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Competition and Bank Liquidity Creation

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Abstract

We use a new identification strategy to assess whether an intensification of competition among banks increases or decreases the provision of a key banking service: liquidity creation. Although theory offers conflicting predictions about the impact of competition on liquidity creation, we find that regulatory-induced competition reduces liquidity creation. Consistent with a subset of models emphasizing that banks pushed toward insolvency reduce risk-taking activities, we discover that regulatory-induced competition reduces liquidity creation more among banks with less risk-absorbing capacity (e.g., less profitable banks).

I. Introduction

Liquidity creation is a vital banking service. Banks create liquidity by using relatively liquid liabilities, such as demand deposits, to fund relatively illiquid assets, such as business loans. This simultaneously satisfies the demand for liquidity by savers and the demand for long-term financing commitments by firms (see, e.g., Bryant (1980), Diamond and Dybvig (1983), and Gatev and Strahan (2006)). Banks also create liquidity off the balance sheet by providing loan commitments and standby letters of credit that allow firms to develop and modify long-run investment strategies efficiently (see, e.g., Holmstrom and Tirole (1988), Kashyap, Rajan, and Stein (2002)). By creating liquidity, theory suggests that banks enable investments in positive net present value projects that would be infeasible without bank liquidity creation (see Donaldson, Piacentino, and Thakor (2018)), improving the allocation of capital and accelerating economic growth (see, e.g., Bencivenga and Smith (1991), Levine (1991)). A considerable body of empirical

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work finds that banks affect economic growth (see, e.g., King and Levine (1993), Levine and Zervos (1998), and Levine, Loayza, and Beck (2000)), and Berger and Sedunov (2017) show that liquidity creation is one of the banking services contributing to these growth effects.

Given the importance of liquidity creation, an emerging body of empirical research examines its determinants. Berger and Bouwman (2009) spurred much of this research by creating comprehensive measures of liquidity creation for U.S. banks from 1993 to 2003. With these data, Berger and Bouwman (2009), (2016) evaluate the connections between bank capital, bank size, and liquidity creation. Cornett, McNutt, Strahan, and Tehranian (2011) examine how financial duress influences liquidity creation, and Berger and Roman (2017) and Duchin and Sosyura (2014) find that the Troubled Asset Relief Program (TARP) increased bank lending, a key component of liquidity creation. Berger and Bouwman (2016) provide a comprehensive review of the liquidity creation literature while offering new analyses.

In this article, we provide the first empirical evaluation of whether U.S. bank regulatory reforms that lowered barriers to competition among banks increased, decreased, or had no effect on liquidity creation. Theory offers two perspectives on the impact of competition on liquidity creation. One strand of research suggests that competition reduces liquidity creation by lowering the risk absorption capacity of banks. By squeezing profit margins and depleting buffers against losses (see, e.g., Jayaratne and Strahan (1998)), competition can induce banks to decrease risk (see Boyd and De Nicolo (2005), Ippolito, Peydro, Polo, and Sette (2016)). Because liquidity creation is risky, therefore, competition can induce banks to decrease risk by reducing liquidity creation.

A second line of research suggests mechanisms through which competition boosts liquidity creation. First, competition tends to spur financial innovation and improve efficiency (see, e.g., Boot and Thakor (2000), Laeven, Levine, and Michalopoulos (2015)). One dimension along which the bank might innovate is liquidity creation. Second, competition tends to make banks more transparent (see Jiang, Levine, and Lin (2016)), which can spur bank managers to devote more effort to screening and monitoring firms. If these efforts improve credit allocation, this can encourage banks to lend more and create more liquidity. Thus, theory provides differing views on the effect of competition on liquidity creation.

The major challenge to assessing the impact of competition on liquidity creation is identification. One influential line of research uses U.S. interstate bank deregulation as a source of variation in the contestability of state banking markets, where contestability is one component of the competitive environment facing banks. Until 1982, states restricted the entry of banks from other states. Starting in 1982 and running through the passage of the Riegle–Neal Interstate Banking and Branching Efficiency Act of 1994 (IBBEA), which eliminated restrictions on interstate banking across all states in 1995, many states started the process of removing regulatory barriers on banks from other states entering their borders, acquiring or establishing subsidiaries, and competing with local banks. Thus, deregulation allowed banks from other states to enter and compete with local banks. In this way, deregulation increased the contestability of local banking markets regardless of whether banks actually entered. Using the date when a state first allowed banks

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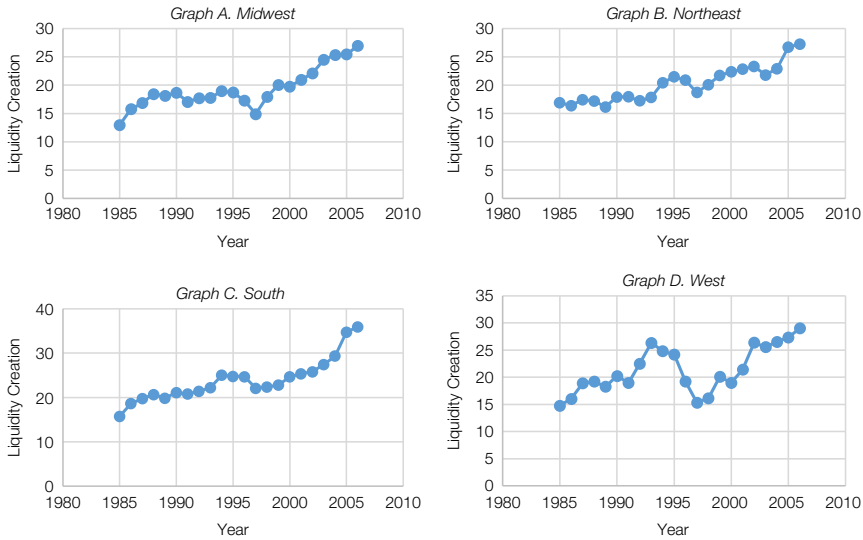
from another state to own a subsidiary within its borders, Jayaratne and Strahan (1998) and others find that interstate bank deregulation was associated with an intensification of the contestability of state banking markets that decreased interest rates on loans and increased interest rates on deposits.

There are two crucial deficiencies, however, with using the first year that a state removed barriers to interstate banking to identify the impact of contestability on liquidity creation. First, other developments might have occurred at the same time the state deregulated interstate banking and these other developments might shape bank liquidity creation in the state. Thus, omitted variables could confound our ability to identify the impact of competition on liquidity creation by using the date that a state starts deregulating interstate banking restrictions. As can be seen from Figure 1, there exist significant time trends in bank liquidity creation across regions. Second, using the first year that a state deregulates with another state ignores the dynamics of interstate deregulation. States both started to deregulate in different years and followed different paths as they signed interstate banking agreements with different states in different years.

FIGURE 1

Liquidity Creation by Region

Figure 1 presents the time trend of liquidity creation over the years by 4 regions in the United States: Midwest, Northeast, South, and West. The U.S. Census Bureau defines these 4 regions as follows: Midwest (Graph A) includes Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; Northeast (Graph B) includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania; South (Graph C) includes Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, District of Columbia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas; and West (Graph D) includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington.



Our identification strategy addresses both of these shortcomings by integrating the dynamic process of interstate bank deregulation with the "gravity model" of investment to construct an exogenous source of variation in the exposure of each bank in each year to the potential entry of banks from other states.

With respect to the dynamics, we exploit the process of each state's interstate banking agreements with every other state by examining the removal of regulatory barriers by states through unilateral, bilateral, or multilateral agreements from 1982 to 1995. With respect to the gravity model, we exploit the assumption that the costs to establishing a bank subsidiary are positively related to the distance between the bank's headquarters and the subsidiary, where Goetz, Laeven, and Levine (2013), (2016) provide empirical support for this assumption.[1] Thus, when state j allows banks from state k to enter, this intensifies competition more among banks in state j that are closer to state k than those that are farther from state k. By integrating the dynamic process of interstate bank deregulation with measures of the distance between each bank and each state, we construct a measure of the time-varying exposure of each bank to the potential entry of banks headquartered in other states. We call this the "regulatory-induced contestability" or the "regulatory-induced competitive pressures" facing a bank. In our analyses, this is the "treatment," as it measures regulatory-induced changes in a bank's exposure to banks from other states. By differentiating among banks within a state and year, we can control for state-year fixed effects to better identify the impact of an intensification of the competitive pressures facing an individual bank on its creation of liquidity.

To measure liquidity creation, we use the four Berger and Bouwman (2009) measures of liquidity creation and extend them to cover our sample period. For the two category-based measures, each on- and off-balance-sheet bank item was categorized as either liquid, semi-liquid, or illiquid. Berger and Bouwman (2009) then use two weighting methods (depending on whether off-balance-sheet items are included) to construct the category-based liquidity measures for each bank in each year. For the two maturity-based liquidity creation measures, the on- and off-balance-sheet items are classified as liquid or illiquid based on whether they mature in less than or more than 1 year. Then, the same weighting methods are used to construct two maturity-based liquidity creation measures. To make the liquidity creation measures comparable across banks, we normalize the four liquidity creation measures by each bank's total assets; that is, we measure liquidity creation per dollar of assets and call this "liquidity creation." In robustness tests, we show that the results hold when weighting by each bank's total assets to ensure that the findings do not reflect a compositional shift across small and large banks.

We use a difference-in-differences estimation strategy to identify the impact of changes in the exposure of each bank to interstate bank deregulation on liquidity creation. We conduct the analyses from 1984 through 2006 using annual data. The dependent variable is one of the liquidity creation measures, which is measured at the bank-year level. The key independent variable is one of our two measures of the regulatory-induced competitive pressures facing each bank in each year. We include state-year fixed effects to control for all time-varying state characteristics, including other regulatory and policy reforms or technological innovations, that could influence liquidity creation in the state and might

[1] Although Goetz et al. (2013), (2016) exploit the gravity model, their focus is different from ours. In particular, they do not create an instrument of the regulatory-induced competitive pressures facing banks.

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therefore confound our ability to identify the impact of an intensification of competition on bank liquidity creation. Thus, including state-year effects helps isolate the connection between the bank-specific competitive pressures triggered by interstate bank deregulation and liquidity creation. We also include bank fixed effects to control for all time-invariant bank traits and show that the results are robust to controlling for various time-varying bank characteristics. Furthermore, we provide validity tests showing that liquidity creation by banks in a state does not predict the timing of interstate bank deregulation.

We find that an intensification of regulatory-induced competitive pressures exerts a negative influence on liquidity creation. That is, the regulatory-induced contestability measures enter negatively and significantly in the liquidity creation regressions. This holds for each of the four measures of liquidity creation. To be clear, we are not arguing that liquidity creation fell during the 1980s and 1990s. Indeed, aggregate liquidity creation increased over this period (Figure 1). Rather, we find that regulatory-induced contestability exerts a negative effect on liquidity creation.

The estimates indicate that the impact is economically large. For example, we find that a 1-standard-deviation increase in the competitive pressures facing a bank is associated with a 3.4-percentage-point reduction in liquidity creation, which is large considering that the sample average level of liquidity creation is 20% of total assets. When applying this estimate to the median (average) bank in our sample, which has gross total assets of $104 million ($627 million), the 3.4-percentage-point reduction in the ratio of liquidity creation to assets implies a loss of $3.5 million ($21.3 million) in liquidity creation by the median (average) bank. We also explore the relation between the regulatory reform measures and the three components of the category-based liquidity creation measure: asset-side, liability-side, and off-balance-sheet liquidity creation. We find that a drop in asset-side liquidity creation accounts for most of the negative effect of regulatory-induced competition on liquidity creation.

We next push the analyses beyond our core question of assessing the effect of competition on liquidity creation and explore one potential mechanism emphasized by theory. As discussed previously, one view is that by squeezing profit margins, competition reduces the willingness of banks to absorb more risk through liquidity creation and hence reduces liquidity creation. If competition affects liquidity creation through this profitability channel, the negative impact of competition on liquidity creation should be smaller among more profitable banks because they have a greater risk-absorbing buffer. To assess this profitability channel, we examine whether the negative impact of regulatory competition on liquidity creation is smaller among more profitable banks. Relatedly, we also examine whether the impact of competition on liquidity creation differs by bank size. If interstate bank deregulation has an especially severe impact on the risk-absorbing capacity of small banks because they now face competition from larger banks that are better able to exploit economies of scale, the negative impact of competition on liquidity creation should be especially large for small banks.

We find evidence consistent with these views. Specifically, we find that more profitable banks, as measured by net interest margins, experience a smaller reduction in liquidity creation in response to interstate bank deregulation.

Similarly, we find that an intensification of a bank's exposure to the potential entry of out-of-state banks from interstate bank deregulation reduces liquidity creation more among smaller banks.

Our article is organized as follows: Section II explains the data and econometric methodology. Section III presents and discusses the empirical results. Section IV concludes.

II. Data and Methodology

This section describes i) the data sources and sample of banks, ii) the construction of the key variables, and iii) the econometric methodology.

A. Data Sources and Sample

We start with the population of commercial banks in the United States from 1984 through 2006. The Federal Reserve Bank of Chicago provides Condition and Income statements for all commercial banks regulated by the Federal Reserve System, Federal Deposit Insurance Corporation, and Comptroller of Currency. We exclude a bank if it has no deposits, has 0 or negative equity capital in the current or lagged year, has no commercial real estate or commercial and industrial loans outstanding, or has unused commitments exceeding 4 times its gross total assets. We also exclude banks that resemble thrifts, are classified by the Federal Reserve as credit card banks, or have consumer loans over 50% of gross total assets. We further exclude banks with average gross total assets below $25 million. Finally, we follow the literature and drop Delaware and South Dakota because they have special laws to encourage credit card banking. Our final sample contains 192,564 bank-year observations from 15,081 banks during 1984–2006.[2]

B. Liquidity Creation

We use the four Berger and Bouwman (2009) measures of liquidity creation: two category-based measures and two maturity-based measures. In classifying bank activities other than loans, we use both product category and maturity information. However, the Call Reports do not provide maturity information for different individual loan categories. Consequently, loans are classified either by category or by maturity. For this reason, Berger and Bouwman (2009) create both category- and maturity-based liquidity creation measures, where the category-based measures classify loans based on category only and the maturity-based measures classify loans based on maturity only.

For the category-based measures, Berger and Bouwman (2009) first classify each on- and off-balance-sheet bank item as either liquid, semi-liquid, or illiquid. The Appendix details how Berger and Bouwman (2009) define each on- and off-balance-sheet item as liquid, semi-liquid, and illiquid. Second, they assign a weight to each category. Specifically, a weight of 0.5 is assigned to illiquid assets

[2]Although the IBBEA ended restrictions on interstate banking starting in 1995, we continue the analyses through 2006 because it might take time for the removal of these entry restrictions to affect the contestability of banking markets and hence bank behavior. As a robustness test, however, we examine whether the results differ in the pre-1996 period. We find that the estimated reduction in liquidity creation from regulatory-induced competition is actually larger in the pre-1996 period.

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(ILL_A), liquid liabilities (L_L), and illiquid off-balance-sheet items (ILL_OFF); a weight of −0.5 is assigned to liquid assets (L_A), illiquid liabilities (ILL_L), and liquid off-balance-sheet items (L_OFF); and a weight of 0 is assigned to semi-liquid assets (SEMI_A) and liabilities (SEMI_L). These weights assume that $1 of liquidity is created (destroyed) when banks transform $1 of illiquid (liquid) assets or off-balance-sheet items into $1 of liquid (illiquid) liabilities. Third, Berger and Bouwman (2009) compute a bank's category-based liquidity creation measure, LIQUIDITY_CREATION_CAT, as the weighted sum of the following items:

$$\text{LIQUIDITY_CREATION_CAT} = \text{ASSET_SIDE_LC} + \text{LIABILITY_SIDE_LC} + \text{OFF_BALANCE_SHEET_LC}, \tag{1}$$

where

$$\text{ASSET_SIDE_LC} = \frac{0.5 \times \text{ILL_A} - 0.5 \times \text{L_A}}{\text{GROSS_TOTAL_ASSETS}},$$

$$\text{LIABILITY_SIDE_LC} = \frac{0.5 \times \text{L_L} - 0.5 \times \text{ILL_L}}{\text{GROSS_TOTAL_ASSETS}},$$

$$\text{OFF_BALANCE_SHEET_LC} = \frac{0.5 \times \text{ILL_OFF} - 0.5 \times \text{L_OFF}}{\text{GROSS_TOTAL_ASSETS}},$$

where the bank-specific measures of on- and off-balance-sheet subcomponents are computed as dollar values. Fourth, Berger and Bouwman (2009) compute the second category-based measure in a similar way, but they exclude off-balance-sheet items. We call this measure LIQUIDITY_CREATION_CAT_2.

The maturity-based measures classify on- and off-balance-sheet items as illiquid or liquid depending on whether they mature in more or less than 1 year. Then, based on these maturity groupings, we use the same process as described for the category-based measures to construct two maturity-based measures: LIQUIDITY_CREATION_MAT and LIQUIDITY_CREATION_MAT_2, which excludes off-balance-sheet items.

Finally, and critically, to make the liquidity creation measures comparable across banks, we normalize by the bank's gross total assets, which equals the sum of total assets, allowances for loan and lease losses, and allocated transfer risk reserve (a reserve for certain foreign loans). We do this normalization for each of the four liquidity measures so that they measure liquidity creation per bank asset. For brevity, we use the term "liquidity creation" when referring to liquidity creation per bank asset. We winsorize the four liquidity creation ratios at the 1% and 99% levels.

C. Interstate Bank Deregulation

State and national policy makers removed regulatory impediments to interstate banking during the last quarter of the 20th century. The process of interstate bank deregulation started in 1982 and ended with the passage of the IBBEA, which effectively eliminated restrictions on interstate banking across the United States in 1995. By lowering barriers to banks acquiring or establishing subsidiaries in other states, interstate bank deregulation increased the contestability of banking markets, reducing interest rates on loans and increasing interest rates on deposits, as shown by Jayaratne and Strahan (1998).

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Researchers typically use the first year that a state allowed banks from any other state to enter its borders and acquire or establish subsidiaries as the date of interstate bank deregulation. We call this traditional measure INTER, which equals 1 if a bank is headquartered in a state that has deregulated interstate banking with at least one other state, and 0 otherwise. INTER varies by state and time as states started removing barriers to the entry of banks headquartered in other states in different years.

There are two shortcomings with INTER, however. First, INTER might not represent an exogenous source of variation in the competitive environment facing banks. If other developments occurred in states at the same time they removed barriers to interstate banking, these other factors could confound our ability to identify the effects of an intensification of the contestability of banking markets, that is, greater competition, on liquidity creation. Second, states both started interstate bank deregulation in different years and followed different paths of deregulation as they signed agreements with different states in different years. States removed restrictions over time by unilaterally opening their state borders and allowing out-of-state banks to enter or by signing reciprocal bilateral and multilateral agreements with other states. INTER does not capture the dynamic, state-specific process of interstate bank deregulation.

To address both shortcomings, we integrate the dynamic, state-specific process of interstate bank deregulation with the gravity model of investment to construct an exogenous source of variation in the exposure of each bank in each year to the potential entry of banks from other states. In particular, for every state j in every year t, we use information on the dynamic process of interstate bank deregulation to measure whether each out-of-state bank can enter state j. In this way, we address the second shortcoming with the traditional INTER measure of deregulation: We include not only information on when each state started the process of interstate bank deregulation, but also information on each state's process of deregulating with all other states. We next integrate the gravity model. The gravity model differentiates among banks within state j. It predicts that the costs to a bank of establishing a subsidiary in a location are positively related to the distance between the bank and the location of the subsidiary. That is, when state j allows banks from state k to enter, this intensifies competition more among banks in state j that are closer to state k than among banks in state j that are farther away from k. The gravity model, therefore, differentiates among banks within a state. By integrating the dynamic process of interstate bank deregulation with the gravity model, we construct a measure of the time-varying exposure of each bank to the potential entry of banks headquartered in other states due to interstate bank deregulation, that is, the regulatory-induced competitive pressures facing each bank.

Thus, we address the core identification concern with the traditional measure of interstate bank deregulation: There might be factors occurring at the same time a state implements interstate bank deregulation that influence liquidity creation in the state, making it impossible to identify the impact of competition on liquidity creation. We address this concern by differentiating among banks within a state and using the time-varying exposure of each bank to the potential entry of banks from other states due to interstate bank deregulation. In this way, we can control for state-year fixed effects and condition out all factors occurring at the same time

states implement interstate bank deregulation that shape liquidity creation at the state-year level.

More specifically, we begin by computing a measure of the distance between each bank i located in state j in each year t and the center of banking activity in all other states (ks) whose banks are allowed to enter state j in year t due to interstate bank deregulation. We use the following 3-step procedure to identify the center of banking activity in each state k in year t: First, calculate the distance between bank i and each county c in each state k (whose banks can enter state j in year t). More specifically, we measure the distance between bank i's zip code and the zip code in county c with the largest population. We use the great-circle distance based on internal points in the geographic area to get the between-zip code distance. Second, for each county c in state k in year t, we i) compute the ratio of the assets of banks located in county c in state k to the total assets of banks in state k and ii) use this ratio to weight the distance between bank i and each county c within state k. Thus, we give greater weight to counties with more bank assets. Third, we sum these weighted distances between bank i and each county c in state k to obtain a measure of the distance between bank i and the center of banking activities in state k in year t, which we call $\text{SYNTHETIC_DISTANCE}_{ikt}$. Formally, we compute the following:

$$\text{SYNTHETIC_DISTANCE}_{ikt} = \sum_{c \in k} (\text{BANK_ASSETS_RATIO}_{ct} \times \text{DISTANCE}_{ic}). \tag{2}$$

Based on this synthetic distance measure, we compute our three main measures of the regulatory-induced competitive pressures facing each bank i in each year t. For the first measure, we sum the inverse of $\text{SYNTHETIC_DISTANCE}_{ikt}$ across all states k whose banks can enter bank i's home state j in year t and taking the natural logarithm of this summation. This yields a measure of each bank's exposure to interstate deregulation in each year. To put it formally, we calculate the following:

$$\text{COMPETITION_DISTANCE_WEIGHTED}_{ijt} = \ln \sum_{k} \frac{O_{jkt}}{\text{SYNTHETIC_DISTANCE}_{ikt}}. \tag{3}$$

In equation (3), O_{jkt} equals 1 if banks from state k are allowed to enter state j in period t, and 0 otherwise.

For the second main regulatory-induced competition measure, we weight the synthetic distance by the number of banks in state k. More specifically, we compute the following:

$$\text{COMPETITION_DISTANCE_WEIGHTED_2}_{ijt} = \ln \sum_{k} \frac{O_{jkt} \times K_{kt}}{\text{SYNTHETIC_DISTANCE}_{ikt}}. \tag{4}$$

In equation (4), K_{kt} represents the total number of banks in state k in period t.

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For the third main measure of the regulatory-induced competitive pressures facing each bank i in each year t, we weight the synthetic distance by the total value of bank assets in state k and call this measure COMPETITION_DISTANCE_WEIGHTED_3$_{ijt}$:

$$\text{(5)} \qquad \text{COMPETITION_DISTANCE_WEIGHTED_3}_{ijt} = \ln \sum_k \frac{O_{jkt} \times R_{kt}}{\text{SYNTHETIC_DISTANCE}_{ikt}}.$$

In equation (5), R_{kt} represents total bank assets in state k in period t. For each of these three distance-weighted measures, we normalize them to fall between 0 and 1.

As a robustness check, we also create and analyze three additional time-varying bank-specific competition measures. The key difference between these additional measures and the main competition measures is the following: Instead of using the synthetic distance between bank i and the center of banking activity in state k, these additional measure use the distance between bank i and the city in state k with the largest number of banks. Paralleling the main measures, therefore, the first alternative measure simply sums the inverse distance from bank i to the city in state k with the largest number of banks as follows:

$$\text{(6)} \qquad \text{ALT_COMPETITION_DISTANCE_WEIGHTED}_{ijt} = \ln \sum_k \frac{O_{jkt}}{\text{DISTANCE}_{ik}},$$

where O_{jkt} equals 1 if banks from state k are allowed to enter state j in period t, and 0 otherwise. For the second alternative measure, we modify equation (6) by weighting the summation of the inverse of distance by the number of banks in state k. For the third additional measure, we weight by total bank assets in state k. We call these two alternative measures, ALT_COMPETITION_DISTANCE_WEIGHTED_2 and ALT_COMPETITION_DISTANCE_WEIGHTED_3, respectively. We also normalize these three bank competition measures to fall between 0 and 1 and report the results in Supplementary Material Table IA1. We obtain consistent results across the six measures of bank competition.

D. Other Variables

To control for other factors that might be related to bank competition and liquidity creation, our regressions include a set of time-varying bank characteristics including the natural logarithm of bank size (ln(SIZE)), the capital asset ratio measured as the book value of equity over total assets (CAPITAL_ASSET_RATIO), and a dummy variable indicating whether a bank belongs to a multibank holding company (MULTIBANK_HOLDING_COMPANY). Table 1 provides summary statistics of the variables used in our analyses. Definitions of the variables are provided in the Appendix. The median commercial bank in our sample has GROSS_TOTAL_ASSETS of $104 million (in 2014 dollars), and the average bank has assets of $627 million. Given the skewness in bank size, we use the natural logarithm of bank size. The average CAPITAL_ASSET_RATIO is 0.09, and about 30% of the commercial banks belong to multibank holding companies.

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TABLE 1
Summary Statistics

Table 1 presents summary statistics of the main indicators of the degree of bank-specific competition, liquidity creation by banks, and other variables used in the analyses. SD denotes standard deviation, and P25 and P75 denote 25th and 75th percentiles, respectively. The Appendix provides variable definitions.

Variable	*N*	Mean	SD	P25	Median	P75	Min.	Max.
Panel A. Bank-Specific Deregulation Measures								
COMPETITION_DISTANCE_WEIGHTED	192,564	0.83	0.32	0.88	0.98	0.98	0.00	1.00
COMPETITION_DISTANCE_WEIGHTED_2	192,564	0.83	0.32	0.92	0.97	0.97	0.00	1.00
COMPETITION_DISTANCE_WEIGHTED_3	192,564	0.80	0.31	0.85	0.93	0.95	0.00	1.00
Panel B. Liquidity Creation Measures								
LIQUIDITY_CREATION_CAT	192,564	0.20	0.18	0.08	0.20	0.32	−0.20	0.65
LIQUIDITY_CREATION_CAT_2	192,564	0.16	0.15	0.06	0.16	0.26	−0.21	0.51
LIQUIDITY_CREATION_MAT	192,564	0.24	0.18	0.11	0.24	0.36	−0.18	0.70
LIQUIDITY_CREATION_MAT_2	192,564	0.20	0.16	0.09	0.20	0.31	−0.20	0.58
ASSET_SIDE_LC	192,564	−0.02	0.14	−0.11	−0.02	0.08	−0.34	0.31
LIABILITY_SIDE_LC	192,564	0.18	0.06	0.13	0.17	0.22	0.03	0.35
OFF_BALANCE_SHEET_LC	192,564	0.04	0.04	0.01	0.03	0.06	0.00	0.20
Panel C. Other Variables								
ln(SIZE)	192,564	11.69	1.14	10.90	11.49	12.20	7.79	20.95
CAPITAL_ASSET_RATIO	192,564	0.09	0.03	0.07	0.09	0.1	0.00	0.88
MULTIBANK_HOLDING_COMPANY	192,564	0.30	0.46	0.00	0.00	1.00	0.00	1.00
PROFITABILITY	192,564	0.04	0.01	0.03	0.04	0.04	0.02	0.06
HIGH_PROFIT	192,564	0.43	0.50	0.00	0.00	1.00	0.00	1.00
SMALL_SIZE	192,564	0.31	0.46	0.00	0.00	1.00	0.00	1.00

E. Econometric Methodology

To evaluate the impact of a bank's exposure to the potential entry of banks headquartered in other states on liquidity creation, we use a difference-in-differences methodology. In our core analyses, we use the two time-varying, bank-specific measures of regulatory-induced competition constructed using the gravity-deregulation procedure described in Section II.C. For completeness and comparison purposes, we also provide results using INTER. Because the unit of analysis in our core analyses is at the bank-state-year level, we can control for both state-time and bank fixed effects. The state-time fixed effects capture all time-varying state influences. Bank fixed effects capture all time-invariant bank characteristics. When we examine INTER, we can only include time and bank fixed effects.

We use the following ordinary least squares (OLS) regression specification in our core analyses:

$$\text{LIQUIDITY_CREATION}_{ijt} = \alpha_{ijt} + \beta \times \text{COMPETITION}_{ijt} + \gamma' X_{ijt} + \delta_i + \delta_{jt} + e_{ijt}, \tag{7}$$

where $\text{LIQUIDITY_CREATION}_{ijt}$ is one of the measures of liquidity creation for bank i in state j in year t, COMPETITION_{ijt} is one of the three measures of a bank's time-varying exposure to interstate deregulation, X_{ijt} is a vector of time-varying bank-specific characteristics (ln(SIZE), CAPITAL_ASSET_RATIO, and MULTIBANK_HOLDING_COMPANY), and δ_i and δ_{jt} are bank and state-year fixed effects, respectively. The state-year fixed effects control for factors influencing the overall state in a year, such as economic activity and regulatory and

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tax policies. In seeking to assess the impact of an intensification of competition on liquidity creation, we focus on estimating β. Because including endogenous bank-specific characteristics could interfere with drawing sharp inferences about β, we provide estimates both with and without the X_{ijt} variables. We discuss and present a series of robustness tests in Sections III.B and III.C. Throughout the analyses, we report standard errors that are heteroscedasticity consistent and 2-way clustered at the state-year level. The results are robust to clustering at either the state or state-year level.

F. Validation Test

One concern is that liquidity creation might influence a state's decisions regarding interstate bank deregulation. For example, the lack of bank lending within a state may induce state officials to liberalize restrictions on interstate banking to boost lending. This concern, however, is unlikely to challenge our identification strategy when we use the bank-specific measures of regulatory-induced competition and control for state-year fixed effects because the state-year fixed effects condition away all state-year factors.

Nevertheless, we assess the possibility that liquidity creation shaped the timing of interstate bank deregulation using the procedure developed by Kroszner and Strahan (1999) and find no indication that liquidity creation predicts the timing of interstate bank deregulation. To their empirical model of the timing of interstate bank deregulation, we add a measure of lagged liquidity creation and examine whether lagged values of liquidity creation predict the timing of interstate banking reforms. Specifically, we calculate an aggregate index of liquidity creation within a state by weighting each bank's liquidity creation by its assets and test whether this index predicts when a state first started to liberalize its interstate banking restrictions. We experiment with different lags and report the results with lags of 1 to 3 years in Table 2. The dependent variable is either the binary interstate bank deregulation indicator, INTER, or the average across banks in a state-year of one of the three measures of the exposure of a bank to interstate deregulation. We control for the set of state characteristics used in Kroszner and Strahan (1999): gross state product per capita, state unemployment rate, small firm share in the state, small bank share in the state, capital ratio of small banks relative to large banks, relative size of insurance in states where banks can sell insurance, relative size of insurance in states where banks cannot sell insurance, an indicator for unit banking law, an indicator for one party control in the state, and share of state government controlled by Democrats. Table 2 shows that liquidity creation does not predict the timing of regulatory reforms. Table 2 provides only the results for the main liquidity measure (LIQUIDITY_CREATION_CAT), and Supplementary Material Table IA2 reports that these results hold when examining the other three liquidity creation measures.

III. Empirical Results

This section presents results on the impact of a bank's exposure to the entry of banks from other states due to interstate bank deregulation on liquidity creation. We organize the section into three parts. As a preliminary examination, we

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TABLE 2

Bank Deregulation and Lagged Liquidity Creation

Table 2 presents ordinary least squares regressions of bank regulatory reforms on lagged values of category-based liquidity creation and other potential predictors of regulatory reforms. The sample consists of state-year observations from 1984 to 2006 and excludes states that deregulated in or before 1984. The variable STATE_WEIGHTED_LIQUIDITY_CREATION_CAT is calculated by aggregating LIQUIDITY_CREATION_CAT across banks within a state and weighting each bank by the proportion of the total assets held by its subsidiaries and branches in that state. The Appendix provides detailed variable definitions. Following Kroszner and Strahan (1999), the following control variables are included but not reported in the table: gross state product per capita, state unemployment rate, small firm share in the state, small bank share in the state, capital ratio of small banks relative to large banks, relative size of insurance in states where banks can sell insurance, relative size of insurance in states where banks cannot sell insurance, an indicator for unit banking law, an indicator for one party control in the state, and share of state government controlled by Democrats. We also include state and year dummy variables. Standard errors are clustered at the state level and appear in parentheses.

	Dependent Variable			
Variable	INTER 1	COMPETITION_ DISTANCE_ WEIGHTED 2	COMPETITION_ DISTANCE_ WEIGHTED_2 3	COMPETITION_ DISTANCE_ WEIGHTED_3 4
STATE_WEIGHTED_LIQUIDITY_ CREATION_CAT (1 year before deregulation)	0.1202 (0.1158)	0.0703 (0.1113)	0.0744 (0.1130)	0.0795 (0.1059)
STATE_WEIGHTED_LIQUIDITY_ CREATION_CAT (2 years before deregulation)	0.1421 (0.1329)	0.1648 (0.1280)	0.1519 (0.1294)	0.1527 (0.1233)
STATE_WEIGHTED_LIQUIDITY_ CREATION_CAT (3 years before deregulation)	−0.2408 (0.1929)	−0.1966 (0.1861)	−0.2164 (0.1881)	−0.1750 (0.1783)
Controls	Yes	Yes	Yes	Yes
N	637	637	637	637
R^2	0.2873	0.3833	0.3190	0.4157

first assess the relation between interstate bank deregulation and liquidity creation using the traditional measure of interstate bank deregulation, INTER, and our three bank-specific regulatory-induced competition measures without controlling for state-year effects. These preliminary analyses help motivate our identification strategy. Second, using the methodology described Section II.E, we evaluate the impact of regulatory-induced competition on liquidity creation. Third, we examine one specific mechanism suggested by theory for how competition influences liquidity creation.

A. Preliminaries: Liquidity Creation and Traditional Deregulation Measure

We use a modified version of equation (7) to examine the relation between liquidity creation and both INTER and bank-specific measures of regulatory-induced competition. The first modification is that we use INTER_{jt}, which equals 1 for state j in the years after it first allows interstate banks from any other state to establish subsidiaries within its borders, and 0 otherwise, rather than examining each banks' exposure to interstate bank deregulation (COMPETITION_{ijt}). The second modification is that we do not control for state-year fixed effects. We cannot control for state-year effects when examining INTER because it does not differ across banks within a state. For consistency, we do not use state-year effects in any of the Table 3 regressions, including those with COMPETITION_{ijt}. Consequently, we control for year and bank fixed effects, along with the vector, X_{ijt}, of time-varying bank traits (i.e., ln(SIZE), CAPITAL_ASSET_RATIO, and MULTIBANK_HOLDING_COMPANY). In Panels A and B, we use category-based and maturity-based liquidity creation measures, respectively, as

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TABLE 3

Liquidity Creation and Bank Competition Without State-Year Effects

Table 3 presents results of the effects of bank deregulation on liquidity creation measures. In Panel A, the dependent variables are one of the two category-based liquidity creation measures. In Panel B, the dependent variables are one of the maturity-based liquidity creation measures. The key explanatory variable is the traditional state-level deregulation indicator in columns 1 and 5 and one of the three bank-level deregulation indicators in the other columns. The sample consists of bank-year observations from 1984 through 2006. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Category-Based Liquidity Creation

	Dependent Variable							
	LIQUIDITY_CREATION_CAT				LIQUIDITY_CREATION_CAT_2			
Variable	1	2	3	4	5	6	7	8
INTER	0.0049				0.0040			
	(0.0115)				(0.0102)			
COMPETITION_DISTANCE_WEIGHTED		0.0065				0.0051		
		(0.0131)				(0.0117)		
COMPETITION_DISTANCE_WEIGHTED_2			0.0052				0.0040	
			(0.0125)				(0.0112)	
COMPETITION_DISTANCE_WEIGHTED_3				0.0056				0.0044
				(0.0135)				(0.0120)
ln(SIZE)	0.0111*	0.0111*	0.0111*	0.0111*	0.0018	0.0019	0.0018	0.0018
	(0.0056)	(0.0055)	(0.0056)	(0.0056)	(0.0048)	(0.0048)	(0.0048)	(0.0048)
CAPITAL_ASSET_RATIO	−0.3867***	−0.3864***	−0.3867***	−0.3867***	−0.4317***	−0.4314***	−0.4317***	−0.4317***
	(0.0567)	(0.0566)	(0.0566)	(0.0566)	(0.0510)	(0.0508)	(0.0508)	(0.0509)
MULTIBANK_HOLDING_COMPANY	0.0276***	0.0276***	0.0276***	0.0276***	0.0233***	0.0233***	0.0233***	0.0233***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0026)	(0.0026)	(0.0026)	(0.0026)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8189	0.8189	0.8189	0.8189	0.8002	0.8002	0.8002	0.8002

Panel B. Maturity-Based Liquidity Creation

	Dependent Variable							
	LIQUIDITY_CREATION_MAT				LIQUIDITY_CREATION_MAT_2			
Variable	1	2	3	4	5	6	7	8
INTER	−0.0119				−0.0129			
	(0.0111)				(0.0100)			
COMPETITION_DISTANCE_WEIGHTED		−0.0125				−0.0140		
		(0.0126)				(0.0114)		
COMPETITION_DISTANCE_WEIGHTED_2			−0.0133				−0.0146	
			(0.0120)				(0.0109)	
COMPETITION_DISTANCE_WEIGHTED_3				−0.0139				−0.0153
				(0.0128)				(0.0116)
ln(SIZE)	0.0139**	0.0140**	0.0139**	0.0139**	0.0050	0.0050	0.0050	0.0050
	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0047)	(0.0047)	(0.0047)	(0.0047)
CAPITAL_ASSET_RATIO	−0.4002***	−0.4002***	−0.4004***	−0.4003***	−0.4427***	−0.4428***	−0.4430***	−0.4428***
	(0.0627)	(0.0626)	(0.0626)	(0.0626)	(0.0579)	(0.0578)	(0.0578)	(0.0578)
MULTIBANK_HOLDING_COMPANY	0.0290***	0.0290***	0.0290***	0.0290***	0.0246***	0.0246***	0.0246***	0.0246***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)	(0.0029)	(0.0029)	(0.0029)	(0.0029)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.7956	0.7956	0.7956	0.7956	0.7747	0.7747	0.7748	0.7747

dependent variables. We find that neither INTER nor COMPETITION_{ijt} enters any of the Table 3 liquidity creation regressions significantly.

These findings could reflect at least two facts. First, the intensification of competition triggered by interstate bank deregulation might not affect liquidity creation. Second, there might be omitted-variable bias. In particular, there might be an omitted third factor that is correlated with interstate bank deregulation and

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affects liquidity creation among the state's banks, confounding the ability to identify the impact of contestability on liquidity creation. One strategy for addressing omitted-variable concerns is to control for state-year fixed effects, which is what we now do.

B. Liquidity Creation, Regulatory-Induced Competition, and State-Year Fixed Effects

Tables 4 and 5 present regression results based on equation (7), where the dependent variable is either the category- or maturity-based measures of liquidity creation, and the main explanatory variable is one of the three time-varying measures of the exposure of each bank to the entry of banks from other states due to interstate bank deregulation. In Table 4, the dependent variable is one of the category-based measures of liquidity creation, and in Table 5, the dependent variables are the maturity-based measures. Identification in these analyses comes from comparing the time-varying exposure of different banks within the same state to the potential entry of banks from other states due to interstate bank deregulation.

TABLE 4

Category-Based Liquidity Creation and Bank Competition

Table 4 presents results of the effects of bank deregulation on category-based liquidity creation measures. The dependent variables are one of the two category-based liquidity creation measures, LIQUIDITY_CREATION_CAT (columns 1–3) and LIQUIDITY_CREATION_CAT_2 (columns 4–6). The main explanatory variable is one of the three bank-level deregulation indicators. The sample consists of bank-year observations from 1984 through 2006. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. *** indicates significance at the 1% level.

	Dependent Variable					
	LIQUIDITY_CREATION_CAT			LIQUIDITY_CREATION_CAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.1072***			−0.0832***		
	(0.0126)			(0.0148)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.1106***			−0.0896***	
		(0.0075)			(0.0090)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.0885***			−0.0894***
			(0.0278)			(0.0203)
ln(SIZE)	0.0126***	0.0126***	0.0125***	0.0036	0.0036	0.0036
	(0.0044)	(0.0045)	(0.0044)	(0.0039)	(0.0039)	(0.0039)
CAPITAL_ASSET_RATIO	−0.4434***	−0.4434***	−0.4427***	−0.4820***	−0.4820***	−0.4813***
	(0.0453)	(0.0453)	(0.0454)	(0.0404)	(0.0404)	(0.0404)
MULTIBANK_HOLDING_COMPANY	0.0224***	0.0224***	0.0224***	0.0186***	0.0186***	0.0185***
	(0.0022)	(0.0023)	(0.0022)	(0.0020)	(0.0020)	(0.0020)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8332	0.8332	0.8332	0.8163	0.8163	0.8163

We find that an intensification of regulatory-induced competition exerts a negative influence on liquidity creation. Each of the three measures of regulatory-induced competition enters negatively and significantly at the 1% significance level across all specifications. These findings hold when examining either category- or maturity-based measures of liquidity creation, as reported in Tables 4 and 5, respectively. The result is also robust to including or excluding the bank-level controls, as shown in Supplementary Material Tables IA1 and IA3.

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TABLE 5

Maturity-Based Liquidity Creation and Bank Competition

Table 5 presents results of the effects of bank deregulation on maturity-based liquidity creation measures. The dependent variables are one of the two maturity-based liquidity creation measures, LIQUIDITY_CREATION_MAT (columns 1–3) and LIQUIDITY_CREATION_MAT_2 (columns 4–6). The main explanatory variable is one of the three bank-level deregulation indicators. The sample consists of bank-year observations from 1984 through 2006. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. ** and *** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable					
	LIQUIDITY_CREATION_MAT			LIQUIDITY_CREATION_MAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.0946***			−0.0719***		
	(0.0162)			(0.0189)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.0947***			−0.0746***	
		(0.0153)			(0.0176)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.1468***			−0.1479***
			(0.0378)			(0.0442)
ln(SIZE)	0.0125**	0.0125**	0.0124**	0.0040	0.0040	0.0039
	(0.0044)	(0.0044)	(0.0044)	(0.0038)	(0.0038)	(0.0038)
CAPITAL_ASSET_RATIO	−0.4799***	−0.4799***	−0.4786***	−0.5161***	−0.5161***	−0.5148***
	(0.0529)	(0.0529)	(0.0529)	(0.0481)	(0.0481)	(0.0481)
MULTIBANK_HOLDING_COMPANY	0.0233***	0.0233***	0.0233***	0.0194***	0.0194***	0.0194***
	(0.0021)	(0.0021)	(0.0021)	(0.0019)	(0.0019)	(0.0019)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8165	0.8165	0.8166	0.7986	0.7986	0.7986

The coefficient estimates indicate that the impact of a regulatory-induced intensification of competition on liquidity creation is economically large. For example, consider the coefficient estimates from the regression in which the dependent variable is LIQUIDITY_CREATION_CAT, the regulatory-induced competition measure is COMPETITION_DISTANCE_WEIGHTED, and the regression includes bank-level controls (i.e., column 1 of Table 4). The coefficient estimate on competition (−0.1072) suggests that a 1-standard-deviation increase (0.32) in COMPETITION_DISTANCE_WEIGHTED is associated with a reduction in LIQUIDITY_CREATION_CAT of about 0.034. This is large, as the median, mean, and standard deviation of LIQUIDITY_CREATION_CAT are about 0.20. To put this estimated impact in dollar terms for an average size bank, consider a bank i) that does not face any competition through interstate banking, so that COMPETITION_DISTANCE_WEIGHTED equals 0, and ii) is of average size, so that its total assets equals $627 million. Now, let the bank experience a regulatory-induced shock to competition of 0.32, for example, the sample standard deviation of COMPETITION_DISTANCE_WEIGHTED. The coefficient estimates from column 1 of Table 4 suggest that liquidity creation will fall by $21 million.

With respect to the bank-level control variables, the results in Table 4 indicate that banks with a higher CAPITAL_ASSET_RATIO tend to create less liquidity. This is consistent with the financial fragility view that additional bank capital makes the bank's capital structure less fragile so that banks are reluctant to commit to monitoring, which in turn impedes the bank's ability to create liquidity. It is also consistent with the prediction of the capital crowd-out theory

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that a higher capital ratio may reduce liquidity creation through crowding out deposits, as deposits are liquid and bank equity is illiquid (see, e.g., Gorton and Winton (2017)). Because our sample is dominated by smaller banks, our results on the CAPITAL_ASSET_RATIO in Tables 4 and 5 are consistent with Berger and Bouwman (2009), who find that capital has a negative effect on liquidity creation in small banks. We also find that liquidity creation is positively related to MULTIBANK_HOLDING_COMPANY, suggesting that banks belonging to multiple bank holding companies (BHCs) create more liquidity. This finding is consistent with the argument that banks within the same BHC serve as an internal capital market to cross-provide liquidity in times of financial distress (Berger and Bouwman (2009)), including distress triggered by competition.

There might be concerns that we are simply capturing a shift from smaller to larger banks when states deregulate. This could arise because we analyze liquidity creation per bank asset. Thus, liquidity creation could fall among many small banks with very few of the state's banking assets and rise among the few largest banks with most of the state's assets. To address this concern, we weight banks by their total assets and repeat the analyses. As shown in Supplementary Material Table IA4, the results continue to hold.

We next explore the relation between the regulatory reform measures and the three components of the category-based indicator of liquidity creation. Table 1 reports that the majority of bank liquidity creation occurs through liability-side items. Specifically, the means (standard deviations) of ASSET_SIDE_LC, LIABILITY_SIDE_LC, and OFF_BALANCE_SHEET_LC are −0.02 (0.14), 0.18 (0.06), and 0.04 (0.04), respectively. Table 6 reports the results of using these asset-side, liability-side, and off-balance-sheet liquidity creation measures as dependent variables in equation (7). For each of the three dependent variables, we separately examine the three regulatory-induced measures of competition. We report the results while including the bank-specific controls, but the results are robust to excluding them.

Overall, the findings in Table 6 indicate that the negative effect of regulatory-induced competition on liquidity creation is largely accounted for by asset-side liquidity creation. As shown, each of the three regulatory-induced competition indicators is associated with a statistically significant and economically large drop in asset-side liquidity creation. In terms of magnitudes, a 1-standard-deviation increase (0.32) in COMPETITION_DISTANCE_WEIGHTED, for example, induces a reduction in ASSET_SIDE_LC of 3.3 ($= 0.1046 \times 0.32$) percentage points. The relations between regulatory-induced competition and both LIABILITY_SIDE_LC and OFF_BALANCE_SHEET_LC are weaker in terms of statistical and economic significance. Specifically, one of the three competition measures (COMPETITION_DISTANCE_WEIGHTED_3) does not enter the LIABILITY_SIDE_LC or OFF_BALANCE_SHEET_LC regressions statistically significantly. For the other two competition measures, the economic impact is small. For example, a 1-standard-deviation increase (0.32) in COMPETITION_DISTANCE_WEIGHTED induces an increase in LIABILITY_SIDE_LC of 0.8 ($= 0.0237 \times 0.32$) percentage points and a decline in OFF_BALANCE_SHEET_LC of 0.7 ($= 0.0233 \times 0.32$) percentage points.

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TABLE 6

Decomposition of Category-Based Liquidity Creation

Table 6 presents results of the effects of banking deregulations on asset-side, liability-side, and off-balance-sheet category-based liquidity creation. The sample consists of bank-year observations from 1984 through 2006. The dependent variables in columns 1–3, 4–6, and 7–9 are ASSET_SIDE_LC, LIABILITY_SIDE_LC, and OFF_BALANCE_SHEET_LC, respectively. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. ** and *** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable								
	ASSET_SIDE_LC			LIABILITY_SIDE_LC			OFF_BALANCE_SHEET_LC		
Variable	1	2	3	4	5	6	7	8	9
COMPETITION_DISTANCE_WEIGHTED	−0.1046***			0.0237***			−0.0233**		
	(0.0197)			(0.0078)			(0.0083)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.1160***			0.0279***			−0.0208***	
		(0.0097)			(0.0057)			(0.0062)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.1053***			0.0191			−0.0001
			(0.0207)			(0.0168)			(0.0115)
ln(SIZE)	0.0184***	0.0184***	0.0184***	−0.0154***	−0.0154***	−0.0154***	0.0083***	0.0083***	0.0083***
	(0.0037)	(0.0038)	(0.0037)	(0.0019)	(0.0019)	(0.0019)	(0.0010)	(0.0010)	(0.0010)
CAPITAL_ASSET_RATIO	−0.0938**	−0.0938**	−0.0929**	−0.3693***	−0.3693***	−0.3695***	0.0361***	0.0361***	0.0360***
	(0.0363)	(0.0363)	(0.0364)	(0.0226)	(0.0226)	(0.0225)	(0.0090)	(0.0090)	(0.0090)
MULTIBANK_HOLDING_COMPANY	0.0186***	0.0186***	0.0186***	−0.0002	−0.0002	−0.0002	0.0039***	0.0039***	0.0039***
	(0.0022)	(0.0023)	(0.0022)	(0.0008)	(0.0008)	(0.0008)	(0.0004)	(0.0004)	(0.0004)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.7938	0.7938	0.7938	0.8272	0.8272	0.8272	0.7783	0.7783	0.7783

We conclude this subsection by describing several additional robustness tests. First, because many corporate policies might be determined at the BHC level, we repeat the regressions using data on BHCs, not on individual banks. The information on BHCs is obtained from the consolidated balance sheets and income statements for holding companies that are provided by the Federal Reserve Bank of Chicago since the third quarter of 1986. We define a banking institution as an ultimate BHC if it owns, but is not owned by, other banking institutions, with at least 50% ownership of the subsidiaries' equity stake (Goetz et al. (2013), Jiang et al. (2016)). We are able to identify 834 BHCs headquartered in the United States (excluding South Dakota and Delaware) between 1986 and 2006.

To construct BHC-level measures of liquidity creation, we aggregate the bank-level liquidity creation measures to the BHC level by weighting each bank's liquidity creation by its proportion of assets within the BHC. Specifically, we take each bank i located in state j within each BHC h headquartered in state w during period t and aggregate as follows:

$$\text{BHC_LIQUIDITY_CREATION}_{hwt} = \sum_{i \in h} \text{LIQUIDITY_CREATION}_{ijt} \times P_{iht}, \tag{8}$$

where P_{iht} is the proportion of assets of each bank i within BHC h in period t relative to the total assets of BHC h, and state w and state j may or may not be the same.

We also compute the regulatory-induced competition measures at the BHC level. We do this by aggregating the bank-level competition measures to the BHC level. Specifically, we first identify each bank i in state j that belongs to BHC h headquartered in state w in period t, and we then calculate BHC h's

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distance-weighted regulatory-induced competition measure as follows:

$$\text{BHC_COMPETITION_DISTANCE_WEIGHTED}_{hwt} = \sum_{i \in h} \text{COMPETITION_DISTANCE_WEIGHTED}_{ijt} \times P_{iht}. \tag{9}$$

We use the same method described in equations (4) and (5) to construct the other two BHC-specific measures: BHC_COMPETITION_DISTANCE_WEIGHTED_2 and BHC_COMPETITION_DISTANCE_WEIGHTED_3. Supplementary Material Table IA5 presents the BHC-level analysis for both the category- and maturity-based measures of liquidity creations. Consistent with the bank-level results, BHC-level competition enters negatively and significantly across all specifications.

The second sensitivity check examines three alternative measures of a bank's exposure to the entry of banks from other states. First, instead of using the distance between each bank and each county of a non-home state weighted by that county's total bank assets, we use the distance from the bank to the county of the city with the greatest number of banks in the non-home state as defined in equation (6). As discussed in Section II.C, we create two additional measures by weighting the summation of the inverse of distance by the number of banks in state k or by bank total assets in state k. Panels A and B of Supplementary Material Table IA4 show that all of the results hold with these three alternative time-varying and bank-specific competition measures.

Finally, there might be concerns that the results are driven only by banks expanding through mergers and acquisitions or being purchased by other banks. Thus, we repeat the analyses while restricting the sample to banks that are not part of any mergers or acquisitions. They are still subject to changes in competitive pressures, as their markets become more contestable due to interstate bank deregulation. When restricting the sample to these banks, as shown in Supplementary Material Table IA6, we find that all of the results hold, and indeed, the estimated effects are larger in absolute value terms with this subsample of banks.

C. An Extension

So far, we have found that when there is an intensification of a bank's exposure to banks headquartered in other states due to interstate bank deregulation, it tends to materially reduce liquidity creation. We have not, however, explored the heterogeneous response of banks to intensification of competition triggered by interstate bank deregulation. As discussed in the Introduction, one line of theoretical research stresses that by squeezing profit margins, competition reduces the willingness of banks to absorb more risk through liquidity creation. If competition affects liquidity creation through this channel, the negative impact of competition on liquidity creation should be smaller among more profitable banks that can better absorb liquidity risk.

To assess this profitability channel, we expand our baseline regression specification and include the interaction between HIGH_PROFIT and the regulatory-induced competition measures. To construct HIGH_PROFIT, we begin by calculating PROFITABILITY, which equals the net interest margin, that is, the ratio of net interest income to total assets. We then set HIGH_PROFIT equal to 1

if PROFITABILITY is greater than the sample median in the initial sample period (1984–1986).[3] The profitability view predicts a positive relation between liquidity creation and the interaction between competition and profitability.

As shown in Panels A and B of Table 7, where Panel A (Panel B) reports the results using category-based (maturity-based) liquidity creation as the dependent variable, the estimates are consistent with the profitability view, as the estimated coefficients on the interaction between regulatory-induced competition and profitability enter positively and significantly in all specifications. We continue to find that regulatory-induced competition enters negatively and significantly. If one interprets HIGH_PROFIT as positively associated with the risk absorption capacity of banks, our findings imply that regulatory-induced competition reduces liquidity creation less when banks have a greater capacity to absorb risk.

TABLE 7

Liquidity Creation and Bank Competition: Differentiating by Profitability

Table 7 presents results on the relation between liquidity creation and bank competition, while differentiating by bank profitability. The sample consists of bank-year observations from 1984 through 2006. In Panel A, the dependent variables are the category-based liquidity creation measures. In Panel B, the dependent variables are one of the maturity-based liquidity creation measures. PROFITABILITY is defined as net interest income over total assets, and lagged 1 year before the observation of the dependent variable. HIGH_PROFIT is defined as a dummy variable that equals 1 if in the initial period (1984–1986) a bank's median profitability is greater than the sample median profitability, and 0 otherwise. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. ** and *** indicate significance at the 5% and 1% levels, respectively.

Panel A. Category-Based Liquidity Creation

	Dependent Variable					
	LIQUIDITY_CREATION_CAT			LIQUIDITY_CREATION_CAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.1206***			−0.0954***		
	(0.0073)			(0.0093)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.1240***			−0.1018***	
		(0.0049)			(0.0045)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.0262			−0.0330
			(0.0690)			(0.0526)
COMPETITION_DISTANCE_WEIGHTED × HIGH_PROFIT	0.0121**			0.0100**		
	(0.0045)			(0.0040)		
COMPETITION_DISTANCE_WEIGHTED_2 × HIGH_PROFIT		0.0120**			0.0101**	
		(0.0043)			(0.0039)	
COMPETITION_DISTANCE_WEIGHTED_3 × HIGH_PROFIT			0.0123***			0.0102**
			(0.0039)			(0.0038)
PROFITABILITY	5.2537***	5.2506***	5.2526***	4.7450***	4.7435***	4.7437***
	(0.2135)	(0.2131)	(0.2138)	(0.2022)	(0.2020)	(0.2024)
ln(SIZE)	0.0131***	0.0131***	0.0131***	0.0041	0.0041	0.0041
	(0.0044)	(0.0045)	(0.0040)	(0.0038)	(0.0041)	(0.0035)
CAPITAL_ASSET_RATIO	−0.4635***	−0.4636***	−0.4634***	−0.5003***	−0.5004***	−0.5002***
	(0.0537)	(0.0537)	(0.0537)	(0.0480)	(0.0480)	(0.0480)
MULTIBANK_HOLDING_COMPANY	0.0197***	0.0197***	0.0197***	0.0161***	0.0161***	0.0161***
	(0.0022)	(0.0023)	(0.0021)	(0.0020)	(0.0022)	(0.0019)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8497	0.8497	0.8349	0.8349	0.8349	0.8349

(continued on next page)

[3] All of the results hold if we instead set HIGH_PROFIT equal to 1 if a bank's PROFITABILITY is greater than the sample median over the entire sample period, and 0 otherwise.

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TABLE 7 (continued)
Liquidity Creation and Bank Competition: Differentiating by Profitability

Panel B. Maturity-Based Liquidity Creation

	Dependent Variable					
	LIQUIDITY_CREATION_MAT			LIQUIDITY_CREATION_MAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.1079*** (0.0118)			−0.0839*** (0.0149)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.1080*** (0.0119)			−0.0867*** (0.0140)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.0856** (0.0339)			−0.0921*** (0.0235)
COMPETITION_DISTANCE_WEIGHTED × HIGH_PROFIT	0.0141*** (0.0035)			0.0114*** (0.0034)		
COMPETITION_DISTANCE_WEIGHTED_2 × HIGH_PROFIT		0.0135*** (0.0034)			0.0110*** (0.0033)	
COMPETITION_DISTANCE_WEIGHTED_3 × HIGH_PROFIT			0.0146*** (0.0036)			0.0118*** (0.0035)
PROFITABILITY	5.1914*** (0.2233)	5.1852*** (0.2231)	5.1901*** (0.2235)	4.7146*** (0.2140)	4.7102*** (0.2140)	4.7134*** (0.2142)
ln(SIZE)	0.0130*** (0.0042)	0.0130*** (0.0043)	0.0130*** (0.0042)	0.0044 (0.0036)	0.0044 (0.0038)	0.0044 (0.0036)
CAPITAL_ASSET_RATIO	−0.4995*** (0.0614)	−0.4997*** (0.0615)	−0.4988*** (0.0615)	−0.5341*** (0.0558)	−0.5343*** (0.0559)	−0.5334*** (0.0559)
MULTIBANK_HOLDING_COMPANY	0.0206*** (0.0022)	0.0206*** (0.0024)	0.0206*** (0.0019)	0.0169*** (0.0020)	0.0169*** (0.0023)	0.0169*** (0.0017)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8323	0.8323	0.8323	0.8155	0.8155	0.8155

Similarly, interstate bank deregulation may squeeze the profit margins of smaller banks more than larger banks. To the extent that smaller banks are generally less efficient than larger banks due to scale economies, the intensification of competition triggered by interstate bank deregulation and entry of large out-of-state banks through mergers and acquisition has an especially adverse effect on the risk-absorption capacity of small banks. From this perspective, therefore, the negative impact of competition on liquidity creation should be stronger among small banks. To test this size effect, we include SMALL_SIZE along with its interaction with the regulatory-induced competition measures in equation (7), where SMALL_SIZE equals 1 if a bank's GROSS_TOTAL_ASSETS are smaller than the sample median during the entire sample period, and 0 otherwise. If this interaction term enters with a negative coefficient, it would be consistent with the view that in response to an intensification of competition, liquidity creation falls more among small banks.

The estimates reported in Panels A and B of Table 8 are broadly consistent with the size effects view, where Panel A (Panel B) reports the results using category-based (maturity-based) liquidity creation as the dependent variable. First, consistent with the findings in Tables 4–7, the regulatory-induced measures of competition enter negatively and significantly, confirming that interstate bank deregulation reduces liquidity creation. Second, the interaction terms of interstate

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TABLE 8
Liquidity Creation and Bank Competition: Differentiating by Bank Size

Table 8 presents results for the relation between liquidity creation and bank competition, while differentiating by bank size. The sample consists of bank-year observations from 1984 through 2006. In Panel A, the dependent variables are the category-based liquidity creation measures. In Panel B, the dependent variables are one of the maturity-based liquidity creation measures. SMALL_SIZE is an indicator variable equal to 1 if a bank's GROSS_TOTAL_ASSETS are smaller than the sample median over the entire period, and 0 otherwise. The control variables ln(SIZE) and CAPITAL_ASSET_RATIO are lagged 1 year. The Appendix provides variable definitions. Standard errors are heteroscedasticity consistent, 2-way clustered at the state-year level, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Category-Based Liquidity Creation

	Dependent Variable					
	LIQUIDITY_CREATION_CAT			LIQUIDITY_CREATION_CAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.1072***			−0.0833***		
	(0.0123)			(0.0147)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.1109***			−0.0897***	
		(0.0074)			(0.0090)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.0869***			−0.0887***
			(0.0279)			(0.0202)
COMPETITION_DISTANCE_WEIGHTED × SMALL_SIZE	−0.0142***			−0.0059		
	(0.0048)			(0.0037)		
COMPETITION_DISTANCE_WEIGHTED_2 × SMALL_SIZE		−0.0127**			−0.0049	
		(0.0047)			(0.0037)	
COMPETITION_DISTANCE_WEIGHTED_3 × SMALL_SIZE			−0.0161***			−0.0072*
			(0.0050)			(0.0038)
ln(SIZE)	0.0116**	0.0118**	0.0114**	0.0032	0.0033	0.0031
	(0.0046)	(0.0047)	(0.0046)	(0.0040)	(0.0041)	(0.0040)
CAPITAL_ASSET_RATIO	−0.4463***	−0.4458***	−0.4459***	−0.4832***	−0.4830***	−0.4827***
	(0.0456)	(0.0456)	(0.0456)	(0.0405)	(0.0405)	(0.0406)
MULTIBANK_HOLDING_COMPANY	0.0224***	0.0224***	0.0223***	0.0185***	0.0185***	0.0185***
	(0.0022)	(0.0025)	(0.0022)	(0.0019)	(0.0022)	(0.0019)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8333	0.8332	0.8333	0.8163	0.8163	0.8163

Panel B. Maturity-Based Liquidity Creation

	Dependent Variable					
	LIQUIDITY_CREATION_MAT			LIQUIDITY_CREATION_MAT_2		
Variable	1	2	3	4	5	6
COMPETITION_DISTANCE_WEIGHTED	−0.0946***			−0.0719***		
	(0.0155)			(0.0186)		
COMPETITION_DISTANCE_WEIGHTED_2		−0.0952***			−0.0749***	
		(0.0145)			(0.0171)	
COMPETITION_DISTANCE_WEIGHTED_3			−0.1446***			−0.1464***
			(0.0382)			(0.0442)
COMPETITION_DISTANCE_WEIGHTED × SMALL_SIZE	−0.0216***			−0.0139***		
	(0.0055)			(0.0046)		
COMPETITION_DISTANCE_WEIGHTED_2 × SMALL_SIZE		−0.0202***			−0.0130**	
		(0.0055)			(0.0047)	
COMPETITION_DISTANCE_WEIGHTED_3 × SMALL_SIZE			−0.0235***			−0.0152***
			(0.0056)			(0.0046)
ln(SIZE)	0.0110**	0.0113**	0.0109**	0.0030	0.0032	0.0029
	(0.0045)	(0.0045)	(0.0045)	(0.0039)	(0.0039)	(0.0039)
CAPITAL_ASSET_RATIO	−0.4843***	−0.4838***	−0.4833***	−0.5190***	−0.5186***	−0.5179***
	(0.0534)	(0.0534)	(0.0534)	(0.0485)	(0.0485)	(0.0485)
MULTIBANK_HOLDING_COMPANY	0.0232***	0.0232***	0.0232***	0.0193***	0.0193***	0.0193***
	(0.0021)	(0.0021)	(0.0021)	(0.0018)	(0.0019)	(0.0018)
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	192,564	192,564	192,564	192,564	192,564	192,564
R^2	0.8168	0.8167	0.8168	0.7987	0.7987	0.7988

bank deregulation and SMALL_SIZE enter negatively and significantly (except for columns 4–5 in Panel A).

IV. Conclusion

In this article, we evaluate how the intensification of a bank's exposure to competition from banks headquartered in other states due to interstate bank deregulation affects liquidity creation. To do this, we employ a novel approach to measuring the time-varying exposure of (almost every) commercial bank in the United States to the entry of banks from other states due to interstate bank deregulation. We use this as a bank-specific, time-varying measure of regulatory-induced competition.

The results are consistent with the view that an intensification of competition exerts a negative effect on liquidity creation per bank asset. This finding is robust to using different measures of liquidity creation and different measures of the contestability of banking markets, including or excluding time-varying bank characteristics, and controlling for state-year and bank fixed effects.

Appendix. Variable Definitions

Liquidity Creation Measures

LIQUIDITY_CREATION_CAT: The construction of this measure follows a 3-step procedure: First, classify all bank balance sheet and off-balance-sheet activities as liquid, semi-liquid, or illiquid. Second, assign a weight of $1/2$ to both illiquid assets and liquid liabilities and guarantees; a weight of $-1/2$ to liquid assets, equity, liquid guarantees and derivatives, and illiquid liabilities; and a weight of 0 to semi-liquid assets, liabilities, and guarantees. Third, combine the activities as classified in the first step and as weighted in the second step to construct the liquidity creation measures. In classifying bank activities other than loans, we use both product category and maturity information. For loans, we use the category classifications for this category-based liquidity creation measure. LIQUIDITY_CREATION_CAT is scaled by GROSS_TOTAL_ASSETS.

LIQUIDITY_CREATION_CAT_2: The construction of this measure is the same as for LIQUIDITY_CREATION_CAT except that all off-balance-sheet activities are excluded. We also scale by GROSS_TOTAL_ASSETS.

LIQUIDITY_CREATION_MAT: The construction of this measure is the same as for LIQUIDITY_CREATION_CAT, except that we use the maturity classification for loans. Details of loan classification can be found in the definitions for ASSET_SIDE_LC, LIABILITY_SIDE_LC, and OFF_BALANCE_SHEET_LC.

LIQUIDITY_CREATION_MAT_2: The construction of this measure is the same as for LIQUIDITY_CREATION_MAT, except that all off-balance-sheet activities are excluded.

ASSET_SIDE_LC: This measure equals illiquid assets minus liquid assets, where liquid assets include cash and due from other institutions, all securities regardless of maturity, trading assets, and federal funds sold, and illiquid assets include the following depending on different liquidity creation measures:

LIQUIDITY_CREATION_CAT: commercial real estate loans, loans to finance agricultural production, commercial and industrial loans, other loans, and lease financing receivables;

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LIQUIDITY_CREATION_MAT: all loans and leases with a remaining maturity longer than 1 year;

LIQUIDITY_CREATION_CAT and LIQUIDITY_CREATION_MAT: other real estate owned, customers' liability on banker's acceptances, investment in unconsolidated subsidiaries, intangible assets, premises, and other assets.

LIABILITY_SIDE_LC: This measure equals liquid liabilities minus illiquid liabilities, where illiquid liabilities include transactions deposits, savings deposits, overnight federal funds purchased, and trading liabilities, and liquid liabilities include bank's liability on bankers' acceptances, subordinated debt, other liabilities, and equity.

OFF_BALANCE_SHEET_LC: This measure equals the total of illiquid off-balance-sheet items (including unused commitments, net standby letters of credit, commercial and similar letters of credit, and all other off-balance-sheet liabilities) minus the total of liquid off-balance-sheet items (including net participations acquired, interest rate derivatives, foreign exchange derivatives, and equity and commodity derivatives).

Competition Measures

INTER: Dummy variable equal to 1 if the bank holding company (BHC) is headquartered in a state that has deregulated interstate banking with at least one other state, and 0 otherwise.

COMPETITION_DISTANCE_WEIGHTED: The interstate bank competitive pressure facing each commercial bank i, located in state j in period t is calculated as follows: Begin by computing a measure of the distance between each bank i located in state j in each year t and the center of banking activity in all other states (ks) whose banks are allowed to enter state j in year t due to interstate bank deregulation. Use the following 3-step procedure to identify the center of banking activity in each state k in year t: First, calculate the distance between bank i and each county c in each state k (whose banks can enter state j in year t). More specifically, measure the distance between bank i's zip code and the zip code in county c with the largest population. We use the great-circle distance based on internal points in the geographic area to get the between–zip code distance. Second, for each county c in state k in year t: i) compute the ratio of the assets of banks located in county c in state k to the total assets of banks in state k and ii) use this ratio to weight the distance between bank i and each county c within state k. Thus, we give greater weight to counties with more bank assets. Third, sum these weighted distances between bank i and each county c in state k to obtain a measure of the distance between bank i and the center of banking activity in state k in year t to get $\text{SYNTHETIC_DISTANCE}_{ikt}$. Then, compute measures of the regulatory-induced competitive pressures facing each bank i in each year t by summing the inverse of $\text{SYNTHETIC_DISTANCE}_{ikt}$ across all states k whose banks can enter bank i's home state j in year t and taking the natural logarithm of this summation. This measure is normalized between 0 and 1.

COMPETITION_DISTANCE_WEIGHTED_2: The construction of this measure is the same as COMPETITION_DISTANCE_WEIGHTED except in the final step, we sum the inverse of $\text{SYNTHETIC_DISTANCE}_{ikt}$ across all states k whose banks can enter bank i's home state j in year t weighted by the number of banks in the other state, and take the natural logarithm of this summation. This measure is also normalized between 0 and 1.

COMPETITION_DISTANCE_WEIGHTED_3: The construction of this measure is the same as COMPETITION_DISTANCE_WEIGHTED except in the final step, we sum the inverse of $\text{SYNTHETIC_DISTANCE}_{ikt}$ across all states k whose banks can enter bank i's home state j in year t weighted by the total assets of banks in the other state,

and taking the natural logarithm of this summation. This measure is also normalized between 0 and 1.

Control Variables

ln(SIZE): Natural logarithm of GROSS_TOTAL_ASSETS in thousands of dollars in year$t-1$. Amounts are adjusted in real 2014 dollars using the implicit GDP price deflator.

CAPITAL_ASSET_RATIO: Ratio of book value of equity over GROSS_TOTAL_ASSETS in year $t-1$.

GROSS_TOTAL_ASSETS: Total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Amounts are adjusted in real 2014 dollars using the implicit GDP price deflator.

MULTIBANK_HOLDING_COMPANY: Dummy variable equal to 1 if a commercial bank has been part of a multibank holding company in the any of the past 3 years, or 0 otherwise; or dummy variable equal to 1 if a BHC is a multibank holding company, and 0 otherwise.

HIGH_PROFIT: Dummy variable equal to 1 if in the initial period (1984–1986) a bank's median profitability is greater than the sample median profitability, and 0 otherwise. Profitability is calculated as the ratio of net interest income over total assets in year $t-1$.

SMALL_SIZE: Dummy variable equal to 1 if a bank's GROSS_TOTAL_ASSETS are smaller than the sample median over the entire period, and 0 otherwise.

Supplementary Material

Supplementary Material for this article is available at https://doi.org/10.1017/S0022109018000820.

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