Does Bank Competition Increase Bank Liquidity Creation? A State-level Perspective[*]

Seungho Choi[**]
University of New South Wales

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Abstract: The proper role of regulations regarding bank competition is to encourage depressed local credit market. Does enhanced competition through bank deregulation revive local economy? Exploiting staggered bank deregulation events in the United States, I document that state-level bank deregulation does, on average, not significantly affect state-level bank liquidity creation, which is an explicit bank-side channel to add value to local market. In addition, state-level subsample analysis and bank-level analysis show that states and banks respond to the state-level deregulation events differently. My results suggest that the policy, that is applied to all heterogeneous banks and states in the same way, does not fit all.

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

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[**] UNSW Australia Business School at University of New South Wales, College Rd, Sydney NSW 2033
Mobile: 0402 560 267 E-mail: seungho.choi@unsw.edu.au.

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).

Despite the importance of bank liquidity creation, the absence of a comprehensive measure of bank liquidity creation prevents empirical studies examining theoretical views of bank liquidity creation. As a result, the role of bank as a liquidity creator remains relatively unexplored. 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.

A past literature addresses that bank competition positively affects local market economy in various ways. Previous studies find that change in bank competition following bank deregulation events increases local economic growth, new incorporation within the deregulated states, small firm finance, and firm total factor productivity (TFP) (e.g., Jayaratne and Strahan, 1996; Black and Strahan, 2002; Cetorelli and Strahan, 2006; Rice and Strahan, 2010; Krishnan, Nandy, and Puri, 2014). However, the empirical results do not show whether the relation between bank competition and local market economy is driven by bank-side activities, including bank liquidity creation.

Since bank liquidity creation is a crucial activity for all banks and has significant implications for local economy in terms of credit availability in the market, change in bank

liquidity creation would be a crucial channel that affects both businesses and other local market participants. Thus, in this paper, I provide aggregate state-level evidence that address whether the positive relationship is caused by the crucial bank activity, which is bank liquidity creation, by examining whether enhanced bank competition following bank deregulation events in the United States leads to more bank liquidity creation in the market, which is favorable condition for local market participants. In addition, I investigate whether there are heterogeneous effects of bank competition on bank liquidity creation depending on bank characteristics and market characteristics.

Following Berger and Bouwman (2009), I use category-based bank liquidity creation measure that includes off-balance sheet activities (cat fat) as a proxy for bank liquidity creation. Because of data limitations, I can only classify loans based on either category or maturity. Generally, it is very difficult to dispose of business loans when banks need to have liquidity regardless of their maturity. On the other hand, it is easier to liquidate consumer loans and residential mortgage loans even though they have longer maturity than business loans. Also, off-balance sheet items create liquidity in similar ways to balance sheet items. Because of these fundamental characteristics, the authors suggest that "cat fat" is the most preferred liquidity creation measure. This is a key dependent variable among the various specifications in this paper.

Following previous studies exploiting U.S. interstate banking deregulation and interstate bank 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 state-level bank competition following the staggered interstate bank deregulation and interstate bank branching deregulation events in the United States.

I exclude intrastate bank deregulation events from analysis because these events mostly occurred before 1984, which is the starting point of my sample period. Interstate bank deregulation, mostly occurred in 1980s and 1990s, allows banks to acquire or establish a charter in deregulated states. It does not allow banks to expand their branches across states. More importantly, the Interstate Banking and Branching Efficiency Act (IBBEA) in 1994 allows banks to acquire or establish a branch as well as a charter in the deregulated states. However, the U.S. government give each state government the authority to erect its own barriers, such as a statewide resulted deposit cap after the acquisition or establishment, minimum age of targets, de novo interstate branching, and the acquisition of individual branches. These two different deregulation events allow me to investigate different perspectives of the government policies.

The important advantage of a difference-in-differences approach, exploiting bank deregulation events, is that I can mitigate endogeneity concerns, such as reverse causality and omitted variables. It is possible that states that create more liquidity may have less competition. Also, aggregate state-level bank liquidity creation could affect the patterns of bank deregulation across states because regulators may implement the policy based on poor liquidity creation within a state. Exploiting state-level regulatory changes could mitigate this issue.

However, as the literature on bank deregulation and political connection shows, external pressures could drive the implementation of government policies, such as bank deregulation and the Troubled Asset Relief Program (TARP). (e.g., Kroszner and Strahan, 1999; Mian, Sufi, and Trebbi, 2010; Duchin and Sosyura, 2012). This suggests that my results could be driven by reverse causality even though I identify change in bank competition through staggered bank deregulation events. To mitigate this issue, following Bertrand and Mullainathan (2003), I examine the dynamic

effects of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity creation.

I also have an omitted variable issue that unobservable variables that coincide with the bank deregulation events could result in change in bank liquidity creation. However, a staggered characteristic of bank deregulation events across states can mitigate the omitted variable bias because omitted variables that are not related to deregulation events would not show same patterns with multiple shocks that occur in different states at different times.

I study state-level bank liquidity, created by almost all commercial banks in the United States from 1984 to 2006. Surprisingly, I find that bank competition does, on average, not significantly affect state-level bank liquidity creation, while the effects of bank competition on state-level bank liquidity creation vary depending on liquidity components, bank size, geographic area, and banks' home state status. In addition, I find different effects of two different regulatory changes on bank liquidity creation in sub-sample analysis.

To be specific, I examine whether relation between bank competition and bank liquidity creation vary depending on bank liquidity components, such as asset-side liquidity creation, liability-side liquidity creation, and off-balance sheet liquidity creation. I find that interstate bank deregulation increases only asset-side bank liquidity creation and that interstate bank branching deregulation does not affect components of liquidity creation significantly, after controlling for state-level macroeconomic variables and state characteristics. The results suggest that the relation between bank competition and bank liquidity creation vary in different liquidity creation components.

I then investigate whether bank size is associated with the relation. I find that interstate banking deregulation increases only state-level bank liquidity created by medium banks and that

interstate bank branching deregulation decreases state-level bank liquidity, created by small banks and medium banks. The results suggest that Enhanced bank competition through two regulatory events is related to state-level bank liquidity creation differently according on the size of banks that create liquidity in the market.

Next, I analyze whether bank's geographic location plays a role in the relation between bank competition and state-level bank liquidity creation. I find that enhanced bank competition following interstate banking deregulation increases state-level bank liquidity, created by banks that locate in non-MSA areas, and I also find that enhanced bank competition following IBBEA decreases state-level liquidity, created by banks, located in non-MSA areas. I find no significant results for state-level liquidity, created by MSA banks. These results suggest that there is heterogeneous effect of bank competition on state-level liquidity creation conditional on bank's location.

Finally, I examine whether bank's headquarter location is associated with the relation between bank competition and liquidity creation at the state level. I find that only interstate bank deregulation increases state bank liquidity, created by banks whose headquarters are located in the deregulated states, and find no significant evidence for state-level liquidity, created by banks, headquartered outside the deregulated states, and interstate bank branching deregulation.

In addition, throughout the analysis, I find that signs of coefficients on two bank deregulation variables are quite the opposite, suggesting that interstate banking deregulation and interstate bank branching deregulation have different effects and implications on state-level bank liquidity creation.

My findings suggest that the government policy, that is applied to all heterogeneous banks and states in the same way, does not fit all. Thus, the results imply that regulators could consider

designing a new policy on bank competition depending on banks' heterogeneity and markets' heterogeneity to encourage local capital market and local economic growth.

My paper contributes the literature that investigates the effects of banking deregulation. Even though the literature on bank deregulation shows that bank deregulation events affect local economic growth and corporate policies, 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. The literature studies 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 (forthcoming), 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 state-level analysis. 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. Even though the distance between commercial bank and capitol city of the deregulated state is close, small banks may not be affected by the interstate bank deregulation because they would not have sufficient resources to acquire/establish a charter in the deregulated state, so it will be important to explore whether both interstate bank deregulation and interstate bank branching deregulation affect bank liquidity creation in the same way. Thus, same as Chava, Oettl, Subramanian, and Subramanian (2013) and Cornaggia, Mao, Tian, and Wolfe (2015), my paper and Jiang, Levine, and Lin (forthcoming) 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 describe data and methodologies. Section 4 provides empirical results and Section 5 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 relations between bank competition and 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 relations between bank competition and 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 "cat fat" measure is better than other measures including Liquidity Transformation gap, which is similar to "mat nonfat" measure of Berger and Bouwman (2009). Different from Liquidity Transformation gap, "cat fat" 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, "cat fat" includes off-balance sheet activities as well as on-balance sheet activities. Thus, "cat fat" 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 "cat fat" 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.

Even though Berger and Bouwman (2009) provide the comprehensive liquidity creation measures, there are still not enough empirical studies exploring the role of banks as a liquidity creator. The literature studies 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).

Also, there are few studies examining the relationship between bank competition and bank liquidity creation, but these studies are different from my study. Different from my paper, Joh and Kim (2008), Horvath, Seidler, and Weill (2013) use non-U.S. data to investigate the relation between bank competition and bank liquidity creation. Horvath, Seidler, and Weill (2013) investigate this research question, 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 "cat fat" measure because of a lack of data about components of "cat fat" measure. According to Berger and Bouwman (2009), "cat fat" 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. Also, they do not provide causal evidence.

Joh and Kim (2008) use an international data covering 25 OECD countries. They use "cat fat" 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.

Unlike these studies, my paper investigates whether bank competition is associated with bank liquidity creation, using the U.S. banking industry dataset. Also, to find causal relation, I exploit exogenous variation in bank competition through the U.S. banking deregulation events, including interstate bank deregulation and interstate branching deregulation, and stick to use "cat fat" measure using sufficient datasets.

Jiang, Levine, and Lin (forthcoming) examine the effects of bank competition on 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 whether bank competition is related to 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.

3. Data and Methodology

My sample consists of an unbalanced panel of bank-level dataset for almost all commercial banks in the United States during the sample period between 1984 and 2006.

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.[1] Based on the restrictions above, Berger and Bouwman (2009) construct four different liquidity creation measures and the bank liquidity creation date is publicly available at Christa Bouwman's personal website.[2]

To obtain state-level macroeconomic data, such as GDP, population, personal income, and house price index, I merge Call Reports data with macroeconomic data, collected from United States Census Bureau, the U.S. Department of the Treasury, U.S. Bureau of Economic Analysis (BEA), and Federal Housing Finance Agency (FHFA).

[1] 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.

[2] I collect the quarterly and annual bank liquidity creation data from Christa Bouwman's personal website (https://sites.google.com/a/tamu.edu/bouwman/data). The website provides four different bank liquidity creation measures, such as "cat fat", "cat nonfat", "mat fat", and "mat nonfat", for almost all commercial banks in the United States.

I also collect branch-level deposit data from Summary of Deposits, provided by Federal Deposit Insurance Corporation (FDIC), and state-level business loan creation data is collected from DealScan.

At the state-level, I exclude banks in Delaware and South Dakota from my sample because the presence of unique credit card industry affected the banking system of these states. My final sample consists of 201,853 bank-years in 1,127 state-years of data on 16,326 unique banks.

3.1 Bank Liquidity Creation

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. They suggest "cat fat" is better measure than three other liquidity creation measures. Thus, I use "cat fat" measure as a key bank liquidity creation variable.

Following Berger and Sedunov (2017), I construct state-level bank liquidity creation measure, relying on each bank's state deposit market shares as a proxy for weights on states where they operate branches. This is because branch-level financial data is not available, except branch-level deposits.

To estimate state-level "cat fat" 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. I can see that Bank of America's market share in Florida is

28.57% (= $10 million/$35 million). If the value of "cat fat" for Bank of America in 2006 is $100 million, then I 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.

3.2 Bank Competition

My key independent variables are proxies for bank competition. Previous studies suggest that bank deregulation facilitates bank competition and reallocates assets to more competitive banks. Following previous studies exploring U.S. interstate banking deregulation and interstate bank branching deregulation, I exploit the exogenous variation in state-level bank competition after the staggered interstate bank deregulation and interstate bank branching deregulation events in the United States.

Interstate banking deregulation mostly occurred in 1980s. It permits banks whose headquarters are in other states to acquire a state's incumbent banks. However, it does not allow to acquire or establish a branch in the deregulated state. Based on years interstate banking permitted, I construct interstate bank deregulation variable (INTER), which is an indicator variable that takes the value of one from the year of deregulation onward and zero prior to the deregulation.

I also 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 construct interstate branching deregulation index, I follow previous seminal papers, such as Johnson and Rice (2008), Rice and Strahan (2010), and Krishnan, Nandy, and Puri (2014).

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 without reciprocal requirement is five, which indicates the states are the most open to interstate bank branching. I mainly use KNP index without reciprocal requirement and use KNP index with reciprocal requirement as a robustness check. Thus, IBBEA variable ranges from one (highly regulated) to five (deregulated) based on regulation changes in a state, and it takes zero prior to the implementation date. Using the bank deregulation events as exogenous shocks allow me to mitigate potential endogeneity concerns, such as omitted variables and reverse causality. Methodology will be discussed in Section 3.4.

To examine bank-level analysis, I use the Lerner index, which is an individual measure of competition for each bank and each period, as a proxy for bank competition. The Lerner index is commonly used in recent studies of bank competition (e.g., Berger, Klapper, and Turk-Ariss, 2009; Jimenez, Lopez, and Saurina, 2013; Berger and Roman, 2014).

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. 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.[3]

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

Using Lerner Index as a proxy for bank competition, I examine the relation between bank competition and bank liquidity creation at the bank level, but I cannot claim causal relation because of endogeneity concerns. To mitigate the endogeneity concerns, same as state-level analysis, I exploit exogenous variations in bank competition through the U.S. bank deregulation events.

3.3 Control variables

To investigate clear relations between bank competition and bank liquidity creation, I include control variables that influence aggregate state-level liquidity created by banks. For state-level analysis, I control for local market macroeconomic conditions, including natural logarithm of state population, Housing Price Index (HPI), natural logarithm of personal income, GDP per capita, state deposit per capita, state equity per capita, number of potential borrowers, and number of competitors.

For bank-level analysis, I include a group of bank-level variables. I control for equity capital ratio, which is the ratio of equity to GTA. To control for bank risk, I include Z-Score, which is the distance to default that measured as the bank's return on assets plus the equity capital/GTA

[3] I provide more detailed process to construct Lerner Index in Internet Appendix B. Please see Appendix B if you want to see the detailed process.

ratio divided by the standard deviation of the return on assets, and 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. However, I control for bank size when I use bank deregulation variables as proxies 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.

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

3.4 Models

To investigate whether bank competition is associated with bank liquidity creation, I estimate following equations:

$$\text{State LC}_{jt} = \alpha_j + \alpha_t + \gamma \text{Control}_{jt-1} + \delta \text{Deregulation}_{jt} + \varepsilon_{jt} \quad (2)$$

where j indexes state, t indexes year, State LC_{jt} is the key dependent variable of interest, which is state-level liquidity creation variables, and Deregulation_{jt} is the key independent variable, which is staggered bank deregulation events, including interstate bank deregulation and interstate bank branching deregulation index. Control_{jt} is a set of state-level macroeconomic variables, and ε_{it} is an error term. I use the lagged values for control variables to mitigate a concern about reverse causality. I also include state fixed effects (α_j) and year fixed effects (α_t) to control for time-invariant unobserved characteristics of states and the time trend such as a set of macroeconomic condition, such as inflation, federal funds rate, and so on.

Using the staggered passage of bank deregulation to measure changes in competition, I perform a difference-in-differences analysis. This allows me to mitigate endogeneity concerns, including reverse causality and omitted variable problem.

States that create more liquidity could have less state-level competition, and state-level bank liquidity creation could affect the patterns of bank deregulation across states because regulators may implement the policy based on poor liquidity creation within a state. Exploiting state-level regulatory changes could mitigate this issue. I can exploit both variation in the bank competition over time and in the cross-section to identify the effect of bank deregulation events because the states were deregulated at different points in time.

Another concern is an omitted variable issue that unobservable variables that coincide with the bank deregulation events could result in change in bank liquidity creation. The staggered characteristic of bank deregulation events across states can address the omitted variable bias because omitted variables that are not related to deregulation events would not show same patterns with multiple shocks that occur in different states at different times.

To examine bank-level relation between bank competition and bank liquidity creation, I use both the fixed effects model and the difference-in-differences model. Please see Table 2 and Internet Appendix A if you want to see more detailed explanation about the models for bank-level analysis.

[Table 1: Summary Statistics]

Panel A of Table 1 shows summary statistics for state-level variables. All financial variables are calculated in real 2006 dollars. Panels B and C 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 16,326 unique sample banks for the sample period between 1984 and 2006. Among the sample banks, numbers of banks that are categorized as large banks and medium banks at least once are only 550 and 1,136 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 C of Table 1, I 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.

4. Empirical Results

4.1 Relation between bank competition and bank liquidity creation at the bank level

This section describes the relation between bank competition and bank liquidity creation. Using Lerner index as a proxy for bank competition and "cat fat" 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 associated with 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 3.3.

[Table 2: Relation between Bank Competition and Bank Liquidity Creation at the bank level]

Columns (1) – (4) of Table 2 present ordinary least squares (OLS) estimates of the relationship between bank competition and bank liquidity creation. Competition variable in these columns is Lerner Index, and all independent variables, except multibank holding company status (MBHC), 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.

Using Lerner Index as a proxy for bank competition, 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 5.9% increase in predicted 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.

Columns (5) and (6) of Table 2 examine the effect of interstate banking deregulation on bank liquidity creation using a difference-in-differences methodology. I find that exogenous variations in bank competition after interstate banking deregulation events do not significantly affect bank liquidity creation on average. This could be because of fixed costs to invest in deregulated states. Because interstate banking deregulation only allow banks to acquire or establish a charter, it requires much higher fixed costs to invest in deregulated states. Thus, 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 Jiang, Levine, and Lin (forthcoming), I exploit interstate bank branching deregulation to identify the variation in bank competition in Columns (7) and (8). Because Jiang, Levine, and Lin (forthcoming) only focus on interstate bank deregulation, their measure may not properly identify the effects of bank competition on liquidity creation after interstate bank branching deregulation. For example, small banks may not have sufficient resources to invest in deregulated states even if neighbor states implement interstate banking deregulation because interstate banking deregulation only allows bank to acquire or establish a charter. In this case, it could be possible that interstate bank competitive pressure facing commercial bank in the deregulated states might not be intense even if their distance-weighted interstate deregulation measure indicates that the pressure is intense. After implementing interstate bank branching deregulation, the fixed cost to invest in deregulated states significantly decreases because it allows banks to acquire or establish a branch in the deregulated states. Thus, exploiting interstate bank branching deregulation could explain different perspective of the relation between bank competition and bank liquidity creation.

Columns (7) and (8) report the results of fixed effects regressions examining the relation between interstate branching deregulation on bank liquidity creation. The coefficient estimates of IBBEA are negative and significant at the 5% level on average. This finding suggests that an increase in banking competition due to bank branching deregulation leads to a decrease in bank liquidity creation. To be specific, based on the coefficient of IBBEA in column (8) of Table 2, states that are completely open to interstate branching generated a total of 2.6% less liquidity creation after interstate bank branching deregulation than states with the most restrictions on

interstate branching after deregulation. The results are consistent with my previous results using Lerner Index and the results of Jiang, Levine, and Lin (forthcoming).[4]

Understanding the relation between bank competition and bank-level liquidity creation is interesting and important but the relation between state-level bank competition and aggregate state-level bank liquidity creation would be much more important because government policies are generally established at the state-level and regulators would put more stress on the state-level performance than on the bank-level performance following government policies, such as interstate banking deregulation and interstate bank branching deregulation. In addition, the state-level analysis allows me to investigate whether the policies about bank competition led to effective bank liquidity creation.

In next section, exploiting interstate bank deregulation and interstate bank branching deregulation, I examine whether change in state-level bank competition following bank deregulation events is related to aggregate state-level bank liquidity creation.

4.2 Relation between bank deregulation and state-level bank liquidity creation

Regulators design a policy to improve market system. Bank deregulation policies are designed to invigorate local market economy by encouraging depressed local capital market. Bank-level results show that enhanced bank competition decreases bank liquidity creation. This suggests that bank deregulation may not lead to effective bank liquidity creation for the perspective of local markets. However, results of sub-sample analysis suggest that the reverse relation between bank

[4] However, the results from Table 2 do not explain what types of banks dominate this relationship and which component of bank liquidity creation is more correlated with the bank competition. I present the findings for different categories of banks, such as bank size and bank liquidity components, in Internet Appendix A. Please see Internet Appendix A if you want to see more results of bank-level analysis.

competition and liquidity creation is driven by small banks. Because of these heterogeneous relations, it is quite unclear whether enhanced bank competition through bank deregulation events is associated with aggregate state-level liquidity creation. Thus, in this section, I directly examine whether bank competition either increases or decreases state-level bank liquidity creation.

[Table 3: Effects of Bank Deregulation on State-Level Bank Liquidity Creation]

Table 3 reports the results of regressions examining the effects of bank deregulation on state-bank liquidity creation per capita. Panel A of Table 3 focuses on interstate banking deregulation and Panel B of Table 3 focuses on interstate bank branching deregulation. Columns (1) and (2) of Panels A and B present the base results, and Columns (3) – (8) of Panels A and B report the results for each liquidity component.

Surprisingly, I find that there is no statistically significant empirical evidence that both deregulation events affect state-level bank liquidity creation. The results are robust if I control for macroeconomic variables and state-level characteristics, such as number of competitors, number of borrowers, state equity per capita, and state deposit per capita.

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 interstate bank deregulation and interstate bank branching deregulation did not play an appropriate role to encourage banks' liquidity creation incentives.

One possible explanation is that the policies did not take bank heterogeneity and market heterogeneity into consideration. Thus, in following section, I examine how different the effect of two bank deregulation events is, according to bank heterogeneity and market heterogeneity.

4.3 The heterogeneous effects of bank deregulation on state-level bank liquidity creation

As I discussed above, interstate banking deregulation and interstate bank branching deregulation have different implications. Interstate banking deregulation could be more effective for large banks because it only allows banks to acquire and/or establish a charter rather than a branch. Because of this restriction, expected costs to enter the deregulated state is relatively high, suggesting that small bank may not be able to invest in the new market because of insufficient funds. Interstate bank branching deregulation lowers the fixed cost by allowing banks to acquire and/or establish a branch in the deregulated state. With the lowered fixed costs, small banks could have more chance to invest in the deregulated states following interstate bank branching deregulation than interstate banking deregulation. Thus, I report the estimation using each event in each panel of following tables.

In Columns (3) – (8) of Panel A of Table 3, I find that interstate bank deregulation increases only asset-side bank liquidity creation. Also, I find a negative relation between interstate bank deregulation and liability-side liquidity creation and a positive relation between interstate bank deregulation and off-balance sheet liquidity creation, but these relations are statistically insignificant. These results show that banks operating in the deregulated states are more likely to create liquidity through asset-side activities, such as illiquid loan creation, and replenish liquidity through liability-side activities, such as illiquid subordinated debt. Exploiting interstate bank branching deregulation, I find no statistically significant relation between competition and liquidity creation, but signs of coefficients on liquidity components are opposite. The results suggest that the relation between bank competition and bank liquidity creation vary in different liquidity creation components.

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 more 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 large banks have more sufficient resources and have much lower default risk than small banks. Thus, in Table 4, I examine whether bank deregulation events affect state-level small bank liquidity creation and large bank liquidity creation differently.

[Table 4: Effects of Bank Deregulation on State-Level Bank Liquidity Creation by Size]

In Column (1) of Panel A of Table 4, I find a positive and statistically significant evidence that interstate banking deregulation affects state-level small bank liquidity creation, but the significant disappears after controlling for state-level macroeconomic variables and state characteristics. Columns (3) and (4) of Panel A report a positive and statistically significant coefficient estimates, suggesting that interstate banking deregulation increases state-level bank liquidity created by medium banks. The result is robust to controlling for state-level control variables. In Columns (5) and (6), I find no significant relation between bank competition and state-level bank liquidity created by large banks.

There are possible explanations about these results. For the perspective of large banks, they may not have huge incentive to create more liquidity to the market if they are dominant players in the market because they can enjoy monopolistic rents in this case, such as lower deposit rates and

higher loan rates. This could explain why there is no significant relation between bank competition and state-level large bank liquidity creation.

As bank competition increases, small banks increase bank liquidity creation to keep their relationship banking because number of new players in the market following interstate banking deregulation might be relatively small due to high fixed costs, but it could be also possible that small banks decrease liquidity creation to avoid the default risk in the competitive market. These opposite incentives could offset each other, and it could explain about the insignificant relation between bank competition and state-level bank liquidity, created by small banks.

Medium banks have more resources than small banks, so they are capable of entering the deregulated markets with the high fixed costs. In addition, medium banks could compete with new players by creating more liquidity in the market. It is also possible that large banks acquire medium banks in the deregulated states or establish medium-sized charter in the deregulated states. In this case, the data captures these banks' liquidity creation as state-level medium bank liquidity creation in the deregulated states. That is why I find the positive and significant effect of bank competition on bank liquidity, created by medium banks.

Panel B of Table 4 reports the results for interstate bank branching deregulation. Interstate bank branching deregulation would be much more important in bank liquidity creation than other 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.

Columns (2) and (4) of Panel B of Table 4 shows that coefficients on IBBEA variable are negative and statistically significant, which suggests that interstate bank branching deregulation

decreases bank liquidity, created by small banks and medium banks, at the state-level. On the other hand, Column (5) and (6) of Panel B present that there is no significant relation between IBBEA and state-level large bank liquidity creation.

As Peterson and Rajan (1994, 1995) suggest, in highly competitive market, there would be many banks in the market to compete, and 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. Thus, in this case, banks lose their information advantage. In the post-IBBEA period, small and medium banks are more likely to lose their information advantage because smaller banks tend to involve in relationship banking with local borrowers. This could explain about the negative and statistically significant relation between IBBEA and small and medium bank liquidity creation at the state level.

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 results 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 conclusion of the analysis by bank size is that both interstate banking deregulation and interstate bank branching deregulation appear to affect state-level bank liquidity creation differently based on the size of banks that create liquidity in the market. This could explain about the insignificant effect of bank competition on state-level bank liquidity creation in Table 3 in some sense. Also, the results are consistent with my expectation that two bank deregulation events have different effects and implications.

To provide further evidence that the effect of bank competition on state-level bank liquidity creation is heterogeneous conditional on bank or market characteristics, I examine whether state-level bank liquidity, created by MSA banks and non-MSA banks, reacts to enhanced bank competition differently. Panel A of Table 5 reports the results examining the effect of interstate banking deregulation on state-level bank liquidity creation. In Columns (1) and (2), I find no significant effect on state-level bank liquidity, created by banks that locate in MSA areas. On the other hand, I find a positive and statistically significant effect on state-level bank liquidity, created by banks that locate in non-MSA areas. This makes sense because non-MSA area is relatively less competitive than MSA area and banks in non-MSA area may still have information advantage over new potential lenders even after interstate banking deregulation. It is also plausible that out-of-state banks would have incentive to acquire non-MSA banks in the deregulated states because of relatively more concentrated circumstance than MSA banks. In this case, the acquired banks could still have information advantage, so they would want to keep the information advantage by creating more liquidity in the relatively concentrated local market.

Panel B of Table 5 reports results for IBBEA. In Columns (1) and (2), I examine whether IBBEA relates to state-level MSA liquidity creation and find no significant results. However, in Columns (3) and (4), I examine whether IBBEA is associated with state-level liquidity, created by banks, located in non-MSA areas, and find a negative and significant relation. Based on private information story, banks in non-MSA areas would lose the information advantage because there would be much more potential new competitors in the case of IBBEA than the case of interstate banking deregulation due to much lower fixed cost for entering the deregulated states. In this situation, these banks may have incentive to keep the liquidity within a bank to avoid default risk.

This could explain the negative relation between IBBEA and state-level non-MSA liquidity creation.

I conclude that the results in Table 5 suggest that there is heterogeneous effect of bank competition on state-level liquidity creation conditional on bank's location, supporting the main finding of my paper. In addition, the results suggest two bank deregulation events have heterogeneous effects and implications.

[Table 5: Effects of Bank Deregulation on State-level MSA Liquidity Creation]

In Table 6, I analyze the effect of bank competition on state-level bank liquidity, created by banks whose headquarters are in-state and by banks whose headquarters are out-of-state, separately. In Columns (1) and (2) of Panel A of Table 6, I find that enhanced bank competition following interstate bank deregulation increases state bank liquidity, created by banks whose headquarters are located in the deregulated states. In Column (3) and (4), I investigate whether interstate banking deregulation affect state-level bank liquidity, created by banks whose headquarters are located outside the deregulated states. In Column (3), I find a negative and statistically significant result, but the significance disappears, after controlling for state characteristics and state-level macroeconomic indicators, as shown in Column (4). These results suggest that home banks and away banks respond to change in bank competition following interstate banking deregulation differently.

In Panel B of Table 6, I analyze the relationship between enhanced bank competition through IBBEA and state-level bank liquidity, created by home banks and away banks. Column

(2) and (4) shows that the coefficients on IBBEA are negative and statistically insignificant, even after controlling for state characteristics and macroeconomic conditions.

I conclude that I find weak evidence that relation between change in bank competition, induced by regulatory events, and state-level bank liquidity vary depending on whether banks are headquartered in the deregulated state or banks are headquartered in the other states. Also, consistent evidence exists that two interstate bank deregulatory events play different roles in the market.

[Table 6: Effects of Bank Deregulation on State-level Liquidity Creation by Home Status]

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 past literature finds that the relaxation of restrictions about positively affects local market economic growth, my results suggest that the positive effects might not be driven by bank-oriented activity, which is bank liquidity creation. Thus, the policy implication of the state-level results is that the government policy regarding bank competition should consider banks' heterogeneity and markets' heterogeneity, and one stubborn policy for all heterogeneous banks and markets would not be an effective policy, maximizing local market growth.

4.4 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.

However, I still have a concern about reverse causality. Previous studies suggest that government policies, including bank deregulation, could be driven by external factors, such as political connection. This suggests that my results could be driven by reverse causality even though I identify change in bank competition through staggered bank deregulation events. To mitigate this issue, following Bertrand and Mullainathan (2003), I examine the dynamic effects of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity creation.

To check the pre-existing trends in bank liquidity creation, I construct four variables for each bank deregulation event. For interstate banking deregulation, I construct four dummy variables based on different time periods, such as all years up to and including two years prior to deregulation, one year prior to deregulation, one year post-deregulation, and two years or more post-deregulation. For interstate bank branching deregulation, I additionally decompose each of the four state-level components of IBBEA into four dummy variables. To identify change in IBBEA index, I sum over the four component variables for each period. Finally, I construct Before2+, Before1, After1, and After2+, corresponding to the four time periods.

The deregulation year is the reference year in this setting. The coefficient estimates of Before2+ and Before1 indicate whether there is any relation between bank liquidity creation and bank deregulatory events before bank deregulation events. The coefficient estimates of After2+ and After1 are important because their significance and magnitude could indicate whether there is any relation between bank deregulation and bank liquidity creation after implementing bank deregulation events. If I find a positive and significant relation in post-deregulation periods, then

it could suggest that government policies lead to effective liquidity creation after one or two years from the effective year.

In Columns (1) and (2) of Table 7, I report the results for interstate bank deregulation. In Column (1), I find a negative and slightly significant relation between Before1 and interstate banking deregulation, but the significance disappears after controlling state-macroeconomic variables and state-level characteristics. In Columns (3) and (4), I present the results for interstate bank branching deregulation, and I find no significant relations for four variables.

The insignificant results suggest that state-level liquidity creation shows no significant change for both pre-bank deregulatory period and post-bank deregulatory period. This indicates trends in state-level bank liquidity creation do not reverse-cause bank deregulation events, and mitigates concerns about reverse causality.

[Table 7: Dynamics of Liquidity Creation surrounding Deregulatory Events]

Another 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 8

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. In Columns (1) and (2) of Panels A and B, I find that there is no significant effect of bank competition on state-level loan creation, which is proxied by natural log of state-level deal amount. As a robustness check, I use alternative state-level loan creation measures, such as state loan creation per capita, state loan creation per in-state borrowers, and state loan creation per in-state competitors in remaining columns. The results are robust to the alternative measures. The results suggest that main state-level liquidity creation measures in this paper are valid, and the results are also credible.

[Table 8: Effects of Bank Deregulation on Local Loan Creation]

Furthermore, I use a different comprehensive liquidity creation measure, "mat fat", instead of "cat fat". Only difference between "cat fat" and "mat fat" measures is a way to classify loans. "cat fat" measure classifies loans by category but "mat fat" 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 "cat fat" 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 "mat fat" measure as a robustness check. The results are still consistent, but I do not report the results to save the space.

5. 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 may not originate from bank-side liquidity creation channel.

Surprisingly, state-level analysis shows that interstate and interstate bank branching deregulation events do not significantly affect state-level bank liquidity creation on average. This suggests that government policy regarding bank competition did not lead to effective bank liquidity creation in local markets on average.

Additional analysis examines whether change in bank competition following bank deregulation events is associated with state-level bank liquidity created by heterogeneous banks or banks in heterogeneous markets. I find that the effects of bank competition on state-level bank liquidity creation vary depending on a type of policy regarding bank competition, bank size, geographic area, and banks' home state status.

The divergent results make sense because interstate bank deregulation, which only allows banks to acquire/establish a charter rather than a branch, requires potential new players in the deregulated states much higher fixed costs. On the other hand, interstate bank branching deregulation allows banks to acquire/establish a branch, so it requires much lower fixed costs when the potential players enter the deregulated markets. This suggests that two deregulation events are fundamentally different and affected groups would be different as well.

More importantly, these results suggest that the policy, that is applied to all heterogeneous banks and markets in the same way, does not fit all. It highlights the role of proper regulation to encourage depressed credit market.

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Table 1: Summary Statistics

This table contains state-level and bank-level summary statistics and contains summary statistics that compare small banks with medium/large banks. The sample comprises 16,326 unique commercial banks over the period 1984 to 2006. All financial values are measured in real 2006 dollars using the implicit GDP price deflator. Panel A shows state-level descriptive statistics. Liquidity creation measure is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities ("cat fat"). INTER is an indicator variable, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. IBBEA Index is Krishnan-Nandy-Puri interstate bank branching deregulation index. It ranges from one (highly regulated) to five (deregulated), and it is equal to zero prior to the deregulation. GDP is state-level gross domestic production. Personal Income is state-level personal income level. HPI is state-level housing price index. In Panel A, state-level variables with a "per capita" suffix are variables normalized by state population. Please see Appendix A for the detailed definition of the variables.

Panel A: Summary Statistics (State-level)

	N	Mean	SD
State-level Bank Deregulation Variables			
INTER	1,127	0.884	0.321
IBBEA	1,127	1.382	1.777
State Liquidity Creation Variables			
Liquidity Creation per Capita	1,127	8.143	5.540
Small Bank Liquidity Creation per Capita	1,127	1.356	1.107
Medium Bank Liquidity Creation per Capita	1,127	0.741	0.729
Large Bank Liquidity Creation per Capita	1,127	6.047	5.571
Small/Medium Bank Liquidity Creation per Capita	1,127	2.096	1.506
MSA Liquidity Creation per Capita	1,127	6.552	5.608
Non-MSA Liquidity Creation per Capita	1,127	1.592	2.026
Liquidity Creation by New Banks per Capita	1,127	0.294	0.904
Liquidity Creation by Existing Banks per Capita	1,127	7.850	5.454
Liquidity Creation by Home Banks per Capita	1,127	6.262	4.765
Liquidity Creation by Away Banks per Capita	1,127	1.881	3.457
Asset-side Liquidity Creation per Capita	1,127	0.669	1.579
Liability-side Liquidity Creation per Capita	1,127	3.968	1.827
Off-balance sheet Liquidity Creation per Capita	1,127	3.507	3.915
State Loan Creation Variables			
LN(State Loan Creation)	1,001	22.122	2.125
LN(State Loan Creation per capita)	1,001	7.017	1.545
LN(State Loan Creation per Borrowers)	1,001	17.742	1.458
LN(State Loan Creation per Competitors)	1,001	17.599	1.895
State-level Variables			
LN(Number of Competitors)	1,078	4.476	1.161
LN(Number of Borrowers)	1,078	4.295	1.337
LN(Population)	1,078	15.025	1.003
HPI	1,078	201.269	85.121
State-level Deposit per Capita	1,078	8.766	3.803
State-level Equity per Capita	1,078	1.654	0.994
GDP per Capita	1,078	28,344	12,930
Personal Income per Capita	1,078	23.216	7.573

Panel B: Summary Statistics (Bank-level)

Panel B presents bank-level descriptive statistics for the full sample, and Panel C 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. Liquidity creation measure is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities. 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. INTER is an indicator variable, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. IBBEA Index is Krishnan-Nandy-Puri interstate bank branching deregulation index. It ranges from one (highly regulated) to five (deregulated), and it is equal to zero prior to the deregulation.

	N	Mean	SD
Liquidity Creation Variables			
Liquidity Creation	201,440	264,188	4,591,513
Asset-side Liquidity Creation	201,440	28,288	740,957
Liability-side Liquidity Creation	201,440	116,638	1,582,129
Off-balance sheet Liquidity Creation	201,440	119,262	2,994,539
Liquidity Creation/GTA	201,440	0.196	0.180
Asset-side Liquidity Creation/GTA	201,440	-0.019	0.137
Liability-side Liquidity Creation/GTA	201,440	0.176	0.065
Off-balance sheet Liquidity Creation/GTA	201,440	0.038	0.060
Bank-level Variables			
Lerner Index	201,440	0.320	0.097
EQRAT	201,440	0.092	0.031
Bank Size	201,440	11.738	1.150
Earnings Volatility	201,375	0.004	0.004
ZSCORE	192,170	47.741	53.773
Multi-BHC	201,440	0.301	0.459
Acquisitions	201,440	0.036	0.188
State-level Bank Deregulation Variables			
INTER	201,440	0.832	0.374
IBBEA	201,440	1.165	1.675

Table 1: Summary Statistics

Panel C: 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								
Liquidity Creation	191,194	36,149	63,804	10,246	4,519,481	19,883,716	4,483,332	0.000
Asset-side Liquidity Creation	191,194	140	30,355	10,246	553,538	3,238,360	553,398	0.000
Liability-side Liquidity Creation	191,194	28,742	35,973	10,246	1,756,816	6,808,689	1,728,074	0.000
Off-balance sheet Liquidity Creation	191,194	7,267	20,967	10,246	2,209,127	13,103,651	2,201,860	0.000
Liquidity Creation/GTA	191,194	0.186	0.173	10,246	0.373	0.213	0.187	0.000
Asset-side Liquidity Creation/GTA	191,194	-0.022	0.137	10,246	0.039	0.121	0.061	0.000
Liability-side Liquidity Creation/GTA	191,194	0.174	0.064	10,246	0.212	0.067	0.038	0.000
Off-balance sheet Liquidity Creation/GTA	191,194	0.034	0.045	10,246	0.122	0.164	0.088	0.000
Bank-level Variables								
Lerner Index	191,194	0.322	0.096	10,246	0.276	0.096	-0.046	0.000
Equity Ratio	191,194	0.092	0.031	10,246	0.077	0.026	-0.015	0.000
Bank Size	191,194	11.561	0.842	10,246	15.039	1.129	3.478	0.000
Earnings Volatility	191,137	0.004	0.004	10,238	0.004	0.003	0.000	0.000
ZSCORE	182,131	47.905	54.013	10,039	44.772	49.125	-3.133	0.000
Multi-BHC	191,194	0.281	0.450	10,246	0.670	0.470	0.389	0.000
Acquisitions	191,194	0.026	0.158	10,246	0.241	0.428	0.215	0.000

Table 2: Relationship between Bank Competition and Bank Liquidity Creation

$$BLC_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1 Lerner_{it-1} + \gamma_1 Control_{it-1} + \gamma_2 Macro\_Control_{jt-1} + \varepsilon_{ijt}$$

$$Liquidity_{it} = \alpha_i + \alpha_t + \delta Deregulation_{jt} + \gamma_1 Control_{it-1} + \gamma_2 Control_{jt-1} + \varepsilon_{ijt}$$

This table presents the estimation results that analyze the relation between bank competition and bank liquidity creation. The analysis is at bank-year level. The dependent variable is "cat fat", which is a category-based liquidity creation measure, including both on-balance sheet and off-balance sheet activities, normalized by GTA. The competition variable in Columns 1 – 4 is Lerner Index, which is the observed price-cost margin divided by price. In columns 5 and 6, the competition variable is interstate banking deregulation variable (INTER), which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. In Columns 7 and 8, the competition variable is interstate bank branching deregulation index (IBBEA), which ranges from one (highly regulated) to four (deregulated) based on regulation changes in a state. The specifications in Column 1, 3, 5, 6, 7, and 8 include bank and year fixed effects. The specifications in Columns 2 and 4 include bank and state-year fixed effects. Macroeconomic variables include natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). Standard errors are adjusted for potential heteroskedasticity and for group correlation at bank level in Columns 1 – 4. Standard errors are clustered at state-level in Columns 5 – 8 to allow for an arbitrary serial correlation within state over time because the deregulation variables vary at the state level. Also, specifications in Columns 7 and 8 control for interstate bank deregulation (INTER) but do not include in the table. All independent variables except bank deregulation variables and MBHC are lagged. Robust standard errors in parentheses. Asterisks indicate significance at 0.01 (***), 0.05 (**), and 0.10 (*) levels.

	(1) Lerner Index	(2) Lerner Index	(3) Lerner Index	(4) Lerner Index	(5) INTER	(6) INTER	(7) IBBEA	(8) IBBEA
Competition	0.093*	0.071*	0.141*	0.129**	0.004	0.013	-0.004**	-0.003**
	(0.05)	(0.04)	(0.07)	(0.06)	(0.01)	(0.01)	(0.00)	(0.00)
EQRAT			-0.788***	-0.827***		-0.664***		-0.662***
			(0.08)	(0.08)		(0.07)		(0.07)
Bank Size						0.014**		0.014**
						(0.01)		(0.01)
EARNVOL			-1.055*	-0.803		-1.284		-1.270
			(0.55)	(0.55)		(0.89)		(0.89)
ZSCORE			-0.000	-0.000***		-0.000		-0.000
			(0.00)	(0.00)		(0.00)		(0.00)
MBHC			0.019***	0.015***		0.020***		0.020***
			(0.00)	(0.00)		(0.00)		(0.00)
Acquisition			0.001	0.003*		-0.004		-0.004
			(0.00)	(0.00)		(0.00)		(0.00)
Constant	0.102***	0.295***	-0.230	0.193***	0.126***	-0.427	0.126***	-0.381
	(0.01)	(0.05)	(0.25)	(0.06)	(0.01)	(0.46)	(0.01)	(0.46)
Observations	182,606	182,606	174,404	174,404	201,853	174,404	201,853	174,404
Adjusted R-squared	0.789	0.806	0.803	0.814	0.770	0.802	0.770	0.802
Control Variables	No	No	Yes	Yes	No	Yes	No	Yes
Macroeconomic Variables	No	No	Yes	No	No	Yes	No	Yes
Fixed Effects	Firm, Year	Firm, State-Year	Firm, Year	Firm, State-Year	Firm, Year	Firm, Year	Firm, Year	Firm, Year
Cluster	Firm	Firm	Firm	Firm	State	State	State	State

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

Table 3: Effects of Bank Deregulation on State-Level Bank Liquidity Creation

This table presents the estimation results that analyze the effect of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity creation. The analysis is at state-year level. The dependent variables are state-level "cat fat" measure normalized by state population (Columns 1 and 2), state-level asset-side liquidity creation normalized by state population (Columns 3 and 4), state-level liability-side liquidity creation normalized by state population (Columns 5 and 6), and state-level off-balance sheet liquidity creation normalized by state population (Columns 7 and 8). The bank deregulation variable in Panel A is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Panel B is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

Panel A: Interstate Bank Deregulation

	(1) State LC	(2) State LC	(3) State LC_A	(4) State LC_A	(5) State LC_L	(6) State LC_L	(7) State LC_O	(8) State LC_O
INTER	0.997	0.774	1.081**	0.650*	0.206	-0.175	-0.291	0.300
	(0.79)	(0.59)	(0.47)	(0.36)	(0.33)	(0.25)	(0.49)	(0.40)
Constant	4.329***	-106.242**	0.054	-46.680*	2.755***	28.399	1.519***	-87.961*
	(0.32)	(51.05)	(0.17)	(26.43)	(0.12)	(18.52)	(0.24)	(46.42)
Observations	1,127	1,078	1,127	1,078	1,127	1,078	1,127	1,078
Adjusted R-squared	0.790	0.838	0.282	0.500	0.747	0.839	0.766	0.823
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Panel B: Interstate Bank Branching Deregulation

	(1) State LC	(2) State LC	(3) State LC_A	(4) State LC_A	(5) State LC_L	(6) State LC_L	(7) State LC_O	(8) State LC_O
IBBEA	-0.263	-0.051	-0.180*	0.028	-0.138**	-0.047	0.055	-0.032
	(0.17)	(0.15)	(0.09)	(0.09)	(0.06)	(0.06)	(0.12)	(0.11)
INTER		0.750		0.663*		-0.198		0.285
		(0.61)		(0.36)		(0.26)		(0.40)
Constant	4.491***	-104.798**	0.231	-47.480*	2.789***	29.745	1.472***	-87.063*
	(0.28)	(51.56)	(0.23)	(26.89)	(0.13)	(19.09)	(0.23)	(47.06)
Observations	1,127	1,078	1,127	1,078	1,127	1,078	1,127	1,078
Adjusted R-squared	0.790	0.838	0.270	0.500	0.750	0.840	0.766	0.823
Control Variables	No	Yes	No	Yes	No	Yes	No	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

Table 4: Effects of Bank Deregulation on State-Level Bank Liquidity Creation by Small, Medium, and Large Banks

This table presents the estimation results that analyze the effect of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity created by different sized banks. The analysis is at state-year level. The dependent variables are state-level bank liquidity created by small banks, normalized by state population (Columns 1 and 2), state-level bank liquidity created by medium banks, normalized by state population (Columns 3 and 4), and state-level bank liquidity created by large banks, normalized by state population (Columns 5 and 6). The bank deregulation variable in Panel A is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Panel B is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

Panel A: Interstate Bank Deregulation

	(1) State Small LC	(2) State Small LC	(3) State Medium LC	(4) State Medium LC	(5) State Large LC	(6) State Large LC
INTER	0.792***	0.272	0.509***	0.423***	-0.305	0.080
	(0.29)	(0.19)	(0.17)	(0.14)	(0.51)	(0.45)
Constant	0.912***	19.188	0.534***	-14.958	2.883***	-110.473**
	(0.12)	(11.81)	(0.10)	(10.33)	(0.30)	(46.80)
Observations	1,127	1,078	1,127	1,078	1,127	1,078
Adjusted R-squared	0.678	0.817	0.335	0.405	0.814	0.851
Control Variables	No	Yes	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Panel B: Interstate Bank Branching Deregulation

	(1) State Small LC	(2) State Small LC	(3) State Medium LC	(4) State Medium LC	(5) State Large LC	(6) State Large LC
IBBEA	-0.261***	-0.104***	-0.143***	-0.060*	0.141	0.112
	(0.06)	(0.04)	(0.05)	(0.03)	(0.17)	(0.16)
INTER		0.222		0.394***		0.134
		(0.19)		(0.14)		(0.45)
Constant	1.041***	22.127*	0.617***	-13.260	2.833***	-113.665**
	(0.09)	(11.35)	(0.10)	(10.11)	(0.27)	(47.42)
Observations	1,127	1,078	1,127	1,078	1,127	1,078
Adjusted R-squared	0.697	0.822	0.342	0.408	0.815	0.851
Control Variables	No	Yes	No	Yes	No	Yes
State FE	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 5: Effects of Bank Deregulation on State-level MSA Liquidity Creation

This table presents the estimation results that analyze the effect of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity created by banks located in metropolitan statistical areas (MSAs) and non-MSA areas. The analysis is at state-year level. The dependent variables are state-level bank liquidity created by MSA banks, normalized by state population (Columns 1 and 2) and state-level bank liquidity created by non-MSA banks, normalized by state population (Columns 3 and 4). The bank deregulation variable in Panel A is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Panel B is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

Panel A: Interstate Bank Deregulation

	(1) State MSA LC	(2) State MSA LC	(3) State Non-MSA LC	(4) State Non-MSA LC
INTER	-0.073	0.031	1.070***	0.743***
	(0.56)	(0.54)	(0.39)	(0.26)
Constant	3.599***	-137.862**	0.730***	31.619
	(0.27)	(54.15)	(0.22)	(23.71)
Observations	1,127	1,078	1,127	1,078
Adjusted R-squared	0.788	0.820	0.401	0.493
Control Variables	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year

Panel B: Interstate Bank Branching Deregulation

	(1) State MSA LC	(2) State MSA LC	(3) State Non-MSA LC	(4) State Non-MSA LC
IBBEA	0.017	0.126	-0.280***	-0.177*
	(0.14)	(0.12)	(0.10)	(0.09)
INTER		0.091		0.659**
		(0.55)		(0.26)
Constant	3.587***	-141.433**	0.905***	36.635
	(0.24)	(55.30)	(0.19)	(22.78)
Observations	1,127	1,078	1,127	1,078
Adjusted R-squared	0.788	0.820	0.402	0.498
Control Variables	No	Yes	No	Yes
State FE	State, Year	State, Year	State, Year	State, Year

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

Table 6: Effects of Bank Deregulation on State-level Liquidity Creation by Home Status

This table presents the estimation results that analyze the effect of interstate bank deregulation and interstate bank branching deregulation on state-level bank liquidity created by banks whose headquarters are located in the state and banks whose headquarters are located outside the state. The analysis is at state-year level. The dependent variables are state-level bank liquidity created by home banks, normalized by state population (Columns 1 and 2) and state-level bank liquidity created by away banks, normalized by state population (Columns 3 and 4). The bank deregulation variable in Panel A is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Panel B is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

Panel A: Interstate Bank Deregulation

	(1) State Home LC	(2) State Home LC	(3) State Away LC	(4) State Away LC
INTER	2.440***	1.067*	-1.443***	-0.293
	(0.84)	(0.61)	(0.45)	(0.32)
Constant	4.086***	-70.286	0.242	-35.957
	(0.36)	(56.38)	(0.21)	(30.00)
Observations	1,127	1,078	1,127	1,078
Adjusted R-squared	0.606	0.730	0.586	0.762
Control Variables	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year

Panel B: Interstate Bank Branching Deregulation

	(1) State Home LC	(2) State Home LC	(3) State Away LC	(4) State Away LC
IBBEA	-0.573*	-0.024	0.310	-0.026
	(0.32)	(0.20)	(0.28)	(0.14)
INTER		1.055*		-0.305
		(0.58)		(0.32)
Constant	4.485***	-69.594	0.006	-35.205
	(0.35)	(55.62)	(0.23)	(29.53)
Observations	1,127	1,078	1,127	1,078
Adjusted R-squared	0.605	0.729	0.584	0.762
Control Variables	No	Yes	No	Yes
State FE	State, Year	State, Year	State, Year	State, Year

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

Table 7: Dynamics of Liquidity Creation surrounding Deregulatory Events

This table presents the estimation results that analyze the dynamics of liquidity creation surrounding deregulation events. The analysis is at state-year level. The dependent variable is state-level "cat fat", normalized by state population. The bank deregulation variable in Columns 1 and 2 is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Columns 3 and 4 is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation. Before2+ is an indicator variable that takes the value of 1×(Δ Deregulation Variable) from the beginning of the window up to two years prior to a regulatory change and zero otherwise. Before1 is an indicator variable that takes the value of 1×(Δ Deregulation Variable) the year prior to a regulatory change and zero otherwise. After2+ is an indicator variable that takes the value of 1×(Δ Deregulation Variable) in the second year following a deregulation until the end of the window and zero otherwise. After1 is an indicator variable that takes the value of 1×(Δ Deregulation Variable) in the year following a regulatory change and zero otherwise. All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

VARIABLES	(1) INTER	(2) INTER	(3) IBBEA	(4) IBBEA
Before 2+	-0.515	-0.902	0.472	0.477
	(0.67)	(0.57)	(0.82)	(0.76)
Before 1	-0.352*	-0.280	0.127	0.110
	(0.21)	(0.24)	(0.46)	(0.50)
After 1	0.277	0.061	-0.207	-0.015
	(0.23)	(0.22)	(0.14)	(0.14)
After 2+	1.210	0.386	-0.237	-0.030
	(0.77)	(0.63)	(0.19)	(0.18)
Constant	4.803***	-108.775**	4.019***	-106.332**
	(0.43)	(50.39)	(0.87)	(52.17)
Observations	1,127	1,078	1,127	1,078
Adjusted R-squared	0.791	0.838	0.789	0.837
Control Variables	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year

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

Table 8: Effects of Bank Deregulation on Local Loan Creation

This table presents the estimation results that analyze the effect of interstate bank deregulation and interstate bank branching deregulation on state-level loan creation. Panel A shows the results that examine the effect of 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 – 2006. The dependent variables are state-level aggregate loan creation measures. The dependent variables are natural log of state-level loan creation in Columns 1 and 2, natural log of state-level loan creation normalized by state population in Columns 3 and 4, natural log of state-level loan creation normalized by number of borrowers within a state in Columns 5 and 6, and natural log of state-level loan creation normalized by number of competitors within a state in Columns 7 and 8, respectively. The bank deregulation variable in Panel A is INTER, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation, and the bank deregulation variable in Panel B is IBBEA, which is equal to 1 from the year of interstate bank deregulation onward and 0 prior to the deregulation All specifications include state and year fixed effects. Control variables include state-level deposit per capita, state-level equity per capita, natural log of number of potential competitors, natural log of number of potential borrowers, natural log of state population, GDP per capita, natural log of state personal income per capita, and house price index (HPI). 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.

Panel A: Interstate Bank Deregulation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ln(Loan Creation)	ln(Loan Creation)	ln(State Loan per capita)	ln(State Loan per capita)	ln(State Loan per borrowers)	ln(State Loan per borrowers)	ln(State Loan per competitors)	ln(State Loan per competitors)
INTER	0.275	0.188	0.227	0.116	0.243	0.171	-0.220	0.024
	(0.42)	(0.43)	(0.41)	(0.42)	(0.41)	(0.43)	(0.42)	(0.44)
Constant	20.104***	16.123	5.186***	14.057	15.914***	16.246	16.056***	20.274*
	(0.42)	(11.47)	(0.40)	(10.81)	(0.42)	(11.26)	(0.43)	(11.45)
Observations	951	951	951	951	951	951	951	951
Adjusted R-squared	0.872	0.873	0.752	0.754	0.655	0.655	0.811	0.820
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Panel B: Interstate Bank Branching Deregulation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(Loan Creation)	ln(Loan Creation)	ln(State Loan per capita)	ln(State Loan per capita)	ln(State Loan per borrowers)	ln(State Loan per borrowers)	ln(State Loan per competitors)	ln(State Loan per competitors)
IBBEA	-0.046	-0.017	-0.031	-0.016	-0.036	-0.019	0.045	-0.012
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
INTER		0.182		0.111		0.164		0.020
		(0.43)		(0.42)		(0.43)		(0.44)
Constant	20.327***	16.613	5.370***	14.495	16.111***	16.780	15.879***	20.627*
	(0.19)	(11.63)	(0.18)	(10.93)	(0.19)	(11.44)	(0.19)	(11.61)
Observations	951	951	951	951	951	951	951	951
Adjusted R-squared	0.872	0.873	0.752	0.754	0.655	0.654	0.811	0.820
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year	State, Year

Appendix A. Variable Definition

State-level Bank Deregulation Variables	Definition	Source
INTER	An indicator variable that is equal to one from the year of interstate banking deregulation onward, and zero prior to interstate banking deregulation	Black and Strahan (2002)
IBBEA	Interstate Bank Branching deregulation index, which is equal to one for the state with the most restrictive interstate branching regulations as of the effective date, and increases by one for each restriction that is relaxed by a state. The index takes a value of zero in all years prior to the effective date	Rice and Strahan (2010) Krishnan, Nandy, and Puri (2015)
State Liquidity Creation Variables		
Liquidity Creation per Capita	Total liquidity creation of all banks in the state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Small Bank Liquidity Creation per Capita	Total liquidity creation of banks in the state with less or equal to $1 billion in gross total assets, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Medium Bank Liquidity Creation per Capita	Total liquidity creation of banks in the state with less or equal to $3 billion and greater than $1 billion in gross total assets, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Large Bank Liquidity Creation per Capita	Total liquidity creation of banks in the state with greater than $3 billion in gross total assets, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Small/Medium Bank Liquidity Creation per Capita	Total liquidity creation of banks in the state with less or equal to $3 billion in gross total assets, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
MSA Liquidity Creation per Capita	Total liquidity creation of all banks in the state that operate in metropolitan statistical areas (MSAs), normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Non-MSA Liquidity Creation per Capita	Total liquidity creation of all banks in the state that operate in non-metropolitan statistical areas (MSAs), normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Liquidity Creation by Home Banks per Capita	Total liquidity creation of all banks in the state whose headquarters are located in the state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Liquidity Creation by Away Banks per Capita	Total liquidity creation of all banks in the state whose headquarters are located in the out-of-state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data

Asset-side Liquidity Creation per Capita	Total asset-side liquidity creation of all banks in the state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Liability-side Liquidity Creation per Capita	Total liability-side creation of all banks in the state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
Off-balance sheet Liquidity Creation per Capita	Total off-balance sheet liquidity creation of all banks in the state, normalized by the state's population	Berger & Bouwman (2009): https://sites.google.com/a/tamu.edu/bouwman/data
State Loan Creation Variables		
LN(State Loan Creation)	LN(1+Total loans borrowed by all firms in the state)	DealScan
LN(State Loan Creation per capita)	Total loans borrowed by all borrowers in the state, normalized by the state's population	DealScan
LN(State Loan Creation per Borrowers)	Total loans borrowed by all borrowers in the state, normalized by total number of potential borrowers in the state	DealScan
LN(State Loan Creation per Competitors)	Total loans borrowed by all borrowers in the state, normalized by total number of potential lenders in the state	DealScan
State-level Variables		
LN(Number of Competitors)	LN(1+Total number of potential borrowers in the state)	Call Report
LN(Number of Borrowers)	LN(1+Total number of potential lenders in the state)	Compustat
LN(Population)	LN(1+The state's population)	US Census
HPI	House price index	Federal Housing Finance Agency (FHFA)
State-level Deposit per Capita	Total bank deposit in the state, normalized by the state's population	Call Report
State-level Equity per Capita	Total bank book equity in the state, normalized by the state's population	Call Report
GDP per Capita	State GDP of the state, normalized by the state's population	Bureau of Economic Analysis (BEA) US Census
Personal Income per Capita	State personal income of the state, normalized by the state's population	Bureau of Economic Analysis (BEA) US Census

Internet Appendix for "Does Bank Competition Increase Bank Liquidity Creation? A State-level Perspective"

Seungho Choi
University of New South Wales

This internet appendix presents additional bank-level analysis tables and a definition of bank-level competition variable, which is Lerner Index, to accompany the paper "Does Bank Competition Increase Bank Liquidity Creation? A State-level Perspective" The contents are as follows:

Internet Appendix A. Additional Bank-level Analysis

Table IA1 consists of two panels. Panel A presents bank-level summary statistics, and Panel B presents t-test between small banks and large/medium banks.

Table IA2 presents regressions of Lerner Index on bank liquidity creation. I find reverse relation between bank competition and bank liquidity creation at the bank level.

Table IA3 reports sub-sample analysis examining the relation between bank competition and liquidity creation by bank size. Empirical results show that the reverse relation between bank competition and bank liquidity creation is driven by small banks. This suggests that small banks tend to keep more liquidity within a bank in the competitive market because small banks do not have sufficient resources to compete with larger banks and want to avoid potential default risk.

Table IA4 reports sub-sample analysis examining the relation between bank competition and liquidity creation by liquidity creation components. The results show that the reverse relation is driven by asset-side liquidity creation and off-balance sheet liquidity creation.

Table IA5 and IA6 examine whether bank competition affects bank liquidity creation and whether the effect of bank competition on liquidity creation is different by bank size. Exploiting interstate banking deregulation, I find no statistically significant results. The passage of the interstate banking deregulation only allows banks to acquire and establish a charter in the deregulated states, so it requires high fixed costs to enter the new market. This means that only large banks would have incentive to expand their businesses in the deregulated states, and small banks may not have enough funds to either acquire or establish the charter. The results suggest that interstate banking deregulation might not be effective to encourage bank liquidity creation.

Table IA7 and IA8 examine whether interstate bank branching deregulation affects bank liquidity creation and whether the effect of bank competition on liquidity creation is different by bank size. Consistent with the results in Table IA2, I find the negative effect of bank competition on bank liquidity creation on average. However, sub-sample analysis shows different perspectives of bank deregulation. Different from interstate banking deregulation, interstation bank branching deregulation allowed banks to either acquire or establish a branch. This means that it requires much lower fixed costs to enter the new market than interstate banking deregulation. This could explain why small banks create more liquidity than large and medium banks and why large banks create less liquidity than small and medium banks. Small banks may want to create more liquidity to keep their relationship with local borrowers, and large banks might want to create less liquidity to enjoy monopolistic rents because they are more likely to be dominant players in the market.

Table IA1: 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 2006. 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. 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. INTER is an indicator variable, which is equal to 1 from the year of interstate deregulation onward and 0 prior to the deregulation. KNP5 Index is Krishnan-Nandy-Puri index of interstate banking deregulation. It ranges from one (highly regulated) to five (deregulated) based on regulation changes in a state.

Panel A: Summary Statistics (Bank-level)

	N	Mean	SD
Liquidity Creation Variables			
Liquidity Creation	201,440	264,188	4,591,513
Asset-side Liquidity Creation	201,440	28,288	740,957
Liability-side Liquidity Creation	201,440	116,638	1,582,129
Off-balance sheet Liquidity Creation	201,440	119,262	2,994,539
Liquidity Creation/GTA	201,440	0.196	0.180
Asset-side Liquidity Creation/GTA	201,440	-0.019	0.137
Liability-side Liquidity Creation/GTA	201,440	0.176	0.065
Off-balance sheet Liquidity Creation/GTA	201,440	0.038	0.060
Bank-level Variables			
Lerner Index	201,440	0.320	0.097
EQRAT	201,440	0.092	0.031
Bank Size	201,440	11.738	1.150
Earnings Volatility	201,375	0.004	0.004
ZSCORE	192,170	47.741	53.773
Multi-BHC	201,440	0.301	0.459
Acquisitions	201,440	0.036	0.188
State-level Bank Deregulation Variables			
INTER	201,440	0.832	0.374
KNP Index (5 Restrictions)	201,440	1.165	1.675
KNP Index (4 Restrictions)	201,440	0.913	1.471

Table IA1: 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								
Liquidity Creation	191,194	36,149	63,804	10,246	4,519,481	19,883,716	4,483,332	0.000
Asset-side Liquidity Creation	191,194	140	30,355	10,246	553,538	3,238,360	553,398	0.000
Liability-side Liquidity Creation	191,194	28,742	35,973	10,246	1,756,816	6,808,689	1,728,074	0.000
Off-balance sheet Liquidity Creation	191,194	7,267	20,967	10,246	2,209,127	13,103,651	2,201,860	0.000
Liquidity Creation/GTA	191,194	0.186	0.173	10,246	0.373	0.213	0.187	0.000
Asset-side Liquidity Creation/GTA	191,194	-0.022	0.137	10,246	0.039	0.121	0.061	0.000
Liability-side Liquidity Creation/GTA	191,194	0.174	0.064	10,246	0.212	0.067	0.038	0.000
Off-balance sheet Liquidity Creation/GTA	191,194	0.034	0.045	10,246	0.122	0.164	0.088	0.000
Bank-level Variables								
Lerner Index	191,194	0.322	0.096	10,246	0.276	0.096	-0.046	0.000
Equity Ratio	191,194	0.092	0.031	10,246	0.077	0.026	-0.015	0.000
Bank Size	191,194	11.561	0.842	10,246	15.039	1.129	3.478	0.000
Earnings Volatility	191,137	0.004	0.004	10,238	0.004	0.003	0.000	0.000
ZSCORE	182,131	47.905	54.013	10,039	44.772	49.125	-3.133	0.000
Multi-BHC	191,194	0.281	0.450	10,246	0.670	0.470	0.389	0.000
Acquisitions	191,194	0.026	0.158	10,246	0.241	0.428	0.215	0.000

Table IA2: 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.

	(1)	(2)	(3)	(4)
Lerner Index	0.044***	0.033***	0.068***	0.070***
	(0.01)	(0.01)	(0.02)	(0.02)
EQRAT			-0.750***	-0.785***
			(0.04)	(0.04)
EARNVOL			-0.474**	-0.136
			(0.22)	(0.22)
ZSCORE			-0.000	-0.000***
			(0.00)	(0.00)
MBHC			0.020***	0.017***
			(0.00)	(0.00)
Acquisition			0.000	0.002
			(0.00)	(0.00)
Constant	0.115***	0.307***	-0.335	0.196***
	(0.00)	(0.05)	(0.24)	(0.05)
Observations	182,259	182,259	174,094	174,094
Adjusted R-squared	0.792	0.805	0.801	0.810
Control Variables	No	No	Yes	Yes
Macroeconomic Variables	No	No	Yes	No
Fixed Effects	Bank, Year	Bank, State-Year	Bank, Year	Bank, State-Year

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

Table IA3: 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.

	(1) Small Bank	(2) Small Bank	(3) Medium Bank	(4) Medium Bank	(5) Large Bank	(6) Large Bank
Lerner Index	0.067***	0.068***	0.078	0.072	0.093	0.084
	(0.02)	(0.02)	(0.11)	(0.08)	(0.11)	(0.08)
EQRAT	-0.769***	-0.804***	-0.299	-0.466	0.060	-0.332
	(0.04)	(0.04)	(0.39)	(0.37)	(0.29)	(0.39)
EARNVOL	-0.308*	0.002	-0.740	-0.426	-3.704*	-3.840**
	(0.18)	(0.18)	(1.42)	(1.25)	(1.89)	(1.59)
ZSCORE	-0.000	-0.000***	0.000	0.000	0.000*	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MBHC	0.022***	0.018***	-0.008	-0.007	-0.002	0.000
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
Acquisition	0.002	0.004**	0.004	0.008*	-0.003	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Constant	-0.199	0.323***	-1.630	0.497***	0.497	0.543***
	(0.27)	(0.03)	(1.26)	(0.04)	(0.81)	(0.05)
Observations	164,739	164,739	5,388	5,388	3,967	3,967
Adjusted R-squared	0.805	0.814	0.711	0.766	0.674	0.743
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	No	Yes	No	Yes	No
Fixed Effects	Bank, Year	Bank, State-Year	Bank, Year	Bank, State-Year	Bank, Year	Bank, State-Year

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

Table IA4: 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)
	Asset-side liquidity creation	Asset-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")
Lerner Index	0.041***	0.054***	0.005	-0.003	0.022**	0.019*
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
EQRAT	-0.269***	-0.317***	-0.440***	-0.424***	-0.041*	-0.044*
	(0.03)	(0.03)	(0.01)	(0.01)	(0.02)	(0.02)
EARNVOL	-0.399**	-0.093	-0.009	0.017	-0.066	-0.060
	(0.16)	(0.16)	(0.06)	(0.06)	(0.16)	(0.17)
ZSCORE	-0.000	-0.000***	0.000***	0.000**	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MBHC	0.020***	0.016***	-0.003***	-0.002***	0.003***	0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Acquisition	0.003**	0.004***	-0.003***	-0.002***	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.405*	-0.047	0.096	0.181***	-0.026	0.062***
	(0.22)	(0.05)	(0.06)	(0.02)	(0.06)	(0.02)
Observations	174,094	174,094	174,094	174,094	174,094	174,094
Adjusted R-squared	0.764	0.778	0.807	0.821	0.633	0.638
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic Variables	Yes	No	Yes	No	Yes	No
Fixed Effects	Bank, Year	Bank, State-Year	Bank, Year	Bank, State-Year	Bank, Year	Bank, State-Year

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

Table IA5: Effects of Interstate 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 key independent variable is 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)
	CATFAT	CATFAT	Asset-side liquidity creation	Asset-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")
INTER	0.003	0.010	-0.000	0.008	0.003	0.000	-0.000	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
EQRAT		-0.672***		-0.189***		-0.487***		0.004
		(0.07)		(0.06)		(0.01)		(0.02)
Size		0.011**		0.018***		-0.018***		0.011***
		(0.01)		(0.00)		(0.00)		(0.00)
EARNVOL		-0.518		-0.337		-0.151		-0.030
		(0.33)		(0.24)		(0.10)		(0.16)
ZSCORE		-0.000		-0.000		0.000**		-0.000***
		(0.00)		(0.00)		(0.00)		(0.00)
MBHC		0.021***		0.020***		-0.003***		0.004***
		(0.00)		(0.00)		(0.00)		(0.00)
Acquisition		-0.003		-0.003		0.002**		-0.003**
		(0.00)		(0.00)		(0.00)		(0.00)
Constant	0.125***	-0.479	-0.050***	-0.540	0.162***	0.145	0.013***	-0.083
	(0.01)	(0.49)	(0.01)	(0.46)	(0.00)	(0.16)	(0.00)	(0.08)
Observations	201,440	174,094	201,440	174,094	201,440	174,094	201,440	174,094
Adjusted R-squared	0.776	0.801	0.734	0.765	0.770	0.813	0.664	0.636
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Macroeconomic Variables	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	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 IA6: Effects of Interstate 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 key independent variable is 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) Small Bank	(3) Medium Bank	(4) Medium Bank	(5) Large Bank	(6) Large Bank
INTER	0.002	0.010	0.001	0.013	0.008	-0.004
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
EQRAT		-0.675***		-0.279		0.095
		(0.07)		(0.36)		(0.24)
Size		0.015**		0.017		-0.013
		(0.01)		(0.01)		(0.02)
EARNVOL		-0.316		-0.894		-4.004**
		(0.29)		(1.61)		(1.99)
ZSCORE		-0.000		0.000		0.000**
		(0.00)		(0.00)		(0.00)
MBHC		0.022***		-0.008		-0.002
		(0.00)		(0.01)		(0.01)
Acquisition		-0.002		0.000		-0.001
		(0.00)		(0.00)		(0.01)
Constant	0.118***	-0.351	0.219***	-1.935	0.318***	0.763
	(0.01)	(0.50)	(0.02)	(1.35)	(0.01)	(0.78)
Observations	191,194	164,739	5,916	5,388	4,330	3,967
Adjusted R-squared	0.777	0.805	0.749	0.711	0.681	0.674
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 IA7: 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 key independent variable is KNP5 Index, which ranges from one (highly regulated) to five (deregulated) based on regulation changes in a state. INTER 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)
	CATFAT	CATFAT	Asset-side liquidity creation	Asset-side liquidity creation	Liability-side liquidity creation	Liability-side liquidity creation	Off-balance sheet liquidity creation ("fat")	Off-balance sheet liquidity creation ("fat")
KNP5	-0.004**	-0.003*	-0.003**	-0.002	-0.001	-0.001	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
INTER		0.009		0.007		0.000		0.002
		(0.01)		(0.01)		(0.00)		(0.00)
EQRAT		-0.670***		-0.187***		-0.487***		0.005
		(0.07)		(0.06)		(0.01)		(0.02)
Size		0.012**		0.018***		-0.018***		0.011***
		(0.01)		(0.00)		(0.00)		(0.00)
EARNVOL		-0.504		-0.327		-0.149		-0.028
		(0.32)		(0.24)		(0.10)		(0.16)
ZSCORE		-0.000		-0.000		0.000**		-0.000***
		(0.00)		(0.00)		(0.00)		(0.00)
MBHC		0.021***		0.020***		-0.003***		0.004***
		(0.00)		(0.00)		(0.00)		(0.00)
Acquisition		-0.003		-0.003		0.002**		-0.003**
		(0.00)		(0.00)		(0.00)		(0.00)
Constant	0.126***	-0.432	-0.050***	-0.508	0.162***	0.153	0.013***	-0.077
	(0.01)	(0.49)	(0.01)	(0.46)	(0.00)	(0.16)	(0.00)	(0.08)
Observations	201,440	174,094	201,440	174,094	201,440	174,094	201,440	174,094
Adjusted R-squared	0.776	0.802	0.734	0.765	0.770	0.813	0.664	0.636
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
Macroeconomic Variables	No	Yes	No	Yes	No	Yes	No	Yes
Fixed Effects	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 IA8: 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 key independent variable is KNP5 Index, which ranges from one (highly regulated) to five (deregulated) based on regulation changes in a state. INTER 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) Small Bank	(3) Medium Bank	(4) Medium Bank	(5) Large Bank	(6) Large Bank	(7) Small Bank	(8) Small Bank	(9) Medium Bank	(10) Medium Bank	(11) Large Bank	(12) Large Bank
KNP5	-0.004**	-0.003	-0.005	-0.003	-0.008	-0.006	-0.010***	-0.007***	-0.004**	-0.003*	-0.004**	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Small Bank							-0.021**	-0.003				
							(0.01)	(0.01)				
Small X KNP5							0.006***	0.005**				
							(0.00)	(0.00)				
Medium Bank									0.011	0.004		
									(0.01)	(0.01)		
Medium X KNP5									-0.003	-0.002		
									(0.00)	(0.00)		
Large Bank											0.021*	-0.002
											(0.01)	(0.01)
Large X KNP5											-0.008***	-0.007**
											(0.00)	(0.00)
Constant	0.118***	-0.315	0.219***	-1.882	0.319***	0.906	0.146***	-0.424	0.125***	-0.430	0.125***	-0.428
	(0.01)	(0.50)	(0.02)	(1.30)	(0.01)	(0.83)	(0.01)	(0.49)	(0.01)	(0.49)	(0.01)	(0.49)
Observations	191,194	164,739	5,916	5,388	4,330	3,967	201,440	174,094	201,440	174,094	201,440	174,094
Adjusted R-squared	0.777	0.805	0.749	0.711	0.681	0.675	0.776	0.802	0.776	0.802	0.776	0.802
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Macroeconomic Variables	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	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

Internet Appendix B. Lerner Index

To indicate bank-level 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).

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:

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