Interstate Banking Deregulation and Bank Loan Commitments*

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March 13, 2011

Abstract

This paper uses the staggering timing of branching and interstate banking deregulation as a natural experiment to explore the effect of agency cost on the use of bank loan commitments. A simple inventory-based model shows that lower agency cost allows a bank to issue more loan commitments because lower agency cost alleviates the difficulty of liquidity management associated with loan commitments. Our empirical analysis confirms the model's testable implication: Commercial banks issue more loan commitments after interstate banking deregulation, which lowers agency costs through expanded internal capital markets across states. However, the effect of branching deregulation is weak or non-existent. Considering the role of bank loan commitments, this result not only shows how banking deregulation affects bank balance sheets but also suggests one route through which interstate banking affects the real economy.

Keywords: loan commitments, interstate banking, internal capital markets
JEL classification: E40, E44, G21

*I gratefully acknowledge the discussions with Randall Kroszner, Susanne Schennach, Atif Mian, Craig Furfine, Anil Kashayp, Amir Sufi, Jean Imbs, Jin Wook Jeong, Kwanho Shin, Cheolbeom Park, Mathias Hoffman, and participants at the Macro/International Workshop at the University of Chicago and seminars at the Federal Reserve Board, Melbourne Business School, Yonsei University, Korea University, and Econometric Society World Congress 2010. I also would like to thank Adam Ashcraft and Richard Rosen for providing the most recent merger file of commercial banks and Donald Morgan and Philip Strahan for their data on interstate banking measures. All remaining errors are mine. The usual disclaimers apply.

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1 Introduction

Bank loan commitment (often called lines of credit), a formal contract by a bank to lend to a specific borrower up to a certain amount at pre-specified terms, is widely used and its use is getting popular over time, as documented by many researchers (Morris and Sellon (1995), Shockley and Thakor (1997), Ergungor (2001)). Figure 1 shows the increasing trends of total loan commitments and other loan commitments with the time-series of total loans and C&I (commercial and industrial) loans.[1] Not only they increased very fast during the last 20-30 years, but also they exhibited the interesting patterns during the recent financial crisis. Figure 2 clearly shows that the share of *unused* loan commitments to total loans declined as the credit spread, a proxy of liquidity in financial markets, widened during the crisis. The share of other loan commitments to C&I loans, which is more relevant to manufacturing firms, declined more sharply during the same period. Ivashina and Scharfstein (2010) document that C&I loans did not drop much during the financial crisis of 2008 and show that it was made by firms' drawing down their credit lines. Figure 2 seems to support their finding. This evidence suggests that firms draw down funds from their existing credit line when market liquidity dries up, implying the significance of loan commitments to the real economy. In addition, empirical studies by Morgan (1998), Jimenez et al. (2009), and Park and Lee (2010) show that loan commitments play a role of additional funding sources especially when market liquidity becomes scarce, suggesting that loan commitments may have real effects to the macroeconomy.

Considering this increased significance of loan commitments for on- and off-balance sheets of commercial banks and economic activity, we attempt to answer the following question: what determines the optimal amount of loan commitments to be issued by a bank? We develop a simple model based on a variant of famous "newsboy problem" in operation research literature and show that a bank with lower agency cost, which can finance funds more cheaply through internal and/or external sources, issues more loan commitments.[2]

[1] Other loan commitments are usually for C&I loans.

[2] For a newsboy who sells papers on a street corner, the demand is uncertain, and the newsboy must decide how many papers to buy from his supplier. If he buys too many papers, he is left with unsold papers that have no value at the end of the day; if he buys too few papers, he has lost the opportunity of making a higher profit. Like a newsboy, a bank with loan commitments needs to control the level of liquidity in face of uncertain liquidity demand. One caveat on the modeling strategy in this paper is that it does not pay much attention to the informational value of loan commitments.

Once the model identifies the ability of tapping uninsured funds with lower cost as one of the key parameters in issuing loan commitments, the next problem is to find an exogenous change in agency cost and to test if loan commitments respond to an exogenous change in agency cost. Table 1 shows that large banks and MBHC (Multi-Bank Holding Company)-affiliated banks use more loan commitments compared to small banks and stand-alone banks. Previously, bank size was often used as a proxy for agency cost a bank face, as shown in Kashyap and Stein (2000), and MBHC-member banks are regarded as those with lower agency cost because of their internal capital markets, as in Campello (2002) and Ashcraft (2006). But, at the individual bank level, it seems more natural to expect individual bank size and affiliation to be less exogenous than state-level deregulation. This is why we use branching and interstate banking deregulation as a natural experiment for an exogenous change of agency cost and add up individual banks' balance sheet variables to the state-level and test at the state level. Another reason for performing our empirical study at the state level is to exploit the different timings of deregulation at the state-level to have more variations. Additionally, a state-level test can alleviate the problem of survivorship bias of individual banks. More importantly, this state-level test enables us to attempt to answer another question on a link between banking deregulation and the real economy, which we'll explain below.

Figure 3 and 4 show that interstate banking and branching deregulation took place in each state or cohort at different timings.[3] It is because the state regulatory authority has discretion over whether to permit branching and interstate banking deregulation or not. This state-level staggering timing of deregulation provides a nice empirical laboratory since it gives room for much cross-sectional and time-series variation. Using this variation, we test if the use of loan commitments by commercial banks has increased after interstate banking and branching deregulation.

Figure 5 shows the kernel densities of the ratio of loan commitments to total loans, our proxy of intensity of using loan commitments, before and after interstate banking deregulation. The density after deregulation moved to the right. The average value before deregulation is 0.23 with standard deviation of 0.14, while the average after deregulation is 0.41 with standard deviation of 0.27, suggesting that the use of loan commitments increased after deregulation. Figure 6 shows a more clear picture. It shows that the ratio of total unused commitments to total loans increased in most states after interstate banking deregulation.

[3]See Kane (1996), Kroszner and Strahan (1999), and Morgan et al. (2004) for more details on deregulation process.

In sum, our objective is to test if staggering timing of interstate banking and branching deregulation, as shown in figure 3 and figure 4, can explain the increased use of loan commitments, described in figure 5 and 6, after controlling for the increasing time trend, state-level industry structures, different bank balance sheet variables. Our empirical study shows that banks issue more loan commitments *after* interstate banking deregulation while the effect of branching deregulation is not found. Alternatively, our result suggests that financial integration *across* states, enabled by expanded internal capital markets, contributed to lowering banks' agency cost more, compared to financial integration *within* each state.

While we start from looking for a link between agency cost and bank loan commitments, this state-level test leads us to attempt to answer another important question on a link between banking deregulation and the real economy. Recent studies have shown that banking deregulation from 1970s, including interstate banking, was beneficial to the real economy. Strahan (2003) shows that U.S. banking deregulation has contributed to increased income, less volatile growth, and more startup companies. Morgan et al. (2004) show that interstate banking has contributed to increased macroeconomic stability. Demyanyk et al. (2007) and Hoffmann and Shcherbakova-Stewen (forthcoming) also show that banking deregulation contributed to better risk-sharing of income and consumption across states.[4] All these studies explicitly or implicitly emphasize the increased capital mobility within and across states after deregulation. One question naturally arises. How do or can increased capital mobility affect the real economy? Our empirical finding sheds some light on this black box. Use of bank loan commitments, which became more active after interstate banking deregulation, may contribute to macroeconomic stability and risk sharing, considering the role of loan commitments suggested in figure 2, Ivashina and Scharfstein (2010), and Park (2010).[5] In this regard, our study not only find a link between agency cost and loan commitments but also suggests one route how interstate banking affect the real economy, which was not delved into in previous studies.

The rest of the paper is organized as follows. The next section presents a simple one-period model which highlights a bank's liquidity management problem in choosing between term loans and

[4] However, they focus more on intrastate banking deregulation.

[5] An empirical study by Park (2010) more explicitly shows the macroeconomic effect of bank loan commitments. It finds that volatility of state-level GDP increases with widening credit spreads and this tendency is found to be weaker in states where usage of loan commitments is high.

loan commitments. It also discusses the literature on internal capital markets and agency costs. Section 3 and 4 will test the model's implication and discuss robustness tests. The final section concludes with the summary and implications for the real economy.

2 Model

2.1 Framework

This section introduces a simple one-period model to highlight the determinants of using loan commitments.[6] A simple case will show how the optimal amount of loan commitments is affected by the degree of adverse selection in capital markets, the degree of uncertainty in borrowers' liquidity demand and other parameters. When the amount of liquidity held inside a bank falls short of the realized takedown from loan commitments, the bank needs to make up for the shortfall. In this situation, the options open to the bank are (1) to get uninsured funds through external financing and (2) to reduce the amount of term loans to be issued. The relative importance of these two options depends on their relative marginal costs. In this paper, we assume that a bank can use only the first option, borrowing from outside, since it suffices to derive the testable implication of our interest.[7]

The one-period model is designed to capture the following characteristics of a bank in a minimalist fashion: (1) a bank provides funds to its customers via term loan (N) or commitment loan (C); and (2) it should maintain a buffer stock of liquid assets (S) inside to meet the unexpected takedown of loan commitments; but (3) it is costly for a bank to raise external funds in case where the amount of takedown is larger than the buffer stock of liquidity. Under this setting, a bank faces a problem of liquidity management. If it piles up too much liquidity inside, it loses more profitable investment opportunities through term loans or commitment loans. To the contrary, it incurs a penalty of more expensive external financing when the expected level of liquidity is smaller than the amount of realized takedown.

In the beginning of the period (period 0), a bank is endowed with deposit D, which is to

[6] The framework is similar to the one in Kashyap et al (2002). They focus on the synergy effect in saving liquidity by dealing with loan commitments and demand deposit under one roof.

[7] It is possible to extend the model, which allows a bank to recall term loans or cut down new loans. An extended version produces another testable implication on the relative share of term loans and loan commitments. However, it is not our main focus.

be optimally divided into term loans and liquidity inside. A bank can make profits by issuing term loans with the rate of r_N. When a bank issues loan commitments, it receives a total contract fee $f(C)C$ where $f(C) = j - hC$ $(j, h > 0)$ and earns r_C per unit of realized takedown.[8] The actual takedown will be determined by a random variable $z \in [0, 1]$, which is realized after a bank's portfolio decision. We assume that z is uniformly distributed in the range of $[a, b]$ where $0 \leq a < b \leq 1$. The difference between term loans and loan commitments is that, in case of the latter, a bank should face the uncertainty of how much of funds will be taken down. If it fails to meet the realized takedown (zC) with the predetermined buffer stock (S_0), it should raise external finance as much as $B = max[zC - S_0, 0]$ at the end of the period (period 1). In order to get a closed-form solution, cost function takes a simple form of $H(B) = \alpha(zC - S_0)$ when $zC > S_0$ with properties of $H'(B) > 0$ and $H(0) = 0$.[9] It is reasonable to assume $\alpha > r_N$ because α can be interpreted as the penalty cost of external financing incurred when it fails to predict the loan commitment takedown correctly. In addition, the parameter α measures the degree of adverse selection problem a bank faces in the capital markets. For example, we expect α to be lower for large banks and MBHC-member banks because they tend to suffer less from capital market imperfections.

A bank seeks to maximize its expected net income:

$$\max_{C,S_0}.E[r_N N + f(C)C + r_C zC - H(B)]$$

subject to

$$N + S_0 = D, \tag{1}$$

$$N + zC + S_1 = D + B, \tag{2}$$

and

$$S_1 = \max\left\{S_0 - zC, 0\right\} \tag{3}$$

where equation (1) and (2) are balance sheet constraints for period 0 and 1 respectively. If the

[8] According to Ergungor (2001), the fee structure may include a commitment fee, which is an up-front fee paid when the contract is made; an annual service fee, which is paid on the borrowed amount; and a usage fee, which is levied on the unused amount. I assume that only commitment fee is charged.

[9] Stein (1998) derives a quadratic form of cost function in a more formal model where there is an adverse selection problem in a bank's uninsured liabilities. When we use a quadratic form, our main results remain untouched. However, closed-form solutions are not available in that case.

period 0 liquidity (S_0) is not sufficient for takedown, additional fund needs to be obtained. This is reflected in (3). Since external financing is necessary only when $zC > S_0$, expected external financing cost function is given by

$$
\begin{aligned}
E[H(B)] &= \int_a^b \alpha(zC - S_0)dF(z) \\
&= \alpha \int_{S_0/C}^{b} (zC - S_0)dF(z) + \alpha \int_0^{S_0/C} 0dF(z) \\
&= \alpha \int_{S_0/C}^{b} (zC - S_0)dF(z)
\end{aligned}
$$

Reformulating the maximization problem gives

$$\max_{C,S_0} .E[r_N(D - S0) + (j - hC)C + zr_C C] - \alpha \int_{S_0/C}^{b} (zC - S_0)dF(z)$$

The first order conditions are

$$[C] : r_C \mu_z + j - 2hC^* = \frac{\alpha}{2}(b^2 - \frac{S_0^{*2}}{C^{*2}})$$

$$[S_0] : r_N = \alpha(b - \frac{S_0^*}{C^*})$$

And the optimal amount of term loans N^* is determined with S_0^* in (1).

The comparative statics for some parameters of our interest shows intuitive results. The first result is about the effect of external financing ability on loan commitments. A bank which faces more severe adverse selection problem in the capital markets (higher α) tends to issue less loan commitments, as shown in equation (4):

$$\frac{\partial C^*}{\partial \alpha} = -\frac{r_N^2}{4h\alpha^2} < 0. \tag{4}$$

Other theoretical studies on the existence of loan commitments predict that small banks and small firms can benefit more from using them since information-intensive activity of using loan commitments may alleviate their agency problem in financial markets. However, our data shows loan commitments prevail far more in large banks and MBHC-affiliated banks, as shown in Table 1. They appear to face lower agency costs in financial markets compared to small banks and stand-alone banks. Consistent with these real world observations, equation (4) implies that the role of liquidity management in issuing loan commitments may be more important than informational values accrued from bilateral agreements. Note that this result is pertinent to the supply side of loan commitments.

As one characteristics of demand side, it would be interesting to see the effect of uncertain takedown on loan commitment issuance. Letting $b = b' + \epsilon$ and $a = a' - \epsilon$, increasing ϵ is equivalent to increase the variance of z leaving its mean unchanged. The second comparative statics shows

$$\frac{\partial C^*}{\partial \epsilon} = -\frac{r_N}{2h} < 0,$$

which implies that a bank with more uncertain liquidity demand from loan commitments tends to rely less on loan commitments. This explains why many banks often imposes usage fees. By charging usage fees on the amount of *unused* loan commitments, it helps a bank better predict the actual amount of loan takedown and more easily manage liquidity.

As to the optimal amount of liquidity held inside, there are two opposing forces. Higher external financing cost (higher α) makes a bank hold more liquidity given C, while it also deters a bank from issuing loan commitments, leading to less demand for liquidity. Equation (5) shows this intuition[10]:

$$\frac{\partial S_0^*}{\partial \alpha} = (1 - \frac{r_N}{\alpha})\frac{\partial C^*}{\partial \alpha} + \frac{r_N}{\alpha^2} C^* \gtrless 0. \tag{5}$$

While it is possible to perform the comparative statics with all the parameters in the model, the first result provides our prediction for empirical analysis.

Proposition 1. *A bank with less severe adverse selection problem in capital markets or with cheaper sources of external funds will issue more loan commitments. Following our notations,* $\partial C^*/\partial \alpha < 0$.

The above proposition implies that larger banks, which face less adverse selection problem in capital markets, and MBHC-affiliated banks, which have internal capital markets, are expected to issue more loan commitments compared to smaller and stand-alone banks. We'll look at the

[10]If the response of loan commitments is not too negative, we expect $\frac{\partial S}{\partial \alpha}$ to be positive. More formally, a sufficient condition for $\frac{\partial S}{\partial \alpha} > 0$ is

$$\frac{r_N}{\alpha(r_N - 1)} < \frac{\partial C^*/\partial \alpha}{C^*} < 0.$$

That is, it says that the elasticity of C to α should not be too negative.

evidence to confirm this prediction below.

2.2 Agency Cost and Interstate Banking Deregulation

In order to test the effect of agency cost on the issuance of bank loan commitments ($\partial C^{*}/\partial \alpha$), we need to find an exogenous change in agency cost (α). Rather than comparing by size, which seems to be endogenous, we interpret the regulatory changes regarding interstate banking and branching as a natural experiment and use them as an identification of exogenous change in α.[11] We conjecture that capital mobility across states increased after interstate banking deregulation. Subsequently, better functioning of internal capital markets and increased capital mobility across states would help subsidiary banks issue more loan commitments. This is our hypothesis for empirical analysis.

Previous studies confirm the role of bank holding companies and internal capital markets, which can be another source of funds to distressed subsidiaries. Ashcraft (2008) shows that a bank affiliated with an MBHC is safer than either a stand-alone bank or a bank affiliated with a one-bank holding company. The Federal Reserve's source-of-strength doctrine seems to force bank holding companies to help their distressed subsidiaries. He also shows that affiliated banks are better able to shield the effect of monetary tightening on bank loan supply by replacing insured deposits with external funds. He attributed these findings to the presence of internal capital markets.

Houston et al. (1997) show that the loan growth of a subsidiary bank is more sensitive to cash flow and capital of the holding company than on the subsidiary's own cash flow and capital. Their conclusion is that holding companies represent internal capital markets through which scarce funds are allocated among subsidiaries in different locations.

These studies support our argument that interstate banking lowers agency costs through internal capital markets across states and lower agency costs in turn make banks issue more loan commitments. This is what we are going to test in the following section.

[11] Deregulation can be endogenous. We'll come back to this issue below.

3 Empirical Analysis

3.1 Data

In the analysis below, I use quarterly data on the population of all insured commercial banks from the Federal Reserve's Report of Condition and Income, often called the Call report. To make a consistent data set, I heavily borrow the variable definitions and exclusion criteria used in Kashyap et al. (2002), Campello (2002), and Ashcraft (2006). One must be careful in making consistent time-series data since there are changes in accounting practices and numerous bank mergers that bring jumps in balance sheet variables. The appendix provides a more detailed note on how to make the variables for our empirical analysis. Although the Call report is available from 1976, the sample period in the analysis is limited to 1984:II-1999:IV because of the availability of loan commitment data, key variable in the analysis. Total unused commitment series is available from 1984:II, while other related variables such as credit card lines and commitment to fund loans secured by real estate are available from 1990:I or 1991:I.

The Call report has a merit that it is the population of all commercial banks, not a sample. Also it has detailed information on bank on- and off-balance sheets. However, there are some missing and misreported numbers. To fix these and remove outliers, all the observations which are not considered as normal operations of banks are eliminated. In detail, observations of bank-quarter with asset growth in excess of 50 percent, those with loan commitments-to-total loans ratio exceeding 4, those with the ratio of total loans to asset below 10 percent, and those with total loan and C&I loan growth rates exceeding 100 percent are eliminated. In addition, the observations with the ratio of non-performing loans to total loans in excess of 50 percent and with the ratio of C&I loans to total loans exceeding 100 percent are dropped. All the bank entities with less than five consecutive quarters are removed from the sample. This screening dropped approximately 7.7% of observations, from the population of 812,970 bank-quarter observations. I also use the most recent merger file from the Federal Reserve Bank of Chicago, used in Ashcraft (2006), to exclude the bank-quarter observations which are involved in mergers since they may create jumps in balance sheet variables unrelated to the real economic activity.

After aggregated to the state level, the state-quarter observations are dropped if COM (= unused amount of loan commitments/total loans) is larger than 2. 28 of 29 observations with

$COM > 2$ are from Delaware, which is peculiar with its credit card business.

3.2 Empirical Specification

Our prediction from the model is that banks with less severe agency problem in capital markets will use more loan commitments because ability of tapping into uninsured funds will help banks manage their liquidity associated with loan commitments. Using the model's notation, we expect $\partial C^*/\partial\alpha < 0$.

Table 1 shows the ratio of unused loan commitments to total loans (COM) and the ratio of other unused commitments to total loans by size and MBHC-membership over time. Even without considering the informational role of loan commitments, our simple model, based on liquidity management approach, can explain the real world observations. Because larger banks and MBHC-affiliated banks are considered to face less severe adverse selection problem in financial markets, compared to smaller banks and stand-alone banks, patterns in Table 1 correspond to the model's prediction that lower α motivates banks to issue more loan commitments.

However, the conclusion based on summary statistics in Table 1 may be indecisive because we do not have exogenous variations in α, our measure of a bank's adverse selection problem in external capital markets. In order to support our conjecture, we test the hypothesis more formally using differences-in-differences (DD) estimation, taking branching and interstate banking deregulation as a natural experiment for exogenous changes in agency costs.

The logic is that, if branching and interstate banking deregulation from 1970s allow many banks to use internal capital markets through mergers, those banks would experience lower agency costs because of internal capital markets and tend to issue more loan commitments. As pointed above, branching and interstate banking deregulation took place in waves, rather than all at once. As Figure 3 and 4 show, staggering timing of deregulation provides a good source of cross-sectional and time-series variations to estimate the effect of regulatory changes on the variable of our interest. If this logic works, we expect to observe a 'jump' in using loan commitments at the time of bank deregulation, which will be captured by dummy variables taking a value of one after deregulation. In this regard, the estimation boils down to capturing the effect of deregulation after taking into account the time trend, unobserved state differences, and aggregate shocks. We estimate the following regression equation:

$$COM_{it} = c + \alpha_I D^I_{it} + \alpha_B D^B_{it} + (\text{control for industry structure})_{it} \\ + (\text{control for bank B/S variables})_{it} + (\text{time fixed effects}) + \alpha_i + u_{it}, \quad (6)$$

where i indexes states, t indexes time, COM_{it} is the ratio of loan commitments to total assets, and α_i is state-specific fixed effect. D^I_{it} and D^B_{it} are deregulation indicators. They take a value of one in all state-quarters after deregulation, and they take a value of zero in all state-quarters before deregulation. For example, D^I_{it} of Illinois that permitted interstate banking in 1986 equals one in all state-quarters from 1987. For controlling for state-level industry structures or differences in initial endowment in each state, ratios of seven industries' sectoral income relative to total non-farm earnings are included. These seven industries are mining, construction, manufacturing, transportation, trade, finance, and services. For state-level bank balance variables, log of real bank assets and the ratio of security to total assets are included as proxies for the share of banking industry and liquidity position in each state. As a proxy for loan quality, the ratio of non-performing loans to total loans is added. The ratio of bank equity to total assets is included, since it can play as a buffer stock to external shocks. Finally, the ratio of transaction deposits to total assets is added, since transaction deposits can be used as an additional funding source.

Our first hypothesis to test is $\alpha_I > 0$, implying that the use of loan commitments increases following interstate banking deregulation. In addition, we expect that the estimate of α_I is larger than that of α_B because branching deregulation allowed integration *within* a state rather than *across* state lines. In other words, if the parameter α in the previous section would be affected more by integration across states, we expect $\alpha_I > \alpha_B > 0$.

3.3 Results

Table 2 shows the results from fixed effect panel regression of (6). Following the definition of our dummy variables D^I_{it} and D^B_{it}, column (1) shows the average 'jump' in the use of loan commitments after deregulation. Both coefficients, α_I and α_B are positive and statistically significant as expected. According to column (1), the average ratios of loan commitments to total loans increase by 10 percent ($\hat{\alpha}_I = 0.10$) and 5 percent ($\hat{\alpha}_B = 0.05$) after interstate banking and branching deregulation, respectively.

When we add the state-level industry structure (column (2)), both estimates are still significant, although they become smaller to 4 percent and 2 percent.[12] State-level bank balance sheet variables also have explanatory power (Column (3)). Bank size, equity ratio, and share of transaction deposits seem to be the important factor in determining the use of loan commitments. The estimation result shows that the states with active and well-managed banking industry issue more loan commitments. One thing interesting is that the coefficient of bank equity ratio is significant while that of bank liquidity is not, which is related to equation (5). It is possible to interpret that there can be many factors for the optimal level of liquidity inside and bank capital as a buffer stock might be more important in determining the amount of loan commitments to be issued.

As shown in figure 1, it is important to take into account the increasing time pattern of loan commitments. Column (4) includes time fixed effects, which are common to all states. Including time fixed effects takes away the explanatory power of branching deregulation. We obtain $\hat{\alpha}_I = 0.05$ and $\hat{\alpha}_B = 0.00$ while the former is still statistically significant. Column (5) shows the result when we exclude the 'early' and 'late' states. These states relaxed the regulation too early or too late so that their dummies are either zero or one during the whole sample period. It shows that we obtain $\hat{\alpha}_I = 0.03$, with high statistical significance. Given these results, we can conclude that interstate banking explains the increased use of loan commitments while branching deregulation cannot. This result suggests that interstate banking made agency costs in financial markets lower through increased capital mobility after interstate banking deregulation.[13] In sum, our baseline estimation results suggest that the ratio of bank loan commitments to total loans increases by 5 percent, even after controlling for the state-level industry structures, bank balance sheet variables, and the time trend.

[12] Although not reported here, we find that the use of loan commitments is more intensive in the states with high shares of tertiary industries such as trade and finance.

[13] One might think that the effect of interstate banking deregulation is not permanent and it would last for a relatively short time after deregulation. We also try the dummies which take one only for 20 quarters (5 years) right after deregulation, not for every quarter after deregulation. The result (not reported here) shows that $\hat{\alpha}_I = 0.02$ with higher statistical significance. The fact that $\hat{\alpha}_I = 0.02$ is smaller than 0.05 in column (4) in Table 2 suggests that the regulatory change affects the use of loan commitments even after 5 years.

3.4 Robustness Tests

3.4.1 Different Dependent Variables

Our dependent variable in the baseline specification is the ratio of total unused loan commitments to total assets. Considering that loan commitments require an issuing bank to hold a certain level of liquidity to prepare for an unexpected takedown, another candidate for the dependent variable can be a function of the unused amount of loan commitments and liquidity held inside. In this regard, we run the same regression with COM^{liquid}, which is defined as (total unused loan commitments/liquid assets). Liquid assets are defined as the state-level sum of cash and securities that banks hold in the corresponding state.

Table 3 shows the results. In the simplest setting, column (1) shows that COM^{liquid}, (total unused loan commitments/liquid assets), increases by 37 percent ($\hat{\alpha}_I = 0.37$) and 14 percent ($\hat{\alpha}_B = 0.14$) after deregulation. Column (2) and (3) show how $\hat{\alpha}_I$ and $\hat{\alpha}_B$ change as we add more explanatory variables to control for the state-level industry structure and bank B/S variables. Both estimates get smaller. Moreover, additional covariates take away the effect of branching deregulation again, making $\hat{\alpha}_B$ virtually zero.

When we add year dummies, column (4) shows that the explanatory power of $\hat{\alpha}_I$ still survives with statistical significance, suggesting that banks issue loan commitments by 18 percent more for one dollar of liquid assets after interstate banking deregulation. Although $\hat{\alpha}_I$ becomes smaller when we control for 'early' and 'late' states, the effect of interstate banking deregulation (α_I) is still significant. We conjecture that it was made possible by increased capital mobility after deregulation.[14]

3.4.2 Robust Standard Errors

We use heteroskedasticity-robust standard errors in the previous section. However, Bell and McCaffrey (2002) compute the small sample bias of the White standard errors and show that this bias is larger for variables that are constant or nearly constant within cluster, which is typical to the treatment variables used in the DD model. Our treatment variables D^I and D^B are not

[14] Although not reported here, we also check the temporary effect of deregulation by replacing D^I_{it} and D^B_{it} with dummies taking one only for five years after deregulation. We obtain $\hat{\alpha}_I = 0.11$ with t-value of 4.73 and $\hat{\alpha}_B = 0.01$ with t-value of 0.32. $\hat{\alpha}_I = 0.11$, smaller than 0.18 in column (4), suggests that we have a long-lasting effect which persists longer than 5 years.

an exception because they take a value of zero before deregulation and take a value of one after deregulation within a state. As Bertrand et al. (2004) emphasize, serial correlation may make a false rejection of the null hypothesis of no effect more likely. In addition, Stock and Watson (2008) suggest that conventional heteroskedasticity-robust standard errors for the fixed effects estimator are not consistent and recommend using cluster-robust standard errors.

We address this problem by using cluster-robust standard errors and Driscoll-Kraay standard errors following Driscoll and Kraary (1998) in order to check the robustness of our estimation results. For the latter, the error structure is assumed to be heteroskedastic, autocorrelated up to some lag, and possibly correlated between the clusters (panels).[15] These standard errors are robust to very general forms of cross-sectional and temporal dependence when the time dimension becomes large.

Table 4 shows the results. We use two different dependent variables, COM and COM^{liquid}. Columns (1)-(4) show the result when we use cluster-robust standard errors to calculate t-values and while columns (5)-(8) are based on Driscoll-Kraay standard errors. One thing noticeable is that we cannot find a statistical evidence for the effect of branching deregulation on the use of loan commitments. $\hat{\alpha}_B$ is virtually zero in all columns, from (1) to (8). In contrast, $\hat{\alpha}_I$ is highly significant in most specifications. Only exception is column (4) in which we obtain $\hat{\alpha}_I = 0.18$ with t-value $= 1.63$. However, even in this case, p-value is 0.11, which we cannot easily dismiss.

In sum, even with standard errors robust to heteroskedasticity and serial correlation within cluster, we find that the use of loan commitments (whether it is measured in terms of total loans or liquid assets) increases after interstate banking deregulation. The effect of branching deregulation cannot be found.

3.4.3 Cross-Guarantee Provisions

Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989 created cross-guarantee provisions, making affiliated institutions in a bank holding company group liable for losses incurred by a failed institution in the group. In other words, it permitted a bank to shift any expected losses associated with the failure of a banking subsidiary onto the capital of non-failing

[15] The maximum lag of autocorrelation is determined by the closest integer to $4(T/100)^{(2/9)}$ where T is 63 in our case.

affiliate banks. Ashcraft (2008) documents that a bank affiliated with an MBHC is significantly safer than either a stand-alone bank or a bank affiliated with a one-bank holding company and this benefit of becoming a member of MBHC is larger after cross-guarantee provisions were introduced in 1989.

As shown in figure 3 and 4, many states lifted up their regulation on interstate banking and branching in the late 1980s. This timing may mix the effect of interstate banking and branching deregulation with that of cross-guarantee provisions. To check this possibility, we add a dummy variable which takes a value of one after 1989 in the regression and let it compete with D_{it}^I and D_{it}^B. The result shows that the effect of cross-guarantee provision does not take away the effect of interstate banking on the use of loan commitments.[16] When we do not have D_{it}^I and D_{it}^B in the regression, the dummy of cross-guarantee provision has a positive coefficient with statistical significance. However, when we add D_{it}^I and D_{it}^B and let three kinds of dummies compete, the explanatory power of cross-guarantee provision vanishes. In addition, the estimates of D_{it}^I is still 0.06 with similar standard errors, as shown in columns (1), (2), (5), and (6) in Table 4. The effect of interstate banking deregulation on loan commitments is robust to the introduction of cross-guarantee provisions.

3.4.4 Loan Commitments and Internal Capital Markets

Kroszner and Strahan (1999) find branching deregulation occurs earlier in states with fewer small banks, in states where small banks are financially weaker, and in states with more small, presumably bank-dependent, firms. In addition, a larger insurance industry delays deregulation when banks may compete in the sale of insurance products. Their story of 'winners' (large banks and small firms) and 'losers' (small banks and insurance firms) suggests the possible endogeneity of deregulation timing.

If the dependent variable is output-related like GDP growth rate, it would be easy to set up an endogeneity link in our regression specification. For example, suppose that a sharp drop of oil price bankrupts many people and banks in Texas. In this situation, the state regulatory authority may permit interstate banking in order for bad banks in Texas to be merged by the

[16] We do not provide the result because adding the dummy left all other estimates and standard errors almost untouched.

out-of-state banks. In our regression context, the deregulation indicator D^I would be correlated with unobserved shocks, which also affects the dependent variable, GDP growth rate. In this case, the indicator should be instrumented by other variables orthogonal to shocks. However, since our dependent variable COM is not a measure of output or overall economy-wide performance, it is not easy to apply the similar story.

Our main interest is to see the link between COM and a measure of capital mobility after interstate banking deregulation. Morgan et al. (2004) develop a measure of interstate banking, called 'interstate asset ratio ($ISAR$).' Higher values of this measure correspond to deeper financial integration and increased capital mobility across states. In this regard, we expect a positive correlation between this measure and our measure of bank loan commitments because our conjecture is that banks would issue more loan commitments due to lower agency cost, made possible by more active internal capital markets. Using their yearly measure from 1984 to 1994, the correlation coefficient between $ISAR$ and COM is 0.41. It can be interpreted that the use of bank loan commitments increases as we have freer flows of funds across states. This adds another support for our finding.

4 Conclusion

In the 1970s, commercial banks operated under regulations on various aspects: Restrictions on interest rates (Regulation Q), restrictions on opening branches in other states, buying out-of-state banks, operating in other states, and restrictions on engageable financial activities. Today, almost all of these restrictions have been lifted up, reflecting changing environments in financial markets and improved information technology. Among those deregulations, we focus on interstate banking and branching deregulation. Relaxing interstate banking regulation allows a bank in one state to acquire banks in other states. This facilitates freer flow of funds *across* states, mainly through internal capital markets overseen by MBHCs. Even in external capital markets, MBHC-affiliated banks face less severe adverse selection problem and finance funds more easily compared to a stand-alone bank of the same characteristics. Branching deregulation does a similar role, but *within* a state. In this regard, we interpret deregulation process as a bank's improved ability of tapping uninsured funds through cheaper external financing or more active internal capital markets, which will help liquidity management associated with loan commitments.

We use interstate banking and branching deregulation as a natural experiment. Since subsidiary banks can get funds from their bank holding company when they need, interstate banking deregulation makes banks issue more loan commitments because it alleviate the problem of liquidity management. Our empirical study confirms this prediction: banks issue more loan commitments after interstate banking deregulation. And this main result is robust to various specifications and additional indirect evidences are examined.

Recently, empirical studies by Strahan (2003), Morgan et al. (2004), Demyanyk et al. (2007), and Hoffmann and Shcherbakova-Stewen (forthcoming) focus on the real effects of interstate and intrastate banking deregulation and attempt to answer the question of *if* such deregulation contributes to increased macroecnomic stability. Then, the next question naturally arises: *how* does or can interstate banking contribute to increased macroeconomic stability? There are few studies on this question and economists' guess is that it would be made possible through extended internal capital markets. In this regard, our empirical finding shows not only the effect of interstate banking on banks' using loan commitments but also suggests one link between banking deregulation and the real economy. Considering the role of loan commitments, as implicitly shown in figure 2, we identify one channel how interstate banking deregulation affects the real economy. Finding more concrete evidence on the role of loan commitments for the real economy would enhance our understanding of interactions between financial markets and the macroeconomy.

A Appendix: Definition of Variables

All bank balance sheet variables are available at the Federal Reserve Bank of Chicago website (http://www.chicagofed.org). Whenever available, I follow the definitions in Kashyap et al (2002), Campello (2000), and Ashcraft (2006).

Assets: total assets are taken from RCFD2170.

Total loans: the item RCFD2125 (total loans, net of unearned income) is used for total loans.

Balance: this variable is defined as the ratio of security to total assets. The amount of security a bank holds is defined as RCFD0390 (securities, book value) plus RCFD1350 (federal funds sold) up until 1993:IV. After that, it is the sum of RCFD1754 (held-to-maturity securities, total), RCFD1773 (available-for-sale securities, total), and RCFD1350.

Non-performing loans: following the definition used in Campello (2002), it equals the ratio of RCFD1407 (loans over 90 days late), plus RCFD1403 (loans not accruing), to total loans.

Commitments: For total unused commitments, the item RCFD3423 is used, which is available for 1983:II-1999:IV. This measure is equal to the sum of RCFD3814 (revolving, open-end lines secured by 1-4 residential properties, e.g. home equity lines), RCFD3815 (credit card lines), RCFD3816 (commitment to fund loans secured by real estate), RCFD3817 (securities underwriting), RCFD3818 (other unused commitments), and RCFD6650 (commitment to fund loans not secured by real estate) from 1991:I.

Industry labor income shares: The data is obtained from the Bureau of Economic Analysis website (http://www.bea.doc.gov). I use the nine industry codes: 100 = agricultural services, forestry, fishing and other, 200 = mining, 300 = construction, 400 = manufacturing, 500 = transportation and public utilities, 610 = wholesale trade, 620 = retail trade, 700 = finance, insurance, and real estate, 800 = services, 900 = government and government enterprises. For trade industry, it is the sum of wholesale and retail trade. To get labor income shares, all industry incomes are divided by non-farm earnings (code = 82).

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Table 1: **Increased Use of Bank Loan Commitments**

Top 1 percent in terms of average assets during the sample period are categorized into 'large banks.' Banks between below 1 percent and top 5 percent are named as 'medium banks' and below 5 percent are defined as 'small banks.' If a bank is affiliated with MBHC, it is an MBHC-affiliated banks. Otherwise, it is called stand-alone banks. The numbers are average values in each size/MBHC-affiliation and the numbers in parentheses are medians. *COM* is defined as (total unused commitments/total loans) and *CICOM* is defined as (other unused commitments/C&I loans). *CICOM* is available from 1990Q1 because 'other unused commitments' item in the Call report was not reported before 1990Q1. Source: authors' calculation based on the Call report.

	1984Q2		1990Q1		1999Q4	
Size/MBHC-affiliation	*COM*	*CICOM*	*COM*	*CICOM*	*COM*	*CICOM*
Large banks	0.40 (0.38)	N/A	0.55 (0.48)	1.08 (1.05)	0.63 (0.51)	1.57 (1.30)
Medium banks	0.16 (0.11)	N/A	0.27 (0.20)	0.55 (0.41)	0.28 (0.25)	0.93 (0.83)
Small banks	0.03 (0.00)	N/A	0.10 (0.07)	0.35 (0.13)	0.15 (0.12)	0.71 (0.48)
MBHC-affiliated banks	0.06 (0.00)	N/A	0.12 (0.08)	0.28 (0.08)	0.16 (0.13)	0.72 (0.51)
Stand-alone banks	0.02 (0.00)	N/A	0.08 (0.05)	0.40 (0.02)	0.14 (0.11)	0.61 (0.39)

Table 2: **Baseline Fixed Effects Regressions**

This table reports quarterly fixed effects regression results using the specification below. The dependent variable COM_{it} is the ratio of a state i's total unused amount of loan commitments to bank assets at time t. D^I_{it} is a dummy which takes a value of one after interstate banking deregulation of state i and D^B_{it} is a dummy for branching deregulation. Column (4) reports the result when yearly time dummies are included and column (5) reports the result when 'early' and 'late' states (Alaska, Connecticut, Hawaii, Maine, Massachusetts, New Yorks) are excluded. t-values calculated using heteroskedasticity-robust standard errors are reported in parenthesis. Coefficients denoted "**" are statistically different from 0 at the 5% level and those denoted "*" are statistically different from 0 at the 10% level.

$$COM_{it} = c + \alpha_I D^I_{it} + \alpha_B D^B_{it} + \text{(control for industry structure)}$$
$$\text{(control for bank B/S variables)} + \text{(time fixed effect)} + \alpha_i + u_{it}$$

	Dependent variable: *COM*				
	(1)	(2)	(3)	(4)	(5)
After interstate banking	0.10**	0.04**	0.04**	0.05**	0.03**
deregulation (α_I)	(16.73)	(6.01)	(5.64)	(5.21)	(3.09)
After branching	0.05**	0.02**	0.01*	-0.00	-0.01*
deregulation (α_B)	(8.62)	(3.32)	(1.71)	(-0.19)	(-1.70)
log(asset)			0.11**	0.11**	0.11**
			(9.23)	(8.47)	(6.76)
Share of liquid assets			-0.16**	-0.15**	-0.11
			(-2.97)	(-2.50)	(-1.62)
Share of nonperforming loans			-0.17	-0.09	-0.47*
			(-0.97)	(-0.54)	(-1.93)
Equity/assets			2.20**	1.91**	2.12**
			(5.99)	(4.39)	(4.21)
Transaction deposits/assets			-0.46**	-0.48**	-0.62**
			(-4.78)	(-4.57)	(-4.95)
Industry structure		Yes	Yes	Yes	Yes
Bank B/S variables			Yes	Yes	Yes
Time dummy				Yes	Yes
Subsample					Yes
R^2	0.12	0.28	0.42	0.46	0.47
N	3,121	3,121	3,121	3,121	2,743
F-test (p-value)	0.00	0.00	0.00	0.00	0.00

Table 3: **Different Dependent Variable**

This table reports quarterly fixed effects regression results when the dependent variable is defined differently. COM_{it}^{liquid} is defined as total unused amount of loan commitments to bank liquid assets at time t. Bank liquid assets are the sum of securities and cash of all commercial banks in state i. t-values calculated using heteroskedasticity-robust standard errors are reported in parenthesis. Coefficients denoted "**" are statistically different from 0 at the 5% level and those denoted "*" are statistically different from 0 at the 10% level.

$$COM_{it}^{liquid} = c + \alpha_I D_{it}^I + \alpha_B D_{it}^B + \text{(control for industry structure)}$$
$$\text{(control for bank B/S variables)} + \text{(time fixed effect)} + \alpha_i + u_{it}$$

	Dependent variable: COM^{liquid}				
	(1)	(2)	(3)	(4)	(5)
After interstate banking	0.37**	0.19**	0.18**	0.18**	0.09**
deregulation (α_I)	(12.84)	(4.89)	(4.64)	(4.20)	(2.16)
After branching	0.14**	0.04	0.00	-0.04	-0.07**
deregulation (α_B)	(5.69)	(1.44)	(0.00)	(-1.47)	(-2.58)
log(asset)			0.48**	0.48**	0.53**
			(7.97)	(7.59)	(6.70)
Share of liquid assets			-2.11**	-2.04**	-1.77**
			(-8.36)	(-7.63)	(-5.54)
Share of nonperforming loans			1.27	1.19	-0.34
			(1.59)	(1.51)	(0.32)
Equity/assets			11.75**	12.62**	14.00**
			(6.75)	(5.68)	(5.50)
Transaction deposits/asset			-2.22**	-2.38**	-2.93**
			(-4.61)	(-4.50)	(-4.69)
Industry structure		Yes	Yes	Yes	Yes
Bank B/S variables			Yes	Yes	Yes
Time dummy				Yes	Yes
Subsample					Yes
R^2	0.08	0.21	0.39	0.42	0.44
N	3,121	3,121	3,121	3,121	2,743
F-test (p-value)	0.00	0.00	0.00	0.00	0.00

Table 4: **Cluster-Robust Standard Errors and Driscoll-Kraay Standard Errors**

This table reports the coefficients and t-values, calculated using cluster-robust and Driscoll-Kraay standard errors, following Bertrand et al. (2004) and Driscoll and Kraary (1998). Eight regression results are displayed by two different dependent variables, two different standard errors and by whether time fixed effects are included. COM is (total unused loan commitments/total assets) and COM^{liquid} is (total unused loan commitments/(cash + securities)).

	Dependent variable							
	COM		COM^{liquid}		COM		COM^{liquid}	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
After interstate banking deregulation (α_I)	0.06**	0.06*	0.18*	0.18	0.06**	0.06**	0.18**	0.18**
	(2.02)	(1.91)	(1.86)	(1.63)	(2.99)	(3.87)	(2.92)	(3.19)
After branching deregulation (α_B)	0.02	0.00	0.00	-0.04	0.02	0.00	0.00	-0.04
	(0.63)	(0.02)	(0.00)	(-0.45)	(1.30)	(0.04)	(0.00)	(-0.86)
log(asset)	0.17**	0.17**	0.48**	0.48**	0.17**	0.17**	0.48**	0.48**
	(3.68)	(3.43)	(2.82)	(2.77)	(7.53)	(7.63)	(6.29)	(6.86)
Share of liquid assets	0.18	0.20	-2.11**	-2.04**	0.18	0.20	-2.11**	-2.04**
	(0.95)	(0.91)	(-3.17)	(-2.91)	(1.56)	(1.51)	(-4.16)	(-3.76)
Share of nonperforming loans	-0.85	-0.74	1.27	1.19	-0.85**	-0.74*	1.27	1.19
	(-1.09)	(-0.85)	(0.56)	(0.49)	(-2.33)	(-1.80)	(0.94)	(0.86)
Equity/assets	2.66*	2.20	11.75**	12.62**	2.66**	2.20*	11.75**	12.62**
	(1.79)	(1.37)	(2.45)	(2.24)	(2.52)	(1.87)	(3.25)	(3.26)
Transaction deposits/assets	-0.67	-0.70	-2.22	-2.38	-0.67**	-0.70**	-2.22**	-2.38**
	(-1.36)	(-1.32)	(-1.30)	(-1.25)	(-4.57)	(-4.04)	(-4.09)	(-3.74)
Time dummy		Yes		Yes		Yes		Yes
Cluster-robust standard errors	Yes	Yes	Yes	Yes				
Driscoll-Kraay standard errors					Yes	Yes	Yes	Yes
R^2	0.44	0.48	0.39	0.42	0.44	0.48	0.39	0.42
N	3,121	3,121	3,121	3,121	3,121	3,121	3,121	3,121
F-test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

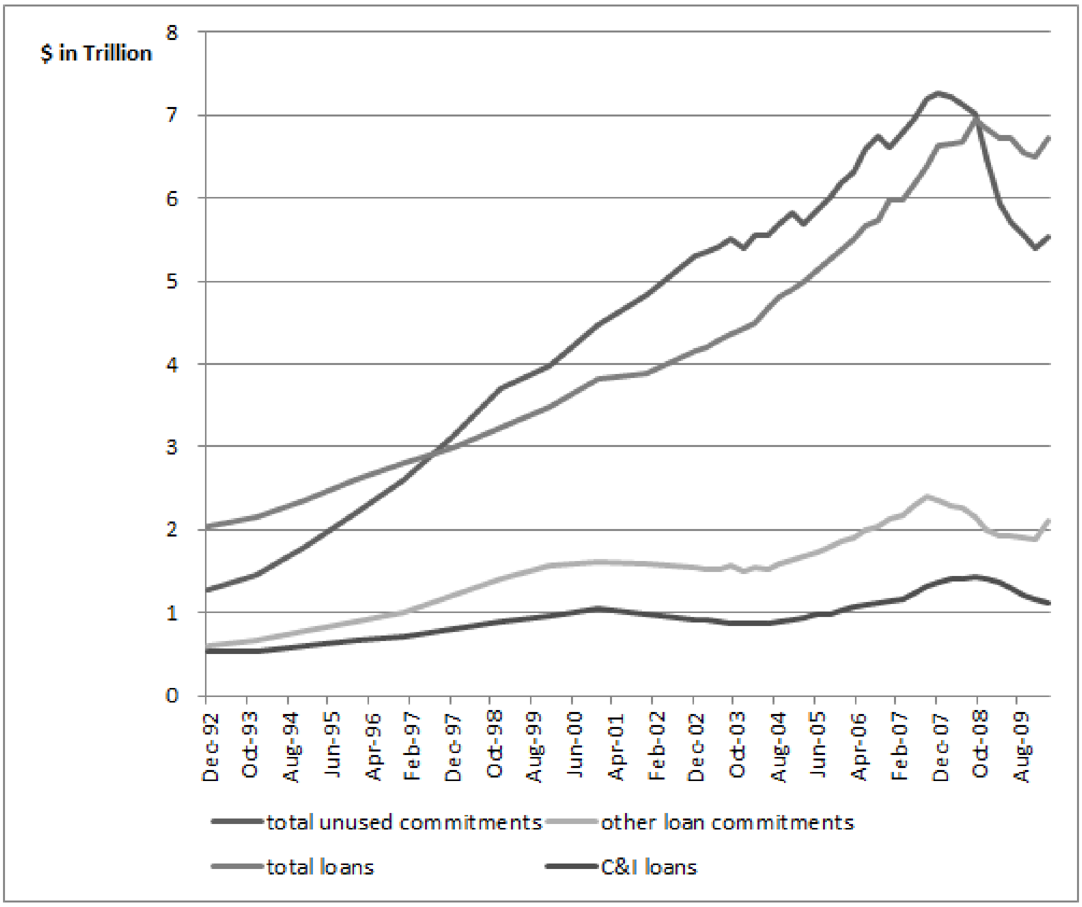

Figure 1: **Increased Use of Loan Commitments over Time**
This figure shows the time trends of the unused amount of total and other loan commitments in off-balance sheets of commercial banks in the U.S. from 1992 to 2009, together with those of total loans and C&I loans. Source: Federal Deposit Insurance Corporation, Statistics on Banking (http://www2.fdic.gov/SDI/SOB/)

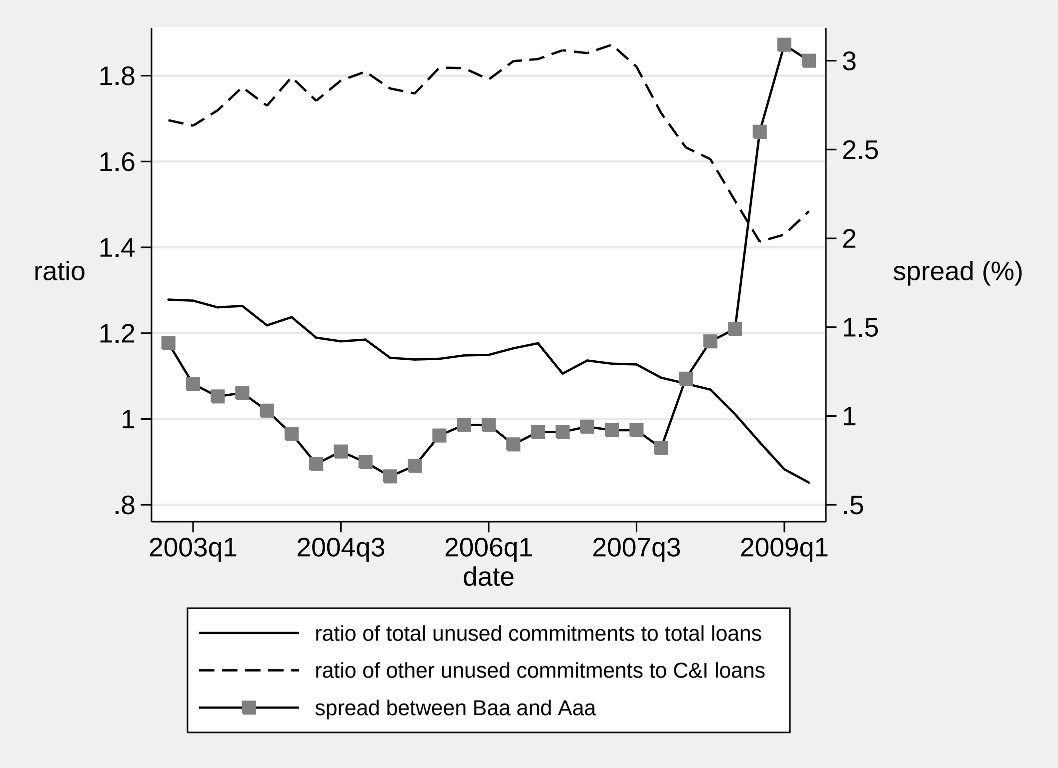

Figure 2: **Ratio of Unused Loan Commitments and the Credit Spread**
The share of unused amount of loan commitments declines as the spread between Baa and Aaa corporate bond yield widens. Source: Federal Deposit Insurance Corporation, Statistics on Banking (http://www2.fdic.gov/SDI/SOB/) and Federal Reserve Bank of St. Louis Economic Data (http://research.stlouisfed.org/fred2/)

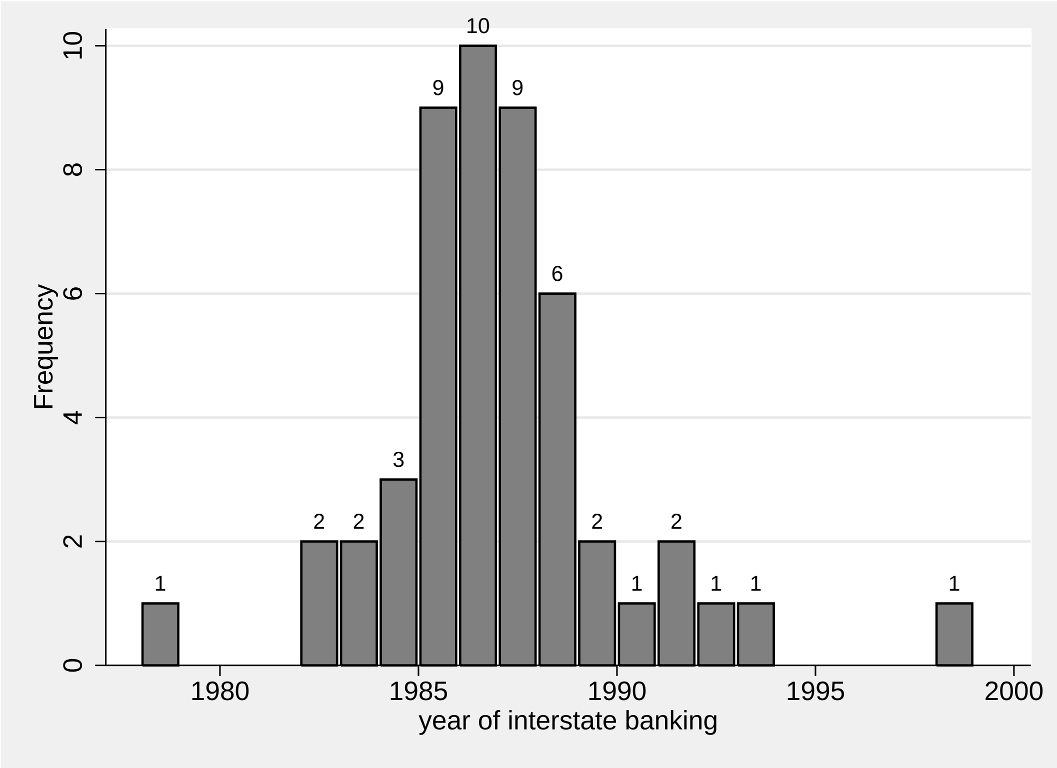

Figure 3: **Year of Interstate Banking Deregulation**
This figure shows the numbers of states which deregulated interstate banking restrictions. The five 'early' states which were deregulated are Maine (1978), Arkansas (1982), New York (1982), Connecticut (1983) and Massachusetts (1983), while five 'late' states are Iowa (1991), North Dakota (1991), Kansas (1992), Montana (1993) and Hawaii (1999).

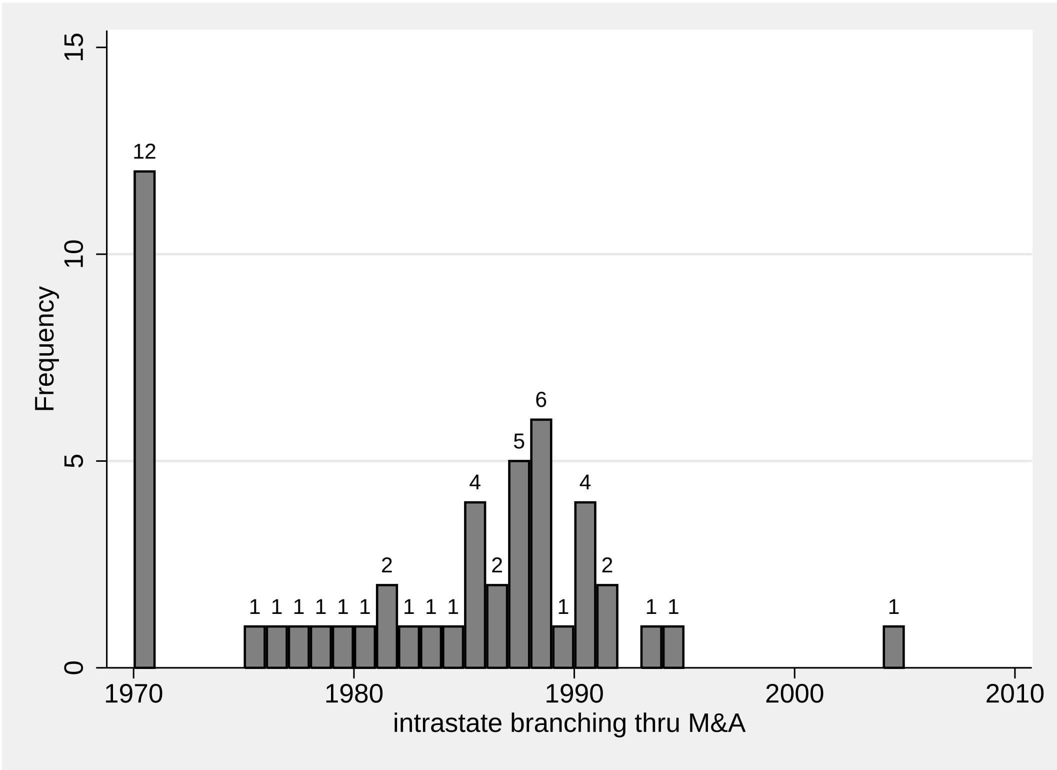

Figure 4: **Year of Intrastate Branching Deregulation**
This figure shows the numbers of states which deregulated branching restrictions. The observations on the year of 1970 are the state which permitted intrastate branching before 1970. They include Maine, California, Maryland, North Carolina, and Delaware. The five 'late' states are Colorado (1991), New Mexico (1991), Minnesota (1993), Arkansas (1994), and Iowa (2005).

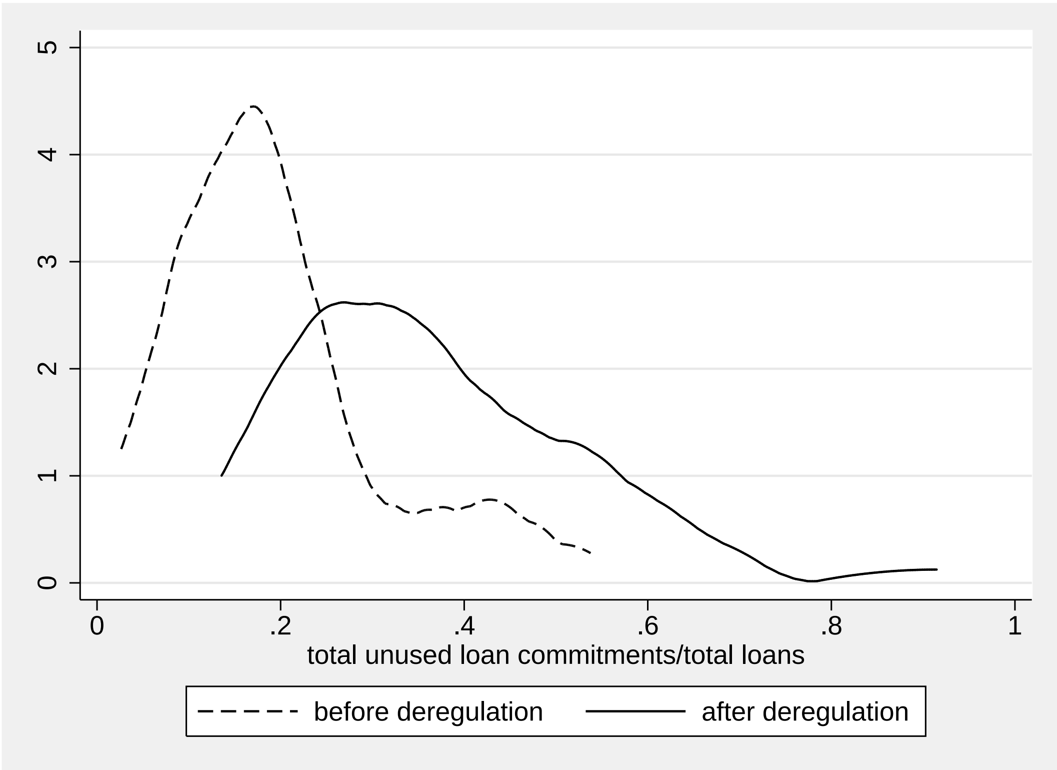

Figure 5: **Use of Loan Commitments Before and After Deregulation**
This figure shows the kernel density functions of state-level average values of (total unused loan commitments/total loans) before and after interstate banking deregulation. The Epanechnikov kernel function is used for calculation.

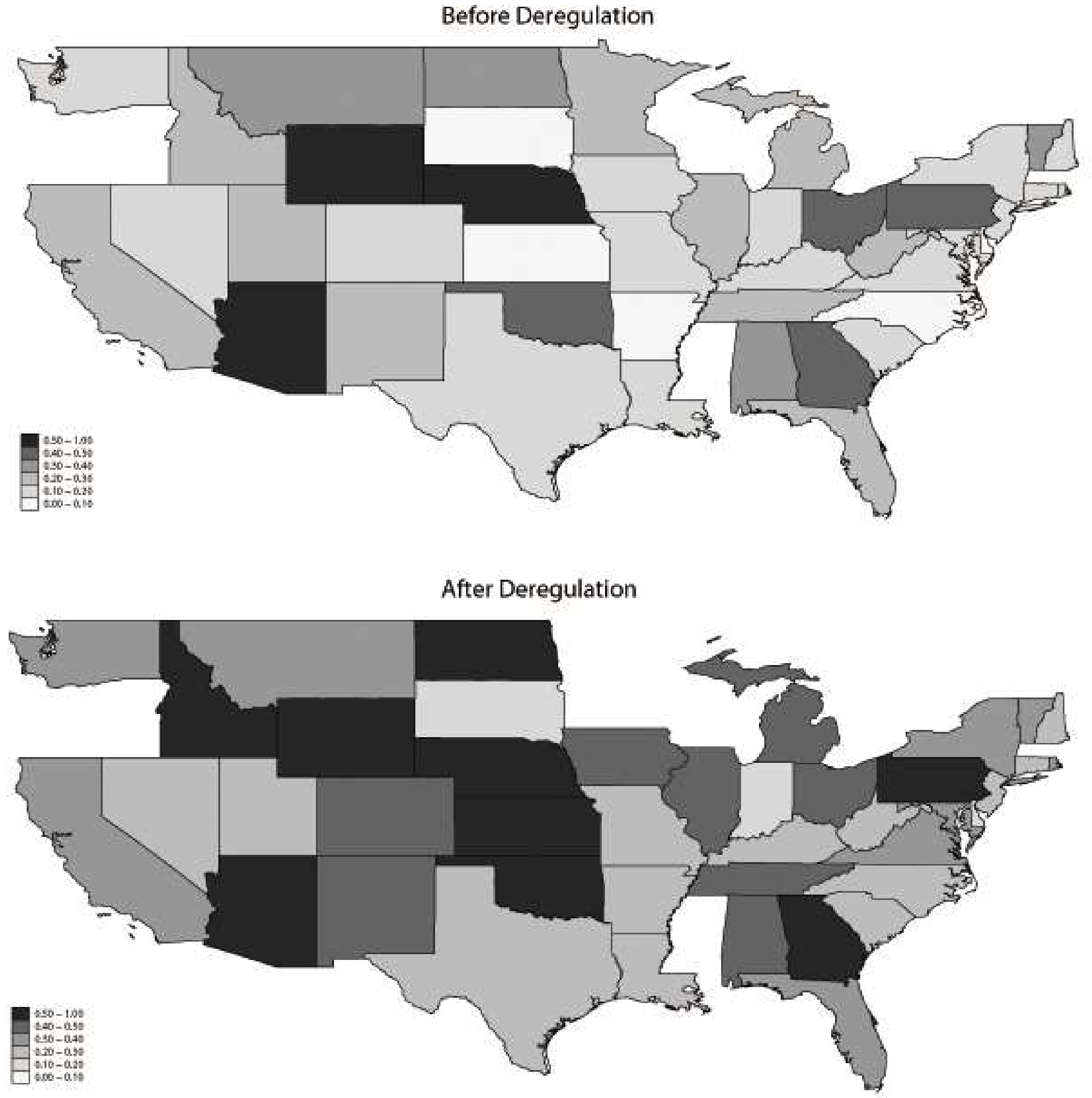

Figure 6: **Loan Commitments Before and After Deregulation**
This figure shows the average values of *COM*, (total ununsed loan commitments/total loans), before and after interstate banking deregulation. The numbers are categorized into five groups: [0,0.1), [0.1,0.2), [0.3 0.4), [0.4,0.5), and [0.5,1.0]. For Connecticut, Maine, Massachusetts, and New York, which did not make the regulatory change during the sample period (1984:II-1999:IV), the average values during the whole sample period are used. Alaska and Hawaii are excluded for better graphics.