Bank Competition and Bank Liquidity Creation*

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Abstract: Using comprehensive measures of bank liquidity creation by Berger and Bouwman (2009), I investigate empirically whether bank competition affects bank liquidity creation among 16367 banks from 1984 to 2007. I find that bank-level competition affects bank's liquidity creation strategy. Using bank-level competition measure, I find that banks create less liquidity when the market is more competitive. Exploiting intra- and interstate bank deregulations and interstate bank branching deregulation, I find that banks create less liquidity as interstate branching restrictions release but banks do not significantly respond to intra- and interstate banking deregulation. Surprisingly, different from bank-level analysis, state-level analysis shows that bank deregulation events do not significantly affect state-level bank liquidity creation on average. The results highlight the role of proper regulation to encourage depressed credit market in the United States.

Keywords*:* Bank Competition, Bank Liquidity Creation, Deregulation, Government Regulation

JEL Classification: G21, G28, G32

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1. Introduction

The two central roles that banks play in the economy are risk transformation and liquidity creation. Since banks have the advantage of economies of scale, they can transform risk by issuing riskless deposits to finance risky loans. This risk transformation may coincide with liquidity creation. As these two main roles are crucially important in the economy, there are many previous studies of them. However, the past literature mostly leans toward the banks' role as risk transformers, even though their role as liquidity creators is an essential part of banking, and interest in bank liquidity creation increases after the recent financial crisis (e.g., Ivashina and Scharfstein, 2010).

The reason why empirical studies examining theoretical views of bank liquidity creation are rare is the absence of a comprehensive measure of bank liquidity creation. However, Berger and Bouwman (2009) provide comprehensive bank liquidity creation measures that allow us to investigate empirical research questions about a bank's role as a liquidity creator. They classify balance sheet activities as liquid, semi-liquid, or illiquid. Once all of the balance sheet activities are classified, the authors assign weights, which are ranged from -0.5 to 0.5, and calculated the measures by summing all weighted activities. The specifications classify all items except loans by combining information on both product category and maturity, while loans are classified based purely on either category or maturity (i.e., "cat" or "mat" measures) because of the lack of data availability. In addition, off-balance-sheet items are either included or excluded (i.e., "fat" or "nonfat" measures).

Bank competition is a popular issue in banking research: both theoretical and empirical literature on the topic has emerged. The previous literature about bank competition mostly focuses on its impact on financial stability, risk-taking, access to credit, and bank failure. Two views of competition—"competition-fragility" and "competition-stability"—are posited in the literature. Even though some studies find empirical evidence for each view, the findings of the empirical research that explores the links between competition and risk are rather mixed and still inconclusive. For example, Berger, Klapper, and Turk-Ariss (2009) find limited support for both the competition-fragility and the competition-stability views. However, there has not been enough discussion about the effect of bank competition on bank liquidity creation. Thus, in this paper, I examine whether bank competition affects bank liquidity creation, using a panel dataset of U.S. banks from 1984 to 2007.

Like bank competition literature, the empirical results of my research could also have mixed evidence. On the one hand, I expect a positive relationship between bank competition and bank liquidity creation. For example, less bank competition (i.e., more market power) may induce banks to raise lending interest rates and, thus, firms to have lower demands for borrowing money from banks, because the banks with a higher level of market power dominate the market. Also, the banks may raise loan rates and lower deposit rates when the market becomes less competitive, which means that banks would have more market power to increase their charter value. From this point of view, large banks are likely to create less liquidity in the market when their market power is significant. Compared to smaller banks, large banks have a more secured buffer for overcoming unexpected financial shocks, because they have several different branches, and each branch would have different market conditions. These variations among different branches of the large banks could be considered as a way of hedging against risk. That is why the large banks could pursue a strategy creating less liquidity, which is an aggressive strategy for maximizing their profit when they dominate the market. Thus, banks in a less competitive market might create less liquidity, and banks in a more competitive market would create more liquidity.

On the other hand, I expect a negative relationship between bank competition and bank liquidity creation. Less bank competition might induce banks to provide more liquidity. For instance, banks supply more loans when the market becomes more concentrated, because the banks are likely to take on more risk when they have more market power. Also, banks in a less competitive market may provide more liquidity because they can supply more loans through relationship banking while taking more deposits. Banks focusing on relationship banking could create more liquidity to keep the relationship with their borrowers. From this point of view, banks would create more liquidity in the market when they have more market power (i.e., when they are less competitive).

To test these hypotheses, I construct a panel dataset for the sample period between 1984 and 2007. The data covers almost all the commercial banks in the United States. I collect the data from various sources such as Call Reports, DealScan, Summary of Deposits surveys, the Federal Housing Finance Agency, the U.S. Census Bureau, the U.S. Department of the Treasury, and Christa Bouwman's personal website.

Following previous studies regarding bank competition (e.g., Fernandez de Guevara, Maudos, and Perex, 2005; Berger, Klapper, and Turk-Ariss, 2009; Koetter, Kolari, and Spierdijk, 2012; Jimenez, Lopez, and Saurina, 2013; and Berger and Roman, 2015), I use the Lerner Index for gross total assets (GTA), which is calculated as the observed price-cost margin divided by price, as a proxy for bank competition, which is a key independent variable in this research. The value of the Lerner Index ranges from 0 to 1. A 0 value on the Lerner Index means perfect competition, and when the value of Lerner Index is equal to 1, a monopoly is considered to exist. Thus, banks with any degree of market power except the two extremes have a positive Lerner Index value. In addition, I exploit the U.S. banking deregulation events, including intra- and interstate deregulation and interstate branching deregulation, as exogenous shocks on bank competition (e.g., Johnson and Strahan, 2008; Rice and Strahan, 2009; Koetter, Kolari, and Spierdijk, 2012; Chava, Oettl, Subramanian, and Subramanian, 2013; Krishnan, Nandy, and Puri, 2014; Cornaggia, Mao, Tian, and Wolfe, 2015).

Based on Berger and Bouwman (2009), I choose the most comprehensive bank liquidity creation measure, "catfat," among four different bank liquidity creation proxies to measure bank liquidity creation. This is a key dependent variable among the various specifications in this paper. In addition, there could be endogeneity issues such as reverse causality and omitted variables. For example, banks that create more liquidity may have higher market power. Also, it is possible that many other factors affecting both bank liquidity creation and bank competition are unobservable. Thus, I used multiple empirical approaches, including a fixed-effects model and difference-in-differences estimation, to mitigate these endogeneity problems.

Using the panel dataset that includes all sample banks, I find that reverse relationship between bank competition and bank liquidity creation. In other words, banks with a higher level of market power create more liquidity in the market. At this stage, I could not check whether this result is caused by reaping monopolistic rents or maintaining a relationship with borrowers. To disentangle these effects, I split the sample into large, medium-sized, and small banks and test whether the negative relationship exists for every size class of banks or only for specific size classes. Through the subsample analysis by bank size, I find that only small-sized banks significantly create more liquidity in the market as bank competition decreases. However, I do not claim causal relation because of endogeneity concerns.

Following previous studies exploiting U.S. intra- and interstate banking deregulation and interstate branching deregulation as exogenous shocks on bank competition (e.g., Johnson and Strahan, 2008; Rice and Strahan, 2009; Koetter, Kolari, and Spierdijk, 2012; Chava, Oettl, Subramanian, and Subramanian, 2013; Krishnan, Nandy, and Puri, 2014; Cornaggia, Mao, Tian, and Wolfe, 2015), I exploit the exogenous variation in bank competition using the U.S. banking deregulation events. Intrastate deregulation allows banks to merge or acquire other banks inside the market where they are located. In contrast, interstate deregulation allows banks to acquire a commercial bank in deregulated states. More importantly, interstate branching deregulation allows out-of-state banks to acquire a branch in the deregulated states and the level of openness varies over time.

The results of analysis using the deregulation events are consistent with the results of analysis using the Lerner Index as a bank competition measure. Exploiting intra- and interstate bank deregulations, I find that banks do not significantly respond to both intra- and interstate banking deregulation. However, exploiting interstate bank branching deregulation, I find that interstate bank branching deregulation leads to reduction in bank liquidity creation. To be specific, banks create more liquidity as the level of interstate branching regulation in their home state increases. I also find that small banks create more liquidity than medium/large banks as branching restrictions release.

The results make sense because interstate deregulation requires much higher fixed costs to invest in deregulated states. Only sizable banks are able to acquire and/or establish a charter in a state outside the main bank's home state. On the other hand, small banks would not compete with the sizable competitors. That is why these two effects could offset each other. In addition, existing large banks in the deregulated state could have chance to invest in the other deregulated states. This could also affect the insignificant effects of interstate deregulation.

Interstate branching deregulation lowers fixed costs to invest in the deregulated states. Different from interstate bank deregulation, interstate branching deregulation allows banks to acquire a branch. For example, banks in highly restrictive states would be secured than banks in highly open states in terms of the outside threat. In addition, they have much lower fixed costs to enter the new market after interstate branching deregulation. Thus, they have incentives to acquire or establish a new branch in the neighboring states, where the level of restrictiveness is lower than

their home state. In this situation, large banks would create less liquidity to enjoy monopolistic rents and small banks would create less liquidity to avoid default risks. In a relative sense, smaller banks would create more liquidity than large banks to keep their relationship banking. This means that the negative effect of bank competition on bank liquidity creation is weaker for smaller banks.

Investigating bank-level relation between bank competition and bank liquidity creation is interesting and important. However, my results suggest that economic magnitude of bank-level analysis is not significant. Causal effects of interstate bank branching deregulation on bank-level liquidity creation suggest that completely open states generate a total of 1.82% less liquidity creation post branching deregulation than the most restrictive states.

In addition, for the perspective of regulators, bank-level analysis would not be important than aggregate state-level analysis because policy makers do care about local market economy. To derive policy implication concerning bank competition and bank liquidity creation, I examine state-level analysis.

Following Berger and Sedunov (2017), I test whether state-level bank competition affects state-level bank liquidity creation. To construct state-level liquidity creation and control variables, I rely on each bank's state deposit market shares as a proxy for weights on states where they operate branches. Interestingly, state-level analysis shows that bank deregulation events do not affect state-level bank liquidity creation on average. This result suggests that intra- and interstate bank deregulation and interstate branching deregulation do not really stimulate the depressed capital market. Based on both bank-level and state-level results, the key policy implication is that a policy to encourage bank competition would be more efficient if the policy applies to banks depending on banks' heterogeneity, such as bank size and bank market share, and markets' heterogeneity, such as market demand and supply-side competition status prior to the policy implementation.

My paper contributes the literature that investigates the effects of banking deregulation. Even though Jayaratne and Strahan (1996) find that interstate deregulation results in economic growth in local markets, results of my paper suggest that the effects might not be driven by banking activities because bank liquidity creation would be crucial bank-side activity to encourage local market growth.

Second, my paper contributes to the literature on bank liquidity creation. Because of lack of comprehensive bank liquidity creation measures, there is few empirical studies examining the

determinants of bank liquidity creation and/or the effects of bank liquidity creation before Berger and Bouwman (2009) provide the comprehensive measure, which is catfat. This literature shows relations between liquidity creation and equity ratio (Berger and Bouwman, 2009), corporate governance (Diaz and Huang, 2017), and real economic output (Berger and Sedunov, 2017).

I am aware of a contemporaneous study by Jiang, Levine, and Lin (2016), which also examine the relationship between bank competition and bank liquidity creation. Based on interstate bank deregulation, they construct distance-weighted bank competition measures, which are continuous bank-level measures. Their measure considers the distance between each bank in the deregulated state and capital city of the other states as a factor of bank competition. Using the bank-level distance-weighted interstate deregulation measures, they find that regulatory-induced competition has a negative effect on bank liquidity creation.

Different from this study, I focus on both state-level and bank-level analyses that examine the effects of bank competition on bank liquidity creation. State-level analysis allows me to generate policy implications on bank competition. In addition, I exploit interstate bank branching deregulation, which would be more important on bank liquidity creation because decisions about loan and deposit contracts are made by branch managers. Same as Chava, Oettl, Subramanian, and Subramanian (2013) and Cornaggia, Mao, Tian, and Wolfe (2015), my paper and Jiang, Levine, and Lin (2016) suggest two different perspectives of bank deregulation.

The remainder of this paper is organized as follows. I first review the existing literatures on bank competition and bank liquidity creation. In Section 3, I develop testable hypotheses. Section 4 describes data and methodologies. Section 5 provides empirical results and Section 6 concludes.

2. Literature Review

2.1 Bank Competition

The deregulation of banking activities has drawn much attention of researchers and regulators on the role of competition in the banking industry. Previous literature about bank competition mostly focused on the impact of bank competition on financial stability, risk-taking, access to credit, and bank failure. However, there is not enough discussion about the effect of bank competition on bank liquidity creation.

There are two strands of literature on bank competition: "competition-fragility" and "competition-stability." The "competition-fragility" view suggests that enhanced bank competition results in reduced profit margins and franchise value, and this induce banks to take excessive risk. According to past literature on the view, profit margins play as a safeguard in the event of financial distress so banks try to recover their profit margins by taking excessive risk even though the projects are high risk projects (e.g., Repullo, 2004). In addition, banks tend to protect their franchise value when the market is more concentrated by taking less risk because high franchise value implies high opportunity costs of bank failure (e.g., Keeley, 1990; Hellmann, Murdock, and Stiglitz, 2000). Thus, the "competition-fragility" view supports the argument that higher level of bank competition would result in more fragility.

The second view of bank competition is the "competition-stability" view. This view argues that bank competition makes financial system more stable. That is, more concentrated market power could lead to higher bank risk and/or higher probability of bank failure. Past literature supporting the "competition-stability" argues that the more bank market power, the more bank risk exposure. This is because the dominant banks enjoy monopolistic rents, such as higher interest rates and lower deposit rates, through their market power and it could lead to adverse selection and risk shifting (e.g., Stiglitz and Weiss, 1981). Boyd and De Nicolo (2005) and Schaeck, Cihak, and Wolfe (2009) also support the "competition-stability" view. These studies suggest that the more market power, the less stable financial system. Different from previous studies, Boyd and De Nicolo (2005) construct models that allow bank competition for both deposit and loan markets, and they suggest the reverse relation between bank competition and bank failure. Less bank competition means more concentrated market power, and less bank competition could lead to higher loan rates and lower deposit rates because banks with higher level of market power have incentives to pursue monopolistic rents. Reduced bank competition could lead to either a more stable credit market, which is an intended result of government policy, or a highly dominated and limited credit market, which is an unexpected incident. Using 45 countries international data, Scaheck, Cihak, and Wolfe (2009) also support this view. They find that enhanced bank competition tends to be more stable and tend not to suffer systemic crisis.

However, Berger, Klapper, and Turk-Ariss (2009) take a moderate position because they find mixed empirical results about the effects of bank competition on financial stability. Berger,

Klapper, and Turk-Ariss (2009) find that market power increases credit risk, but banks with more market power face less risk overall, using a variety of risk and competition measures derived from a dataset of banks located in 23 countries. Thus, the paper suggests limited support to both the competition-fragility and the competition-stability views. These mixed results suggest that the effects of bank competition on bank activities could also be mixed under heterogeneous circumstances.

2.2 Bank Liquidity Creation

There are many past studies that suggests the reason why banks exist is to create liquidity to borrowers and lenders (e.g., Bryant, 1980; Diamond and Dybvig, 1983; Gorton and Pennacchi, 1990; Holmstrom and Tirole, 1996; Kashyap, Rajan, and Stein, 2002; Gatev and Strahan, 2006). Banks create liquidity because they grant long-term and illiquid loans to borrowers by using short-term and liquid deposits. Bryant (1980) and Diamond and Dybvig (1983) argue that banks create liquidity on the balance sheet by financing relatively illiquid assets with relatively liquid liabilities. Also, Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002) suggest that banks also create liquidity in form of loan commitments or credit lines. This means that banks create liquidity off the balance sheet as well. Loan commitments can give a borrower the option to draw down them on demand during the period of the contract. These withdrawals are uncertain to the bank. From the perspectives of customers, loan commitments provide liquidity whenever they require liquidity unexpectedly.

Empirical studies concerning about bank liquidity creation are relatively insufficient because of the absence of comprehensive measure of bank liquidity creation. Deep and Schaefer (2004) develop Liquidity Transformation gap as a measure of liquidity creation, but it is not comprehensive measure. Berger and Bouwman (2009) provide four measures of liquidity creation and argue that catfat measure is better than other measures including Liquidity Transformation gap, which is similar to matnonfat measure of Berger and Bouwman (2009). Different from Liquidity Transformation gap, catfat liquidity creation measure classifies loans by category, rather than by maturity. This measure treats business loans as illiquid regardless of their maturity because banks generally cannot easily dispose of them to meet liquidity needs, but this measure treats residential mortgages and consumer loans as semiliquid because these loans can often be

securitized and sold to meet demands for liquid funds. Also, catfat includes off-balance sheet activities as well as on-balance sheet activities. Thus, catfat measure is advanced and more comprehensive measure of liquidity creation.

Berger and Bouwman (2009) construct a comprehensive measure of bank liquidity creation by including off-balance sheet items and by considering categories rather than maturities. There is three-step procedure to construct the liquidity creation measures. In Step 1, all balance sheet and off-balance sheets activities are classified as liquid, semi-liquid, or illiquid. The classification is based on the ease, cost, and time for customers to obtain liquid funds from the bank, and the ease cost, and time for banks to dispose of their obligations to meet these liquidity demands. The balance sheet items are classified by product category and maturity. In Step 2, weights are assigned to the items classified in Step 1. In Step 3, liquidity creation is measured by combining the items as classified in Step 1 and as weighted in Step 2.

Using virtually all U.S. commercial banks from 1993 to 2003, they find that the U.S. banking industry creates $2.84 trillion in liquidity in 2003, which is equivalent to $4.56 of liquidity creation per $1 of bank equity capital, and liquidity creation has grown substantially over the sample period by using catfat measure. They also report that the liquidity creation differs considerably among banks by different size. Banks categorized as large banks, about 2 percent of their sample, account for 81 percent of the bank liquidity creation. In addition, off-balance sheet items played a significant role in generating liquidity for banks of all sizes.

There are not enough studies examining the relationship between bank competition and bank liquidity creation. Three exceptions are Joh and Kim (2008), Horvath, Seidler, and Weill (2013), and Jiang, Lin, and Levine (2016). Different from my paper, first two papers use non-U.S. data to investigate the effects of bank competition on bank liquidity creation. Horvath, Seidler, and Weill (2013) investigate this research question but their dataset is from the Czech banking industry. They analyze the impact of bank competition on liquidity creation, using a dataset of Czech banks from 2002 to 2010. They find that enhanced competition reduces liquidity creation and suggest that pro-competitive policies in the banking industry can reduce liquidity provision by banks. However, they do not use catfat measure because of a lack of information about components of catfat measure. According to Berger and Bouwman (2009), catfat measure is the most comprehensive measure among the four liquidity creation measures because it includes off-balance

sheet liquidity creation and classification for loans is based on category. Joh and Kim (2008) use an international data covering 25 OECD countries. They use catfat measure following Berger and Bouwman (2009) but they control for size and market shares even though the key explanatory variable is Lerner Index, which is strongly related to those variables. This could lead to biased results.

Different from these papers, my paper investigates the relationship between bank competition and bank liquidity creation, using the U.S. banking industry dataset. Also, I exploit exogenous variation in bank competition through the U. S. banking deregulation events, including intra- and interstate bank deregulation and interstate branching deregulation, and stick to use catfat measure using sufficient datasets.

3. Hypothesis Development

This section details my hypotheses. By examining these hypotheses, I figure out how bank competition affects banks' liquidity creation strategies in a variety of circumstances.

The first testable hypothesis is that the relationship between bank competition and bank liquidity creation is negative. In other words, I expect the positive effect of bank market power on bank liquidity creation. The basic idea behind this hypothesis is that, in the more competitive market, banks would suffer severe default risk and bank run risk. This is because many banks in the competitive market try to survive by reducing their risk exposure if their resources are concentrated on the market and they have no alternative market to move. By doing this, banks could keep a certain amount of cash holdings, which acts as a buffer against bank default risk and bank run risk. Thus, banks in the competitive market would create less liquidity in the market to avoid bank failure. From a perspective of bank market power, banks with higher level of market power would have enough sources of financing borrowers and have relatively sound internal stability to respond to unexpected financial shocks. This argument is in line with Petersen and Rajan (1995), suggesting that banks are less likely to supply credit when markets are more competitive (i.e. less concentrated). They argue it is difficult for banks to internalize the benefits of assisting the firms, so banks are less likely to grant credit to firms that do not have long-term relationship with the banks. In other words, banks have much worse accessibility to information on borrowers in the competitive market than in the concentrated market. Thus, banks have no

incentive to create liquidity for new customers without reliable information about them. Banks could utilize their own cumulative information about existing long-term customers to evaluate underlying risks to create more liquidity in the market. From these two perspectives, I expect that the relationship between bank competition and liquidity creation is negative.

Hypothesis 1: Bank competition is negatively associated with bank liquidity creation.

As I discuss in the previous section, two different views on bank competition, which are "competition-fragility" and "competition-stability" views, could raise a possibility to have mixed empirical results about the effects of bank competition on bank liquidity creation. The first hypothesis is based on "competition-fragility" view. From the perspective of "competition-stability" view, it would be possible that the impact of bank competition on bank liquidity creation is positive.

Bank competition condition could affect banks' decision on loan pricing and deposit rate. To be specific, banks in more competitive market may reduce loan rates and increase deposit rate to increase demand for both loans and deposits (e.g., Carbo-Valverde, Rodriguez-Fernandez and Udell, 2009; Love and Martinez Peria, 2012). Also, on the other hand, less bank competition may induce banks to raise lending interest rates and thus firms have lower demands to borrow money from banks. In addition, Beck, Demirgüc-Kunt and Maksimovic (2004) suggest that keen competition increases demand for loans by alleviating financing obstacles, such as collateral, to dominate the market. This leads to higher liquidity creation. This could be a case for large banks. Because large banks have sufficient resources to compete with the other banks in the competitive market, they would tend to dominate the market when bank competition is severe. From the perspective of market power, the large banks with substantial market power would tend not to create liquidity with favorable terms because they have less default risk and bank run risk by possessing sufficient funds in several different markets. This mechanism would allow them to pursue monopolistic gains, such as higher loan rate and lower deposit rate. Thus, the effects of bank competition on bank liquidity creation would not inverse but direct.

Hypothesis 2: For large banks, bank competition is positively associated with bank liquidity creation.

Using proprietary data, Peterson and Rajan (1994) investigate the effects of relationship banking between banks and small firms on the availability and cost of financing. They find that relationship banking positively affects financing availability of the borrowers. They also find that a wide and shallow relationship with multiple lenders would result in both increase in costs and decrease in the availability of financing. These results suggest that bank competition condition affect the efficiency of relationship banking. In highly competitive market, there are many banks in the market to compete. In this case, borrowers have many different alternatives to finance. This would aggravate existing lender's private information about borrowers because new lenders can verify the private information. On the other hand, in less competitive market (i.e. more concentrated market), the existing lender could enjoy its informational monopoly because possibility that the private information is verified is quite low in this case. This would lead to availability of funds for the firms involving the relationship.

Peterson and Rajan (1995) also examine the effects of competition on relationship banking. Results of this paper suggest that creditors are more likely to finance credit-constrained firms when bank competition is less competitive because banks could internalize the benefits from the relationship banking more easily in the concentrated market. This suggests that banks would want to keep this information advantage in the concentrated market. Different from large banks, small banks with the long-term lending relationships would create more liquidity in the less competitive market. Because they do not have strong capabilities to build multiple deep relationships with borrowers, they would tend to utilize their own private information and try to maximize their profits under the constrained circumstance. From the view of bank competition, these small banks would not create liquidity aggressively to stand a chance in competition with the other banks because they have significant default risk and bank run risk in the highly competitive market. Thus, in this case, they would keep their liquidity to protect themselves against the risks.

Enhanced bank competition could either increase or decrease bank-level liquidity creation. In the competitive market, large banks would increase bank liquidity creation to dominate the market. On the other hand, large banks would not increase liquidity creation to enjoy monopolistic

gains. Small banks would increase bank liquidity creation to keep their relationship banking, but it could be also possible that small banks would decrease liquidity creation to avoid the default risk in the competitive market.

Based on arguments that the market is segmented and that banks could react to bank competition differently, I expect that the effects of bank competition on bank-level liquidity creation could offset each other at state-level.

Hypothesis 3: For small banks, bank competition is negatively associated with bank liquidity creation.
Hypothesis 4: The effects of bank competition on bank-level bank liquidity creation would be offset at the state-level.

Previous studies exploit the U.S. banking deregulation as exogenous shocks on bank competition (e.g., Johnson and Strahan, 2008; Rice and Strahan, 2009; Koetter, Kolari, and Spierdijk, 2012; Chava, Oettl, Subramanian, and Subramanian, 2013; Krishnan, Nandy, and Puri, 2014; Cornaggia, Mao, Tian, and Wolfe, 2015). These studies use the exogenous variation in bank competition after the banking deregulation. Theoretically, banking deregulation could increase bank competition, bank efficiency, and M&A activities. Also, this could improve local market macroeconomic condition (e.g., Jayaratne and Strahan, 1996). These studies suggest that intrastate banking deregulation and intrastate banking deregulation have different effects on banks. Intrastate deregulation enhances market concentration because number of competitions is fixed within the state. On the other hand, interstate deregulation leads to more competitive market because out-of-state banks can enter the deregulated states.

Based on arguments above, I expect that the effects of intrastate deregulation could be mixed. Generally, banks in the concentrated market through intrastate deregulation would create less liquidity because dominant players would want to exploit monopolistic rents. However, if the dominant players focus on relationship banking, then they could create more liquidity in the market to keep their relationship with borrowers.

The effects of interstate deregulation could be also mixed. This is because of relatively high fixed costs for acquiring and/or establishing a charter in deregulated states. Interstate bank

deregulation does not allow out-of-state banks to acquire or establish a branch in the deregulated state. The deregulation only allows them to acquire or establish a chartered bank in the deregulated state. This means that the newcomers are more likely to be aggressive in terms of liquidity creation. Existing dominant banks in the state would also create more liquidity to compete with the incoming competitors if they have sufficient resources and there is no other investment option. If they have other investment opportunities, such as investment in the other deregulated states, they could create less liquidity in the home state and create more liquidity in the new market. In addition, smaller banks would create less liquidity creation to avoid default risks in the competitive market. Thus, I expect that the effects of interstate bank deregulation on bank liquidity creation would offset.

Interstate bank branching deregulation would have different effects on bank liquidity creation. Different from intra- and interstate bank deregulation, interstate branching deregulation lowers fixed costs to enter the deregulated markets. Banks in more restrictive states would be more secured than bank in more open states. Because the level of restrictiveness varies over time and the fixed cost acquiring a branch is much lower than the fixed cost acquiring a commercial bank, banks in relatively restrictive states could invest in a branch of the contiguous states, where the level of restrictiveness in terms of bank branching is lower than the bank's home state. Thus, I expect that interstate deregulation and interstate bank branching deregulation would have contrasting effects on bank liquidity creation and that the more restrictive interstate bank branching regulation would lead to more bank liquidity creation.

Hypothesis 5: The effects of intra- and interstate bank deregulation on bank liquidity creation would be mixed.
Hypothesis 6: The effects of interstate bank branching deregulation on bank liquidity creation would be negative.

4. Data and Methodology

4.1 Data

To investigate the effect of bank competition on bank liquidity creation, I construct an unbalanced panel of bank-level dataset for almost all commercial banks in the United States during the sample period between 1984 and 2007. I collect the data from various sources such as Call Reports,

Summary of Deposits, DealScan, Federal Housing Finance Agency, United States Census Bureau, the U.S. Department of the Treasury, and Christa Bouwman's personal website.[1]

Financial data from Call Reports covers the period between 1976 and 2016. However, my sample starts from 1984 because of missing observations for required items to construct liquidity creation measures before 1984. In addition, following Berger and Bouwman (2009), I impose the following restrictions to include only valid commercial banks in my sample. First, I exclude a bank with zero commercial real estate or commercial and industrial loans. Second, I exclude a bank with zero deposits. Third, I exclude zero or negative equity capital in the current or lagged year. Fourth, I exclude a bank whose average lagged gross total assets (GTA) are below $25 million. Fifth, I exclude a bank that has four times more unused commitments than GTA. Lastly, I exclude a bank that resembles a thrift bank or a credit card bank.[2] My final sample of almost all commercial banks in the United States from 1984 to 2007 consists of 203,711 bank-years in 1,176 state-years of data on 16,367 unique banks.

4.2 Key Dependent Variables and Independent Variables

In light of the foregoing discussion of previous literatures, I study several factors that affect my key variables. According to Berger and Bouwman (2009), the ability to securitize loans is closer to product category concept than the time until self-liquidation, and the authors also show that off-balance sheet activities provide liquidity in functionally similar ways to on-balance sheet items. Thus, I use catfat measure as a key dependent variable, as Berger and Bouwman (2009) suggest catfat is better measure than three other liquidity creation measures.

My key independent variables are proxies for bank competition. To indicate bank competition, I use the Lerner index, which is an individual measure of competition for each bank and each period. The Lerner index is commonly used in recent studies of bank competition (e.g., Fernandez de Guevara, Maudos, and Perex, 2005; Berger, Klapper, and Turk-Ariss, 2009; Jimenez, Lopez, and Saurina, 2013; Berger and Roman, 2014).

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[1] I collect the quarterly bank liquidity creation data from Christa Bouwman's personal website (http://faculty.weatherhead.case.edu/bouwman/data.html). The website provides four different quarterly bank liquidity creation measures, such as catfat, catnonfat, matfat, and matnonfat, for almost all commercial banks in the United States.

[2] I consider a bank as a thrift if the bank has residential real estate loans exceeding 50% of GTA and consider a bank as a credit card bank if the bank has consumer loans exceeding 50% of GTA.

The Lerner index is defined as the difference between price and marginal cost, divided by price, i.e., it measures the market power of a bank to set a price above marginal cost. Thus, high values of the Lerner index are associated with significant market power.

$$Lerner_{it} = \frac{Price_{it} - MC_{it}}{Price_{it}}$$

Following the methodological approach of Fernandez de Guevara, Maudos, and Perex (2005), Berger, Klapper, and Turk-Ariss (2009), and Berger and Roman (2014), I consider $Price_{it}$ as the price of GTA proxied by the ratio of total revenues to GTA for bank i at time t and MC_{it} as the marginal cost of total assets for a bank i at time t. To compute MC_{it} for each bank for each time period, I take the derivative from the following estimated translog cost function:

$$\ln(Cost_{it}) = \theta_0 + \theta_1 \ln GTA_{it} + \frac{\theta_2}{2} \ln GTA_{it}^2 + \sum_{k=1}^{3} \gamma_k \ln W_{k,it} + \sum_{k=1}^{3} \emptyset_k \ln GTA_{it} \ln W_{k,it} + \sum_{k=1}^{3} \sum_{j=1}^{3} \gamma_{kj} \ln W_{k,it} \ln W_{j,it} + \theta_3 Time_t + \mu_{it}$$

where i represents banks, t represents time in quarters, $Cost_{it}$ is total operating plus financial costs, GTA_{it} is gross total assets, $W_{k,it}$ represents input prices, $W_{1,it}$ is the ratio of personnel expenses to GTA, which is proxy for input price of labor, $W_{2,it}$ is the ratio of interest expenses to total deposits and money market funding, which is proxy for input price of all funds, $W_{3,it}$ is the ratio of other operating and administrative expenses to GTA, which is proxy for input price of fixed capital, and $Time_t$ is a vector of time fixed effects. The estimated coefficients of the cost function are then used to compute the marginal cost for GTA:

$$MC_{it} = \frac{Cost_{it}}{GTA_{it}} \left[\widehat{\theta_1} + \widehat{\theta_2} \ln GTA_{it} + \sum_{k=1}^{3} \widehat{\emptyset_k} \ln W_{k,it} \right]$$

I also use bank-level Herfindahl index as an alternative proxy for bank competition for the robustness check. To measure the bank-level HHI, I establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. I use the natural logarithm of the HHI to avoid distorting the regression analyses due to large values.

Using Lerner Index as a proxy for bank competition, I examine the relation between bank competition and bank liquidity creation, but I cannot claim causal relation because of endogeneity concerns, such as omitted variables and reverse causality problems. To mitigate the endogeneity concerns, I exploit exogenous variations in bank competition through the U.S. bank deregulation events, such as intra- and interstate bank deregulation and interstate bank branching deregulation. Following previous studies exploiting bank deregulation events (e.g., Jayaratne and Strahan, 1996; Black and Strahan, 2002; Johnson and Rice, 2008; Rice and Strahan, 2010; Krishnan, Nandy, and Puri, 2014), I construct intra- and interstate deregulation indicator variables, Rice-Strahan index, and Krishnan-Nandy-Puri index.

The intra- and interstate deregulation indicator variables take the value of one from the year of deregulation onward and zero prior to the deregulation. Rice-Strahan index of interstate banking deregulation ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state. On the other hand, Krishnan-Nandy-Puri index ranges from one (highly regulated) to five (deregulated).

4.3 Control variables

To investigate clear relations between bank competition and bank liquidity creation, I include some control variables that influence bank liquidity created by banks. Following Berger and Bouwman (2009), I include a group of bank-level variables. To capture the risk, I include equity capital ratio, which is the ratio of equity to GTA, and Z-Score, which is the distance to default that measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets, as a proxy for credit risk. In addition to the ZSCORE, I include earnings volatility, which is measured as the standard deviation of the bank's return on assets over the previous twelve (minimum: eight) quarters. I also control for the bank's multibank holding company (MBHC) status because banks of multibank holding company could have much more

sufficient resources that can potentially affect bank liquidity creation strategy. Furthermore, I control for the bank's merger and acquisition history because banks often substantially alter their lending behavior following mergers and acquisitions.

Different from Berger and Bouwman (2009), I do not include bank size, market share, and a bank-level Herfindahl index as control variables in specifications using Lerner Index as a proxy for bank competition because these variables are strongly related to Lerner index, which is an indicator for bank competition. However, I control for bank size when I use bank deregulation variables as a proxy for bank competition. To control for macroeconomic condition of local markets in bank-level analysis, I control for natural logarithm of state population, Housing Price Index (HPI), natural logarithm of personal income, and GDP per capita.

For state-level analysis, I control for local market macroeconomic conditions, such as natural logarithm of state population, Housing Price Index (HPI), natural logarithm of personal income, GDP per capita, Ln(Population), HPI, State deposit per capita, State equity per capita, Number of potential borrowers, and Number of competitors.

Lastly, I include year fixed effects, firm fixed effects, state fixed effects, and state-year fixed effects in various specifications in this paper to control for time-specific effects, individual firm specific effects, state-specific effects, and state-level trends, respectively. In this paper, I do not report results including state-fixed effects because state fixed effects are almost nested within bank fixed effects and the results are consistent with specifications including bank fixed effects.

4.4 Models

To investigate the impact of bank competition on bank liquidity creation and test hypotheses, I estimate following equations:

$$\text{Liquidity}_{ijt} = \alpha_i + \alpha_t + \beta_0 + \beta_1 \text{Lerner}_{ijt-1} + \gamma \text{Control}_{ijt-1} + \varepsilon_{ijt} \qquad (1)$$

where i indexes banks, j indexes state of the banks, t indexes year, and α_i and α_t are bank fixed and year fixed effects, respectively.

As I discussed in 4.3, the key dependent variable is the dollar amount of liquidity a bank has created normalized by GTA, using catfat measure from Berger and Bouwman (2009) and the

key explanatory variable is the lagged Lerner Index, which is a popular proxy for market power, and control variables that could affect the bank liquidity creation are included. I use the lagged values for independent variables and employ the fixed effects model to mitigate the endogeneity of the measures of bank competition and to avoid biased results because fixed effect model control a problem that biased results might be yielded because of unobserved individual characteristics if I regress without fixed effect model and the fixed effect model is more robust to endogeneity. Year fixed effects control for the time trend such as a set of macroeconomic condition including inflation. In the equation, μ_i means each bank's individual specific effect, and ν_t means that time specific effect. $Liquidity_{it}$ is the dollar amount of liquidity a bank has created normalized by GTA, $Lerner_{it-1}$ is the lagged Lerner Index, $Control_{it-1}$ is a set of control variables, and ε_{it} is an error term, which assumes that $E(\varepsilon_{it})=0$ and $Var(\varepsilon_{it})=\sigma^2$. All regressions are estimated with robust standard errors, clustered by bank, to control for heteroskedasticity, as well as possible correlation among observations of the same bank in different years.

To mitigate the endogeneity concerns, I also employ a difference-in-differences estimator. Using the proportion of state-level bank liquidity creation, we investigate whether banks differently react to change in bank competition. Banks would decide their liquidity creation decisions strategically in response to different level of supply-side competition in different states. Some banks would prefer to focus on less competitive market to easily dominate the market as early as possible and to enjoy the stable life. However, the other banks would prefer to compete in competitive market to keep their competitive positions in the market and to expand their territories.

Bank deregulation ignites bank competition and reallocates assets to more competitive banks. Thus, it affects bank competition at the beginning of the deregulation. As Jayaratne and Strahan (1997) suggest that banking deregulation affects not credit supply but bank competition, using the staggered banking deregulation events as exogenous shocks allows us to exploit the exogenous variation in bank competition. It mitigates potential endogeneity concerns. Following several previous studies using the bank deregulation (e.g., Johnson and Rice, 2008; Rice and Strahan, 2010; Koetter, Kolari, and Spierdijk, 2012; Chava, Oettl, Subramanian, and Subramanian, 2013; Krishnan, Nandy, and Puri, 2014; Cornaggia, Mao, Tian, and Wolfe, 2015), I use a difference-in-differences approach to examine a causal effect of bank competition on bank liquidity creation after a change in bank branching regulation.

$$\text{Liquidity}_{ijt} = \alpha_i + \alpha_t + \gamma\text{Control}_{ijt} + \delta Deregulation_{jt} + \varepsilon_{ijt} \quad (2)$$

where i indexes banks, j indexes state of the banks, t indexes year, Liquidity$_{it}$ is the key dependent variable of interest, and α_i and α_t are firm fixed and year fixed effects, respectively. $Control_{ijt}$ is a set of control variables, and ε_{it} is an error term, which assumes that E(ε_{it})=0 and Var(ε_{it})=σ^2. $Deregulation_{jt}$ includes intra- and interstate bank deregulation indicator variables and interstate bank branching deregulation variables. This methodology fully controls for fixed differences between treated and control banks via the bank fixed effects. Also, year fixed effects for aggregate fluctuations. δ is estimate of the banking deregulation effects. All regressions are estimated with robust standard errors, clustered by state, to control for heteroskedasticity, as well as to allow for an arbitrary serial correlation within state over time because bank deregulation variables vary at the state level.

To examine the effects of state-level bank competition on state-level bank liquidity creation, I estimate a following equation:

$$\text{State Liquidity}_{jt} = \alpha_j + \alpha_t + \gamma\text{Control}_{jt} + \delta Deregulation_{jt} + \varepsilon_{jt} \quad (2)$$

where j indexes state, t indexes year, State Liquidity$_{jt}$ is the key dependent variable of interest, and α_j and α_t are state fixed and year fixed effects, respectively. $Control_{jt}$ is a set of state-level macroeconomic variables, and ε_{it} is an error term, which assumes that E(ε_{it})=0 and Var(ε_{it})=σ^2. $Deregulation_{jt}$ includes intra- and interstate bank deregulation indicator variables and interstate bank branching deregulation variables.

[Table 1: Summary Statistics]

Panels A and B of Table 1 report summary statistics for all sample banks, large banks, small banks, and the difference in summary statistics between large banks and small banks. I divide sample banks into three groups by size. I define a bank as a large bank if its gross total assets (GTA) exceed $3 billion. If a bank's GTA is between $1 billion and $3 billion, then I define the

bank as a medium bank. Lastly, the other sample banks whose GTA is up to $1 billion are considered as small banks. I have 16,367 unique sample banks for the sample period between 1984 and 2007. Among the sample banks, numbers of banks that are categorized as large banks and medium banks at least once are only 563 and 1,184 respectively. It is only 10% of total sample banks. This means that approximately 90% of the sample banks are small banks in this setting.

From Panel B of Table 1, we can also see that there are highly statistically significant differences between small banks and medium/large banks for all liquidity creation behavior and bank characteristic variables. This suggests that there is substantial heterogeneity between small banks and medium/large banks for the perspective of both liquidity creation behaviors and bank characteristics.

5. Empirical Results

5.1 The effect of bank competition on bank liquidity creation

This section describes the effect of bank competition on bank liquidity creation. In this section, I examine the relationship between bank competition and bank liquidity creation. Using Lerner index as a proxy for bank competition and catfat measure, which is scaled by gross total assets, as a proxy for bank-level liquidity creation, I investigate how bank-level strategy for liquidity creation is affected by the ex-ante extent of bank competition. My analysis includes controls for a wide range of variables that could affect bank liquidity creation as mentioned in Section 4.

[Table 2: Base regressions]

Table 2 presents ordinary least squares (OLS) estimates of the relationship between bank competition and bank liquidity creation. All independent variables are lagged. Columns (1) and (3) of Table 2 include both bank fixed effects and time fixed effects, and Columns (2) and (4) include both bank fixed effects and state-specific time trend fixed effects. Also, all specifications are estimated with robust standard errors, clustered by bank, to control for heteroskedasticity, as well as possible correlation among observations of the same bank in different years.

In Table 2, I find a statistically and economically significant inverse relationship between bank competition and bank liquidity creation. Because higher value of Lerner Index implies greater

market power, this means that banks with greater market power would create more liquidity in the market. The result remains significant even after I control for bank characteristics and state-level macroeconomic conditions. This shows that an increase of one standard deviation in Lerner Index is related to 8.7% increase of a standard deviation in bank liquidity creation. To control for state-specific time trend, such as regulatory changes, I include state-year fixed effects instead of year fixed effects in Columns (2) and (4). The inverse relation between bank competition and liquidity creation is still held. However, the results from Table 2 do not explain what types of banks dominate this effect and which component of bank liquidity creation is more correlated with the bank competition.

Now, to investigate these parts, I present the findings for different categories of banks. First sub-sample analysis is for small, medium, and large banks. Second sub-sample analysis is for sub-components of liquidity creation, such as asset-side liquidity creation, liability-side liquidity creation, and off-balance sheet liquidity creation.

[Table 3: Sub-sample regressions (Size)]

In Table 3, which contains sub-sample analyses by bank size, I find that small banks and medium and large banks react differently as Lerner Index increases. Columns (1) and (2) show the results for small banks, Columns (3) and (4) show the results for medium banks, and Columns (5) and (6) show the results for large banks. Columns (1), (3), and (5) include bank fixed effects and year fixed effects. On the other hand, Columns (2), (4), and (6) control for time invariant bank specific characteristics and state-specific time trend. Table 3 shows that statistically significant and positive coefficients on Lerner Index in Table 2 are strongly driven by small banks. The coefficients on Lerner Index for medium and large banks are statistically insignificant. That is, I find that only small banks create more liquidity in the market as bank competition decreases. The results show that medium and large banks' liquidity creation strategies would not be significantly correlated with bank competition.

As I discuss in section 2, these results suggest that small banks create more liquidity when the market is concentrated because their resources are relatively focusing on the market and they do want to utilize their own private information about their customers by keeping the relationship

with the borrowers. On the other hand, in the concentrated market, large banks would prefer to pursue monopolistic gains, such as higher interest rate and lower deposit rate. Since they have sufficient resources to overcome reduced demand of borrowers and unexpected financial shocks for a while until the borrowers inevitably take the bad deals, they could respond to bank competition differently. In Columns (2), (4), and (6) of Table 3, we can see that the coefficients on Lerner Index is quite similar to the coefficients on Lerner Index when I control for bank fixed effects and year fixed effects. This means that differential time trends in bank liquidity creation across states are correlated with bank competition but the omitted variable bias regarding state-specific time trend is not significant.

[Table 4: Sub-sample regressions (Components of BLC)]

In Table 4, I examine the relation between bank competition and three different components of bank liquidity creation, including asset-side, liability-side, and off-balance sheet liquidity creation. Table 4 shows that positive and statistically significant relation between Lerner Index and bank liquidity creation is only driven by asset-side liquidity creation. For the perspective economic significance, the result in Column (3) means that an increase of one standard deviation in Lerner Index causes 2.9% increase of a standard deviation in asset-side liquidity creation. The results suggest that banks in less competitive market create more liquidity only through asset-side, such as commercial and industrial loans, real estate loans, and so on. This result is consistent with the evidence that the positive correlation between bank competition and liquidity creation is driven by small banks. This is because small banks are more focusing on asset-side liquidity creation activities than large banks and off-the-balance sheet activities are mostly occurred in large banks. The specifications in Columns (2), (4), (6), (8), (10), and (12) include state-time trend fixed effects. From the columns containing state-time trend, we can see that the estimates are not affected by state-specific trends because the coefficients remain stable.

I conclude that banks create less liquidity in the competitive market. To be specific, this relation is driven by small banks and asset-side liquidity creation activities. The results suggest that banks react differently to change in market competition structure and have heterogenous liquidity creation strategies. In this section, I investigate the relation between bank competition

and liquidity creation and do not claim causal conclusions from my analysis. In following section, I exploit the U.S. bank deregulation events to mitigate endogeneity concerns.

5.2 The effects of bank deregulation on bank liquidity creation

In this section, I examine the effects of bank deregulation on bank liquidity creation. Previous studies suggest that bank deregulation facilitates bank competition and reallocates assets to more competitive banks. Thus, as Jayaratne and Strahan (1996) suggest that banking deregulation affects not credit supply but bank competition, using the staggered banking deregulation events as exogenous shocks allows us to exploit the exogenous variation in bank competition. It mitigates potential endogeneity concerns. Following several previous studies using the bank deregulation (e.g., Koetter, Kolari, and Spierdijk, 2012; Chava, Oettl, Subramanian, and Subramanian, 2013), I use a difference-in-differences approach to examine a causal effect of bank competition on bank liquidity creation after a change in both intra- and interstate bank regulation. Table 5 shows base regressions examining the effects of intra- and interstate banking deregulation events on bank liquidity creation.

[Table 5: Effects of Bank Deregulation on Bank Liquidity Creation]

Using both intrastate and interstate bank deregulation events as exogenous shocks, I find that exogenous variations in bank competition after both intra- and interstate deregulation events do not significantly affect bank liquidity creation. This could be because of fixed costs to invest in deregulated states. Because interstate deregulation requires much higher fixed costs to invest in deregulated states, only sizable banks are able to acquire and/or establish a charter in a state outside the main bank's home state. On the other hand, small banks would not compete with the sizable competitors. That is why these two effects could offset each other. In addition, existing large banks in the deregulated state could have chance to invest in the other deregulated states. This could also affect the insignificant effects of interstate deregulation.

Different from previous studies examining the effects of bank deregulation, results in Table 5 show that intrastate deregulation and interstate deregulation have resembling effects on bank

liquidity creation on average. To disentangle the effects, I examine sub-sample analysis by bank size in Table 6.

[Table 6: Effects of Bank Deregulation on Bank Liquidity Creation: Size]

Columns (1) – (3) show the results of sub-sample analysis and Columns (4) – (6) show the results of specifications including interaction terms between bank size dummy variables and bank deregulation variables. In Column (1), I find positive but insignificant effects of interstate deregulation on bank liquidity creation. We can see that the result in Column (1) of Table 5 is driven by small banks and fixed cost channel. From Columns (2) and (3), we can see that there are positive and slightly significant effects of interstate deregulation on medium and large banks' liquidity creation. These results suggest that banks that have more sufficient resources either to invest in the deregulated market or to compete with newcomers from outside the state create more liquidity after the interstate bank deregulation.

To identify relative effects of bank size, I include interaction terms in Column (4) – (6). Consistent with previous studies, I find that intrastate deregulation and interstate deregulation have contrasting effects on bank liquidity creation. Small banks in states that passed intrastate bank deregulation create more liquidity in the market but the small banks in states that passed interstate bank deregulation create less liquidity in the market than the other sized banks. On the other hand, large banks create less liquidity after intrastate deregulation but create more liquidity after interstate deregulation. This is because of characteristics of competitors.

For the intrastate competition, competitors are limited, and banks are aware of their intrastate competitors. That is why small banks could create more liquidity to keep their relationship with current customers and large banks could create less liquidity to enjoy monopolistic rents. However, for the interstate competition, banks in the deregulated states would not have sufficient information about potential competitors. Small banks would not have ample resources to compete with incoming out-of-state banks, but large banks would have sufficient resources to dominate the market even after interstate deregulation. That is why small banks would create relatively less liquidity creation in the market than larger banks to avoid default risk and larger banks would create more liquidity to dominate the market.

For the perspective of out-of-state banks, they would not want to compete with large banks operating in the deregulated states because there is little chance to dominate the market over the large local banks. That is why large banks might not need to create more liquidity after interstate deregulation on average. This could explain positive but statistically insignificant coefficient on interaction term between large bank dummy and interstate deregulation.

5.3 The effects of interstate branching deregulation on bank liquidity creation

In this section, to mitigate endogeneity concerns, I exploit the staggered interstate bank branching deregulation. In 1994, the Interstate Banking and Branching Efficiency Act (IBBEA) is passed and the IBBEA is implemented in 1997 to allow interstate branching. However, the U.S. government gives state governments authorities to regulate interstate branching. State governments can either create or relax interstate bank branching restrictions.

As Johnson and Rice (2008) and Rice and Strahan (2010) state, interstate bank branching deregulation is more important than intra- and interstate bank deregulation regarding bank competition and credit supply. This is because loan contracts and deposit contracts are accomplished at the branch-level. To measure interstate branching deregulation, I follow previous seminal papers, such as Johnson and Rice (2008), Rice and Strahan (2010), and Krishnan, Nandy, and Puri (2014). I mainly use Rice and Strahan Index and use Krishnan, Nandy, and Puri Index for the robustness checks.

The Interstate Banking and Branching Efficiency Act (IBBEA) allows state governments to erect barriers to entry. According to Johnson and Rice (2008) and Rice and Strahan (2010), there are four specific restriction on interstate bank branching. Based on the four restrictions, they construct Rice and Strahan Index (RSI, thereafter). I add one to the RSI when a state adds any of barriers to entry. Thus, maximum value of RSI is four, which indicates the states are the most restrictive to interstate bank branching and minimum value of RSI is zero, which indicates the states are the most open to interstate bank branching. First restriction is the minimum age of the target banks. States could impose a minimum age of 3 or more years on target banks of interstate branch acquirers. A maximum age restriction is 5 years. Second restriction is de novo interstate branching. I add one to RSI if states do not allow de novo interstate branching. Third restriction is the acquisition of individual branches. To weaken excessive external acquisitions, deregulated

states could require an out-of-state bidder bank to acquire all branches of its target bank. I add one to RSI if states do not allow individual branch acquisition. Last restriction is a statewide deposit cap. The IBBEA has a provision about deposit concentration, which is 30%. However, state governments still have authorities to build a higher or lower entry barrier regarding deposit cap, which is the maximum amount of deposits that a single bank can hold. Thus, I add one if states set the deposit cap less than 30%.

Krishnan, Nandy, and Puri (2014) add one more restriction to RSI. Krishnan, Nandy, and Puri Index (KNP, thereafter) includes four restrictions that RSI already has and an additional restriction, which is reciprocal requirement. This requirement means that interstate branching is allowed only if a state where an out-of-state bank want to enter, and a home state of the out-of-state bank permit the same level of interstate branching. Different from RSI, value of KNP index increases as the state relax restrictions. Thus, maximum value of KNP index is five, which indicates the states are the most open to interstate bank branching. This index takes the value zero for all years before the implementation of interstate bank branching deregulation.

[Table 7: Effects of Interstate Branching Deregulation on Liquidity Creation]

[Table 8: Effects of Interstate Branching Deregulation on Liquidity Creation by bank size]

Table 7 reports the results of fixed effects regressions examining the effects of interstate branching deregulation on bank liquidity creation. The coefficient estimates of RSI are positive and significant at the 1% level on average. This finding suggests that an increase in banking competition due to bank branching deregulation (i.e., a decrease in RSI) leads to a decrease in bank liquidity creation. To be specific, based on the coefficient of RSI in column (3) of Table 7, states that are completely open to interstate branching generated a total of 1.55% (=4×0.00388) less liquidity creation after interstate bank branching deregulation than states with the most restrictions on interstate branching after deregulation. I find robust evidence when I use KNP index instead of RSI index. The results suggest that interstate bank branching deregulation causes statistically significant effects on bank-level liquidity creation, but economic significance is not substantial.

The results in Table 7 are surprising. This is because I find contrasting effects of interstate bank deregulation on bank liquidity creation. Both interstate deregulation and interstate branching

deregulation exogenously increase bank competition, but the effects are different. This could be explained by

Interstate deregulation allows out-of-state banks to acquire banks in deregulated states, but interstate branching deregulation allows out-of-state banks to acquire or establish branches in deregulated states. This means that there will be much higher fixed costs that incoming banks must pay in the case of interstate deregulation. As we can see from findings in Table 6, the higher fixed costs could be a role of an entry barrier, so relatively large banks are more likely to enter the new market, which is the deregulated state. Thus, both newcomers and existing medium and large banks in the deregulated banks would create more liquidity to compete each other.

However, interstate branching deregulation lowers the fixed costs to enter new markets. That is why existing banks in the most restrictive states could choose to invest in the other open markets. For example, a bank in the most restrictive states could establish or acquire a branch at neighboring states if the fixed cost for setting up a new branch in the adjacent states is much lower than expected returns of the investment and/or the fixed cost for expanding a business within its home state. This could be possible explanation about the conflicting effects of interstate deregulation and interstate branching deregulation.

Table 8 reports the results of subsample analysis by bank size. This examines whether the effects of interstate branching deregulation on liquidity creation vary in different bank size. In the competitive market, small banks tend to create more liquidity than medium/large banks to avoid bank failure. On the other hand, large banks create even less liquidity than medium/small banks because they are more likely to be a dominant player in the market and they prefer to enjoy monopolistic rents. These results are robust to controlling for bank characteristics, macroeconomic conditions, banking deregulatory events that precede the IBBEA, bank fixed effects, and year fixed effects.

5.4 The effects of bank deregulation on state-level bank liquidity creation

In previous sections, I examine the effects of bank competition on bank-level liquidity creation. Understanding the effects of bank competition on bank-level liquidity creation is interesting and important but the effects state-level bank competition on aggregate state-level bank liquidity creation would be much more important because government policies are generally established at

the state-level. In this section, using bank deregulation events, including intra- and interstate bank deregulation and interstate bank branching deregulation, I examine whether state-level bank competition affects state-level bank liquidity creation.

Following Berger and Sedunov (2017), I define state-level bank liquidity creation as aggregate deposit of the state normalized by population of the state. To estimate state-level catfat measure, I firstly construct each bank's bank-state level market share using state-level deposit data from FDIC. By multiplying the bank-state level market share by each bank's liquidity creation measures, I can estimate bank-state level liquidity creation. For example, suppose Bank of America's total deposit in 2006 is $35 million and Florida branches have $10 million of deposit, South Carolina branches have $5 million of deposit, and Texas branches have $20 million of deposit. We can see that Bank of America's market share in Florida is 28.57% (= $10 million/$35 million). If the value of catfat for Bank of America in 2006 is $100 million, then we can assume that Bank of America creates $28.57 million in Florida at that time. After calculating the bank-state level liquidity creation, I combine all bank-state level liquidity creation by state. Lastly, I normalize the aggregate state-level bank liquidity creation by state population, which is collected from the U.S. Bureau of Economic Analysis (BEA).

State-level control variables are collected from Call Report, U.S. Bureau of Economic Analysis (BEA), and Federal Housing Finance Agency (FHFA). State-level control variables include natural logarithm of state population, GDP per capita, state personal income per capita, house price index (HPI), total state deposit per capita, state book equity per capita, and inflation. Also, state and year fixed effects are included in all specifications.

[Table 9: Effects of Intra- and Interstate Deregulation on State-level Liquidity Creation]

Table 9 reports the results of regressions examining the effects of intra- and interstate bank deregulation on state-bank liquidity creation per capita. I find that there is no statistically significant empirical evidence that intra- and interstate bank deregulation events affect state-level bank liquidity creation. Because bank deregulation stimulates bank competition and its objective is to enhance financing condition of the market, this result is meaningful. The results suggest that intra- and interstate bank deregulation policy did not play an appropriate role to encourage banks'

liquidity creation incentives. Based on empirical results in previous tables, one possible explanation is that the effects of bank deregulation events on large banks and on small banks offset each other. This suggests that the policy, that is applied to all heterogenous banks in the same way, does not fit all.

[Table 10: Effects of Intra- and Interstate Deregulation on State-level Liquidity Creation by Size]

Berger and Sedunov (2017) find that small bank liquidity creation is more important than large bank liquidity creation for the perspective of per dollar effects. This could be because small banks are more focused on small firm finance, which is important to local market growth, than large banks. Different from small-sized borrowers, large firms have more options to raise funds and they would prefer large lenders because of large banks have much sufficient resources and have much lower default risk than small banks.

In Table 10, I examine whether bank deregulation events affect state-level small bank liquidity creation and large bank liquidity creation differently. I find no statistically significant evidence that bank deregulation events affect state-level small bank and/or large bank liquidity creation. In Columns (4) – (6) and (10) – (12) of Table 10, I also find that the results are robust to including state-level macroeconomic variables.

As I discussed in section 5.3, interstate bank branching deregulation would be much more important in bank liquidity creation than bank deregulation events occurred in 1970s and 1980s. Because loan and deposit decisions, which are major drivers of on-balance sheet liquidity creation, are generally made at branch-level, interstate bank branching deregulation would have more direct and significant effects on bank liquidity creation.

[Table 11: Effects of Bank Branching Deregulation on State-Level Bank Liquidity Creation]

Table 11 presents the results of state-level analysis examining the effects of interstate branching deregulation on aggregate state-level liquidity creation per capita. Consistent with previous results of intra- and interstate bank deregulation, I find no significant empirical evidence. This suggests that, on average, even interstate bank branching deregulation does not affect state-

level bank liquidity creation per capita. The result is robust to a variety of alternative proxies for interstate bank branching deregulation, such as KNP Index.

[Table 12: Effects of Bank Branching Deregulation on State-Level Small/Large Bank LC]

However, different from analyses using intra- and interstate bank deregulation, I find significantly different effects of interstate bank branching deregulation on small bank and large bank liquidity creation. Table 12 reports that enhanced bank competition caused by interstate bank branching deregulation leads to less liquidity per capita created by small banks in the market. Based on the coefficient of RS Index in Column (2) of Table 12, we can see that the result is economically significant as well. On the other hand, I find no significant effects on large bank liquidity creation. Because large banks create more liquidity in terms of dollar values and small banks are reluctant to create liquidity in the competitive market, the results support the view that large banks enjoy monopolistic rents if they are dominant players. The results are robust if I use alternative measures of interstate bank branching deregulation. The results suggest that interstate bank branching deregulation result in even worse local market liquidity condition because small bank liquidity creation is crucial channel for local market growth (e.g., Berger and Sedunov, 2017).

The results of state-level analyses provide an important policy implication. The objective of bank deregulation is to encourage local market economy and a crucial channel that banks can contribute to local market economic growth is bank liquidity creation. Even though Jayaratne and Strahan (1996) find that the relaxation of bank branching restrictions positively affects local market economic growth, my results suggest that the positive effects might not be driven by bank-oriented effects, which is bank liquidity creation. Thus, the policy implication of the state-level results is that the government policy regarding bank competition need to consider banks' heterogeneity, such as bank size and bank market share, and markets' heterogeneity, such as market demand and supply-side competition status.

5.5 Additional robustness tests

Results in state-level analyses support the implication that a policy to encourage bank competition would be more efficient if the policy applies to banks depending on banks' heterogeneity, such as

bank size and bank market share, and markets' heterogeneity, such as market demand and supply-side competition status prior to the policy implementation.

One concern about state-level analysis is a definition of state-level bank liquidity creation. Because there is no available branch-level financial and accounting data except branch-level deposit data, I only rely on deposit market share to calculate weights for each state when I construct state-level liquidity creation. Deposit market share would be closely related to bank's concentration on the market but there is a potential measurement error issue. To mitigate this concern, I use DealScan data to construct a partial measure of state-level bank liquidity creation. DealScan data provides information about borrower's location and total loan amount so I use the information to calculate more accurate state-level liquidity creation weights. Even though loan creation is a part of bank liquidity creation, which is a part of asset-side liquidity creation, using DealScan data allows me to identify correct weights for each state where a bank operates. Table 13 shows results of state-level analyses using DealScan data are consistent with previous results using state-level bank liquidity creation relying on deposit market shares. This suggests that main state-level liquidity creation measures in this paper are valid.

In untabulated tests, I conduct several additional robustness checks. Firstly, to resolve a concern about any potential bias on bank competition measure, I run identical tests using different explanatory variables. As I mentioned in previous sections, one of key independent variables of this paper is Lerner Index, which is a proxy for bank competition (i.e. bank market power). As banking literature widely uses Herfindahl-Hirschman Index as one of the proxy for bank competition or bank concentration, I explore same specification with Herfindahl-Hirschman Index instead of Lerner Index. Results are generally consistent with the results using Lerner Index.

In addition, I use a different comprehensive liquidity creation measure, matfat, instead of catfat. As I discuss in Section 2, only difference between catfat and matfat measures is a way to classify loans. Catfat measure classifies loans by category but matfat measure classifies loans by maturity. It will be ideal if I can consider both category and maturity when I classify the loans. Unfortunately, lack of available data does not allow us to consider both ways. Because category-based classification captures loan-specific characteristics, Berger and Bouwman (2009) suggest that catfat measure is the most comprehensive measure of bank liquidity creation among their four liquidity creation measures. However, maturity-based classification would be essential when I

compare same kinds of loans. Thus, there is a possibility that maturity-based classification has a merit to evaluate loan-side liquidity creation. Thus, I run the identical tests using the matfat measure as a robustness check. The results are still consistent.

6. Conclusion and Discussion

Banks' role as liquidity creators is crucial for local market condition and economic growth. However, the determinants of bank liquidity creation are understudied. While a large literature suggests that bank competition affects local market economic growth, it is unclear whether bank-side liquidity creation is a major economic channel of the effects of bank competition on economic outputs. Empirical evidence of this paper suggests that the effects of bank competition on economic growth would not originate from bank-side liquidity creation channel.

From bank-level analysis, I find that bank competition affects bank-level liquidity creation behavior. I also find that staggered interstate bank branching deregulation, which represents an exogenous variation in bank competition, affects bank-level liquidity creation.

Different from bank-level analysis, state-level analysis shows that bank deregulation events do not significantly affect state-level bank liquidity creation on average. Additional analysis regarding in-state banks' liquidity creation and out-of-state banks' liquidity creation shows that the effects of bank competition offset each other. Also, I find that bank competition affects differently small/medium bank liquidity creation and large bank liquidity creation. These effects offset each other as well. The results suggest that the policy, that is applied to all heterogenous banks in the same way, does not fit all. It highlights the role of proper regulation to encourage depressed credit market.

There are some points I can develop deeper. Firstly, the U.S. government implemented TARP program after the recent financial crisis to encourage credit supply, so it will be interesting to use TARP as an exogenous shock on market power. Even though this is not purely random, it is worth to exploit the exogenous variation in market power.

According to Bayazitova and Shivdasani (2012) and Duchin and Sosyura (2014), there are some banks that received TARP fund offer but withdrew the offer. Collecting data for these qualified but non-TARP recipients would allow me cleaner tests. Even though it would be quite small sample analysis, comparing this group with TARP recipients would be cleaner test than

comparing TARP recipients and non-recipients. This further analysis could provide additional evidence whether government achieved its expected results of the government intervention or bank managers took excessive risks at the expense of the government, following theoretical models of bank risk-taking.

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Table 1: Summary Statistics

This table contains summary statistics for all sample banks and contains summary statistics that compare small banks with medium/large banks. The sample comprises 16,367 unique commercial banks over the period 1984 to 2007. Panel A presents bank -level descriptive statistics for the full sample. Panel B presents univariate differences between small banks versus medium/large banks. Each bank is categorized by size based on its gross total assets (GTA). Gross total assets (GTA) is total assets + the allowance for loan and lease losses + the allocated transfer risk reserve (a reserve for certain foreign loans). A bank is classified as a large bank if its GTA are exceeding $3 billion, as a medium bank if its GTA are between $1 billion and $3 billion, and as a small bank if its GTA are below $1 billion. Panel C shows state-level descriptive statistics. All financial values are measured in real 2007 dollars using the implicit GDP price deflator. The table reports number of observations, sample means, and standard deviations. For liquidity creation measures, catfat is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities. catnonfat is a category-based liquidity creation measure, including only on-balance sheet activities. lc_a, lc_l, and lc_obs are asset-side liquidity creation, liability-side liquidity creation, and off-the-balance sheet liquidity creation, respectively. Liquidity creation variables with a "gta" suffix are liquidity creation measures normalized by GTA. Lerner Index is the observed price-cost margin divided by price. Equity Ratio is total equity capital divided by GTA. Bank Size is Natural log of GTA. Earnings Volatility is standard deviation of the bank's quarterly return on assets measured over the previous twelve quarters, multiplied by 100. ZSCORE is the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. Multi-BHC is an indicator variable, which is equal to 1 if the bank has been part of a multibank holding company over the past three years. Acquisitions is an indicator variable, which is equal to 1 if the bank was acquired in the last three years. INTRA is an indicator variable, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation. INTER is an indicator variable, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. RS Index is Rice-Strahan index of interstate banking deregulation. It ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state. KNP Index is Krishnan-Nandy-Puri index. It ranges from one (highly regulated) to five (deregulated). GDP is state-level gross domestic production. Personal Income is state-level personal income level. HPI is state-level housing price index. In Panel C, state-level variables with a "per capita" suffix are variables normalized by state population.

Panel A: Summary Statistics (Bank-level)

	N	Mean	SD
Liquidity Creation Variables			
catfat	206,198	267,479	4,728,000
catnonfat	206,198	130,205	1,728,000
lc_a	206,198	27,485	667,700
lc_l	206,198	102,720	1,388,000
lc_obs	206,198	137,274	3,576,000
catfat_gta	206,198	0.201	0.194
catnonfat_gta	206,198	0.160	0.150
lc_a_gta	206,198	-0.0151	0.138
lc_l_gta	206,198	0.175	0.0651
lc_obs_gta	206,198	0.0406	0.0958
Bank-level Variables			
Lerner Index	203,711	0.315	0.109
Equity Ratio	205,097	0.0939	0.0421
Gross Total Assets	205,100	537,878	7,602,000
Bank Size	205,315	11.61	1.150
Earnings Volatility	203,011	0.00448	0.00360
ZSCORE	193,588	47.68	53.39
Small Bank	206,198	0.953	0.212
Medium Bank	206,198	0.0269	0.162
Large Bank	206,198	0.0201	0.140
Multi-BHC	206,198	0.254	0.435
Acquisitions	206,198	0.0777	0.268
State-level Bank Deregulation Variables			
INTRA	206,198	0.779	0.415
INTER	206,198	0.837	0.369
RS Index (4 Restrictions)	206,198	3.423	1.152
KNP Index (5 Restrictions)	206,198	1.231	1.704
KNP Index (4 Restrictions)	206,198	0.968	1.506

Table 1: Summary Statistics

Panel B: t-test (Small Banks vs. Large/Medium Banks)

	Small Banks			Large and Medium Banks			t-test	
	N	Mean	SD	N	Mean	SD	Difference	p-value
Liquidity Creation Variables								
catfat	196,500	34,426	63,416	9,698	4,990,000	21,260,000	4,955,574	0.0000
catnonfat	196,500	27,381	48,484	9,698	2,214,000	7,676,000	2,186,619	0.0000
lc_a	196,500	1,068	29,556	9,698	562,751	3,027,000	561,683	0.0000
lc_l	196,500	26,313	34,310	9,698	1,651,000	6,200,000	1,624,687	0.0000
lc_obs	196,500	7,045	23,319	9,698	2,776,000	16,270,000	2,768,955	0.0000
catfat_gta	196,500	0.191	0.175	9,698	0.404	0.375	0.213	0.0000
catnonfat_gta	196,500	0.156	0.150	9,698	0.252	0.125	0.096	0.0000
lc_a_gta	196,500	-0.0180	0.139	9,698	0.0440	0.122	0.062	0.0000
lc_l_gta	196,500	0.174	0.0643	9,698	0.208	0.0711	0.034	0.0000
lc_obs_gta	196,500	0.0350	0.0473	9,698	0.152	0.370	0.117	0.0000
Bank-level Variables								
Lerner Index	194,064	0.317	0.107	9,647	0.271	0.134	-0.046	0.0000
Equity Ratio	195,431	0.0947	0.0425	9,666	0.0772	0.0308	-0.018	0.0000
Gross Total Assets	195,433	133,000	144,298	9,667	8,723,000	33,990,000	8,590,000	0.0000
Bank Size	195,633	11.44	0.853	9,682	15.00	1.128	3.560	0.0000
Earnings Volatility	193,388	0.00450	0.00362	9,623	0.00406	0.00313	0.000	0.0000
ZSCORE	184,173	47.83	53.57	9,415	44.70	49.71	-3.130	0.0000
Multi-BHC	196,500	0.236	0.425	9,698	0.614	0.487	0.378	0.0000
Acquisitions	196,500	0.0589	0.235	9,698	0.459	0.498	0.400	0.0000

Table 1: Summary Statistics

Panel C: Summary Statistics (State-level)

	N	Mean	Median	Q1	Q3	SD
State-level Bank Deregulation Variables						
INTRA	1,166	0.894	1	1	1	0.308
INTER	1,166	0.886	1	1	1	0.318
RS Index (4 Restrictions)	1,166	3.032	4	3	4	1.425
KNP Index (5 Restrictions)	1,166	1.467	0	0	2	1.803
KNP Index (4 Restrictions)	1,166	1.774	0	0	3	1.984
State Liquidity Creation Variables						
Liquidity Creation per Capita	1,166	7.465	6.597	4.332	9.399	4.707
Small Bank Liquidity Creation per Capita	1,164	1.414	1.051	0.634	1.917	1.132
Medium Bank Liquidity Creation per Capita	1,106	0.742	0.573	0.332	0.928	0.666
Large Bank Liquidity Creation per Capita	1,047	5.958	4.827	2.877	7.722	4.833
Small/Medium Bank Liquidity Creation per Capita	1,165	2.116	1.665	1.082	2.745	1.500
Asset-side Liquidity Creation per Capita	1,166	0.762	0.595	-0.181	1.624	1.316
Liability-side Liquidity Creation per Capita	1,166	3.660	3.525	2.969	4.178	1.181
Off-balance sheet Liquidity Creation per Capita	1,166	3.042	2.191	1.243	3.719	3.437
State-level Variables						
State-level Deposit per Capita	1,117	8.489	7.962	6.506	10.20	2.925
State-level Equity per Capita	1,117	1.294	1.180	0.933	1.558	0.556
GDP per Capita	1,166	28,053	25,657	19,280	34,035	13,470
Personal Income per Capita	1,166	23.12	22.00	16.54	28.58	8.181
LN(Population)	1,166	15.04	15.13	14.31	15.64	0.995
HPI	1,166	205.5	186.9	135.3	241.6	94.82

Table 2: Relationship between Bank Competition and Bank Liquidity Creation

This table contains OLS panel regressions that examine the relation between bank competition and bank liquidity creation. The analysis is at bank-year level. The dependent variable is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The independent variable is Lerner Index, which is the observed price-cost margin divided by price. The specifications in Column 1 and 3 include bank and year fixed effects. The specifications in Columns 2 and 4 include bank and state-year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at firm level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

VARIABLES	(1)	(2)	(3)	(4)
Lerner Index	0.0731**	0.0581**	0.142**	0.126**
	(0.0325)	(0.0251)	(0.0680)	(0.0544)
EQRAT			-0.902***	-0.971***
			(0.0946)	(0.0875)
EARNVOL			-0.812	-0.684
			(0.527)	(0.577)
ZSCORE			-5.48e-06	-2.37e-05***
			(7.05e-06)	(6.01e-06)
MBHC			0.0228***	0.0180***
			(0.00220)	(0.00219)
Acquisition			0.00554***	0.00764***
			(0.00184)	(0.00172)
Constant	0.109***	-0.166***	-0.0614	0.167***
	(0.00817)	(0.0375)	(0.240)	(0.0449)
Observations	203,711	203,711	181,141	181,141
Adjusted R-squared	0.777	0.796	0.801	0.814
Control Variables	No	No	Yes	Yes
Macroeconomic Variables	No	No	Yes	No
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
State time trend	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Relationship between Bank Competition and Bank Liquidity Creation: Sub-sample analysis by bank size

This table contains OLS panel regressions that examine the relation between bank competition and bank liquidity creation in small, medium, and large banks. A bank is classified as a large bank if its GTA are exceeding $3 billion, as a medium bank if its GTA are between $1 billion and $3 billion, and as a small bank if its GTA are below $1 billion. The analysis is at bank-year level. The dependent variable is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The independent variable is Lerner Index, which is the observed price-cost margin divided by price. The specifications in Column 1, 3, and 5 include bank and year fixed effects. The specifications in Columns 2, 4, and 6 include bank and state-year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at firm level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

VARIABLES	(1) Small Bank	(2) Small Bank	(3) Medium Bank	(4) Medium Bank	(5) Large Bank	(6) Large Bank
Lerner Index	0.0748***	0.0717***	0.0934	0.0746	0.268	0.195
	(0.0189)	(0.0190)	(0.105)	(0.0731)	(0.391)	(0.395)
EQRAT	-0.893***	-0.957***	-0.167	-0.633	1.428	1.733
	(0.0458)	(0.0456)	(0.453)	(0.419)	(1.440)	(1.702)
EARNVOL	-0.0167	0.221	-2.357	1.489	-25.77*	-26.06*
	(0.188)	(0.187)	(2.208)	(1.491)	(14.51)	(14.29)
ZSCORE	-1.56e-06	-2.07e-05***	1.27e-05	3.01e-05	2.31e-05	-3.44e-05
	(5.70e-06)	(5.51e-06)	(3.06e-05)	(3.63e-05)	(0.000102)	(0.000105)
MBHC	0.0254***	0.0212***	0.00485	-0.00771	-0.0179	-0.0273
	(0.00203)	(0.00199)	(0.00928)	(0.0103)	(0.0177)	(0.0292)
Acquisition	0.00640***	0.00817***	-0.000464	0.00994*	-0.00237	-0.000531
	(0.00172)	(0.00167)	(0.00486)	(0.00587)	(0.0101)	(0.0120)
Constant	0.0749	0.401***	-4.760	0.355***	0.972	0.391***
	(0.253)	(0.0153)	(3.907)	(0.0313)	(1.769)	(0.109)
Observations	171,097	171,097	5,787	5,787	4,257	4,257
Adjusted R-squared	0.801	0.813	0.678	0.774	0.826	0.836
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	No	Yes	No	Yes	No
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
State time trend	No	Yes	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Relationship between Bank Competition and Bank Liquidity Creation: Sub-sample analysis by liquidity creation components

This table contains OLS panel regressions that examine the relation between bank competition and components of bank liquidity creation. The analysis is at bank-year level. The dependent variable in Columns 1 – 4 is asset-side liquidity creation normalized by GTA. The dependent variable in Columns 5 – 8 is liability-side liquidity creation normalized by GTA. The dependent variable in Columns 9 – 12 is off-the-balance sheet-side liquidity creation normalized by GTA. The independent variable is Lerner Index, which is the observed price-cost margin divided by price. The specifications in Column 1, 3, 5, 7, 9, and 11 include bank and year fixed effects. The specifications in Columns 2, 4, 6, 8, 10, and 12 include bank and state-year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at firm level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Asset-side liquidity creation	Asset-side liquidity creation	Asset-side liquidity creation	Asset-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")
Lerner Index	0.0315***	0.0285***	0.0381***	0.0450***	0.000384	0.000347	-0.000164	-0.00503	0.0412	0.0293	0.104	0.0858
	(0.00463)	(0.00425)	(0.0113)	(0.0115)	(0.00212)	(0.00199)	(0.00524)	(0.00364)	(0.0351)	(0.0264)	(0.0793)	(0.0631)
EQRAT			-0.277***	-0.355***			-0.535***	-0.512***			-0.0905	-0.104
			(0.0392)	(0.0392)			(0.0147)	(0.0137)			(0.0991)	(0.0899)
EARNVOL			0.0306	0.222			-0.104	-0.0286			-0.739	-0.878
			(0.156)	(0.150)			(0.0785)	(0.0757)			(0.519)	(0.575)
ZSCORE			2.46e-06	-1.58e-05***			6.07e-06***	4.81e-06**			-1.40e-05***	-1.27e-05***
			(4.94e-06)	(4.72e-06)			(2.04e-06)	(1.96e-06)			(5.03e-06)	(3.29e-06)
MBHC			0.0218***	0.0173***			-0.00182***	-0.00112*			0.00277**	0.00186
			(0.00172)	(0.00166)			(0.000668)	(0.000647)			(0.00125)	(0.00133)
Acquisition			0.00475***	0.00694***			-0.00269***	-0.00262***			0.00348***	0.00331***
			(0.00126)	(0.00118)			(0.000509)	(0.000495)			(0.00126)	(0.00115)
Constant	-0.0574***	-0.473***	-0.0991	-0.0822**	0.163***	0.217***	-0.0852	0.197***	0.00360	0.0896***	0.123	0.0526***
	(0.00152)	(0.0325)	(0.209)	(0.0356)	(0.000661)	(0.0108)	(0.0650)	(0.0139)	(0.00874)	(0.0146)	(0.0936)	(0.0202)
Observations	203,711	203,711	181,141	181,141	203,711	203,711	181,141	181,141	203,711	203,711	181,141	181,141
Adjusted R-squared	0.741	0.767	0.759	0.778	0.772	0.792	0.801	0.815	0.715	0.750	0.754	0.774
Control Variables	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Macroeconomic Variables	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
State time trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Effects of Bank Deregulation on Bank Liquidity Creation

This table presents the estimation results that analyze the effect bank competition on bank liquidity creation. The analysis is at bank-year level. The dependent variable in Column 1 is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The dependent variables in Columns 2, 3, and 4 are asset-side liquidity creation normalized by GTA, liability-side liquidity creation normalized by GTA, and off-the-balance sheet-side liquidity creation normalized by GTA, respectively. The independent variables are INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include bank and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level. Different from the previous specifications using Lerner Index as a proxy for bank competition, all specifications in this table control for Bank Size and cluster by state-level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Liquidity creation (catfat)	Liquidity creation (catfat)	Liquidity creation (catfat)	Asset-side liquidity creation	Asset-side liquidity creation	Asset-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")
INTRA	0.00301		0.00283	0.00009		-0.00003	0.00482**		0.00482**	-0.00191		-0.00196
	(0.00595)		(0.00596)	(0.00587)		(0.00592)	(0.00202)		(0.00201)	(0.00185)		(0.00184)
INTER		0.0135	0.0135		0.00939	0.00939		0.000365	0.000277		0.00375	0.00379
		(0.00872)	(0.00875)		(0.00997)	(0.00998)		(0.00271)	(0.00262)		(0.00227)	(0.00226)
EQRAT	-0.611***	-0.611***	-0.610***	-0.137**	-0.137**	-0.137**	-0.473***	-0.476***	-0.473***	-0.000202	0.00117	7.94e-05
	(0.0677)	(0.0682)	(0.0679)	(0.0534)	(0.0544)	(0.0536)	(0.0137)	(0.0133)	(0.0137)	(0.0359)	(0.0362)	(0.0360)
Bank Size	0.0193***	0.0195***	0.0196***	0.0240***	0.0242***	0.0242***	-0.018***	-0.018***	-0.018***	0.0130***	0.0132***	0.0131***
	(0.00584)	(0.00592)	(0.00576)	(0.00425)	(0.00424)	(0.00414)	(0.00151)	(0.00153)	(0.00150)	(0.00264)	(0.00276)	(0.00269)
EARNVOL	-0.978	-0.956	-0.956	0.0511	0.0665	0.0665	-0.228**	-0.227**	-0.228**	-0.801	-0.795	-0.795
	(0.827)	(0.822)	(0.821)	(0.231)	(0.228)	(0.228)	(0.0989)	(0.1000)	(0.0977)	(0.783)	(0.779)	(0.779)
ZSCORE	0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000**	0.0000**	0.0000**	-0.0000**	-0.0000**	-0.0000**
	(9.22e-06)	(8.45e-06)	(8.56e-06)	(7.82e-06)	(6.86e-06)	(6.99e-06)	(2.29e-06)	(2.19e-06)	(2.13e-06)	(4.33e-06)	(4.57e-06)	(4.49e-06)
MBHC	0.0218***	0.0217***	0.0216***	0.0191***	0.0189***	0.0189***	-0.0014	-0.0013	-0.0014	0.0042***	0.0041***	0.0041***
	(0.00311)	(0.00316)	(0.00307)	(0.00232)	(0.00234)	(0.00233)	(0.00119)	(0.00121)	(0.00118)	(0.00119)	(0.00122)	(0.00119)
Acquisition	-0.00151	-0.00176	-0.00180	-0.00343	-0.00363	-0.00363	0.0025***	0.0026***	0.0025***	-0.000594	-0.000707	-0.000675
	(0.00289)	(0.00290)	(0.00288)	(0.00255)	(0.00252)	(0.00250)	(0.000883)	(0.000889)	(0.000870)	(0.00103)	(0.00105)	(0.00103)
Constant	-0.0124	-0.0701	-0.0828	-0.154	-0.203	-0.203	0.0778	0.0980	0.0764	0.0634	0.0347	0.0435
	(0.446)	(0.416)	(0.426)	(0.457)	(0.430)	(0.433)	(0.174)	(0.172)	(0.171)	(0.141)	(0.133)	(0.136)
Observations	193,032	193,032	193,032	193,032	193,032	193,032	193,032	193,032	193,032	193,032	193,032	193,032
Adjusted R-squared	0.792	0.793	0.793	0.752	0.752	0.752	0.804	0.803	0.804	0.740	0.740	0.740
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Effects of Bank Deregulation on Bank Liquidity Creation: Sub-sample analysis by bank size

This table presents the estimation results that analyze the effect bank competition on bank liquidity creation in small, medium, and large banks. A bank is classified as a large bank if its GTA are exceeding $3 billion, as a medium bank if its GTA are between $1 billion and $3 billion, and as a small bank if its GTA are below $1 billion. The analysis is at bank-year level. The dependent variable is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The independent variables are INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include bank and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level. Different from the previous specifications using Lerner Index as a proxy for bank competition, all specifications in this table control for Bank Size and cluster by state-level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) Small Bank	(2) Medium Bank	(3) Large Bank	(4) Small Bank	(5) Medium Bank	(6) Large Bank
INTRA	0.00359	-0.0289	-0.0391	-0.0195	0.00321	0.00322
	(0.00571)	(0.0237)	(0.0284)	(0.0159)	(0.00590)	(0.00589)
INTER	0.0114	0.0380*	0.0670*	0.0615**	0.0126	0.0130
	(0.00884)	(0.0225)	(0.0346)	(0.0303)	(0.00867)	(0.00877)
Small Bank				0.0393*		
				(0.0213)		
Small Bank * INTRA				0.0231		
				(0.0152)		
Small Bank * INTER				-0.0495*		
				(0.0288)		
Medium Bank					-0.0425	
					(0.0269)	
Medium Bank * INTRA					-0.0142	
					(0.0180)	
Medium Bank * INTER					0.0506*	
					(0.0300)	
Large Bank						-0.0155
						(0.0192)
Large Bank * INTRA						-0.0359**
						(0.0157)
Large Bank * INTER						0.0432
						(0.0297)
Constant	-0.00417	-3.614	1.575	-0.175	-0.136	-0.136
	(0.445)	(3.691)	(2.049)	(0.438)	(0.438)	(0.436)
Observations	183,627	5,372	4,033	193,032	193,032	193,032
Adjusted R-squared	0.793	0.684	0.830	0.793	0.793	0.793
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Effects of Interstate Branching Deregulation on Bank Liquidity Creation

This table presents the estimation results that analyze the effect interstate bank branching deregulation on bank liquidity creation. The analysis is at bank-year level. The dependent variable is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The independent variables are RS Index, which ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state, KNP4 Index, which ranges from one (highly regulated) to four (deregulated), KNP5 Index, which ranges from one (highly regulated) to five (deregulated), INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include bank and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level. Different from the previous specifications using Lerner Index as a proxy for bank competition, all specifications in this table control for Bank Size and cluster by state-level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1)	(2)	(3)	(4)	(5)	(6)
RS Index	0.00455**	0.00388*				
	(0.00206)	(0.00229)				
KNP4 Index			-0.00451**	-0.00366*		
			(0.00177)	(0.00196)		
KNP5 Index					-0.00415**	-0.00376**
					(0.00182)	(0.00173)
INTRA		0.000685		0.000722		0.000992
		(0.00602)		(0.00604)		(0.00598)
INTER		0.0116		0.0118		0.0121
		(0.00793)		(0.00803)		(0.00819)
EQRAT		-0.608***		-0.608***		-0.608***
		(0.0676)		(0.0677)		(0.0676)
Bank Size		0.0198***		0.0198***		0.0198***
		(0.00569)		(0.00570)		(0.00571)
EARNVOL		-0.940		-0.940		-0.935
		(0.821)		(0.821)		(0.820)
ZSCORE		-2.87e-06		-2.82e-06		-2.71e-06
		(8.39e-06)		(8.37e-06)		(8.35e-06)
MBHC		0.0214***		0.0214***		0.0214***
		(0.00310)		(0.00310)		(0.00307)
Acquisition		-0.00164		-0.00165		-0.00167
		(0.00289)		(0.00289)		(0.00288)
Constant	0.108***	-0.119	0.126***	-0.104	0.126***	-0.0960
	(0.0148)	(0.417)	(0.00980)	(0.417)	(0.00989)	(0.420)
Observations	206,198	193,032	206,198	193,032	206,198	193,032
Adjusted R-squared	0.773	0.793	0.773	0.793	0.773	0.793
Control Variables	No	Yes	No	Yes	No	Yes
Macroeconomic Variables	No	Yes	No	Yes	No	Yes
Fixed Effects	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Effects of Interstate Branching Deregulation on Bank Liquidity Creation: Sub-sample analysis by bank size

This table presents the estimation results that analyze the effect interstate bank branching deregulation on bank liquidity creation in small, medium, and large banks. A bank is classified as a large bank if its GTA are exceeding $3 billion, as a medium bank if its GTA are between $1 billion and $3 billion, and as a small bank if its GTA are below $1 billion. The analysis is at bank-year level. The dependent variable is catfat, which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The independent variables are RS Index, which ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state, KNP4 Index, which ranges from one (highly regulated) to four (deregulated), KNP5 Index, which ranges from one (highly regulated) to five (deregulated), INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include bank and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level. Different from the previous specifications using Lerner Index as a proxy for bank competition, all specifications in this table control for Bank Size and cluster by state-level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All independent variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

VARIABLES	(1) Small Bank	(2) Medium Bank	(3) Large Bank	(4) Small Bank	(5) Medium Bank	(6) Large Bank
RSI	0.00288	0.00393	0.0158	0.00886***	0.00374	0.00355
	(0.00223)	(0.00449)	(0.0109)	(0.00294)	(0.00228)	(0.00231)
INTRA	0.00203	-0.0297	-0.0463	0.000594	0.000681	0.000630
	(0.00566)	(0.0237)	(0.0311)	(0.00599)	(0.00599)	(0.00597)
INTER	0.0101	0.0376	0.0640*	0.0117	0.0116	0.0117
	(0.00807)	(0.0225)	(0.0342)	(0.00792)	(0.00793)	(0.00793)
Small Bank				0.0271***		
				(0.00909)		
Small Bank X RS Index				-0.00546**		
				(0.00253)		
Medium Bank					-0.0154	
					(0.0100)	
Medium Bank X RS Index					0.00267	
					(0.00307)	
Large Bank						-0.0303
						(0.0220)
Large Bank X RS Index						0.00871*
						(0.00438)
Constant	0.00672	-3.452	1.709	-0.141	-0.120	-0.107
	(0.431)	(3.612)	(2.067)	(0.420)	(0.417)	(0.419)
Observations	183,627	5,372	4,033	193,032	193,032	193,032
Adjusted R-squared	0.793	0.684	0.830	0.793	0.793	0.793
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year	Bank, Year

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Effects of Bank Deregulation on State-Level Bank Liquidity Creation

This table presents the estimation results that analyze the effect intra- and interstate bank deregulation on state-level bank liquidity creation. The analysis is at state-year level. The dependent variable is state-level aggregate catfat normalized by state population. The independent variables are INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include state and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All control variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) State catfat per capita	(2) State catfat per capita	(3) State catfat per capita	(4) State catfat per capita	(5) State catfat per capita	(6) State catfat per capita
INTRA	-1.706**		-1.530**	-0.671		-0.688
	(0.717)		(0.626)	(0.484)		(0.471)
INTER		-1.189	-0.802		-0.0224	0.0997
		(0.847)	(0.744)		(0.522)	(0.496)
LN(Population)				8.686***	8.905***	8.739***
				(3.010)	(2.979)	(3.006)
HPI				-0.0186***	-0.0186***	-0.0187***
				(0.00615)	(0.00617)	(0.00615)
Number of Borrowers				0.00348	0.00396	0.00349
				(0.00334)	(0.00339)	(0.00338)
Number of Competitors				0.00293	0.00358*	0.00294
				(0.00223)	(0.00206)	(0.00224)
Deposit per capita				0.0859	0.0831	0.0866
				(0.185)	(0.188)	(0.187)
Equity per capita				2.822***	2.839***	2.821***
				(0.806)	(0.813)	(0.810)
GDP per capita				0.000268***	0.000266***	0.000268***
				(4.42e-05)	(4.48e-05)	(4.43e-05)
Personal Income per capita				-0.0467	-0.0282	-0.0433
				(0.130)	(0.136)	(0.132)
Constant	0.766**	0.194	0.818**	-132.5***	-136.6***	-133.4***
	(0.312)	(0.311)	(0.318)	(45.14)	(44.63)	(45.19)
Observations	1,176	1,176	1,176	1,127	1,127	1,127
Adjusted R-squared	0.739	0.736	0.739	0.826	0.826	0.826
Control Variables	No	No	No	Yes	Yes	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Effects of Bank Deregulation on State-Level Bank Liquidity Creation by Small and Large Banks

This table presents the estimation results that analyze the effect intra- and interstate bank deregulation on state-level bank liquidity creation. The analysis is at state-year level. The dependent variable is state-level aggregate catfat, created by either small banks within a state or large banks within a state, normalized by state population. The dependent variable in Columns 1 – 6 is state-level small bank catfat normalized by state population, and the dependent variable in Columns 7 – 12 is state-level large bank catfat normalized by state population. The independent variables are INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include state and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All control variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) State catfat per capita (Small Bank)	(2) State catfat per capita (Small Bank)	(3) State catfat per capita (Small Bank)	(4) State catfat per capita (Medium Bank)	(5) State catfat per capita (Medium Bank)	(6) State catfat per capita (Medium Bank)	(7) State catfat per capita (Large Bank)	(8) State catfat per capita (Large Bank)	(9) State catfat per capita (Large Bank)
INTRA	0.2870		0.2261	0.4340***		0.3421***	-0.2875		-0.3368
	(0.1882)		(0.1882)	(0.1360)		(0.1177)	(0.3884)		(0.3777)
INTER		0.4032*	0.3635		0.6089***	0.5488***		0.2351	0.2942
		(0.2187)	(0.2199)		(0.1786)	(0.1722)		(0.4555)	(0.4414)
LN(Population)	-0.5245	-0.3884	-0.3347	0.8410	1.0465	1.1277	8.6299***	8.8636***	8.7836***
	(0.9057)	(0.8074)	(0.8202)	(1.0535)	(0.9840)	(0.9777)	(3.2126)	(3.2035)	(3.2223)
HPI	-0.0034*	-0.0036**	-0.0036**	0.0003	0.0001	0.0000	-0.0151**	-0.0153**	-0.0153**
	(0.0017)	(0.0017)	(0.0017)	(0.0011)	(0.0011)	(0.0011)	(0.0060)	(0.0060)	(0.0060)
Number of Borrowers	0.0001	-0.0000	0.0001	0.0003	0.0002	0.0004	-0.0052*	-0.0049*	-0.0051*
	(0.0005)	(0.0006)	(0.0005)	(0.0007)	(0.0006)	(0.0005)	(0.0029)	(0.0029)	(0.0029)
Number of Competitors	0.0009**	0.0007	0.0009**	-0.0005	-0.0008	-0.0004	0.0018	0.0021*	0.0018
	(0.0004)	(0.0005)	(0.0004)	(0.0006)	(0.0007)	(0.0006)	(0.0012)	(0.0012)	(0.0012)
Deposit per capita	0.1240***	0.1281***	0.1268***	0.0673**	0.0736**	0.0716**	0.3551***	0.3554***	0.3574***
	(0.0231)	(0.0241)	(0.0241)	(0.0317)	(0.0326)	(0.0319)	(0.1133)	(0.1151)	(0.1146)
Equity per capita	-0.2843**	-0.2967**	-0.2850**	-0.0887	-0.1076	-0.0898	0.4821	0.4990	0.4815
	(0.1220)	(0.1256)	(0.1237)	(0.0952)	(0.1004)	(0.0979)	(0.6405)	(0.6432)	(0.6434)
GDP per capita	0.0000	0.0000	0.0000	-0.0000**	-0.0000**	-0.0000**	0.0003***	0.0003***	0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Personal Income per capita	-0.0470	-0.0395	-0.0345	-0.0096	0.0016	0.0091	-0.1771	-0.1597	-0.1670
	(0.0624)	(0.0637)	(0.0643)	(0.0512)	(0.0510)	(0.0518)	(0.1366)	(0.1397)	(0.1371)
Constant	8.6803	6.5932	5.5638	-12.0058	-15.1546	-16.7116	-129.9183***	-133.9739***	-132.4408***
	(13.6808)	(12.1136)	(12.3849)	(15.8832)	(14.7960)	(14.7630)	(48.2185)	(48.0960)	(48.4746)
Observations	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127
Adjusted R-squared	0.767	0.770	0.771	0.332	0.344	0.352	0.782	0.782	0.782
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Effects of Bank Branching Deregulation on State-Level Bank Liquidity Creation

This table presents the estimation results that analyze the effect interstate bank branching deregulation on state-level bank liquidity creation. The analysis is at state-year level. The dependent variable is state-level aggregate catfat normalized by state population. The independent variables are RS Index, which ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state, KNP4 Index, which ranges from one (highly regulated) to four (deregulated), KNP5 Index, which ranges from one (highly regulated) to five (deregulated), INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include state and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All control variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) State catfat per capita	(2) State catfat per capita	(3) State catfat per capita	(4) State catfat per capita	(5) State catfat per capita	(6) State catfat per capita
RS Index	0.2030	0.0641				
	(0.1847)	(0.1652)				
KNP4 Index			-0.1897	-0.0624		
			(0.1680)	(0.1441)		
KNP5 Index					-0.1984	-0.1130
					(0.1760)	(0.1515)
INTRA		0.1765		0.1762		0.1506
		(0.5047)		(0.4966)		(0.4911)
INTER		1.1687*		1.1689*		1.1556*
		(0.6793)		(0.6803)		(0.6623)
LN(Population)		9.4109**		9.4144**		9.3219**
		(4.4929)		(4.4644)		(4.5044)
HPI		-0.0189***		-0.0189***		-0.0189***
		(0.0060)		(0.0060)		(0.0061)
Number of Borrowers		-0.0046		-0.0046		-0.0046
		(0.0029)		(0.0029)		(0.0029)
Number of Competitors		0.0022		0.0022		0.0022
		(0.0016)		(0.0016)		(0.0016)
Deposit per capita		0.5507***		0.5507***		0.5473***
		(0.1237)		(0.1232)		(0.1222)
Equity per capita		0.1316		0.1319		0.1504
		(0.7125)		(0.7096)		(0.7128)
GDP per capita		0.0002***		0.0002***		0.0002***
		(0.0000)		(0.0000)		(0.0000)
Personal Income per capita		-0.1860		-0.1862		-0.1829
		(0.1291)		(0.1281)		(0.1279)
Constant	3.4432***	-141.3582**	4.2552***	-141.1510**	4.2552***	-139.7925**
	(0.8450)	(67.3184)	(0.2783)	(67.0455)	(0.2781)	(67.6398)
Observations	1,176	1,127	1,176	1,127	1,176	1,127
Adjusted R-squared	0.707	0.760	0.707	0.760	0.707	0.760
Control Variables	No	Yes	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Effects of Bank Branching Deregulation on State-Level Bank Liquidity Creation by Small and Large Banks

This table presents the estimation results that analyze the effect interstate bank branching deregulation on state-level bank liquidity creation. The analysis is at state-year level. The dependent variable is state-level aggregate catfat, created by either small banks within a state or large banks within a state, normalized by state population. The dependent variable in Columns 1 – 6 is state-level small bank catfat normalized by state population, and the dependent variable in Columns 7 – 12 is state-level large bank catfat normalized by state population. The independent variables are RS Index, which ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state, KNP4 Index, which ranges from one (highly regulated) to four (deregulated), KNP5 Index, which ranges from one (highly regulated) to five (deregulated), INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. All specifications include state and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All control variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) State catfat per capita (Small Bank)	(2) State catfat per capita (Small Bank)	(3) State catfat per capita (Small Bank)	(4) State catfat per capita (Medium Bank)	(5) State catfat per capita (Medium Bank)	(6) State catfat per capita (Medium Bank)	(7) State catfat per capita (Large Bank)	(8) State catfat per capita (Large Bank)	(9) State catfat per capita (Large Bank)
RS Index	0.1718***			0.1039**			-0.2116		
	(0.0459)			(0.0409)			(0.1692)		
KNP4 Index		-0.1479***			-0.0912**			0.1766	
		(0.0405)			(0.0368)			(0.1445)	
KNP5 Index			-0.1387***			-0.0926**			0.1183
			(0.0379)			(0.0410)			(0.1411)
INTRA	0.0791	0.0953	0.1270	0.2531*	0.2614**	0.2759**	-0.1556	-0.1805	-0.2523
	(0.1647)	(0.1671)	(0.1744)	(0.1306)	(0.1298)	(0.1288)	(0.4198)	(0.4112)	(0.3982)
INTER	0.2619	0.2743	0.3010	0.4874***	0.4939***	0.5071***	0.4194	0.4007	0.3475
	(0.2031)	(0.2049)	(0.1990)	(0.1642)	(0.1664)	(0.1600)	(0.4528)	(0.4520)	(0.4498)
Constant	11.5443	11.3385	10.2212	-13.0933	-13.1511	-13.6015	-139.8093***	-139.3385***	-136.4121***
	(11.8569)	(11.9013)	(12.3682)	(15.0485)	(15.0025)	(15.3552)	(48.6442)	(48.4717)	(48.4128)
Observations	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127
Adjusted R-squared	0.786	0.784	0.781	0.363	0.361	0.361	0.783	0.783	0.782
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Effects of Bank Deregulation on Local Loan Creation

This table presents the estimation results that analyze the effect of bank deregulation events on state-level loan creation. Panel A shows the results that examine the effect of intra- and interstate bank deregulation on state-level loan creation, and Panel B shows the results that examine the effect of interstate bank branching deregulation on state-level loan creation. The analysis is at state-year level. Because of significant missing observations before 1987, the sample period for the analysis in this table is from 1987 – 2007. The dependent variable is state-level aggregate loan creation measures. The dependent variables are natural log of state-level loan creation in Columns 1 and 5, state-level loan creation normalized by state population in Columns 2 and 6, state-level loan creation normalized by number of borrowers within a state in Columns 3 and 7, and state-level loan creation normalized by number of competitors within a state in Columns 4 and 8, respectively. The independent variables are RS Index, which ranges from zero (deregulated) to four (highly regulated) based on regulation changes in a state, KNP4 Index, which ranges from one (highly regulated) to four (deregulated), KNP5 Index, which ranges from one (highly regulated) to five (deregulated), INTRA, which is equal to 1 from the year of intrastate deregulation onward and 0 prior to the deregulation, and INTER, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. Control variables include ln(Population), HPI, Number of Borrowers, Number of Competitors, State Deposit per capita, State Equity per capita, and GDP per capita, and Personal Income per capita. All specifications include state and year fixed effects. Standard errors are adjusted for potential heteroskedasticity and for group correlation at state level to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. All control variables are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) ln(Loan Creation)	(2) ln(State Loan per capita)	(3) ln(State Loan per borrowers)	(4) ln(State Loan per competitors)	(5) ln(Loan Creation)	(6) ln(State Loan per capita)	(7) ln(State Loan per borrowers)	(8) ln(State Loan per competitors)
RSI					0.0110	0.0113	0.0053	0.0093
					(0.0300)	(0.0300)	(0.0314)	(0.0338)
INTRA	0.1577	0.1541	0.2385	0.1928	0.1459	0.1420	0.2329	0.1828
	(0.1999)	(0.1998)	(0.1896)	(0.2113)	(0.1935)	(0.1934)	(0.1862)	(0.2040)
INTER	0.2061	0.2050	0.1376	0.1923	0.1975	0.1962	0.1335	0.1850
	(0.4047)	(0.4040)	(0.4075)	(0.3990)	(0.4109)	(0.4103)	(0.4126)	(0.4073)
Constant	14.3260	14.0380	15.8956	30.2601***	14.7622	14.4828	16.1036	30.6282***
	(11.1364)	(11.1561)	(9.9597)	(9.9420)	(11.2671)	(11.2921)	(10.1552)	(10.0347)
Observations	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Adjusted R-squared	0.876	0.747	0.674	0.852	0.876	0.747	0.674	0.851
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1