and monetary policy effectiveness is that the measurement of competition is subject to major concerns. A first popular approach is to use market concentration as the measure of market power (Adams and Amel 2011). However, there is a growing consensus that concentration measures are not good proxies for bank competition (Claessens and Laeven 2004; Clerides, Delis, and Kokas 2015). Alternatively, more recent literature follows non-structural approaches that attempt to estimate competition directly from banks' behavior, such as the

Rosse-Panzar measure, the Lerner index, and the Boone Indicator (Brissimis, Delis, and Iosifidi 2014). However, these measures are susceptible to endogeneity concerns. Carbó et al. (2009) and Clerides, Delis, and Kokas (2015) show that Lerner index movements broadly coincide with those of the business cycle. Since both the Lerner index and the outcome variable, loan growth, are procyclical, there may be a large class of omitted procyclical variables correlated with each. Potential correlation with loan demand is particularly concerning. While the Lerner index has been commonly used in the literature (e.g., Fungáčová, Solanko, and Weill 2014; Brissimis, Delis, and Iosifidi 2014), we would ideally have a proxy for bank competition that is uncorrelated with the business cycle, and which thus mitigates the potential for omitted variable bias.

To deal with this identification problem, we exploit differences in regulatory barriers to interstate branching in the U.S. between 1994 to 2008 to capture exogenous variation in states' competitive environments. The 1994 Interstate Banking and Branching Efficiency Act (IBBEA) lowered barriers to entry for out-of-state banks, thereby increasing state-level bank competition. However, the IBBEA granted states the right to keep some of the barriers that prohibited competition from out-of-state banks. Rice and Strahan (2010) uses these restrictions to construct an annual time-varying state-level deregulation index from 1994-2005. We extend the Rice-Strahan Index to 2008 following Shenoy and Williams (2017) and use it as our primary proxy for bank competition.

The link between bank competition and monetary policy transmission to the real economy is analyzed through two empirical tests. First, we use detailed U.S. bank-level data to empirically evaluate the role that bank competition plays in the transmission of monetary policy through the bank lending channel. If bank competition does indeed impact the transmission of monetary policy, then the state-level deregulation index should significantly impact the pass-through of monetary policy to the supply of credit. Second, we use aggregated state-level data to investigate the role that competition may play in amplifying aggregate monetary policy shocks. Specifically, we exploit the heterogeneity across states in the U.S. to demonstrate how the interaction between bank competition and local monetary conditions can amplify regional credit cycles.

The paper provides two main empirical findings. First, banks in deregulated states experienced a stronger lending response to monetary policy changes. This result suggests that different levels of bank competition can significantly shape the Fed's ability to slow or boost lending via the bank lending channel. The findings are robust to a broad array of sensitivity

checks, including different empirical specifications, testing for timing and trend explanations, controlling for the possibility that the results are driven by survival bias and considering alternative explanations. Second, we find that in the years leading to the Great Recession, states that had a more deregulated banking sector were more sensitive to loose monetary conditions. The results support the idea that local credit supply conditions, specifically banks' market power, could have amplified the reaction to the loose monetary conditions in the recent credit boom.

This paper makes several novel contributions. First, to the best of our knowledge, this paper is the first to use the U.S. branching deregulation as a "quasi-natural experiment" to investigate how banks' market power shapes the effectiveness of monetary policy.[3] Second, this paper attempts to explain cross-state variations in the credit buildup that preceded the recent credit boom and bust cycle. While identifying the exact forces which led to the Great Recession is beyond the scope of this paper, the results suggest that variation in deregulation and changes in banks competition across states created different credit supply conditions that resulted in different responses to the relatively loose monetary policy of the early 2000's. This, in turn, may have amplified the size of the boom-bust cycle in some regions of the United States.

From a policy perspective, this research has important implications for the debate over financial stability. The recent literature has contrasted macroprudential regulatory policy versus "lean-against-the-wind" monetary policy as potential tools for protecting against financial imbalances, such as excess credit growth. There is a further debate over what type of macroprudential policies to implement and how to implement them. The fact that monetary policy asymmetrically affects lending conditional on local banking competition, and that monetary policy may have contributed to local credit bubbles in the run up to the 2008 financial crisis, points towards a greater role for regionally targeted macroprudential policies. Overall, the results are in line with recent research that stresses the importance of accounting for the structure of the banking system when designing both monetary and regulatory policies (Corbae and Levine 2018).

This paper proceeds as follows: Section 2 reviews related literature and reports the research hypotheses. Section 3 presents the empirical specification and data sources. Sections 4 presents the empirical results and robustness tests. Section 5 documents the effect of bank competition

[3]It is important to note that this study is not the first to use the Interstate Banking and Branching Efficiency Act (IBBEA) in the U.S. as an exogenous change in banks' competition. See Section 2 for review of the literature.

on the pass-through of monetary policy at the state level. Section 6 concludes.

2 Related Literature and Research Hypotheses

Monetary policy can influence bank lending in a variety of ways. The traditional interest rate channel proposes that by increasing or decreasing rates, and thereby influencing investment and consumption decisions, policy can impact the demand for bank loans and other sources of credit. On the other hand, the broad credit channel suggests that monetary policy can also impact the supply of credit.[4] Indeed, this paper is related to an extensive body of empirical research which studies how credit market imperfections shape the transmission of monetary policy through financial intermediaries.

Traditionally, the credit channel can be divided into a balance sheet channel and a bank lending channel. The balance sheet channel is operative if monetary policy affects the net wealth (i.e. creditworthiness) of prospective borrowers and alters their access to external funds. The bank lending channel is operative if uninsured liabilities are not perfect substitutes for insurable deposits, leading banks to curtail their loan portfolio in response to a contractionary monetary policy shock.[5] Specifically, a monetary tightening may decrease a bank's reserves and insured deposits. If this decrease in loanable funds cannot be costlessly replaced by uninsured sources of funding (e.g. large C.D.'s, new equity, etc.) then banks may draw down their loan portfolios in response. More recently, a distinct risk-taking channel of monetary policy has been identified whereby monetary policy not only affects the supply of loans, but also the risk characteristics of a bank's loan portfolio.

A key implication of the bank lending channel is that banks are not equally dependent on deposit financing. The sensitivity of loan supply to deposits depends on certain bank characteristics. Relevant characteristics established by the empirical literature include size (Kashyap and Stein 1995; Kashyap and Stein 2000), liquidity (Kashyap and Stein 2000; Gambacorta 2005), and capitalization (Gambacorta 2005; Kishan and Opiela 2006). Accordingly, loan supply is thought to be less dependent on deposit financing (and therefore less sensitive to monetary policy) for bigger banks, banks with a higher proportion of liquid assets, and better capitalized banks. A fourth characteristic which has gained increasing attention in recent years is a bank's

[4] See Bernanke and Gertler 1995 for an overview of the credit channel.

[5] Reviewing the full spectrum of research on banks' role in the transmission of monetary policy is beyond the scope of this paper. See Beck, Colciago, and Pfajfar (2014) for an excellent review.

competitive environment.

The previous literature has highlighted opposing channels through which competition could influence the lending channel. First, in a more competitive environment with fewer barriers to expansion, the weakest banks may be pushed out of the market. Relatively under-performing banks find it more difficult and more expensive to access external funding. Thus, if these banks are pushed out of the market by superior competitors with greater access to non-deposit finance, the overall lending channel may be weakened. Drechsler, Savov, and Schnabl (2017) propose a theoretical model where banks with greater deposit pricing power experience a larger outflow of deposits in the wake of a monetary tightening, and consequently a larger contraction in lending. According to this mechanism, an increase in competition which decreases power over deposit pricing will weaken the effect of monetary policy on loan supply.

On the other hand, the monetary policy rate can be viewed as a determinant of the marginal cost of loan production. Lending should respond more strongly to changes in marginal cost in relatively more competitive markets. Indeed, Corbae and Levine (2018) develop a model where thinner profit margins engendered by greater competition intensify the bank balance sheet response to monetary policy. Furthermore, banks in more competitive states have lower market power on average. Market power can increase access to alternative sources of funds (for example, banks with greater market power may be able to more cheaply raise funds through issuing large CD's). To the degree that greater competition reduces market power, banks may become more reliant on deposit finance, resulting in a strengthening of the lending channel.

Finally, changes in the competitive environment can have opposing effects on the "risk-taking" channel. Hellmann, Murdock, and Stiglitz (2000) and Repullo (2004) develop models where greater competitive pressure erodes the ability of banks to capture rents. If banks seek to maintain a fixed level of profitability the erosion of rents may incentive banks to issue a larger quantity of riskier loans, particularly in low interest rate environments. Boyd and De Nicolo (2005) argue for the existence of an opposing mechanism where greater competition leads to lower loan rates, lower probabilities of bankruptcy, and less risky lending. This study will not explicitly examine the risk characteristics of bank portfolios, however to the degree that banks adjust their loan supply when "reaching for yield", a strengthening or weakening of the "risk-taking" channel due to competition could manifest itself through an altered sensitivity of loan supply to monetary policy.

The literature provides not only contradictory theoretical mechanisms, but also contradictory empirical evidence regarding the effect of bank competition on the transmission of mone-

tary policy. For example, Adams and Amel (2011) use county-level U.S. data to demonstrate a negative relationship between banking sector concentration and monetary policy effectiveness. Brissimis, Delis, and Iosifidi (2014) also present evidence that bank competition amplifies the bank lending channel using bank-level data from the U.S. and the Euro area.[6] Drechsler, Savov, and Schnabl (2017) on the other hand show that banks located in more concentrated regions in the U.S. increase deposits spreads more following changes in the Fed funds rate which induces a higher outflow of deposits and stronger contraction of bank lending. Evidence that increased competition weakens the response of lending to monetary policy was also found by Amidu and Wolfe (2013) for a panel of 978 banks from 55 countries and by Olivero, Li, and Jeon (2011a) for a panel of Asian and Latin American countries. Finally, mixed results on the connection between banks' market power and monetary transmission are found by Yang and Shao (2016) and Khan, Ahmad, and Gee (2016) using data from Asian and Latin American countries. These conflicting results, both theoretical and empirical, imply two opposing hypotheses for the effects of increased competition on monetary transmission:

Hypothesis I (H1a): Increased bank competition *strengthens* the impact of monetary policy through the bank lending channel.
Alternative Hypothesis I (H1b): Increased bank competition *weakens* the impact of monetary policy through the bank lending channel.

A major contribution of this paper is to test these conflicting hypotheses for recent U.S. history using changes in geographical branch banking restrictions to measure exogenous variation in banking sector competition.

This paper is also related to the literature which studies the effects of the financial deregulation process in the U.S., specifically the deregulation of restrictions on banks geographic expansion.[7] The literature examines two distinct waves of banking deregulation. The first group of papers focuses on the economic consequences of the deregulation process between 1970 to 1994. For example, these papers have examined the connection between deregulation and economic growth (Jayaratne and Strahan 1996), economic volatility (Morgan, Rime, and Strahan 2004), income inequality (Beck, Levine, and Levkov 2010), investment efficiency

[6]Similar results are found by Leroy (2014) and Fungáčová, Solanko, and Weill (2014) for the Euro area.
[7]See Kroszner and Strahan (2014) for an excellent historical review.

(Acharya, Imbs, and Sturgess 2010), innovation (Chava et al. 2013), bank valuations (Goetz, Laeven, and Levine 2013), employment (Boustanifar 2014), and monetary policy effectiveness (Lakdawala, Minetti, and Schaffer 2018). This paper is more closely related to another growing group of papers, which follow Rice and Strahan (2010) and use differences in state openness to interstate branching after the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) in 1994 as an exogenous measure for banks' competition (Krishnan, Nandy, and Puri 2014; Cornaggia et al. 2015; Favara and Imbs 2015; Celerier and Matray 2016; Biswas, Gómez, and Zhai 2017; Chu 2017; Keil and Müller 2017; Marsh and Sengupta 2017; Shenoy and Williams 2017; Berger, Öztekin, and Roman 2018).

This paper is also related to the literature which uses cross-sectional regional variation in the U.S. to examine the fundamental mechanisms which led to the Great Recession (Mian and Sufi 2009; Mian and Sufi 2010b; Goetz and Gozzi 2010; Mian and Sufi 2011; Liebersohn 2017). Recent literature has used the regional variation to explore the link between monetary policy and credit booms (Cooper, Luengo-Prado, and Olivei 2016; Albuquerque et al. 2017). A number of studies point to overly accommodative monetary conditions as playing an important role in credit booms and exceptional leveraging by households (Taylor 2009; Jordà, Schularick, and Taylor 2015). To the extent that monetary conditions were indeed too loose in the years leading to the crisis, the long process of deregulation in the banking sector may have magnified the effect of the monetary shock. This paper, therefore, contributes to this literature by investigating how changes in local bank competition contributed to the differences in regional credit booms by affecting the local reaction to loose monetary conditions. Indeed, we test a key aggregate implication of Hypothesis 1 (H1a): other things being equal, the connection between regional credit booms and loose monetary policy in the run up to the recent crisis was more pronounced in states with a more deregulated, and therefore more competitive, banking sector.

3 Methodology and Data

This section first explains the measure of bank competition used in this study. It then discusses the empirical methodology and data sources.

3.1 Measuring Banks' Competition

Empirical research on credit supply responses to monetary policy and bank competition typically uses structural and non-structural measures to infer the level of bank competition.[8] Recent research has suggested that the structural measures offer a poor gauge of actual competitive conditions, given that they rely on the assumption of a constant inverse relationship between concentration and competition, which in reality may not always hold. As an alternative, many studies implement a non-structural measure, with the Lerner index in particular being a popular option. The advantage of the Lerner index is that it can be calculated at the obervation-level (e.g., bank-year) and has a direct interpretation, as it reflects the pricing power of a bank. However, recent research has documented procyclical behavior in the Lerner index. For example, (Clerides, Delis, and Kokas 2015) show that Lerner index movements broadly coincide with those of the business cycle, suggesting that the index may not be treated as exogenous to market conditions. In particular, one may be concerned that because the outcome variable, loan growth, is also procyclical, there may be a large category of omitted procyclical variables correlated with each. Given that we're aiming to identify the impact of competition on the bank lending channel, potential correlation between the Lerner index and loan demand is particularly concerning. Thus, using the Lerner index as a proxy for competition raises concerns over omitted variable bias.

To deal with the issue, we exploit the introduction of the Interstate Banking and Branching Efficiency Act (IBBEA) in the U.S. as an exogenous change to banks' competitive environments. The IBBEA relaxed geographical restrictions on bank expansion across state borders and enabled banks to enter into new markets in other states thereby increasing the level of bank competition in the deregulated states. While the IBBEA eliminated the geographical limitation faced by banks, it gave states considerable decision-making power over the time and manner in which it was implemented. Following Rice and Strahan (2010), we use the timing of the deregulation in each state to proxy for state-level banking competition. Specifically, our proxy is Rice and Strahan's restriction on interstate branching index ($RSindex$). Their index runs from 1994 to 2005 and takes values between zero and four. They set the index to zero for states with no restrictions and add 1 for each type of the following restrictions: minimum age of

[8] The most popular structural measures are the five-bank concentration ratio (CR5) and the Herfindahl-Hirschman Index (HHI), while the non-structural approach includes the Boone Indicator, the Lerner Index, and the Panzar-Rosse measure. See Clerides, Delis, and Kokas (2015) for a review on the different measures.

the target institution, de novo interstate branching, allowance of the acquisition of individual branches, and statewide deposit cap on branch acquisitions. We extend Rice and Strahan's (2010) original index to 2008 using the updated index of Shenoy and Williams (2017). We follow Favara and Imbs (2015) and reverse the index so that high values refer to deregulated states.[9]

To deal with the fact that some banks operate in more than one state, our primary measure of competition is a bank-level weighted *RSindex*, where the weights are based on the proportions of bank deposits in each state in which the bank operates.[10] As an alternative specification we restrict the sample to only banks that operate in a single state and use the state-level *RSindex* as the proxy of bank competition. Results across all specifications and robustness tests are consistent between these two identification strategies.[11]

Using the *RSindex* as an exogenous proxy for bank competition builds on three key assumptions. First, every state is assumed fully restricted in 1994. Rice and Strahan (2010) claim that while a limited number of states permitted some form of interstate branching before 1994, this option was hardly ever exercised. This assumption is supported by Figure 2 which shows that from 1994 until 2008 the number of multistate banks rose from 8 to 402 and the number of branches of out-of-state banks (interstate branches) rose from only 2,135 to more than 40,000. Second, the identification builds on the assumption that state-level deregulation was exogenous to the business cycle. This assumption is supported by an extensive body of research which provides evidence that interstate bank deregulation was exogenous to local bank structure or local economic conditions (Jayaratne and Strahan 1996; Jayaratne and Strahan 1998; Kroszner and Strahan 2014; Goetz, Laeven, and Levine 2013; Goetz, Laeven, and Levine 2016).

Third, it is assumed that the geographical deregulation significantly *increased* competition in the banking sector (Dick 2006; Kroszner and Strahan 2014). This assumption is in line with a growing number of studies that use the passage of the IBBEA to test how exogenous shocks to banks' competition affect firm financing (Rice and Strahan 2010; Francis, Ren, and Wu 2017), firm innovation (Cornaggia et al. 2015), bank lines of credit (Shenoy and Williams 2017), bank fragility (Marsh and Sengupta 2017), and bank capital structure (Berger, Öztekin,

[9] See Table 1 in Rice and Strahan (2010) or Table 1 in Krishnan, Nandy, and Puri (2014) for the deregulation date, restrictions type and restriction index for each state.

[10] Branch level deposit data from the Summary of Deposits (SoD) are used for weights.

[11] To conserve space, the results for the single state banks are reported in the Online Appendix.

and Roman 2018). Figure 3 presents additional support for the claim that bank branching deregulation is a good proxy for bank competition. The figure shows a negative relationship between branching deregulation and a measure of the state level Lerner index, suggesting that branching deregulation increased banking competition. Thus, despite the decline in competition depicted in Figure 1, implementation of the IBBEA increased competition and partially offset the overall trend.

One drawback of using the *RSindex* as a measure of bank competition is that, in addition to impacting competitive conditions, branching deregulation also influenced other aspects of the banking sector. For instance, Goetz, Laeven, and Levine (2016) find that geographic bank expansion reduced risk. It is therefore possible that branching deregulation influenced the potency of monetary policy through some alternative mechanism, e.g., if healthier risk profiles allowed banks to increase leverage.[12] In Section 4.3 we investigate, and find no evidence for a variety of alternative mechanisms. Indeed, we find consistent support for our main results when replacing the *RSindex* with alternative measures of competition.

3.2 Empirical specification

We start from a standard specification for studying the effects of monetary policy on bank lending growth with individual bank balance sheet data:[13]

$$\Delta \ln (loans)_{i,j,t} = \alpha_i + \beta_1 \Delta MP_t + \beta_2 X_{i,t-1} + \beta_3 Z_{j,t} + \beta_4 \Delta MP_t * X_{i,t-1} + \gamma Time_t + \varepsilon_{i,j,t} \tag{1}$$

where $\Delta \ln (loans)_{i,j,t}$ is the annual growth rate of loans in period t of bank i headquartered in state j. MP is the monetary policy stance, $X_{i,t-1}$ is a vector of bank-specific controls and $Z_{j,t}$ is a vector of state-specific macroeconomic control. In order to asses if the effect of monetary policy on lending changes under different levels of bank competition, i.e., to test Hypothesis I, we modify Eq. (1) by adding the extended Rice and Strahan (2010) deregulation index ($RSindex$) to the specification:

[12] The literature suggests leverage tends to increase sensitivity to monetary policy, see (Bernanke, Gertler, and Gilchrist 1999), (Gertler, Kiyotaki, et al. 2010), (Cúrdia and Woodford 2016), (Rubio and Carrasco-Gallego 2016).

[13] The baseline model builds on existing papers that study monetary policy effectiveness using annual bank-level data. A nonexhaustive list includes Altunbaş, Fazylov, and Molyneux (2002), Gambacorta (2005), Ashcraft (2006), Delis and Kouretas (2011), Leroy (2014), Brissimis, Delis, and Iosifidi (2014), and Borio and Gambacorta (2017).

$$\Delta \ln (loans)_{i,j,t} = \alpha_i + \beta_1 \Delta MP_t + \beta_2 RSindex_{j,t} + \beta_3 \Delta MP_t * RSindex_{j,t} + \beta_4 X_{i,t-1} + \beta_5 Z_{j,t} + \beta_6 \Delta MP_t * X_{i,t-1} + \gamma Time_t + \varepsilon_{i,j,t} \quad (2)$$

RSindex is interacted with the changes in the policy variable to investigate the marginal effect of policy on loan growth following branching deregulation. We use two measures of monetary policy changes.[14] The first is the level change of the average effective federal funds rate (FFR) between year t and $t-1$. While there is no consensus as to the best indicator of monetary policy stance, most studies use short-term market interest rates, such as the FFR to measure policy action. A problem with using the FFR is that it is likely to be endogenous to the U.S. macroeconomic conditions which can also affect the supply of credit by banks. Additionally, it does not account for the expected components of monetary policy which may already be reflected in banks decision to supply credit before the actual policy change. To overcome these issues, we also use the Romer and Romer (2004) measure of the exogenous component of monetary policy.[15]

The key variable of interest in Eq. (2) is β_3, the coefficient of the interaction between the measure of monetary policy and the state level regulation dummy. Significant levels of β_3 indicate that holding all else equal, banks located in deregulated states react differently to monetary policy (in terms of change in the supply of credit) relative to banks located in regulated states. To the extent that the *RSindex* is indeed a good proxy for bank competition, a significant coefficient on the interaction term with the policy variable will indicate that bank competition affects the transmission of monetary policy.[16] Higher values for the *RSindex* represent a greater degree of competition. Therefore, a negative β_3 would provide evidence in favor of Hypothesis HIa, indicating a stronger response of loan supply to monetary policy for banks operating in more competitive environments. In contrast, a positive β_3 provides support for Hypothesis HIb, indicating that competition dampens the response of loan supply to monetary policy.

[14] As a third policy measure we also test the results using Taylor rule residuals. Results are in line with the two other measures and are reported in the Online Appendix to conserve space.

[15] We obtained the Romer and Romer (2004) measure from Barakchian and Crowe (2010) who extend the measure through 2008. We thank Barakchian and Crowe for making the measure available. For each year, we sum the monthly shocks to obtain an annual measure. As common in the literature, the Romer and Romer shock is lagged one period.

[16] Section 4.3 provides evidence supporting our interpretation of the *RSindex* as a good proxy for bank competition.

We include a wide range of controls in Eq. (2). The vector of bank-specific controls, $X_{i,t-1}$, includes banks' size, liquidity, and capitalization. Adding these variables builds on previous studies which documented that bank-specific characteristics may influence the effectiveness of monetary policy.[17] Size is measured by the log of total assets, liquidity is defined as the ratio of liquid assets to total assets, and capitalization is given by the ratio of bank capital to total assets. Bank-specific characteristics are lagged one period to reduce endogeneity concerns. Following Ashcraft (2006) and Altunbas, Gambacorta, and Marques-Ibanez (2009), we also add interactions between the monetary policy shock and bank characteristics. All banks are analyzed on the charter bank and not on the bank holding company level. Ashcraft (2006) shows that banks that are affiliated with a bank holding company are less sensitive to changes in monetary policy relative to unaffiliated banks. Thus, we also add a dummy variable equal to one if the bank is affiliated with a bank holding company. We also add state-specific macroeconomic variables to control for cross-sectional differences in demand between states. Following Favara and Imbs (2015), the vector of state-specific macroeconomic control, $Z_{j,t}$, includes the state level log change in income per capita, unemployment and house prices.[18] The model is estimated with bank-specific fixed effects, α_j, to control for any time-invariant bank-specific factors that are not accounted for by the control variables, and a linear time trend, $Time_t$, to control for the general change in banks' lending behavior over the sample period. For robustness, we alternatively consider time fixed effects, α_t, instead of the time trend to control for time-varying factors that are common to all banks. Since monetary policy is conducted on the national level, avoiding perfect multicollinearity requires dropping the standalone monetary policy variable in the specifications with the time fixed effects.

3.3 Data and variable construction

We use annual bank-level data from the Federal Reserve's Report of Condition and Income (Call Reports), made available from Wharton Research Data Services (WRDS). We focus on FDIC-insured (rssd9424 = 1, 2, 6 or 7) commercial banks (rssd9048 = 200) since branching deregulation only covered depository institutions and within depository institutions themselves, only federal and state-chartered commercial banks (Favara and Imbs 2015).

We follow Ashcraft and Campello (2007) and exclude any bank-year observation where the

[17] See for example Kashyap and Stein (2000) and Kishan and Opiela (2006), among many others.

[18] See Appendix B for variable construction and definitions.

bank was involved in a merger.[19] Additionally, we use only banks with positive values for total assets and loans and eliminate any bank-year observation with loan-growth exceeding five standard deviations from the annual mean. Finally, we limit the sample to banks that have at least two consecutive years of data. Banks are identified as part of a holding company using the bank's topmost BHC identity (rssd9348). Details about the formation of all bank level variable using the Call Reports data are given in Appendix B.

We link the bank-specific information with state-level macroeconomic information obtained from a number of sources: state-level unemployment from the Bureau of Labor Statistics (BLS), state-level house price index from the Federal Housing Finance Agency (FHFA), per capita income from Bureau of Economic Analysis (BEA), and state-level per capita total debt balance from NYFED Center for Microeconomic Data. The full sample includes 9,721 banks with a total of 110,822 bank-year observations over the period of 1994-2008. Descriptive statistics for the main variables used in the estimation are presented in Table 2.

4 Empirical results

In this section we present the results for the baseline empirical specification. we then provide a number of robustness tests.

4.1 Main results

Table 3 presents the results of the baseline estimation. Columns 1 through 3 display the results when using changes in the FFR as the measure of monetary policy and columns 4 through 6 display the results when using the Romer & Romer measure. Columns 1 and 4 present the results of the estimation without the deregulation index. The response of bank lending to monetary policy shocks as well as the various control variables are in line with the literature on banking and monetary policy, suggesting that Eq. (1) is a valid benchmark. The other columns present the results with the *RSindex* where columns 3 and 6 also include time fixed effects instead of the linear trend.

The coefficient on the interaction between monetary policy and deregulation is statistically significant and negative across all specifications. The negative coefficient indicates that after the branching deregulation, banks display more contraction in loan supply following a contrac-

[19] To identify mergers and acquisitions we use the most recent merger file from the Federal Reserve Bank of Chicago.

tionary monetary shock. For example, from column 2 we see that a 100 basis point change in the FFR induces banks to change the supply of loans by around 12 basis points **more** in less restricted states (higher $RSindex$). Since a higher value for the $RSindex$ indicates an increase in competition, the negative regression coefficient indicates that banks in more competitive markets tend to adjust their loan supply more following a monetary shock. These results are consistent with the empirical dominance of Hypothesis H1a over H1b. That is, banks in more competitive environments are more sensitive to changes in the policy rate.

Section 2 outlines three potential mechanisms driving this result: loan production responding more strongly to changes in marginal cost in more competitive markets, a reduction in bank market power increasing the cost of non-deposit funding, and a reduction in rents incentivizing banks to "reach-for-yield." Given the limitations of the data it is not possible to decompose the contribution of each mechanism. However, our results provide support for new theoretical work along the lines of Corbae and Levine (2018) which explicitly accounts for the role of bank competition in shaping monetary transmission.

Next, we examine the dynamic impact of the increase in competition on monetary effectiveness. Specifically, we re-estimate Eq. (2) and replace the $RSindex$ with a series of dummy variables which indicate three years before to four years after the year any state banking deregulation was first implemented:

$$\Delta \ln (loans)_{i,j,t} = \alpha_i + \alpha_t + \sum_{k=-3}^{4} \beta_{1,k} D_{j,t}^{k} + \sum_{k=-3}^{4} \beta_{2,k} \Delta MP_t * D_{j,t}^{k} + \beta_3 X_{i,t-1} + \beta_4 Z_{j,t} + \beta_5 \Delta MP_t * X_{i,t-1} + \varepsilon_{i,j,t} \quad (3)$$

where $\sum_{k=-3}^{4} D_{j,t}^{k}$ is equal to one in the k^{th} year before or after the deregulation and zero otherwise. Monetary policy is measured using the Romer & Romer shocks.[20] The other control variables are the same as in Eq. (2) including bank and year fixed effects.

The year-by-year effect of the branching deregulation is presented in the dynamic path shown in Figure 4. The figure illustrates two important points. First, all of the coefficients before the year of the deregulation are not significantly different from zero. The insignificant coefficients before the deregulation suggest that there was no preexisting trend in monetary policy effectiveness which reduces the concern of reverse causality. If the timing of the deregula-

[20] The results are similar but less persistent when using the FFR instead of the Romer & Romer measure and are available upon request.

tion in each state was caused by a change in monetary policy effectiveness, then the coefficients estimated on the pre-deregulation dummy variables should be statistically significant. Second, monetary policy effectiveness increases after the deregulation and becomes significant at the 5 percent level two years after the deregulation was completed. The negative coefficients remain statistically significant at least three years after the deregulation.[21] This suggests a significant and persistent increase in banks' reaction to monetary changes following an increase in competition.

4.2 Robustness checks

In this section, we present a number of robustness tests to the baseline empirical specification.

4.2.1 Adding lagged dependent variable

A first concern with the baseline specification is that banks' loan growth may have a considerable degree of persistence. To account for the possible effect of past lending, we re-estimate Eq. (2) as a dynamic panel by adding a lagged dependent variable as an additional control:

$$\Delta \ln (loans)_{i,j,t} = \alpha_i + \beta_0 \Delta \ln (loans)_{i,j,t-1} + \beta_1 \Delta MP_t + \beta_2 RSindex_{j,t} + \beta_3 \Delta MP_t * RSindex_{j,t} + \beta_4 X_{i,t-1} + \beta_5 Z_{j,t} + \beta_6 \Delta MP_t * X_{i,t-1} + \gamma Time_t + \varepsilon_{i,j,t} \quad (4)$$

Eq. (4) cannot be estimated using an OLS fixed-effects estimator, since the lagged dependent variable can cause biased estimation.[22] In line with previous studies that use a dynamic panel model, Eq. (4) is estimated using the general method of moments (GMM) estimation strategy of Arellano and Bond (1991). This methodology removes time-invariant bank fixed effects and accounts for the possibly endogenous right-hand side variables by using lagged endogenous variables as instruments. As instruments, we use the second lag of the dependent variable and employ the two-step procedure with robust standard errors using the Windmeijer finite sample correction. To ensure efficiency and consistency of the model we check that it is not subject to serial correlation of order two using the Arellano-Bond test for second-order serial correlation.

[21] The timing of the deregulation is between $t = 0$ to $t = 1$, depending on the state.

[22] Known as the Nickell bias (Nickell 1981).

Table 4 presents the results for estimating Eq. (4). The interaction term between monetary policy and the *RSindex* are negative and statistically different from zero through all the specifications, confirming the baseline results. The significance of the coefficients on the lagged dependent variables suggests that bank lending is affected by past lending. In all the specifications, the AR(1) and AR(2) statistics have p-values of 0.00 and greater than 0.10, respectively. This implies that we cannot reject the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation, but we can for the first-order, as required by the specification.

4.2.2 Evidence using quarterly data

We conduct our main analysis with annual data in accordance with the annual frequency of the Rice-Strahan index and for the sake of consistency with the prior literature on competition and the bank lending channel.[23] Furthermore, a number of papers in the lending channel literature, including Gambacorta (2005), Ashcraft (2006), and Delis and Kouretas (2011), find little difference in results whether using annual or quarterly data. Nevertheless, a potential criticism of our analysis is that annual data may be insufficient to properly identify the sensitivity of bank lending to monetary policy.

To assuage these concerns we consider a variation of equation 2 at a quarterly frequency. Consistent with prior studies (e.g., Kashyap and Stein (2000)) we estimate the following dynamic panel model:[24]

$$\begin{aligned}\Delta \ln (loans)_{i,j,t} = \alpha_i &+ \sum_{k=1}^{4} \beta_{0,k} \Delta \ln (loans)_{i,j,t-k} + \sum_{k=0}^{4} \beta_{1,k} \Delta MP_{t-k} + \beta_2 RSindex_{j,t} \\ &+ \sum_{k=0}^{4} \beta_{3,k} \Delta MP_{t-k} * RSindex_{j,t} + \beta_4 X_{i,t-1} + \sum_{k=0}^{4} \beta_{5,k} Z_{j,t-k} \\ &+ \sum_{k=0}^{4} \beta_{6,k} \Delta MP_{t-k} * X_{i,t-1} + \gamma Time_t + \varepsilon_{i,j,t} \end{aligned} \tag{5}$$

[23] The majority of prior studies on this topic including Adams and Amel (2011), Olivero, Li, and Jeon (2011a), Olivero, Li, and Jeon (2011b), Amidu and Wolfe (2013), Fungáčová, Solanko, and Weill (2014), and Brissimis, Delis, and Iosifidi (2014) are all at an annual frequency.

[24] With a time dimension of 60 quarters, Nickell bias resulting from the inclusion of lagged dependent variables is no longer a concern.

Results are reported in Table 5. The coefficient estimates for the interaction between monetary policy and the *RSindex* are very similar to those in Table 3 in both magnitude and statistical significance, confirming that the main results are not driven by choice of data frequency.[25]

4.2.3 Pre-existing trend

Kroszner and Strahan (1999) argue that state-level characteristics could have affected the timing of deregulation across states. Therefore, it is possible that reverse causality or an omitted variable drive the results. That is, differences in banks' reaction to monetary policy across states may have influenced policymakers' decisions when setting levels of branching regulation. As noted in Section 3.1, one of the central assumptions of the identification strategy is that for every state, the timing of the deregulation was exogenous. That is, banks did not change their behavior in anticipation of deregulation, and states did not consider an increase in bank competition or monetary policy effectiveness when choosing when to implement the branching deregulation.

While the dynamic impact of the deregulation presented in Figure 4 reduces these reverse causality concerns, we further rule out timing and trend explanations by following Krishnan, Nandy, and Puri (2014), and adding a dummy variable to Eq. (2) associated with four periods before the deregulation year. The *Before Dummy* equals one if the year is within four years before the interstate bank branching deregulation and zero otherwise. If reverse causality is present, we should find a statistically significant coefficient for the *Before Dummy* and its interaction with monetary policy which will indicate changes in monetary policy effectiveness before the deregulation took place.

Table 6 presents the results of estimating the baseline model with the *Before Dummy* variable. The coefficient of the *Before Dummy* in all the specifications and the interaction with monetary policy is insignificant in all but one specification. This non-result suggests that trends in loan supply and monetary policy effectiveness do not reverse-cause branching deregulation.

4.2.4 Survival bias

We also consider the possibility that sample selection bias in the form of survival bias can affect the results. As noted by Kroszner and Strahan (2014), survivorship biases are of particular

[25] We have estimated all tests in this paper with quarterly data. The results are similar in every case. Additional quarterly results are available upon request.

concern in studies that deal with financial deregulation, since the increase in competition following the deregulation increases the probability that only banks with specific characteristics will survive the changes. These characteristics can then be the source of the observed results and not the increased competition.

To deal with this possible bias, we again follow Krishnan, Nandy, and Puri (2014) and estimate the model by using only the banks that survived the deregulation. If this specific group of banks drives the baseline results, the effect should disappear when we estimate the model using only those banks in the sample. The new sample reduces the number of banks to 5,611 and the number of bank-year observations to 81,619.

Table 7 presents the results using the sample of banks where we exclude all banks that disappear before the end of the sample period. The columns correspond to the specifications in Table 3 regarding the measure of monetary policy and time fixed effect. The interaction between changes in monetary policy and the *RSindex* continues to be negative and significant, suggesting that survival bias is not a big issue in the sample.

4.2.5 Additional robustness tests

In this subsection we summarize the results from several additional robustness tests. The full results are reported in the Online Appendix. First, the effect of competition on the responsiveness of lending to monetary policy is stronger and more significant for small banks, consistent with the large body of work on the bank lending channel. Second, accounting for the stage of the business cycle does not alter the results. Specifically, the coefficient on a triple interaction between monetary policy, the *RSindex* and a recession dummy is positive but statistically insignificant, indicating that the effect of competition on the lending channel is similar in both expansions and contractions. Finally, we examine the impact of competition on the sensitivity of different loan categories (commercial and industrial (C&I) loans, real estate loans and consumer loans) to monetary policy. Results for C&I loans and real estate loans are consistent with the main findings and insignificant for consumer (personal) loans. C&I and real estate lending makes up roughly 65% of total loans over the sample, providing further evidence that competition has an important influence on the general potency of the lending channel. On the other hand, the insignificant result for consumer loans could be driven by the relative stickiness of consumer loan rates (Den Haan, Sumner, and Yamashiro 2007).

4.3 Alternative interpretations

As discussed in Section 3.1, the major drawback of using the *RSindex* as our primary measure of competition is that interstate branching deregulation impacted other features of the banking sector besides competition. Thus, it is possible that the greater sensitivity of lending to monetary policy for banks in more deregulated states is driven by some other mechanism, rather than by changes in the competitive environment. For example, branching deregulation which allowed banks to cross state lines led to higher profitability and lower risk (Goetz, Laeven, and Levine 2016). This, in turn, may have led to lower funding costs and an increase in banks' reliance on wholesale funding and leverage (Levine, Lin, and Xie 2016; Aguirregabiria, Clark, and Wang 2016). The effectiveness of monetary policy may then increase since more leveraged banks tend to be more sensitive to policy changes (Bernanke, Gertler, and Gilchrist 1999; Gertler, Kiyotaki, et al. 2010; Cúrdia and Woodford 2016; Rubio and Carrasco-Gallego 2016). Also, deregulation created a broader market in which technologies could be utilized which promoted financial innovation, including the process of loan securitization (Rajan 2005). Aysun and Hepp (2011) show that the monetary policy mainly operates through banks that securitize some of their assets. Evanoff and Ors (2008) and Chortareas, Kapetanios, and Ventouri (2016) provide evidence that deregulation increased bank efficiency. The greater responsiveness of lending to monetary policy may therefore be driven by efficiency rather than competition. In this section we investigate whether the main results are truly driven by competition or instead by one of these alternative channels.

4.3.1 Alternative measure of competition

If the *RSindex* is influencing the sensitivity of lending to monetary policy through competition, we would expect to find similar results when using alternative proxies for competition. We therefore re-estimate the main specification with the structural and non-structural competition measures frequently studied in the literature. Specifically, we use two variations of the Lerner index (state-level and bank-level) as well as a county-level branch deposit based Herfindahl Hirschman Index (HHI).[26]

As discussed in Section 3.1, each of these measures has flaws which motivate the adoption

[26]Details on the construction of the Lerner index are presented in Appendix A.1. We construct two versions, one at the state-level and one at the bank-level. HHI is the sum of squared county-level deposit shares. The HHI for each bank is then constructed as a weighed average based on branch deposit share.

of the *RSindex* as our preferred proxy for competition. For instance, the procyclicality of the Lerner index raises concerns over omitted variable bias, although these concerns can be mitigated to some degree by including the index at one lag. On the other hand, the main concern for the HHI is that interpreting it as a proxy for competition relies on the questionable assumption of an inverse relationship between concentration and competition. While the *RSindex*, Lerner index, and HHI all have imperfections, it is important to emphasize that they are *unique* imperfections. That is to say, the weaknesses of each measure are unique and unrelated to the weaknesses of the others. A consistent pattern of results across all three measures would therefore provide robust evidence that we have indeed identified the effect of competition on the lending channel.

Equation 2 is estimated with the three alternative measures of competition, with results reported in Table 8. A higher value of the Lerner index or HHI represents a higher level of market power or concentration, respectively. Thus, for these results to be consistent with Table 3 we would expect a positive and statsistically significant coefficient on the interaction between monetary policy and the alternative competition measures. This pattern holds for the majority of Table 8. Specifically, Panel A shows that lending is less responsive to monetary policy for banks located in states with a higher Lerner index, i.e. states where banks have greater market power and are less competitive. The results are similar in Panel B, as columns (1) and (2) report that bank-specific market power significantly weakens the response of lending to monetary policy. Finally, Panel C shows that lending is less responsive to monetary policy for banks operating in more highly concentrated counties. To summarize, across a variety of measures we consistently find that higher levels of competition in the banking sector strengthens the response of lending to monetary policy.

4.3.2 Alternative channels

The results in Table 8 indicate that the effect of the *RSindex* on the lending response to monetary policy is indeed driven by competition. To provide additional support for this interpretation, we next explicitly control for other banking sector characteristics which were impacted by interstate branching deregulation. There is evidence that deregulation increased profitability, decreased risk, increased efficiency, and increased loan securitization. It is therefore possible that lending became more sensitive to monetary policy for banks in less regulated states, not because of greater competition, but instead due to higher profitability, lower risk,

greater efficiency, or greater securitization.

To test for the influence of these alternative channels we re-estimate the main specification while including a proxy for each, along with the proxy's interaction with monetary policy. Profitability is measured by return on assets (ROA), risk is captured by the non-performing loan ratio, efficiency is measured via the cost efficiency ratio, and securitization is the ratio of securitized loans to total loans.[27] Results are reported in Table 9. In all four cases, monetary policy has a larger impact on lending in states with a higher *RSindex*, with magnitudes very similar to those reported in Table 3. The interactions between monetary policy and each of the four alternative variables are statistically insignificant across every specification, indicating that the response of lending to monetary policy is not dependent on profitability, risk, efficiency, or securitization. More importantly, the results indicate that the effect of the *RSindex* on the relationship between lending and monetary policy is not being driven by one of these alternative channels, providing further support for the interpretation of the *RSindex* as operating through bank competition.

4.3.3 State specific time trend

Our main specification controls for state-level macroeconomic variables and includes bank fixed effects, which will absorb any time-invariant state-specific characteristics for banks which are headquartered in the same state from 1994-2008 (the vast majority of the sample). However, one may be concerned that other changes in the state-level regulatory or economic environment could be influencing the main results. To more precisely control for potential differential trends, we include state-specific time trends in our main specification with results reported in Table 10. The coefficients on the interaction between monetary policy and the *RSindex* are virtually unchanged from those in Table 3.

5 Aggregate Effects

The results from the previous section provide robust evidence that the lending reaction of an individual bank to monetary policy shocks increases in more competitive environments. The bank-level results therefore support Hypothesis HIa. In this section, we examine a key

[27] Specifically, return on assets is net income over total assets, non-performing loan ratio is loans past 90 days due or in nonaccrual over total loans, cost efficiency ratio is non-interest expenses over revenue, and securitization is the outstanding principal balance of loans sold and securitized over total loans.

aggregate implication of the hypothesis. Specifically, we use the variation in credit cycle across states in the U.S. to demonstrate how the interaction between banks' market power and local monetary conditions can amplify regional credit cycles.

The recent crisis in the U.S. was characterized by significant variations in the magnitude of the boom-bust cycle across states. These regional variations are documented in Figure 5. Panel A plots the time series of debt-to-income and debt per capita for the U.S. in the years leading to and following the crisis. Panel B, on the other hand, plots the same two credit measures for each state separately.[28] The figures show the significant differences in the size of the boom-bust cycle across states. A large body of empirical literature uses these regional variations to study how household leverage and local financial conditions can affect real economic activity (Mian and Sufi 2010b; Mian, Rao, and Sufi 2013). However, the source of these regional variations remains an open question. One possible explanation is the asymmetric effect that a single monetary policy tends to have on different regions (Albuquerque et al. 2017).[29] A natural question thus arises: did loose monetary policy, in the years leading to the Great Recession, asymmetrically stimulate regions with more deregulated, and therefore more competitive, banking sectors?

To answer this question, we begin by exploring the behavior of credit growth given different levels of banking regulation and local monetary conditions. Specifically, we divide all states into four groups based on their relative level of banking regulation and local monetary conditions. We then examine if the magnitude of the credit boom-bust cycle differs across the four groups. To determine the banking regulation conditions for each state we follow Biswas, Gómez, and Zhai (2017) and use the time-weighted average of the state deregulation index ($RSindex$).[30] The state-level time-weighted index, $DEREG$, reflects the regulatory and competitive environment of each state's banking sector. We then divide all states based on their $DEREG$ score relative to the median score for all states. State j is characterized as part of the "Deregulation" group if $DEREG_j$ is greater than the cross-state median and "Regulated" otherwise. To measure local monetary conditions we follow Delis, Hasan, and Mylonidis (2017) and estimate the state-specific Taylor rule residual for each year. State-specific Taylor rule residuals

[28] The legend detailing the location of each state on the graph is omitted to conserve space. The state-level time series used to plot Panel B are available upon request.

[29] Other explanations include differences in industry exposure that led to asymmetric demand shocks and differences in the local elasticity to a given shock as the driving forces of the regional variation (Beraja, Hurst, and Ospina 2016; Liebersohn 2017).

[30] We use the time-weighted average over the full deregulation period, 1994-2008, to capture the over time effect and intensity of the deregulation for each state.

are obtained by regressing the national target federal funds rate on state-level inflation and the unemployment gap.[31] Positive residuals indicate that the effective federal funds rate was greater than what the local economic conditions imply. Thus, higher levels of state-specific Taylor rule residuals indicate that the state was facing tight monetary conditions. State j is then part of the "tight" group if the sum of the state-specific Taylor rule residuals during the credit boom (2001-2007) was higher than the cross-state median. The two credit measures are finally aggregated into four groups, representing their relative banking regulation conditions (Deregulated/Regulated) and monetary conditions (Loose/Tight).[32]

The results of this exercise are shown in Figure 6. The figure plots the weighted mean of credit to income and per capita debt aggregated by the four groups where the state-level GDP is used as weights.[33] It is clear from the figure that the group of states which experienced the strongest credit boom were also the states that had the most deregulated banking sector while also facing relatively more accommodating monetary conditions. In accordance, states facing the relatively tighter monetary conditions and more regulated banking sector experienced the mildest boom. The results strongly suggest that the interaction between monetary conditions and the local banking system had important implications for the magnitude of the local credit cycle, and subsequently the local business cycle.

A limitation of the above results is that they do not control for other factors that may affect the local credit cycle, such as state fixed effects and other local economic conditions. To verify if states that had a more deregulated banking system were indeed more affected by loose monetary conditions, we follow Kroszner and Strahan (2014) and estimate a standard state-level panel regression:

$$\begin{aligned}\Delta Y_{j,t} = \alpha_j + \alpha_t + \gamma_1 Taylor_{j,t-1} + \gamma_2 RSindex_{j,t} \\ + \gamma_3 Taylor_{j,t-1} * RSindex_{j,t} + Z_{j,t} + \varepsilon_{j,t}\end{aligned} \tag{6}$$

where Y is one of the two variables that represent the credit boom: households' debt-to-income ratio (DTI) and the logarithm of the total debt per capita (Debt). j and t denote state and time, respectively. α_j and α_t are state and time fixed effects that control for local characteristics and national time-varying factors that may affect the magnitude of short run credit growth.

[31] See Appendix A.2 for detailed explanation on calculating the Taylor rule for each state.

[32] The final Division of states by groups, as well as the state-specific Taylor rule residuals (Taylor) and the state-level time-weighted deregulation index (DEREG) are presented in Table 11.

[33] Results are similar when using regular mean or when using the size of the population in each state as weights.

Taylor is the state-level Taylor rule residual which captures the local monetary stance and *RSindex* is the branching deregulation index used in the previous section. Finally, Z is a set of state-level control variables which include changes in the unemployment rate and house prices.

Table 12 presents the results of estimating Eq. (6). Columns 1 through 4 present the results from a variety of specifications when using the change in the state-level debt to income ratio as the dependent variable. In columns 5 through 9 the dependent variable is the log change of total per capita household debt. For both measures of credit and in all the specifications the interaction terms between the measure of monetary conditions and the deregulation index are negative and significant. The significant results indicate that during the years of the credit boom, states that had a more deregulated banking sector were more sensitive to the loose monetary conditions relative to states that had a more regulated banking sector.

Following the recent crisis, some studies pointed to loose monetary conditions and relaxed credit standards as some of the key driving forces of the unsustainable credit boom that preceded the crisis (Taylor 2009; Mian and Sufi 2009; Favara and Imbs 2015). On the other hand, others have argued that it is not clear that monetary conditions are to be blamed for the credit boom and housing bubble (Bean et al. 2010; Bernanke 2010). The results presented here, providing further support for Hypothesis HIa, suggest that deregulation of the banking sector may have magnified the effect of the relatively low policy rates in the years leading to the crisis.

6 Summary

In this paper we have presented an empirical investigation of the relationship between competitiveness in the banking sector and the transmission of monetary policy. Following existing literature, we use the deregulation of interstate branching in the U.S. as an exogenous shock to state-level bank competition. As shown by Dick (2006), states that relaxed bank branching restrictions experienced a dramatic increase in the number of out of state bank branches which translated into a decrease in the dominance of regional banks. The overall result of the deregulation was, therefore, an increase in local bank competition. We use a bank-level weighted deregulation index that ranges from 0 to 4 to capture the state-level branching restrictions, where an increase in the index implies weaker branching restrictions and greater competition.

Theory offers contradicting mechanisms through which bank competition can influence the transmission of monetary policy to bank lending supply. For example, on one hand, banks that have less market power may have less access to alternative funding sources and may, therefore,

be more affected by policy changes. Furthermore, monetary policy influences the marginal cost of loan production, and lending should respond more strongly to changes in marginal cost in more competitive markets. On the other hand, increased competition may weaken monetary transmission by expanding the market share of superior banks with cheaper access to non-deposit finance.

We use the bank branching deregulation index as an exogenous proxy of bank competition in a standard bank lending channel regression. The results reveal that greater competition intensifies the impact of monetary policy on lending. Specifically, monetary policy shocks induced banks to change their loan supply by a greater magnitude in states that had less stringent branching restrictions. The results suggest that bank branching deregulation in the U.S. strengthened the transmission of monetary policy and are robust to a wide array of different tests.

We then attempt to address the still-debated issue of the role played by monetary policy in the recent housing bubble. The results support the idea that local financial conditions, specifically local banking competition, could have amplified the reaction to loose monetary conditions during the years of the credit boom. Additionally, the results suggest that interactions between a nationally over-accommodating monetary stance and differences in state-level regulation can help explain the regional variation in the recent housing and credit boom.

The results have important implications for the debate over financial stability. Various approaches have been proposed over the last decade for dealing with potentially destabilizing financial imbalances, such as excess credit growth. The results here point towards a greater role for regionally targeted macroprudential policy and a lesser role for one-size-fit-all, "lean-against-the-wind" monetary policy. This is complementary to a recent line of research which uses macro models to study the optimal implementation of monetary and macroprudential policies when there is regional heterogeneity (Brzoza-Brzezina, Kolasa, and Makarski 2015; Beraja et al. 2017; Dehmej and Gambacorta 2019). For example, Dehmej and Gambacorta (2019) use a New Keynesian model of a monetary union to show that country-targeted macroprudential policy could complement a single monetary policy, conducted on the union level. Claessens and Schanz (2019) claim that under extreme cases, it might be appropriate to use macroprudential policies targeted specifically to address regional house price fluctuations. The evidence presented here provides support for further work on this important topic. Finally, the results demonstrate that increased competition in the banking sector can magnify the likelihood of credit booms. This is a downside to competitive deregulation which policymakers must weigh against potential

efficiency gains, and provides further evidence of a trade-off between competition and stability (Corbae and Levine 2018).

The empirical analysis is not without its drawbacks. Most importantly, the analysis in the previous section does not attempt to evaluate specific policy proposals to achieve optimal coordination between monetary policy and financial regulation. Recent increases in bank market power and concentration make such policy recommendations all the more urgent. Therefore, there is a need for a more general perspective on the interaction between bank competition, monetary policy, policymaker objectives, and the real economy. These are important extensions which we leave for future work.

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A Derivations

A.1 Lerner index calculation

The Lerner index measures market power by estimating banks' ability to charge markup over its marginal cost. The Lerner index is defined as:

$$Lerner_t = \frac{p_t - mc_t}{p_t} \tag{7}$$

where p_t and mc_t are the price of output and marginal cost respectively. Thus, the index equals zero when banks face perfect competition and one under a pure monopoly. The annual bank-level year-end data used to estimate the Lerner index comes from Koetter, Kolari, and Spierdijk (2012), who used data from the Call Reports of the Federal Reserve.[34] As is common in the literature, we estimate the price of output as the ratio of total revenue to total assets. Following Koetter, Kolari, and Spierdijk (2012), the marginal cost is estimated from a translog cost function with two outputs and three input prices of the following form:

$$\begin{aligned}\ln(TC)_{it} = \alpha_0 &+ \sum_{j=1}^{2} \alpha_j \ln(y_j)_{it} + .5 \sum_{j=1}^{2}\sum_{k=1}^{2} \alpha_{jk} \ln(y)_{j,it} \ln(y)_{k,it} + \sum_{n=1}^{3} \beta_n \ln(w_n)_{it} \\ &+ .5 \sum_{n=1}^{3}\sum_{m=1}^{3} \beta_{nm} \ln(w_n)_{it} \ln(w_m)_{it} + \sum_{j=1}^{2}\sum_{n=1}^{3} \theta_{jn} \ln(y_j)_{it} \ln(w_n)_{it} \\ &+ \delta \ln(z)_{it} + \sum_{p=1}^{2} \nu_p trend^p + \sum_{j=1}^{2} \nu_j \ln(y_j)_{it} trend + \sum_{n=1}^{3} \nu_n \ln(w_n)_{it} trend + \varepsilon_{it}\end{aligned} \tag{8}$$

where TC_{it} represents the total costs of bank i at time t. y_j denotes the two banking outputs: total securities (y_1) and total loans (y_2). w_n denotes the three input prices: price of fixed assets (w_1), price of labor (w_2) and price of borrowed funds (w_3). z represents total equity and *trend* is a time trend.[35] we impose linear homogeneity in input prices by normalizing total costs and input prices with the price of borrowed funds (w_3). Eq. (8) is estimated using the entire panel using pooled OLS.

Once the cost function is estimated, the marginal cost for each bank is determined as:

[34] See Koetter, Kolari, and Spierdijk (2012) Table 1 for details on how the Call Report Data have been used to obtain the required variables.

[35] Trend is included in Eq. (8) to capture the movements in the cost function over time.

$$mc_{it} = \frac{TC_{it}}{y_{1,it}} \left[\alpha_1 + \alpha_{11} \ln (y)_{1,it} + \alpha_{12} \ln (y)_{2,it} + \sum_{n=1}^{2} \theta_{1n} \ln (w_n)_{it} + \nu_1 trend \right] + \frac{TC_{it}}{y_{2,it}} \left[\alpha_2 + \alpha_{22} \ln (y)_{1,it} + \alpha_{12} \ln (y)_{1,it} + \sum_{n=1}^{2} \theta_{2n} \ln (w_n)_{it} + \nu_2 trend \right] \quad (9)$$

Using the estimated p and mc in Eq. (7) we calculate the Lerner index for each bank i at year t. Finally, to obtain state-level competition measures, WE take the weighted mean of the bank level measures for each state in each year, using deposit market shares as the weights.

A.2 State-level Taylor rule residuals calculation

I present the methodology for constructing Taylor rule residuals for each U.S. state. Taylor rule residuals are measured as the difference between the effective federal funds rate and the Taylor rule rate which is typically estimated as a function of the output gap and inflation in the following way:

$$i_t = r + \pi_t + \alpha(\pi_t - \pi_t^*) + \beta(Y_t - Y_t^*). \quad (10)$$

where $(Y_t - Y_t^*)$ is the output gap measured as the difference between potential output and real GDP. π_t is the inflation rate. π_t^* is the inflation target rate, typically assumed to be 2% and r is the steady-state real interest rate, assumed to be 2%. Estimating the Taylor rule on a state-level basis requires, therefore, a state-level measure of inflation and the output gap.

For the state level inflation rate we follow Cooper, Luengo-Prado, and Olivei (2016) and use the change in each state's Gross State Product (GSP) deflator. GSP deflators are measured using the annual nominal and real GSP measures published by the U.S. Bureau of Economic Analysis (BEA).[36] Following Albuquerque et al. (2017) we use the unemployment gap for each state as a proxy for the output gap, where the natural rate of unemployment is measured as the average unemployment during the 1990s for each state.

The final step is to regress the Effective Federal Funds Rate on the state-level inflation measure and the estimated unemployment gap. The residuals from the regression are then used as a proxy for the local monetary conditions with higher residuals indication tighter monetary conditions.

[36] The two measures are published annually for each state since 1970.

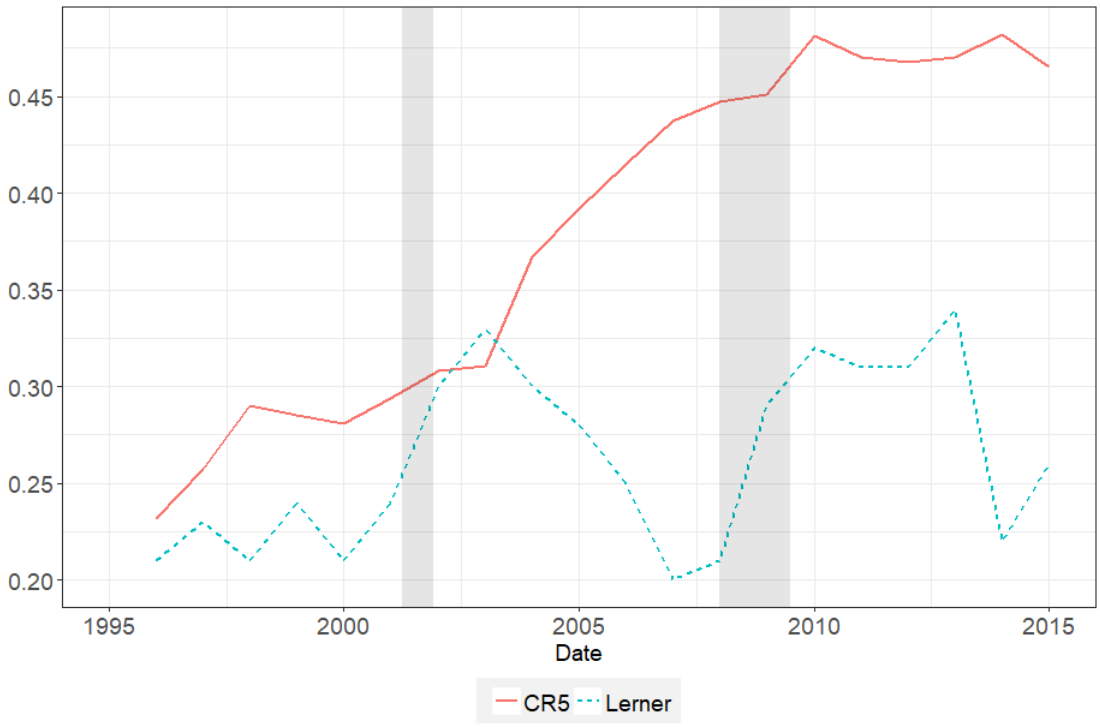
B Data and Variables Definition

Table 1: Data and variables definition

Variable	Definition	Source
RSindex	Rice and Strahan (2010) reversed index of interstate banking deregulation, extended to 2008 following Shenoy and Williams (2017). The index ranges from zero (regulated) to four (highly deregulated).	Rice and Strahan (2010) and Shenoy and Williams (2017)
Loans	Gross total loans and leases. Series: rcon1400	Call Reports
Size	Logarithm of total assets. Series: rcfd2170	Call Reports
Capitalization	Ratio of equity capital to total assets Series: rcfd3210/rcfd2170	Call Reports
Liquidity	Banks liquidity ratio Series: (rcfd1754 + rcfd1773 + rcfd1350 + rcfd3545)/rcfd2170	Call Reports
BHC	Dummy equals one if bank is part of BHC. Series: rssd9348	Call Reports
PerCapitaIncome	State level per capita personal income (dollars)	BEA (SA1)
Unemployment	State level unemployment, not seasonally adjusted	BLS
HPI	State level house price index, all-Transactions Indexes	Federal Housing Finance Agency (FHFA)
FFR	Effective Federal Funds Rate, Percent, Annual	Research Division Federal Reserve Bank of St. Louis (FRED)
Romer&Romer	Romer and Romer (2004) measure of monetary policy shocks. Higher values indicate tighter monetary policy conditions	Barakchian and Crowe (2010)
Taylor	Taylor rule by state. The residuals of the regression of Effective Federal Funds Rate, on state inflation and unemployment gap.	Author's calculation. See Appendix A.2

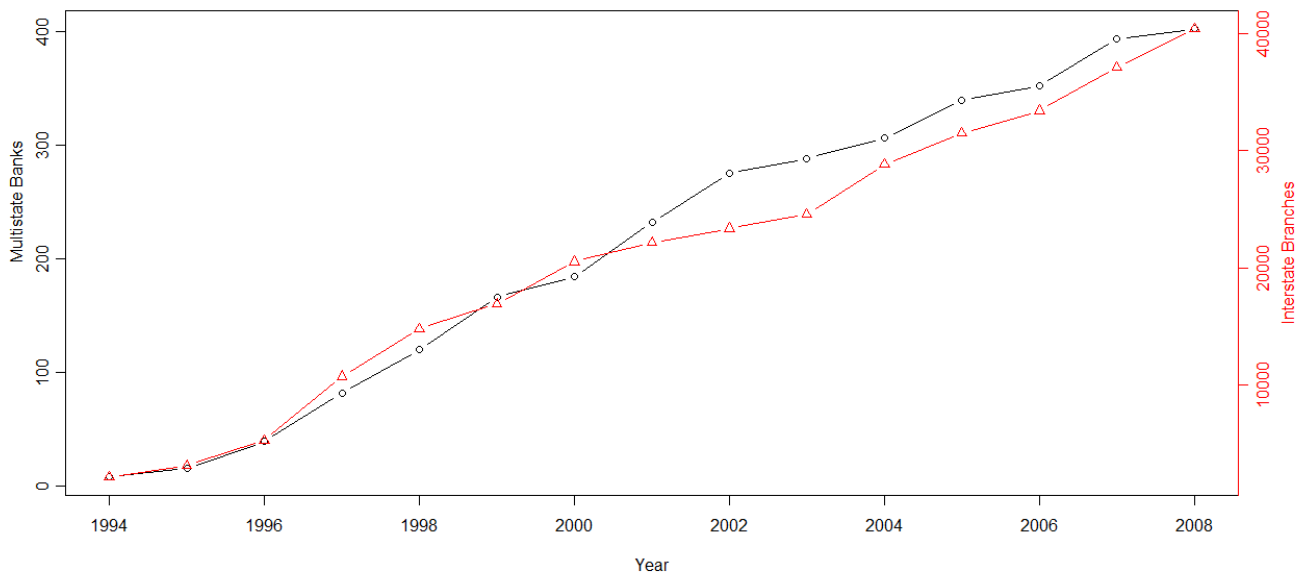
C Figures

Figure 1: Bank competition and concentration in the United States



Note: The figure shows the annual average for the Lerner index and the 5-Bank concentration ratio (CR5). The Lerner index ranges between 0 and 1, where larger values are interpreted as indicating more market power (less competition). The CR5 ratio is the assets of five largest banks as a share of total commercial banking assets. Data from FRED, Federal Reserve Bank of St. Louis.

Figure 2: Number of multistate banks and interstate branches



Note: The figure shows the number of interstate branches operated by FDIC insured commercial banks and number of multistate banking organizations between 1994 to 2008. Data is from the FDIC Summary of Deposits.

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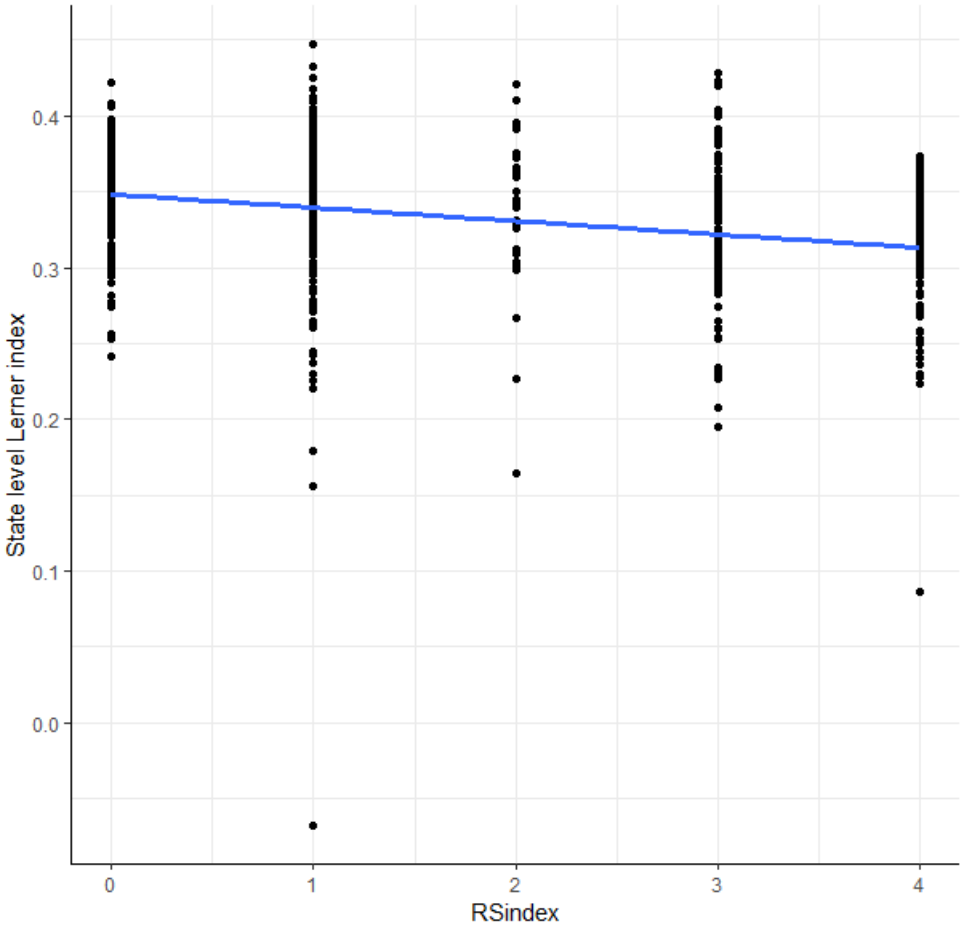
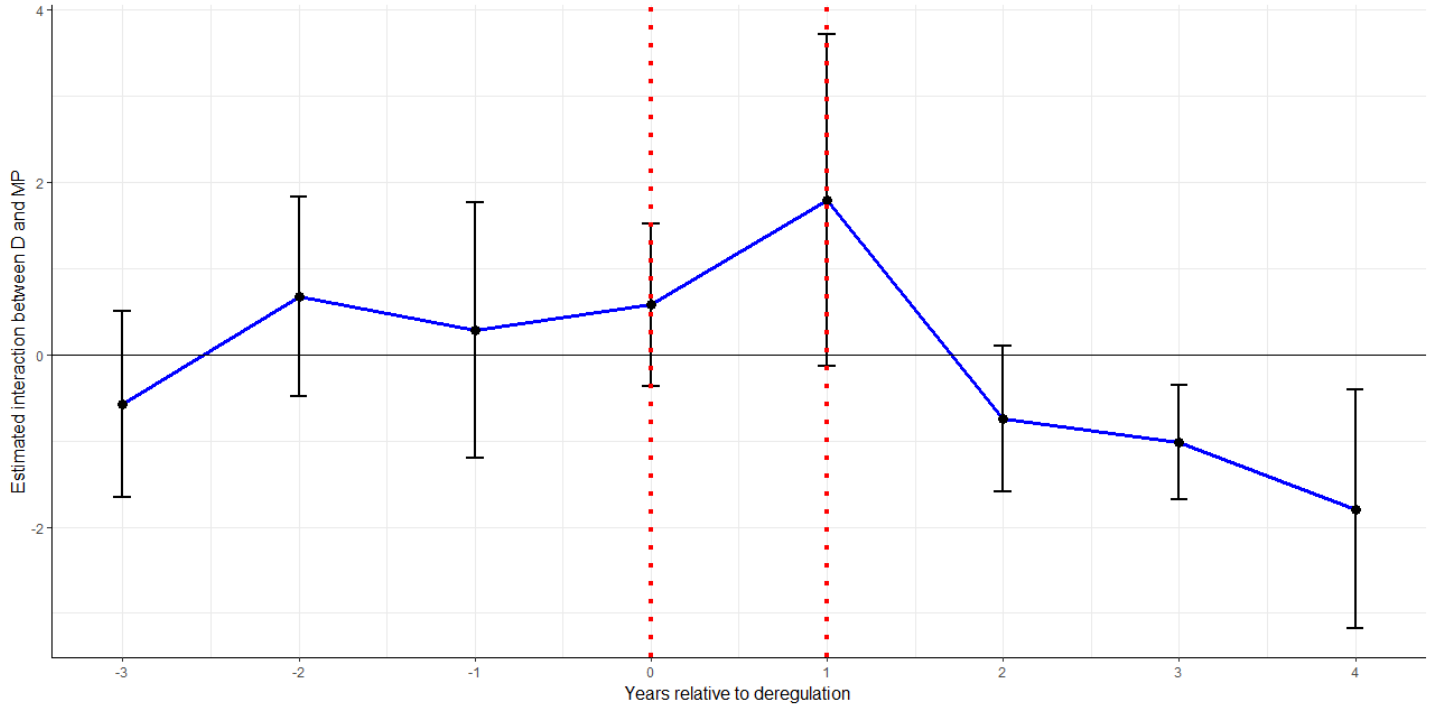
Figure 3: Bank competition and bank branching deregulation



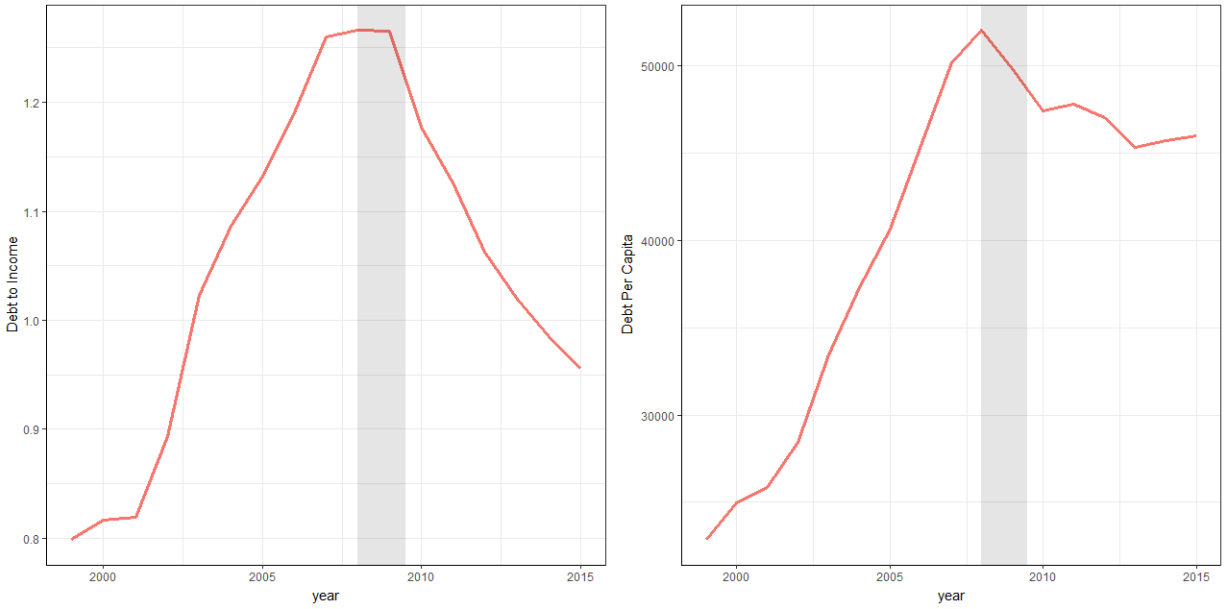
Note: The figure presents the scatter plot and trend line of the state level Lerner index and the RSindex. The Lerner index ranges between 0 and 1, where larger values are interpreted as indicating more market power (less competition). The RSindex is the Rice and Strahan (2010) bank branching deregulation index, where larger values indicate less restrictions. See Appendix A.1 for details on calculating bank level Lerner index. State-level measures are the weighted mean of the bank level measures for each state in each year, using deposit market shares as the weights.

Figure 4: Dynamic impact

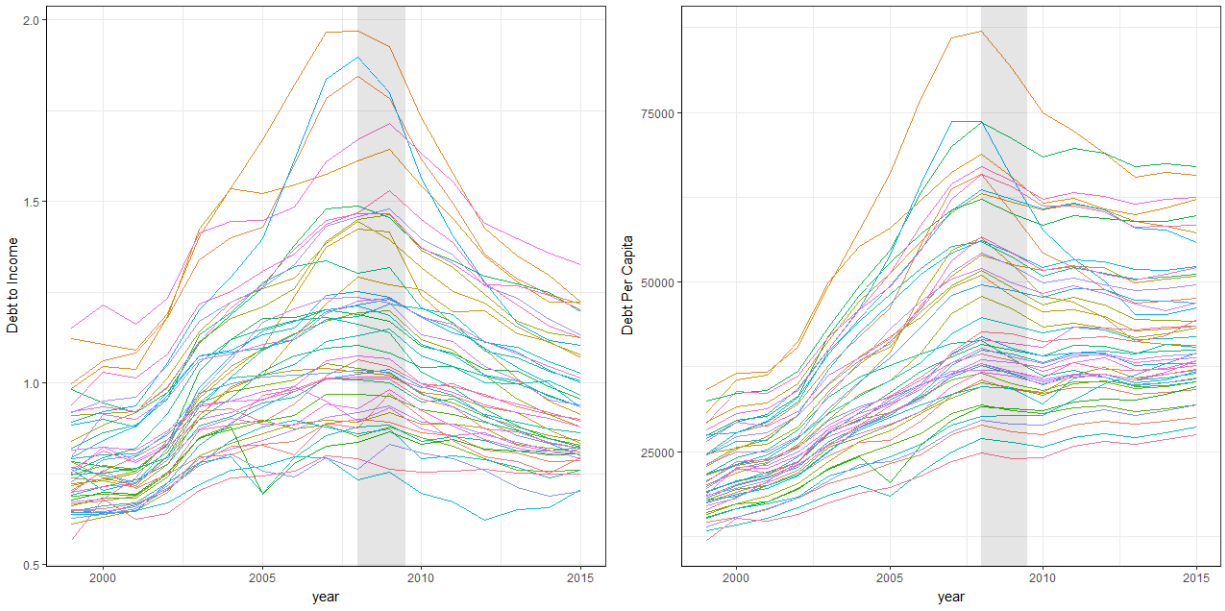


Note: This figure presents the dynamic effect of branching deregulation on monetary policy effectiveness relative to the year of the reform. The specification is the same as Eq. (2) with additional dummy variables, $D_{j,t}^{-k}$ and $D_{j,t}^{+k}$. $D_{j,t}^{-k}$ is equal to one in the k^{th} year before deregulation and zero otherwise (up to and including three years) and $D_{j,t}^{+k}$ is equal to one in the k^{th} year after the deregulation and zero otherwise (up to and including four years). The interaction term between monetary policy, measured using the Romer & Romer measure, and the additional dummy variables are plotted with 95% confidence intervals. Standard errors are clustered at the state level.

Figure 5: Debt to income and total per capita debt in the U.S.



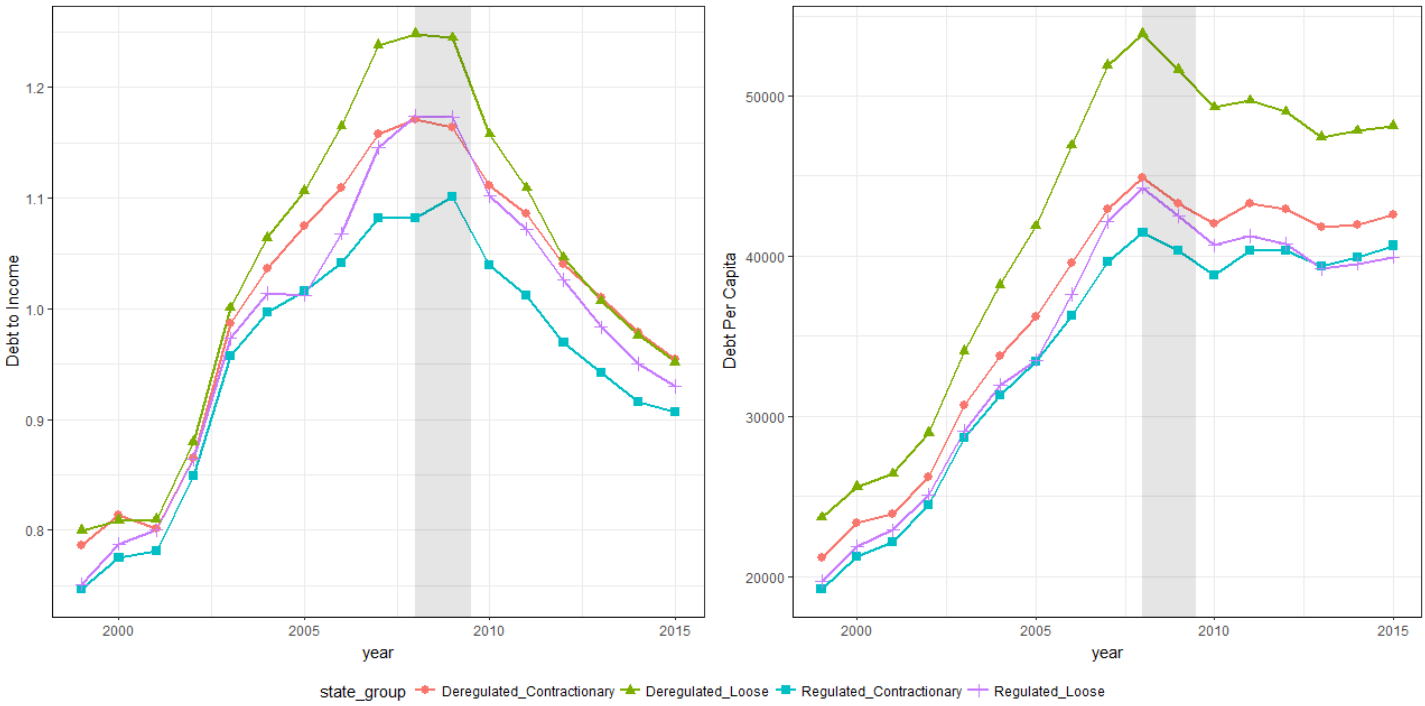
(a) Aggregate



(b) By State

Source: Bureau of Economic Analysis (BEA) + NY Fed Center for Microeconomic Data.

Figure 6: Debt to income and total debt aggregated by group



Source: Author's calculations. The figure plots the weighted mean of debt to income and per capita debt with GDP-by-state used as weights. Division of states by groups can be found in Table 11.

D Tables

Table 2: Descriptive Statistics

	Mean	St. Dev	Median	Min	Max
$\Delta Loans$	9.944	19.743	7.928	−799.736	898.931
$RSindex$	0.976	1.301	0	0	4
$RSindex$ (weighted)	1.041	1.315	1	0	4
FFR	4.038	1.637	4.960	1.130	6.240
ΔFFR	−0.074	1.394	−0.110	−3.090	1.860
$Romer\&Romer$	0.217	0.840	0.210	−1.524	1.861
$Size$	11.391	1.246	11.267	6.939	20.995
$Liquidity$	30.993	15.388	29.180	0	99.272
$Capitalization$	10.455	4.430	9.431	−2.518	99.821
$\Delta PerCapitaIncome$	4.282	1.910	4.269	−3.349	12.625
$\Delta Unemployment$	−1.625	12.435	−4.445	−47.000	49.784
ΔHPI	4.460	3.552	4.343	−22.343	26.027
BHC	0.625	0.484	1	0	1

Notes: This table presents the descriptive statistics for the main variables used in Eq. (2). Full descriptions and sources of all variables are given in Table 1. The sample period is 1994 - 2008. The sample includes 9,721 banks with a total of 110,822 bank-year observations. Mean, standard deviation, median, minimum and maximum of each variable are given.

Table 3: Results for main estimation

	$\Delta Loans$					
	Federal Funds Rate			Romer & Romer		
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex		−0.0290	−0.0490		−0.0020	−0.0002
		(0.1481)	(0.1293)		(0.1372)	(0.1275)
ΔMP	−1.3919	−1.5630*		−2.2266	−2.5830	
	(0.9362)	(0.9173)		(1.8809)	(1.9041)	
$\Delta MP * RSindex$		−0.1152**	−0.1594***		−0.1964**	−0.2805***
		(0.0470)	(0.0431)		(0.0969)	(0.0814)
Size	−12.6207***	−12.2593***	−12.2581***	−12.6888***	−12.3513***	−12.3733***
	(0.6837)	(0.6585)	(0.6557)	(0.7007)	(0.6807)	(0.6778)
Liquidity	0.3612***	0.3579***	0.3579***	0.3510***	0.3480***	0.3471***
	(0.0302)	(0.0294)	(0.0292)	(0.0296)	(0.0287)	(0.0286)
Capitalization	1.1818***	1.0946***	1.0928***	1.1871***	1.0979***	1.0984***
	(0.1527)	(0.1573)	(0.1580)	(0.1481)	(0.1526)	(0.1532)
$\Delta PerCapitaIncome$	0.1897***	0.1883**	−0.0351	0.2177***	0.2162***	−0.0452
	(0.0716)	(0.0732)	(0.0618)	(0.0746)	(0.0774)	(0.0637)
$\Delta Unemployment$	−0.0053	−0.0085	−0.0133	−0.0147	−0.0175*	−0.0115
	(0.0121)	(0.0120)	(0.0113)	(0.0108)	(0.0105)	(0.0110)
ΔHPI	0.2707***	0.2748***	0.3593***	0.2837***	0.2864***	0.3685***
	(0.0503)	(0.0455)	(0.0480)	(0.0469)	(0.0438)	(0.0481)
BHC	4.1222***	4.1410***	3.9935***	4.1051***	4.1303***	3.9951***
	(0.6422)	(0.6374)	(0.6493)	(0.6431)	(0.6361)	(0.6466)
$\Delta MP * Size$	0.0982	0.1230*	0.1437**	0.1140	0.1547	0.1466
	(0.0680)	(0.0685)	(0.0680)	(0.1072)	(0.1120)	(0.1188)
$\Delta MP * Liquidity$	0.0047	0.0041	0.0060	0.0339***	0.0322***	0.0368***
	(0.0049)	(0.0049)	(0.0049)	(0.0092)	(0.0095)	(0.0097)
$\Delta MP * Capitalization$	0.0166	0.0202	0.0197	−0.0331	−0.0184	−0.0263
	(0.0380)	(0.0383)	(0.0386)	(0.0824)	(0.0838)	(0.0844)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Linear Trend	Yes	Yes	No	Yes	Yes	No
Observations	110,972	110,822	110,822	110,972	110,822	110,822
Adjusted R^2	0.2454	0.2319	0.2367	0.2458	0.2324	0.2371

Notes: The table reports the results of estimating Eq. (1) and Eq. (2). Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-3) or the Romer-Romer measure (columns 4-6). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates(see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008. Full descriptions and sources of all variables are given in Table 1.

*p<0.1; **p<0.05; ***p<0.01

Table 4: Dynamic panel data estimation

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$\Delta Loans_{t-1}$	-0.0676^{***}	-0.0620^{***}	-0.0734^{***}	-0.0613^{***}
	(0.0098)	(0.0095)	(0.0091)	(0.0090)
$RSindex$	0.0003	0.1050	0.0070	0.1725^{*}
	(0.1008)	(0.1012)	(0.1030)	(0.1010)
ΔMP	-0.8341		-4.1007^{**}	
	(0.6960)		(1.8776)	
$\Delta MP * RSindex$	-0.0483^{*}	-0.0867^{***}	-0.1039^{**}	-0.1851^{***}
	(0.0272)	(0.0246)	(0.0443)	(0.0434)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	No
Observations	110822	110822	110822	110822
AR(1) (p-value)	0.000	0.000	0.000	0.000
AR(2) (p-value)	0.284	0.324	0.228	0.352

Notes: The table reports the results of estimating Eq. (4) using Arellano and Bond (1991) difference GMM estimation strategy. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust (Windmeijer) standard errors are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 5: Results for main estimation using quarterly data

	$\Delta Loans$					
	Federal Funds Rate			Romer & Romer		
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex		−0.0198	−0.0442		−0.0131	−0.0367
		(0.0261)	(0.0291)		(0.0264)	(0.0302)
ΔMP	1.5400**	1.3247**		0.4589	0.0897	
	(0.6093)	(0.5858)		(0.7943)	(0.7802)	
$\Delta MP * RSindex$		−0.1256***	−0.1492***		−0.1742***	−0.2261***
		(0.0470)	(0.0455)		(0.0475)	(0.0579)
Size	−1.0362***	−1.0354***	−1.0428***	−1.0405***	−1.0412***	−1.0469***
	(0.0862)	(0.0880)	(0.0915)	(0.0884)	(0.0902)	(0.0929)
Liquidity	0.0983***	0.0980***	0.0978***	0.0980***	0.0978***	0.0974***
	(0.0036)	(0.0036)	(0.0036)	(0.0036)	(0.0036)	(0.0035)
Capitalization	0.0915***	0.0920***	0.0970***	0.0901***	0.0903***	0.0958***
	(0.0139)	(0.0139)	(0.0143)	(0.0144)	(0.0144)	(0.0146)
$\Delta PerCapitaIncome$	0.0997	0.1040*	−0.0801	0.0549	0.0595	−0.0885
	(0.0606)	(0.0583)	(0.0736)	(0.0577)	(0.0561)	(0.0745)
$\Delta Unemployment$	−0.0243*	−0.0253**	−0.0199**	−0.0274**	−0.0282**	−0.0193**
	(0.0127)	(0.0122)	(0.0096)	(0.0116)	(0.0105)	(0.0110)
ΔHPI	0.0919***	0.0964***	0.1664***	0.0917***	0.0958***	0.1623***
	(0.0312)	(0.0304)	(0.0381)	(0.0316)	(0.0308)	(0.0383)
BHC	0.5391***	0.5390***	0.5191***	0.5401***	0.5386***	0.5192***
	(0.0664)	(0.0665)	(0.0660)	(0.0667)	(0.0670)	(0.0662)
$\Delta MP * Size$	−0.1603***	−0.1284***	−0.1209**	−0.0816	−0.0333	−0.0486
	(0.0447)	(0.0433)	(0.0455)	(0.0560)	(0.0559)	(0.0574)
$\Delta MP * Liquidity$	0.0054	0.0052	0.0068	0.0055	0.0041	0.0080
	(0.0044)	(0.0043)	(0.0043)	(0.0055)	(0.0056)	(0.0057)
$\Delta MP * Capitalization$	0.0095	0.0115	0.0102	0.0140	0.0191	0.0085
	(0.0188)	(0.0185)	(0.0194)	(0.0289)	(0.0287)	(0.0299)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Linear Trend	Yes	Yes	No	Yes	Yes	No
Observations	375,143	375,143	375,143	375,143	375,143	375,143
Adjusted R^2	0.1156	0.1158	0.1205	0.1155	0.1157	0.1204

Notes: The table reports the results of estimating Eq. (5). Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-3) or the Romer-Romer measure (columns 4-6). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates(see Section 3.1 for details). Coefficients are summed across all lags for each variable. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 6: Timing and trend explanations

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$BeforeDummy$	−0.2168	0.2638	−0.8764	−0.0222
	(0.4874)	(0.5309)	(0.7248)	(0.6645)
$RSindex$	−0.1197	−0.0159	−0.1155	0.0126
	(0.1437)	(0.1368)	(0.1530)	(0.1406)
ΔMP	−1.3865		−2.5412	
	(0.9113)		(1.9338)	
$\Delta MP * BeforeDummy$	−0.8356**	−0.1527	0.2569	0.2096
	(0.3709)	(0.4251)	(0.5408)	(0.5470)
$\Delta MP * RSindex$	−0.1529***	−0.1618***	−0.1887**	−0.2767***
	(0.0480)	(0.0438)	(0.0918)	(0.0817)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Observations	110,822	110,822	110,822	110,822
Adjusted R^2	0.2322	0.2367	0.2325	0.2371

Notes: The table reports the results of estimating Eq. (2) including $BeforeDummy$ which is a dummy variable equal to one for the four years prior the deregulation year. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). $RSindex$ is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 7: Controlling for survival bias

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$RSindex$	−0.0933	−0.0366	−0.0425	0.0128
	(0.1126)	(0.1171)	(0.1088)	(0.1125)
ΔMP	−1.3203**		−3.0327***	
	(0.6419)		(1.1192)	
$\Delta MP * RSindex$	−0.1154***	−0.1280***	−0.1900**	−0.2224***
	(0.0387)	(0.0351)	(0.0937)	(0.0768)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Observations	81,619	81,619	81,619	81,619
Adjusted R^2	0.1370	0.1443	0.1371	0.1444

Notes: The table reports the results of estimating Eq. (2) using only banks that apper in the full time period. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates. (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 8: Alternative measures of bank competition

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. State level Lerner index				
Competition	−34.0178***	−9.8974	−27.8952***	−15.0733**
	(4.9497)	(7.3388)	(4.6586)	(7.2109)
ΔMP	−4.8729***		−6.9733***	
	(1.5637)		(2.4244)	
$\Delta MP * Competition$	4.1993**	13.6656***	9.0101***	12.6115***
	(2.0049)	(2.7460)	(3.2990)	(4.4092)
Observations	103,623	103,623	103,623	103,623
Adjusted R^2	0.2595	0.2636	0.2595	0.2636
Panel B. Bank level Lerner index				
Competition	−27.8231***	−26.6226***	−27.4697***	−26.6280***
	(1.8065)	(1.8416)	(1.7425)	(1.7705)
ΔMP	−3.5520***		−2.5308**	
	(0.7036)		(1.0094)	
$\Delta MP * Competition$	3.5371***	3.9379***	1.4643	1.4016
	(1.0081)	(1.0366)	(1.5421)	(1.5699)
Observations	96,842	96,842	96,842	96,842
Adjusted R^2	0.3200	0.3256	0.3190	0.3249
Panel C. Log of county level Herfindahl-Hirschman Index (HHI).				
Competition	−1.7265***	−1.7712***	−1.9055***	−1.9247***
	(0.5601)	(0.5601)	(0.5662)	(0.5663)
ΔMP	−1.2351		−2.0010	
	(0.8848)		(1.5919)	
$\Delta MP * Competition$	0.2139***	0.2214***	0.3971***	0.3568***
	(0.0499)	(0.0503)	(0.0909)	(0.0912)
Observations	110,937	110,937	110,937	110,937
Adjusted R^2	0.2470	0.2515	0.2475	0.2519
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) with three alternative measures of bank competition. For all three measures higher values indicate weaker bank competition. See Appendix A.1 for details on computing bank and state level Lerner index. The HHI is calculated each year using the deposit market shares of all bank branches in a given county. Branch deposit data is from the FDIC Summary of Deposits. Robust standard errors, clustered at the level of the competition measure, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 9: Testing alternative explanations

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A				
$\Delta MP * RSindex$	−0.1165***	−0.1600***	−0.1997***	−0.2817***
	(0.0292)	(0.0277)	(0.0568)	(0.0540)
$\Delta MP * ROA$	−0.7171	−0.8798	−1.7585	−1.8618
	(0.5856)	(0.6067)	(1.8330)	(1.8424)
Observations	110,822	110,822	110,822	110,822
Adjusted R^2	0.2320	0.2367	0.2324	0.2371
Panel B				
$\Delta MP * RSindex$	−0.1051***	−0.1331***	−0.1870***	−0.2422***
	(0.0290)	(0.0271)	(0.0566)	(0.0541)
$\Delta MP * Risk$	−5.4634	−2.0193	−4.5837	−1.7537
	(6.8826)	(7.0572)	(12.1337)	(12.3497)
Observations	110,820	110,820	110,820	110,820
Adjusted R^2	0.2492	0.2539	0.2498	0.2544
Panel C				
$\Delta MP * RSindex$	−0.1212***	−0.1563***	−0.2584***	−0.2722***
	(0.0290)	(0.0276)	(0.0560)	(0.0537)
$\Delta MP * Efficiency$	−0.8133	−0.3846	0.5265	0.3637
	(0.8174)	(0.8372)	(1.4522)	(1.4991)
Observations	110,822	110,822	110,822	110,822
Adjusted R^2	0.2364	0.2399	0.2372	0.2403
Panel D				
$\Delta MP * RSindex$	−0.1361***	−0.1390***	−0.2345***	−0.2283***
	(0.0314)	(0.0314)	(0.0599)	(0.0598)
$\Delta MP * Securitization$	0.5938	0.5993	−2.5263	−2.5462
	(1.0346)	(1.0285)	(2.0237)	(2.0258)
Observations	54,898	54,898	54,898	54,898
Adjusted R^2	0.3020	0.3032	0.3024	0.3037
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) while controlling for alternative channels through which branching deregulation may have operated. Each variable is included in levels and interacted with the monetary policy shock. See Section 4.3.2 for alternative bank variable definitions. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 10: State specific linear time trends

	$\Delta Loans$	
	Federal Funds Rate	Romer & Romer
	(1)	(2)
$RSindex$	0.2278	0.2113
	(0.1895)	(0.1893)
ΔMP	-1.5956^{*}	-2.4871
	(0.9575)	(1.9766)
$\Delta MP * RSindex$	-0.1197^{***}	-0.1824^{**}
	(0.0456)	(0.0894)
Bank controls	Yes	Yes
State controls	Yes	Yes
Bank FE	Yes	Yes
State Specific Linear Trend	Yes	Yes
Observations	110,822	110,822
Adjusted R^2	0.2347	0.2351

Notes: The table reports the results of estimating Eq. (2) while controlling for state-specific trends. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 11: State-Level Taylor Residuals, DEREG and Group.

State	Taylor	DEREG	Group
Alabama	-7.90	0.70	Regulated_Loose
Arizona	-9.60	1.30	Deregulated_Loose
Arkansas	-7.10	0.00	Regulated_Tight
California	-9.30	0.90	Deregulated_Loose
Colorado	-7.10	0.00	Regulated_Tight
Connecticut	-8.70	2.60	Deregulated_Loose
Delaware	-6.60	0.90	Deregulated_Tight
Florida	-7.60	0.70	Regulated_Loose
Georgia	-8.50	0.70	Regulated_Loose
Idaho	-8.00	0.90	Deregulated_Loose
Illinois	-8.80	1.50	Deregulated_Loose
Indiana	-7.40	2.30	Deregulated_Tight
Iowa	-6.90	0.00	Regulated_Tight
Kansas	-3.80	0.00	Regulated_Tight
Kentucky	-7.90	0.50	Regulated_Loose
Louisiana	-8.60	0.70	Regulated_Loose
Maine	-7.00	2.90	Deregulated_Tight
Maryland	-7.90	3.50	Deregulated_Loose
Massachusetts	-8.20	2.40	Deregulated_Loose
Michigan	-7.50	3.50	Deregulated_Tight
Minnesota	-7.30	0.70	Regulated_Tight
Mississippi	-6.90	0.30	Regulated_Tight
Missouri	-7.80	0.00	Regulated_Loose
Montana	-3.70	0.20	Regulated_Tight
Nebraska	2.80	0.00	Regulated_Tight
Nevada	-8.70	0.90	Deregulated_Loose
New Hampshire	-7.30	2.00	Deregulated_Tight
New Jersey	-9.10	2.40	Deregulated_Loose
New Mexico	-5.40	0.80	Regulated_Tight
New York	-9.80	1.50	Deregulated_Loose
North Carolina	-2.90	3.50	Deregulated_Tight
North Dakota	-7.90	1.40	Deregulated_Loose
Ohio	-8.00	2.90	Deregulated_Loose
Oklahoma	-8.20	1.60	Deregulated_Loose
Oregon	-4.40	0.70	Regulated_Tight
Pennsylvania	-9.00	3.50	Deregulated_Loose
Rhode Island	-6.90	3.50	Deregulated_Tight
South Carolina	-6.00	0.80	Regulated_Tight
South Dakota	-7.30	0.80	Regulated_Tight
Tennessee	-8.30	1.90	Deregulated_Loose
Texas	-9.30	1.20	Deregulated_Loose
Utah	-5.60	2.20	Deregulated_Tight
Vermont	-6.50	2.50	Deregulated_Tight
Virginia	-8.20	3.50	Deregulated_Loose
Washington	-7.90	0.80	Regulated_Loose
West Virginia	-4.60	2.20	Deregulated_Tight
Wisconsin	-4.00	0.80	Regulated_Tight
Wyoming	-4.00	0.70	Regulated_Tight

Note: This table reports the aggregated measures of monetary policy conditions and banking regulation for each state during the credit boom of 2001-2007. The table also reports the groups used in Figure 6. Taylor is the sum of the state-level Taylor rule residuals during the credit boom (2001-2007) for each state. DEREG is the time-weighted mean of the state-level bank deregulation index ($RSindex$) from 1995-2007. See Table 1 for definitions of the state-level Taylor rule residual and $RSindex$. States are considered "Deregulated" if DEREG was greater then the cross-state mean and "Regulated" otherwise. A state monetary condition is considered "Tight" if the state level monetary conditions were greater then the cross-state mean and "Loose" otherwise.

Table 12: State-Level Panel Regression

	ΔDebt to Income				ΔTotal Debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RSindex	0.001	0.003	0.003	0.003	0.73	0.81	0.90	0.80
	(0.01)	(0.01)	(0.01)	(0.01)	(1.27)	(1.35)	(0.94)	(0.77)
Taylor	−0.004	−0.01*	0.002	0.002	−0.55	−0.65*	0.21	0.24
	(0.003)	(0.004)	(0.004)	(0.004)	(0.35)	(0.39)	(0.47)	(0.33)
Taylor ∗ *RSindex*	−0.002**	−0.003**	−0.003***	−0.003***	−0.22*	−0.22*	−0.29**	−0.22**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.12)	(0.11)	(0.11)	(0.09)
State Controls	No	Yes	No	Yes	No	Yes	No	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	No	No	Yes	Yes
Linear Trend	Yes	Yes	No	No	Yes	Yes	No	No
Observations	336	336	336	336	336	336	336	336
Adjusted R^2	0.18	0.22	0.57	0.57	0.11	0.12	0.55	0.61

Notes: The table reports the results of estimating Eq. (6). Dependent variable is the change in debt to income (columns 1-4) and log change in per capita total debt (columns 5-9). *Taylor* is the state-level Taylor rulr residuals. *RSindex* is the extended Rice and Strahan (2010) Index of Interstate Branching Deregulation (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 2001-2007. Full descriptions and sources of all variables are given in Table 1. The coefficients for the control variables that have been omitted are available upon request. *p<0.1; **p<0.05; ***p<0.01

E Online Appendix (not for publication)

E.1 Additional tests for baseline specification

Table 13: Business cycle effect

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$RSindex$	−0.0077	−0.0340	0.0054	−0.0053
	(0.1451)	(0.1309)	(0.1341)	(0.1268)
ΔMP	−1.6516*		−2.5653	
	(0.9113)		(1.9150)	
$\Delta MP * RSindex$	−0.1317***	−0.1835***	−0.1814*	−0.2870***
	(0.0503)	(0.0458)	(0.1027)	(0.0841)
$\Delta MP * RSindex * RecessionDummy$	0.1183	0.1556	0.1036	0.2354
	(0.1081)	(0.1012)	(0.4637)	(0.4575)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Number of banks				
Observations	110,822	110,822	110,822	110,822
Adjusted R^2	0.2321	0.2367	0.2324	0.2371

Notes: The table reports the results of estimating Eq. (2) with the inclusion of a recession dummy, constructed using the standard NBER business cycle turning points. The recession dummy is included in its level, in interactions with ΔMP and $RSindex$, and in a triple interaction with both. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). $RSindex$ is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008. *p<0.1; **p<0.05; ***p<0.01

Table 14: Sample split by bank size

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. Small banks				
RSindex	−0.0369	−0.0633	−0.0136	−0.0135
	(0.1492)	(0.1315)	(0.1402)	(0.1312)
ΔMP	−0.7276		−3.0539	
	(1.0236)		(2.0368)	
$\Delta MP * RSindex$	−0.1051**	−0.1565***	−0.1536	−0.2547***
	(0.0468)	(0.0418)	(0.0986)	(0.0837)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Observations	105,846	105,846	105,846	105,846
Adjusted R^2	0.2753	0.2807	0.2760	0.2814
Panel B. Large banks				
RSindex	0.5144	0.7957	0.6722	1.0177
	(0.8967)	(0.9312)	(0.9676)	(1.0071)
ΔMP	0.6815		15.7007	
	(5.2775)		(12.5474)	
$\Delta MP * RSindex$	−0.0646	−0.0609	−0.8373**	−0.7334*
	(0.2099)	(0.2029)	(0.3770)	(0.4319)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Observations	4,976	4,976	4,976	4,976
Adjusted R^2	0.1973	0.1998	0.2079	0.2108

Notes: The table reports the results of separately estimating Eq. (2) for small and large banks. Banks are classified as large if they are in the top 5% of the size distribution in a given year. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008. *p<0.1; **p<0.05; ***p<0.01

Table 15: Loan categories

	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. Δ C&I Loans				
RSindex	0.2847	0.2136	0.3982*	0.2812
	(0.2041)	(0.1707)	(0.2087)	(0.1760)
ΔMP	−0.3864		−0.6195	
	(1.1576)		(2.8302)	
$\Delta MP * RSindex$	−0.1421*	−0.1967***	−0.3411*	−0.3305**
	(0.0785)	(0.0763)	(0.1774)	(0.1624)
Observations	109,883	109,883	109,883	109,883
Adjusted R^2	0.0449	0.0471	0.0448	0.0472
Panel B. Δ Real Estate Loans				
RSindex	0.0771	0.0095	0.0654	0.0739
	(0.2658)	(0.2008)	(0.2426)	(0.2025)
ΔMP	−1.3714*		−3.6735***	
	(0.7571)		(0.9148)	
$\Delta MP * RSindex$	−0.0760	−0.1334**	−0.1882*	−0.2788***
	(0.0571)	(0.0541)	(0.1133)	(0.0985)
Observations	110,234	110,234	110,234	110,234
Adjusted R^2	0.1944	0.1988	0.1952	0.1990
Panel C. Δ Consumer Loans				
RSindex	−0.1904	−0.1767	−0.0790	−0.1696
	(0.3237)	(0.2740)	(0.2800)	(0.2695)
ΔMP	−0.5674		−0.8543	
	(0.9656)		(1.3718)	
$\Delta MP * RSindex$	0.0937	0.0846	0.0166	−0.1098
	(0.0679)	(0.0707)	(0.1061)	(0.0991)
Observations	110,293	110,293	110,293	110,293
Adjusted R^2	0.0842	0.0896	0.0850	0.0898
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) for the three major loan categories: commercial and industrial (C&I), real estate, and consumer (personal). Dependent variable is the growth rate of each loan category. Data for different loan categories are from the Federal Reserve's Report of Condition and Income (Call Reports). C&I loans is variable rcfd1766, Real Estate loans is variable rcfd1410 and Consumer loans is variable rcfd1975. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 16: Results for main estimation using Taylor rule residuals

	(1)	(2)	(3)
RSindex		−0.0490	−0.0105
		(0.1316)	(0.1206)
ΔMP	−1.9004	−2.0736*	
	(1.2278)	(1.2395)	
$\Delta MP * RSindex$		−0.0881*	−0.1455***
		(0.0475)	(0.0517)
Size	−12.6453***	−12.3023***	−12.2984***
	(0.7111)	(0.6870)	(0.6820)
Liquidity	0.3652***	0.3626***	0.3606***
	(0.0303)	(0.0295)	(0.0293)
Capitalization	1.1588***	1.0706***	1.0768***
	(0.1534)	(0.1573)	(0.1582)
$\Delta PerCapitaIncome$	0.1589**	0.1508**	−0.0389
	(0.0645)	(0.0661)	(0.0627)
$\Delta Unemployment$	−0.0180	−0.0198*	−0.0116
	(0.0118)	(0.0117)	(0.0110)
ΔHPI	0.2696***	0.2719***	0.3544***
	(0.0473)	(0.0438)	(0.0471)
BHC	4.0697***	4.0996***	4.0167***
	(0.6392)	(0.6325)	(0.6400)
$\Delta MP * Size$	0.1778*	0.1947**	0.2095**
	(0.0934)	(0.0974)	(0.0968)
$\Delta MP * Liquidity$	−0.0089	−0.0108*	−0.0092
	(0.0065)	(0.0063)	(0.0061)
$\Delta MP * Capitalization$	−0.0025	0.0105	0.0076
	(0.0421)	(0.0409)	(0.0410)
Bank FE	Yes	Yes	Yes
Year FE	No	No	Yes
Linear Trend	Yes	Yes	No
Observations	110,972	110,822	110,822
Adjusted R^2	0.2459	0.2324	0.2369

Notes: The table reports the results of estimating Eq. (1) and Eq. (2). Dependent variable is the loan growth rate. Monetary policy (MP) is measured by a Taylor rule residual. The residuals are from the regression of the Effective Federal Funds Rate on a lag of itself, inflation, and the output gap. *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

E.2 Results using single state banks

Table 17: Descriptive Statistics

	Mean	St. Dev	Median	Min	Max
$\Delta Loans$	9.905	19.685	7.913	−799.736	898.931
$RSindex$	1.021	1.305	1	0	4
$RSindex$ (weighted)	1.017	1.305	1	0	4
FFR	4.131	1.667	4.960	1.130	6.240
ΔFFR	−0.035	1.431	0.060	−3.090	1.860
$Romer\&Romer$	0.248	0.863	0.210	−1.524	1.861
$Size$	11.297	1.137	11.211	6.939	18.993
$Liquidity$	31.322	15.395	29.557	0	99.272
$Capitalization$	10.486	4.327	9.479	−2.518	99.015
$\Delta PerCapitaIncome$	4.378	1.913	4.402	−3.349	12.625
$\Delta Unemployment$	−1.326	12.608	−4.167	−47.000	49.784
ΔHPI	4.533	3.571	4.423	−22.343	26.027
BHC	0.798	0.402	1	0	1

Notes: This table presents the descriptive statistics for the main variables used in Eq. (2) when using only single state banks. Full descriptions and sources of all variables are given in Table 1. The sample period is 1994 - 2008. The sample includes 9,681 banks with a total of 108,166 bank-year observations. Mean, standard deviation, median, minimum and maximum of each variable are given.

Table 18: Results for main estimation

	$\Delta Loans$					
	Federal Funds Rate			Romer & Romer		
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex		−0.0020	−0.0292		0.0238	0.0224
		(0.1551)	(0.1353)		(0.1425)	(0.1332)
ΔMP	−1.4741	−1.6694		−2.3063	−2.6664	
	(1.0262)	(1.0157)		(1.9002)	(1.9438)	
$\Delta MP * RSindex$		−0.1144**	−0.1605***		−0.1981**	−0.2839***
		(0.0458)	(0.0430)		(0.0977)	(0.0831)
Size	−12.9206***	−12.8990***	−12.9048***	−12.9896***	−12.9849***	−13.0101***
	(0.7246)	(0.7240)	(0.7244)	(0.7428)	(0.7455)	(0.7453)
Liquidity	0.3637***	0.3633***	0.3636***	0.3538***	0.3537***	0.3531***
	(0.0306)	(0.0307)	(0.0304)	(0.0300)	(0.0300)	(0.0298)
Capitalization	1.2010***	1.2033***	1.2005***	1.2051***	1.2064***	1.2063***
	(0.1525)	(0.1529)	(0.1539)	(0.1480)	(0.1482)	(0.1490)
$\Delta PerCapitaIncome$	0.1822**	0.1859**	−0.0259	0.2122***	0.2176***	−0.0354
	(0.0745)	(0.0751)	(0.0601)	(0.0776)	(0.0798)	(0.0624)
$\Delta Unemployment$	−0.0058	−0.0078	−0.0115	−0.0144	−0.0165	−0.0098
	(0.0121)	(0.0119)	(0.0111)	(0.0111)	(0.0106)	(0.0108)
ΔHPI	0.2776***	0.2827***	0.3610***	0.2888***	0.2930***	0.3696***
	(0.0490)	(0.0442)	(0.0483)	(0.0461)	(0.0432)	(0.0488)
BHC	4.2053***	4.2032***	4.0574***	4.1884***	4.1885***	4.0555***
	(0.6427)	(0.6454)	(0.6573)	(0.6440)	(0.6447)	(0.6555)
$\Delta MP * Size$	0.1029	0.1308*	0.1499**	0.1198	0.1678	0.1576
	(0.0774)	(0.0778)	(0.0762)	(0.1109)	(0.1184)	(0.1242)
$\Delta MP * Liquidity$	0.0049	0.0045	0.0067	0.0324***	0.0311***	0.0359***
	(0.0049)	(0.0049)	(0.0049)	(0.0095)	(0.0097)	(0.0100)
$\Delta MP * Capitalization$	0.0181	0.0204	0.0190	−0.0284	−0.0234	−0.0315
	(0.0383)	(0.0384)	(0.0388)	(0.0835)	(0.0846)	(0.0853)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Linear Trend	Yes	Yes	No	Yes	Yes	No
Number of banks	9,681	9,681	9,681	9,681	9,681	9,681
Observations	108,166	108,166	108,166	108,166	108,166	108,166
Adjusted R^2	0.2529	0.2531	0.2576	0.2534	0.2535	0.2579

Notes: The table reports the results of estimating Eq. (1) and Eq. (2) when using only single state banks. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-3) or the Romer-Romer measure (columns 4-6). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008. Full descriptions and sources of all variables are given in Table 1.
*p<0.1; **p<0.05; ***p<0.01

Table 19: Results for main estimation using Taylor rule residuals

	$\Delta Loans$		
	(1)	(2)	(3)
RSindex		−0.0235	0.0052
		(0.1388)	(0.1257)
ΔMP	−1.9942	−2.1514	
	(1.3896)	(1.4136)	
Size	−12.9364***	−12.9315***	−12.9257***
	(0.7550)	(0.7547)	(0.7522)
Liquidity	0.3678***	0.3677***	0.3661***
	(0.0308)	(0.0308)	(0.0306)
Capitalization	1.1779***	1.1778***	1.1832***
	(0.1531)	(0.1533)	(0.1544)
$\Delta PerCapitaIncome$	0.1493**	0.1463**	−0.0292
	(0.0660)	(0.0668)	(0.0615)
$\Delta Unemployment$	−0.0182	−0.0193	−0.0098
	(0.0120)	(0.0118)	(0.0108)
ΔHPI	0.2771***	0.2818***	0.3570***
	(0.0457)	(0.0424)	(0.0474)
BHC	4.1484***	4.1583***	4.0747***
	(0.6406)	(0.6419)	(0.6495)
$\Delta MP * RSindex$		−0.0840*	−0.1455***
		(0.0469)	(0.0519)
$\Delta MP * Size$	0.1851*	0.2062*	0.2181**
	(0.1078)	(0.1114)	(0.1109)
$\Delta MP * Liquidity$	−0.0084	−0.0090	−0.0070
	(0.0063)	(0.0063)	(0.0060)
$\Delta MP * Capitalization$	−0.0026	−0.0005	−0.0041
	(0.0432)	(0.0434)	(0.0435)
Bank FE	Yes	Yes	Yes
Year FE	No	No	Yes
Linear Trend	Yes	Yes	No
Observations	108,166	108,166	108,166
Adjusted R^2	0.2535	0.2535	0.2578

Notes: The table reports the results of estimating Eq. (1) and Eq. (2) when using only single state banks. Dependent variable is the loan growth rate. Monetary policy (MP) is measured by a Taylor rule residual. The residuals are from the regression of the Effective Federal Funds Rate on a lag of itself, inflation, and the output gap. *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 20: Dynamic panel data estimation

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$\Delta Loans_{t-1}$	-0.0721^{***}	-0.0627^{***}	-0.0787^{***}	-0.0619^{***}
	(0.0100)	(0.0095)	(0.0092)	(0.0095)
$RSindex$	0.0239	0.1657^{*}	0.0331	0.2353^{**}
	(0.0986)	(0.0987)	(0.1004)	(0.0986)
ΔMP	-0.8228		-3.1741	
	(0.7350)		(2.0156)	
$\Delta MP * RSindex$	-0.0433	-0.0823^{***}	-0.1106^{**}	-0.1849^{***}
	(0.0276)	(0.0250)	(0.0446)	(0.0436)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	No
Number of banks	9681	9681	9681	9681
Observations	108166	108166	108166	108166
AR(1) (p-value)	0.000	0.000	0.000	0.000
AR(2) (p-value)	0.241	0.299	0.189	0.331

Notes: The table reports the results of estimating Eq. (4) using Arellano and Bond (1991) difference GMM estimation strategy when using only single state banks. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended Rice and Strahan (2010) Index of Interstate Branching Deregulation (see Section 3.1 for details). Robust (Windmeijer) standard errors are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 21: Results for main estimation using quarterly data

	$\Delta Loans$					
	Federal Funds Rate			Romer & Romer		
	(1)	(2)	(3)	(4)	(5)	(6)
$RSindex$		−0.0190	−0.0453		−0.0162	−0.0377
		(0.0264)	(0.0294)		(0.0267)	(0.0306)
ΔMP	1.7170**	1.4913**		0.6035	0.2151	
	(0.6468)	(0.6249)		(0.8252)	(0.7802)	
$\Delta MP * RSindex$		−0.1256***	−0.1499***		−0.1774***	−0.2030***
		(0.0417)	(0.0463)		(0.0480)	(0.0566)
$Size$	−1.048***	−1.0473***	−1.0564***	−1.0543***	−1.0567***	−1.0603***
	(0.0857)	(0.0879)	(0.0919)	(0.0872)	(0.0895)	(0.0927)
$Liquidity$	0.0995***	0.0992***	0.0989***	0.0992***	0.0990***	0.0985***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0036)	(0.0036)
$Capitalization$	0.0929***	0.0935***	0.0984***	0.0916***	0.0918***	0.0970***
	(0.0137)	(0.0137)	(0.0140)	(0.0141)	(0.0141)	(0.0143)
$\Delta PerCapitaIncome$	0.1075*	0.1120*	−0.0794	0.0565	0.0608	−0.0874
	(0.0623)	(0.0600)	(0.0752)	(0.0576)	(0.0560)	(0.0765)
$\Delta Unemployment$	−0.0225*	−0.0236*	−0.0187*	−0.0301**	−0.0311***	−0.0183*
	(0.0129)	(0.0124)	(0.0097)	(0.0116)	(0.0110)	(0.0095)
ΔHPI	0.1025***	0.1069***	0.1779***	0.0961***	0.1010***	0.1738***
	(0.0315)	(0.0308)	(0.0392)	(0.0324)	(0.0317)	(0.0396)
BHC	0.5362***	0.5360***	0.5150***	0.5341***	0.5322***	0.5153***
	(0.0664)	(0.0665)	(0.0665)	(0.0665)	(0.0669)	(0.0665)
$\Delta MP * Size$	−0.1766***	−0.1439***	−0.1369***	−0.1081*	−0.0584	−0.0657
	(0.0486)	(0.0474)	(0.0492)	(0.0608)	(0.0606)	(0.0618)
$\Delta MP * Liquidity$	0.0053	0.0051	0.0069	0.0069	0.0057	0.0083
	(0.0042)	(0.0041)	(0.0041)	(0.0052)	(0.0052)	(0.0053)
$\Delta MP * Capitalization$	0.0100	0.0122	0.0102	0.0104	0.0157	0.0076
	(0.0185)	(0.0182)	(0.0191)	(0.0277)	(0.0276)	(0.0287)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Linear Trend	Yes	Yes	No	Yes	Yes	No
Observations	367,530	367,530	367,530	367,530	367,530	367,530
Adjusted R^2	0.1155	0.1157	0.1204	0.1155	0.1156	0.1202

Notes: The table reports the results of estimating Eq. (5) when using only single state banks. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-3) or the Romer-Romer measure (columns 4-6). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates (see Section 3.1 for details). Coefficients are summed across all lags for each variable. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 22: Timing and trend explanations

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$BeforeDummy$	−0.3110	0.1930	−0.9920	−0.1320
	(0.4781)	(0.5209)	(0.7214)	(0.6537)
$RSindex$	−0.1042	−0.0045	−0.1017	0.0257
	(0.1482)	(0.1383)	(0.1552)	(0.1421)
ΔMP	−1.5045		−2.6314	
	(1.0046)		(1.9763)	
$\Delta MP * BeforeDummy$	−0.7818**	−0.1042	0.3360	0.2949
	(0.3737)	(0.4245)	(0.5396)	(0.5370)
$\Delta MP * RSindex$	−0.1507***	−0.1622***	−0.1853**	−0.2780***
	(0.0473)	(0.0437)	(0.0924)	(0.0836)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Number of banks	9,722	9,722	9,722	9,722
Observations	108,166	108,166	108,166	108,166
Adjusted R^2	0.2533	0.2576	0.2536	0.2579

Notes: The table reports the results of estimating Eq. (2) when using only single state banks including $BeforeDummy$ which is a dummy variable equal to one for the four years prior the deregulation year. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). $RSindex$ is the extended Rice and Strahan (2010) Index of Interstate Branching Deregulation (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.
*p<0.1; **p<0.05; ***p<0.01

Table 23: Controlling for survival bias

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
RSindex	−0.0976	−0.0425	−0.0489	0.0058
	(0.1145)	(0.1178)	(0.1124)	(0.1140)
ΔMP	−1.0082		−2.7726**	
	(0.6756)		(1.1574)	
$\Delta MP * RSindex$	−0.1046***	−0.1188***	−0.1824*	−0.2153***
	(0.0404)	(0.0363)	(0.0954)	(0.0788)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Number of banks	5,606	5,606	5,606	5,606
Observations	79,869	79,869	79,869	79,869
Adjusted R^2	0.1402	0.1476	0.1403	0.1477

Notes: The table reports the results of estimating Eq. (2) using only single state banks that apper in the full time period. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended Rice and Strahan (2010) Index of Interstate Branching Deregulation (see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 24: Business cycle effect

	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
$RSindex$	0.0200	−0.0129	0.0306	0.0181
	(0.1519)	(0.1372)	(0.1400)	(0.1332)
ΔMP	−1.7484*		−2.6511	
	(1.0125)		(1.9547)	
$\Delta MP * RSindex$	−0.1327***	−0.1870***	−0.1841*	−0.2894***
	(0.0495)	(0.0455)	(0.1031)	(0.0854)
$\Delta MP * RSindex * RecessionDummy$	0.1291	0.1692	0.0691	0.1971
	(0.1147)	(0.1076)	(0.4882)	(0.4857)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Number of banks				
Observations	108,166	108,166	108,166	108,166
Adjusted R^2	0.2532	0.2576	0.2535	0.2579

Notes: The table reports the results of estimating Eq. (2) using only single state banks, with the inclusion of a recession dummy, constructed using the standard NBER business cycle turning points. The recession dummy is included in its level, in interactions with ΔMP and $RSindex$, and in a triple interaction with both. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). $RSindex$ is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates(see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 25: Sample split by bank size

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. Small banks				
RSindex	−0.0025	−0.0362	0.0200	0.0160
	(0.1573)	(0.1376)	(0.1459)	(0.1367)
ΔMP	−0.6448		−2.6814	
	(1.0526)		(2.0073)	
$\Delta MP * RSindex$	−0.1026**	−0.1564***	−0.1620	−0.2685***
	(0.0480)	(0.0431)	(0.1021)	(0.0876)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Observations	104,214	104,214	104,214	104,214
Adjusted R^2	0.2942	0.2995	0.2948	0.3001
Panel B. Large banks				
RSindex	0.2540	0.8173	0.4491	0.9581
	(0.7116)	(0.7560)	(0.8357)	(0.9054)
ΔMP	−6.5114		8.1167	
	(8.4273)		(14.3897)	
$\Delta MP * RSindex$	0.0352	0.1408	−0.6409	−0.2956
	(0.2517)	(0.2750)	(0.4280)	(0.5954)
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes
Adjusted R^2	0.2192	0.2208	0.2298	0.2318

Notes: The table reports the results of separately estimating Eq. (2) for small and large banks, using only single state banks. Banks are classified as large if they are in the top 5% of the size distribution in a given year. Dependent variable is the loan growth rate. Monetary policy (MP) is measured using the change in the effective federal funds rate (columns 1-2) or the Romer-Romer measure (columns 3-4). *RSindex* is the extended, bank-level weighted Rice and Strahan (2010) Index of Interstate Branching Deregulation, where the weights are based on the proportions of bank deposits in each state in which the bank operates(see Section 3.1 for details). Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 26: Loan categories

	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. Δ C&I Loans				
RSindex	0.3562	0.2794	0.4668**	0.3471*
	(0.2171)	(0.1829)	(0.2186)	(0.1850)
ΔMP	−0.1466		−0.0557	
	(1.2997)		(3.0512)	
$\Delta MP * RSindex$	−0.1423*	−0.1967**	−0.3466*	−0.3376**
	(0.0848)	(0.0856)	(0.1786)	(0.1654)
Observations	107,236	107,236	107,236	107,236
Adjusted R^2	0.0491	0.0513	0.0490	0.0514
Panel B. Δ Real Estate Loans				
RSindex	0.1189	0.0413	0.1084	0.1105
	(0.2714)	(0.2066)	(0.2483)	(0.2092)
ΔMP	−1.1776*		−3.8834***	
	(0.7058)		(1.0221)	
$\Delta MP * RSindex$	−0.0662	−0.1257**	−0.1845	−0.2790***
	(0.0557)	(0.0539)	(0.1141)	(0.1000)
Observations	107,579	107,579	107,579	107,579
Adjusted R^2	0.2163	0.2206	0.2172	0.2209
Panel C. Δ Consumer Loans				
RSindex	−0.1231	−0.1176	−0.0128	−0.1068
	(0.3225)	(0.2732)	(0.2753)	(0.2638)
ΔMP	−1.0930		−2.0453	
	(0.9113)		(1.2961)	
$\Delta MP * RSindex$	0.1040	0.0963	0.0180	−0.1056
	(0.0669)	(0.0748)	(0.1110)	(0.1154)
Observations	107,653	107,653	107,653	107,653
Adjusted R^2	0.0942	0.0994	0.0951	0.0996
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) using only single state banks for the three major loan categories: commercial and industrial (C&I), real estate, and consumer (personal). Dependent variable is the growth rate of each loan category. Data for different loan categories are from the Federal Reserve's Report of Condition and Income (Call Reports). C&I loans is variable rcfd1766, Real Estate loans is variable rcfd1410 and Consumer loans is variable rcfd1975. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 27: Alternative measures of bank competition

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A. State level Lerner index				
Competition	−34.8476***	−11.1236	−28.9800***	−16.6392**
	(5.1007)	(7.7649)	(4.8225)	(7.6046)
ΔMP	−5.0011***		−7.2919***	
	(1.6673)		(2.6110)	
$\Delta MP * Competition$	4.4898**	13.5267***	9.5888***	13.2614***
	(2.0847)	(2.8725)	(3.4547)	(4.6360)
Observations	101,215	101,215	101,215	101,215
Adjusted R^2	0.2668	0.2709	0.2668	0.2709
Panel B. Bank level Lerner index				
Competition	−27.8951***	−26.7129***	−27.5808***	−26.7280***
	(1.8263)	(1.8588)	(1.7587)	(1.7842)
ΔMP	−3.2332***		−2.4646**	
	(0.7095)		(1.0382)	
$\Delta MP * Competition$	3.4710***	3.8296***	1.2617	1.1786
	(1.0225)	(1.0490)	(1.5583)	(1.5831)
Observations	94,697	94,697	94,697	94,697
Adjusted R^2	0.3273	0.3329	0.3265	0.3323
Panel C. Log of county level Herfindahl-Hirschman Index (HHI).				
Competition	−1.9940***	−2.0349***	−2.1835***	−2.1977***
	(0.5721)	(0.5719)	(0.5792)	(0.5791)
ΔMP	−1.3742		−2.1338	
	(0.9601)		(1.7175)	
$\Delta MP * Competition$	0.2212***	0.2266***	0.4167***	0.3776***
	(0.0516)	(0.0522)	(0.0938)	(0.0942)
Observations	108,150	108,150	108,150	108,150
Adjusted R^2	0.2538	0.2582	0.2543	0.2586
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) using only single state banks, with three alternative measures of bank competition. For all three measures higher values indicate weaker bank competition. See Appendix A.1 for details on computing bank and state level Lerner index. The HHI is calculated each year using the deposit market shares of all bank branches in a given county. Branch deposit data is from the FDIC Summary of Deposits. Robust standard errors, clustered at the level of the competition measure, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 28: Testing alternative explanations

	$\Delta Loans$			
	Federal Funds Rate		Romer & Romer	
	(1)	(2)	(3)	(4)
Panel A				
$\Delta MP * RSindex$	−0.1158***	−0.1612***	−0.2012***	−0.2851***
	(0.0305)	(0.0287)	(0.0586)	(0.0550)
$\Delta MP * ROA$	−0.7013	−0.8512	−1.6467	−1.7372
	(0.5827)	(0.6029)	(1.8374)	(1.8465)
Observations	108,166	108,166	108,166	108,166
Adjusted R^2	0.2531	0.2576	0.2535	0.2580
Panel B				
$\Delta MP * RSindex$	−0.1057***	−0.1361***	−0.1859***	−0.2443***
	(0.0304)	(0.0281)	(0.0585)	(0.0553)
$\Delta MP * Risk$	−4.3062	−0.9449	−3.4101	−0.7403
	(7.2828)	(7.4645)	(12.4683)	(12.6750)
Observations	108,164	108,164	108,164	108,164
Adjusted R^2	0.2696	0.2740	0.2701	0.2745
Panel C				
$\Delta MP * RSindex$	−0.1200***	−0.1569***	−0.2626***	−0.2773***
	(0.0304)	(0.0286)	(0.0577)	(0.0546)
$\Delta MP * Efficiency$	−0.8733	−0.4719	0.3723	0.2166
	(0.8419)	(0.8638)	(1.4928)	(1.5388)
Observations	108,166	108,166	108,166	108,166
Adjusted R^2	0.2575	0.2608	0.2582	0.2612
Panel D				
$\Delta MP * RSindex$	−0.1378***	−0.1408***	−0.2307***	−0.2254***
	(0.0328)	(0.0328)	(0.0624)	(0.0623)
$\Delta MP * Securitization$	0.5240	0.5254	−2.5290	−2.5406
	(1.0773)	(1.0714)	(2.0385)	(2.0392)
Observations	52,655	52,655	52,655	52,655
Adjusted R^2	0.3203	0.3216	0.3207	0.3221
Bank controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Linear Trend	Yes	No	Yes	Yes

Notes: The table reports the results of estimating Eq. (2) using only single state banks, while controlling for alternative channels. Each variable is included in levels and interacted with the monetary policy shock. See Section 4.3.2 for alternative bank variable definitions. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01

Table 29: State specific linear time trends

	$\Delta Loans$	
	Federal Funds Rate	Romer & Romer
	(1)	(2)
$RSindex$	0.2721	0.2528
	(0.1917)	(0.1908)
ΔMP	-1.6119	-2.3908
	(1.0891)	(2.1161)
$\Delta MP * RSindex$	-0.1179^{***}	-0.1813^{**}
	(0.0453)	(0.0910)
Bank controls	Yes	Yes
State controls	Yes	Yes
Bank FE	Yes	Yes
State Specific Linear Trend	Yes	Yes
Observations	108,166	108,166
Adjusted R^2	0.2567	0.2571

Notes: The table reports the results of estimating Eq. (2) using only single state banks, while controlling for state-specific trends. Robust standard errors, clustered at the state level, are reported in parentheses. Estimation period is 1994-2008.

*p<0.1; **p<0.05; ***p<0.01