Bank Liquidity Creation

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Although the modern theory of financial intermediation portrays liquidity creation as an essential role of banks, comprehensive measures of bank liquidity creation do not exist. We construct four measures and apply them to data on U.S. banks from 1993-2003. We find that bank liquidity creation increased every year and exceeded $2.8 trillion in 2003. Large banks, multibank holding company members, retail banks, and recently merged banks create the most liquidity. Bank liquidity creation is also positively correlated with bank value. Testing recent theories, we find that bank capital has a positive (negative) effect on liquidity creation for large (small) banks.

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1. Introduction

According to the modern theory on financial intermediation, banks exist because they perform two central roles in the economy – they create liquidity and they transform risk.[1] Analyses of banks' role in creating liquidity and thereby spurring economic growth have a long tradition, dating back to Adam Smith (1776).[2] Modern reincarnations of the idea that liquidity creation is central to banking appear most prominently in the formal analyses in Bryant (1980) and Diamond and Dybvig (1983). These theories argue that banks create liquidity on the balance sheet by financing relatively illiquid assets with relatively liquid liabilities. Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002) suggest that banks also create liquidity off the balance sheet through loan commitments and similar claims to liquid funds. Banks' role as risk transformers is also well-documented. A vast literature has emerged on bank risk taking and prudential regulation, supervision, and market discipline to control risk-taking behavior. According to the risk transformation theories, banks transform risk by issuing riskless deposits to finance risky loans (e.g., Diamond 1984, Ramakrishnan and Thakor 1984). Risk transformation may coincide with liquidity creation, as for example, when banks issue riskless liquid deposits to finance risky illiquid loans. However, liquidity creation and risk transformation do not move in perfect tandem – the amount of liquidity created may vary considerably for a given amount of risk transformed. It is therefore essential to study both roles.

Most of the empirical literature has focused on banks' role as risk transformers, not on their role as liquidity creators. Consequently, although creating liquidity is an essential role of banks, comprehensive empirical measures of bank liquidity creation are conspicuously absent, making it difficult to address numerous questions of research and policy interest. How much liquidity does the banking sector create? How has bank liquidity creation changed over time? How does it vary in the cross-section? Which banks create the most and least liquidity? What are the value implications of bank liquidity creation? Moreover, without measures of liquidity creation in hand, it is not possible to examine policy-relevant issues such as the effect of bank capital on bank liquidity creation.

Our main goals here are three-fold. Our first goal is to develop measures of bank liquidity creation. We create four such measures that differ in how off-balance sheet activities are treated and how loans are

[1] These two roles are often jointly referred to as banks' qualitative asset transformation (QAT) function (see, e.g., Bhattacharya and Thakor 1993).

[2] Smith (book II, chapter II, 1776) highlights the importance of liquidity creation by banks and describes how it helped commerce in Scotland. In particular, he notes: "That the trade and industry of Scotland, however, have increased very considerably during this period, and that the banks have contributed a good deal to this increase, cannot be doubted."

classified. Our second goal is to use these measures to gain a deeper insight into banks' role as liquidity creators by addressing the questions highlighted above. Specifically, we explore how much liquidity banks create, how liquidity creation has changed over time, how it varies in the cross-section, which banks create the most and least liquidity, and how liquidity creation is related to bank value. We do this by applying our liquidity creation measures to data on virtually all U.S. banks over 1993-2003, by splitting the data in various ways (by bank size, bank holding company status, wholesale versus retail orientation, and merger status), by contrasting the top 25% and bottom 25% of liquidity creators in each size class, and by examining the correlations between liquidity creation and bank value. Our third goal is to use our liquidity creation measures to examine the policy-relevant issue mentioned above – the effect of bank capital on bank liquidity creation. Some recent theories predict that bank capital reduces bank liquidity creation, while others predict that capital makes banks more capable of absorbing risk and thereby allows them to create more liquidity. We develop economic intuition about the types of banks for which these opposing effects may dominate, and test the effects of capital on liquidity creation predicted by the theories.

To construct our liquidity creation measures, we use a three-step procedure. In Step 1, we classify all bank assets, liabilities, equity, and off-balance sheet activities as liquid, semi-liquid, or illiquid. We do this 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 in order to meet these liquidity demands. Our use of just three liquidity classifications (liquid, semi-liquid, and illiquid) is a necessary simplification – any finer distinctions would have to be made rather arbitrarily. In Step 2, we assign weights to the activities classified in Step 1. The weights are consistent with the theory – maximum (i.e., dollar-for-dollar) liquidity is created when illiquid assets are transformed into liquid liabilities and maximum liquidity is destroyed when liquid assets are transformed into illiquid liabilities or equity. In Step 3, we construct four liquidity creation measures by combining the activities as classified in Step 1 and as weighted in Step 2 in different ways. The measures classify all activities other than loans by both product category and maturity but – due to data limitations – classify loans based either on category ("cat") or on maturity ("mat"). To assess how much liquidity banks create on the balance sheet versus off the balance sheet, we alternatively include off-balance sheet activities ("fat") or exclude them ("nonfat"). We thus construct liquidity creation measures based on the four combinations, "cat fat," "mat fat," "cat nonfat," and "mat nonfat." As explained in more detail below, "cat fat" is our preferred measure.

When we apply our measures to the data, we find that the U.S. banking industry created $2.843 trillion in liquidity in 2003 using our preferred "cat fat" measure.[3] This equals 39% of bank gross total assets or GTA (total assets plus allowance for loan and lease losses and the allocated transfer risk reserve) and is 4.56 times the overall level of bank equity capital, suggesting that the industry creates approximately $4.56 of liquidity per $1 of capital. To provide further perspective on liquidity creation relative to bank size, we note that bank liquidity creation equals 70% of gross loans and 58% of total deposits.

Liquidity creation has grown dramatically over time – it increased every year and virtually doubled between 1993 and 2003 based on our preferred "cat fat" measure. Our results are fairly similar when we calculate liquidity creation using our "mat fat" measure that classifies loans based on maturity instead of category. This evidence contradicts the notion that the role of banks in creating liquidity has declined due to the development of capital markets. Results based on our "nonfat" measures reveal that the banking sector only creates about half of its liquidity on the balance sheet, highlighting the importance of liquidity created off the balance sheet as in Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002).

Liquidity creation differs considerably among large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion), and small banks (GTA up to $1 billion) (measured in real 2003 dollars). We split our sample by bank size because size differences among banks are substantial and various empirical studies have shown that components of liquidity creation vary greatly by bank size. Based on our preferred "cat fat" measure, large banks are responsible for 81% of industry liquidity creation, while comprising only 2% of the sample observations. All size classes generate substantial portions of their liquidity off the balance sheet, but the fraction is much higher for large banks. All size classes increased liquidity creation in real terms over the sample period. While large banks showed the greatest growth in the dollar value of liquidity creation, small banks had the greatest growth in liquidity creation divided by GTA, equity, loans, and deposits.

Liquidity creation also varies with several key bank characteristics. It is starkly different for banks split by bank holding company status, wholesale versus retail orientation, and merger status. Based on our preferred "cat fat" measure, banks that are members of a multibank holding company, have a retail orientation, and engaged in M&A activity during the prior three years created most of the banking industry's overall liquidity. These banks also showed the strongest growth in liquidity creation over time.

[3] All liquidity creation measures in the paper are as of December 31 of a given year.

Liquidity creation is also positively linked with value. We examine the value implications of liquidity creation by focusing on listed independent banks and banks that are part of a listed bank holding company. We find that banks and bank holding companies that create more liquidity have significantly higher market-to-book and price-earnings ratios.

Turning to the theories on the relationship between bank capital and liquidity creation, some recent contributions suggest that bank capital may impede liquidity creation by making the bank's capital structure less fragile (e.g., Diamond and Rajan 2000, 2001). A fragile capital structure encourages the bank to commit to monitoring its borrowers, and hence allows it to extend loans. Additional equity capital makes it harder for the less-fragile bank to commit to monitoring, which in turn hampers the bank's ability to create liquidity. Capital may also reduce liquidity creation because it "crowds out" deposits (e.g., Gorton and Winton 2000). For expositional ease, we refer to this first set of theories jointly as the "financial fragility-crowding out" hypothesis of capital.

An alternative view – related to banks' role as risk transformers – is that higher capital improves banks' ability to absorb risk and hence their ability to create liquidity. Liquidity creation exposes banks to risk – the greater the liquidity created, the greater are the likelihood and severity of losses associated with having to dispose of illiquid assets to meet customers' liquidity demands (Diamond and Dybvig 1983, Allen and Santomero 1998, Allen and Gale 2003). Capital absorbs risk and expands banks' risk-bearing capacity (e.g., Bhattacharya and Thakor 1993, Repullo 2004, Von Thadden 2004, Coval and Thakor forthcoming), so higher capital ratios may allow banks to create more liquidity. We refer to this second set of theories collectively as the "risk absorption" hypothesis, while recognizing that the theories together rather than separately produce this prediction.

Both the "financial fragility-crowding out" and the "risk absorption" effects may apply in differing degrees to liquidity creation by different banks, so the relevant empirical issue is discovering the circumstances under which each effect empirically dominates. We address this by testing whether the net effect of bank capital on liquidity creation is negative or positive for different sizes of banks. We expect that the "financial fragility-crowding out" effect is likely to be relatively strong for small banks. One reason is that, compared with large banks, small banks deal more with entrepreneurial-type small businesses, where the close monitoring highlighted in Diamond and Rajan (2000, 2001) is important. A second reason is that small banks tend to raise funds locally, so that capital may "crowd out" deposits (as in Gorton and Winton

2000), whereas this effect is likely to be relatively weak for large banks that can more easily access funding from national or international capital markets. In contrast, the "risk absorption" effect is likely to be stronger for large banks because they are generally subject to greater regulatory scrutiny and market discipline than small banks, which may affect their capacity to absorb risk. Since medium banks fall somewhere in the middle, we expect that either effect may dominate for these banks or that these effects may simply offset each other.

We test the net effect of capital on liquidity creation by regressing the dollar amount of bank liquidity creation (calculated using our measures and normalized by GTA) for each bank-year observation on the bank's lagged equity capital ratio and a number of control variables. We use three-year lagged average values of capital and the other exogenous variables to mitigate potential endogeneity problems, as lagged values represent earlier bank decisions. We run the tests separately for large, medium, and small banks to allow for the possibility that capital may affect these banks differently.

We find strong empirical support for both hypotheses. For large banks, capital has a positive effect on liquidity, consistent with the expected empirical dominance of the "risk absorption" effect. In sharp contrast, for small banks, the effect of capital on liquidity creation is negative, consistent with the expected dominance of the "financial fragility-crowding out" effect for these institutions. The two effects appear to cancel each other out for medium banks, yielding insignificant results for this size class. To understand more deeply why these differences exist, we also examine the impact of capital on the individual components of liquidity creation and find substantial differences across size classes in which components are affected by capital.

We test the robustness of our regression results in various ways. First, since the effect of capital on liquidity creation may be driven by banks' role as risk transformers rather than their role as liquidity creators, we rerun our regressions controlling for bank risk. Second, our liquidity creation measures are based on the ease, cost, and time for customers to obtain liquid funds, and the ease, cost, and time for banks to dispose of obligations to provide liquid funds. Since buyers of loan commitments and letters of credit may not fully draw down committed funds, we construct an alternative measure that incorporates the likelihood with which these customers request actual funds. Third, we construct a liquidity creation measure that uses an alternative way to establishing which assets are securitizable. Fourth, to address a potential concern that our dependent variable (liquidity creation) includes current equity capital with a weight of -½ while our key independent variable is the lagged equity capital ratio, we construct an alternative liquidity creation measure that does not include current capital. Fifth, since the theories sometimes use a broader definition of equity that includes other funds that cannot easily run on banks, we use an alternative capital ratio that includes equity plus other financial instruments such as long-term subordinated debt (total capital specified in the Basel I capital standards). Sixth, because the intertemporal and cross-sectional liquidity creation patterns are so different for banks split by holding company status, wholesale versus retail orientation, and merger status, we rerun our regressions for these subsamples. Seventh, we recognize the potential endogeneity of capital in our regressions – capital and liquidity creation may be jointly determined – and that our use of three-year lagged average values of capital may not be sufficient to mitigate such endogeneity concerns. To address this, we use an instrumental variable approach with three instruments for lagged capital (effective state income tax rate, dividend payer dummy, bank holding company dummy). The results of our robustness checks reinforce our main findings: the effect of capital on liquidity creation is positive for large banks, insignificant for medium banks, and negative for small banks.

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 describes the construction of our liquidity creation measures. Section 4 discusses our panel data set of U.S. banks over 1993-2003, shows how bank liquidity creation varies over time and in the cross-section, contrasts high and low liquidity creators, and explores the value implications of bank liquidity creation. Section 5 outlines our regression framework and Section 6 contains our regression results. Section 7 addresses robustness issues, and Section 8 concludes.

2. Literature review

In this section, we provide a brief review of the literature to place our paper in context. Our research is related to three strands of literature: the measurement of bank liquidity creation; the theories of the effect of capital on liquidity creation; and the empirical studies of capital and liquidity creation. We discuss these three literatures in turn.

2.1. Measurement of bank liquidity creation

We are aware of only one paper that measures bank liquidity creation. Deep and Schaefer (2004) construct a measure of liquidity transformation and apply it to data on the 200 largest U.S. banks from 1997 to 2001. They define the liquidity transformation gap or "LT gap" as (liquid liabilities – liquid assets) / total assets.

They consider all loans with maturity of one year or less to be liquid, and they explicitly exclude loan commitments and other off-balance sheet activities because of their contingent nature. They find that the LT gap is about 20% of total assets on average for their sample of large banks. The authors conclude that these banks do not appear to create much liquidity, and run some tests to explain this finding, examining the roles of insured deposits, credit risk, and loan commitments.

The LT gap is an intuitive step forward, but we do not believe it is sufficiently comprehensive. To illustrate, we highlight a few key differences between their approach and ours. First, we include virtually all commercial banks and compare findings for large, medium, and small banks, rather than including only the largest institutions. Second, our preferred "cat fat" liquidity creation measure classifies loans by category ("cat"), rather than by maturity. We treat business loans as illiquid regardless of their maturity because banks generally cannot easily dispose of them to meet liquidity needs, but we treat residential mortgages and consumer loans as semi-liquid because these loans can often be securitized and sold to meet demands for liquid funds. Third, our preferred measure includes off-balance sheet activities ("fat"), consistent with the arguments in Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002). In our less-preferred liquidity measures, we classify loans by maturity ("mat") and exclude off-balance sheet activities ("nonfat") to determine the effects of these assumptions. As discussed in Section 3 below, the LT gap is conceptually close to our "mat nonfat" measure.

2.2. Bank liquidity creation and capital: the theories

In the initial theories on financial intermediary existence highlighted in the Introduction, banks do not hold any capital. Bank capital was introduced in subsequent papers, which argue that the primary reason why banks hold capital is to absorb risk – including the risk of liquidity crunches, protection against bank runs, and various other risks, most importantly credit risk. Although the reason why banks hold capital is motivated by their risk transformation role, recent theories suggest that bank capital may also affect banks' ability to create liquidity. These theories produce opposing predictions on the link between capital and liquidity creation.

One set of theories – which we refer to collectively as the "financial fragility-crowding out" hypothesis – predicts that higher capital reduces liquidity creation. Diamond and Rajan (2000, 2001) focus on financial fragility. They model a relationship bank that raises funds from investors to provide financing to an entrepreneur. The entrepreneur may withhold effort, which reduces the amount of bank financing attainable. More importantly, the bank may also withhold effort, which limits the bank's ability to raise financing. A deposit contract mitigates the bank's holdup problem – because depositors can run on the bank if the bank threatens to withhold effort – and therefore maximizes liquidity creation. Providers of capital cannot run on the bank, which limits their willingness to provide funds, and hence reduces liquidity creation. Thus, the higher a bank's capital ratio, the less liquidity it will create.[4] Note that the negative effect of capital on liquidity creation as suggested by Diamond and Rajan (2000, 2001) depends crucially on deposit insurance coverage being incomplete. If deposit insurance were complete, depositors have no incentive to run on the bank, and a deposit contract does not mitigate the bank's holdup problem.

Gorton and Winton (2000) show how a higher capital ratio may reduce liquidity creation through the crowding out of deposits. They argue that deposits are more effective liquidity hedges for investors than investments in equity capital. Thus, higher capital ratios shift investors' funds from relatively liquid deposits to relatively illiquid bank capital, reducing overall liquidity for investors.[5]

Under the alternative "risk absorption" hypothesis, which is directly linked to the risk-transformation role of banks, higher capital enhances banks' ability to create liquidity. This insight is based on two strands of the literature. One strand consists of papers that argue that liquidity creation exposes banks to risk (e.g., Diamond and Dybvig 1983, Allen and Santomero 1998, Allen and Gale 2004). The more liquidity that is created, the greater is the likelihood and severity of losses associated with having to dispose of illiquid assets to meet the liquidity demands of customers. The second strand consists of papers that posit that bank capital absorbs risk and expands banks' risk-bearing capacity (e.g., Bhattacharya and Thakor 1993, Repullo 2004, Von Thadden 2004, Coval and Thakor forthcoming). Combining these two strands yields the prediction that higher capital ratios may allow banks to create more liquidity.

Finally, we point out one additional contribution of some of the recent theories. The standard view of liquidity creation is that banks create liquidity by transforming illiquid assets into liquid liabilities. Diamond and Rajan (2000, 2001) and Gorton and Winton (2000) show, however, that banks can create more or less liquidity by simply changing their funding mix on the liability side. Thakor (1996) shows that capital

[4] Diamond and Rajan's model builds on Calomiris and Kahn's (1991) argument that the ability of uninsured depositors to run on the bank in the event of expected wealth expropriation by bank managers is an important disciplining mechanism. A related idea is proposed by Flannery (1994), who focuses on the disciplining effect of depositors' ability to withdraw funds on demand, and thus prevent the bank from expropriating depositor wealth through excessively risky investments.

[5] Gorton and Winton's (2000) analysis suggests that even if equity holders did not reduce funding to the bank in Diamond-Rajan (2000), there would be less liquidity creation with a higher capital ratio.

may also affect banks' asset portfolio composition, thereby affecting liquidity creation through a change in the asset mix. Our measures of liquidity creation incorporate these insights – they explicitly recognize that liquidity creation by banks occurs through changes in the mixes on both sides of the balance sheet as well as through off-balance sheet activities.

2.3. Bank capital and liquidity creation: the existing empirical evidence

Some empirical studies examine issues related to liquidity creation, but do not focus on the role of capital. Kashyap, Rajan, and Stein (2002) provide empirical evidence of synergies between commitment lending and deposits, consistent with their model. Gatev, Schuermann, and Strahan (2005) and Gatev and Strahan (forthcoming) find that banks have a comparative advantage in hedging liquidity risk in the economy because banks experience deposit inflows following a market crisis or liquidity shock that allow them to have more funds to provide the additional loans drawn down under commitments at such times. Pennacchi (2006) confirms the existence of synergies between loan commitments and deposit taking, but finds that such synergies do not hold prior to the creation of FDIC deposit insurance. These studies do not focus on the role of bank capital, but they do in some cases include the capital ratios in regressions of some liquidity creation components, yielding ambiguous predictions related to the effect of capital on liquidity creation.[6]

The credit crunch literature tests hypotheses about bank capital and one type of liquidity creation, usually business lending or real estate lending, during the early 1990s when bank lending declined significantly. Several studies find that the decline in bank capital ratios arising from loan losses in the late 1980s and early 1990s contributed significantly to the reduction in lending (e.g., Peek and Rosengren 1995). This is consistent with a positive relationship between capital and liquidity creation during a period of distress. In the early 1990s, U.S. regulators also imposed new leverage requirements, as well as the Basel I risk-based capital standards. Most of the studies found that the leverage requirements contributed to the decline in lending, consistent with the hypothesis of a negative effect of bank capital on liquidity creation (e.g., Berger and Udell 1994, Hancock, Laing, and Wilcox 1995, Peek and Rosengren 1995), and generally concluded that the risk-based capital requirements had little effect on lending. Unfortunately, the unusual combination of several major changes in bank capital regulation and a recession makes it difficult to parse the different effects and draw general conclusions.

[6] For example, Gatev and Strahan (forthcoming) find that a higher bank capital ratio tends to be followed by greater loans and deposits (which may increase liquidity creation) and greater liquid assets and non-deposit liabilities (which may reduce liquidity creation).

Finally, some studies of bank lending behavior include capital ratios, but focus on other issues. For example, Berger and Udell (2004) study procyclical lending and find positive, statistically significant effects of capital on the annual growth of business loans. Holod and Peek (2004) examine monetary policy effects and find that the capital ratio has significant positive effects on loan growth. Gambacorta and Mistrulli (2004) use Italian data and find that the impact of monetary policy and GDP shocks on bank lending depends on bank capitalization.

Thus, the existing empirical literature sheds relatively little light on the relationship between bank capital and liquidity creation. Some studies test the liquidity creation theories, but do not focus on the role of bank capital. Others include capital in regressions, but specify only limited components of liquidity creation, and often under unusual circumstances. Our empirical analysis uses a significantly different approach.

3. Construction of our liquidity creation measures

In this section, we pursue our first main goal of developing measures of liquidity creation. We explain the construction of our four liquidity creation measures and clarify which is our preferred measure. We also show how Deep and Schaefer's (2004) liquidity transformation measure can be viewed as a special case of one of our measures.

We construct the liquidity creation measures using a three-step procedure. In Step 1, we classify all bank balance sheet and off-balance sheet activities as liquid, semi-liquid, or illiquid. In Step 2, we assign weights to the activities classified in Step 1. In Step 3, we combine the activities as classified in Step 1 and as weighted in Step 2 in different ways to construct our four liquidity creation measures, "cat fat," "mat fat," "cat nonfat," and "mat nonfat." The first page of Table 1 illustrates Steps 1 and 2 and the second page of Table 1 illustrates Step 3. We discuss these steps in turn.

3.1. Step 1 – Classifying activities as liquid, semi-liquid, or illiquid

In Step 1, we classify all assets as liquid, semi-liquid, or illiquid based on the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds to meet customers' demands. We similarly classify bank liabilities plus equity as liquid, semi-liquid, or illiquid, based on the ease, cost, and time for customers to obtain liquid funds from the bank. Off-balance sheet guarantees and derivatives are classified consistently with treatments of functionally similar on-balance sheet items.[7]

Ideally, we would use information on both product category and maturity to classify all bank activities. For example, as noted above, business loans are generally more illiquid than residential mortgages and consumer loans, as the latter can often be more easily securitized and sold to meet liquidity demands. Within each category, shorter maturity items are more liquid than longer maturity items because they self-liquidate without effort or cost sooner.

For bank activities other than loans, Call Reports provide sufficient detail on category and maturity, so our classifications incorporate both aspects. Unfortunately, this is not the case for loans. Call Reports split loans into various loan categories and into different maturity classes, but do not provide maturity information for individual loan categories. We therefore either classify loans entirely by category ("cat") or entirely by maturity ("mat"). Thus, our "cat" and "mat" liquidity creation measures constructed below classify loans either by category or maturity, but in all cases incorporate both key characteristics for other bank activities.

Assets

- Classifying loans:
    - *category ("cat"):* For the "cat" measures of liquidity creation, we classify business loans and leases as illiquid assets, because these items typically can not be sold quickly without incurring a major loss. Residential mortgages and consumer loans are generally relatively easy to securitize, and loans to depositories and governments are likely to be comparatively easy to sell or otherwise disposed of because the counterparties are relatively large and informationally transparent. We classify these loan categories as semi-liquid assets.[8]
    - *maturity ("mat"):* As discussed above, shorter maturity items are more liquid than longer maturity items because they self-liquidate sooner. We therefore classify all short-term loans of up to one year as semi-liquid and all long-term loans of over one year as illiquid for the "mat" measures.
- Classifying assets other than loans: We classify premises and investments in unconsolidated subsidiaries as illiquid assets, because typically these items can not be sold quickly without incurring a major loss. We classify cash, securities, and other marketable assets that the bank can use to meet liquidity needs

[7] In a robustness check, we use an alternative approach to measuring the liquidity contribution of some of these items (see Section 7.2).
[8] In a robustness check, we use a different method to establishing which loans are securitizable (see Section 7.3).

quickly without incurring major losses as liquid assets.

Liabilities plus equity

- Classifying liabilities: We count funds that can be quickly withdrawn without penalty by customers – such as transactions deposits, savings deposits, and overnight federal funds purchased – as liquid liabilities. We classify deposits that can be withdrawn with slightly more difficulty or penalty as semi-liquid. This includes all time deposits regardless of maturity. We do not differentiate between short-term and long-term time deposits since all time deposits can be borrowed against with a penalty regardless of maturity. We also classify as semi-liquid the balance sheet item 'other borrowed money,' which contains other short- and medium-maturities with terms longer than overnight, such as term federal funds, repurchase agreements, and borrowings from Federal Reserve Banks and Federal Home Loan Banks. We classify long-term liabilities that generally cannot be withdrawn easily or quickly, such as subordinated debt, as illiquid.
- Classifying equity: We classify equity as illiquid because investors can not demand liquid funds from the bank and the maturity is very long. Although the equity of some banks is publicly traded and may be sold relatively easily, the investors are able to retrieve liquid funds through the capital market, not from the bank. Thus, while traded equity may be liquid from an individual investor's point of view, such liquidity is created by the capital market, rather than by the bank, the focus of this paper.

Off-balance sheet activities

- Classifying guarantees: We classify loan commitments and letters of credit as illiquid guarantees. These items are functionally similar to on-balance sheet business loans in that they are obligations that are illiquid from the point of view of the bank – except in very unusual circumstances, the bank must provide the funds to the customer upon demand.[9] As well, in most cases, the bank cannot sell or participate these items. We classify net credit derivatives (i.e., the amount guaranteed minus the beneficiary amount) and net securities lent (i.e., the amount lent minus the amount borrowed) as semi-liquid guarantees since they can potentially be sold or participated, analogous to semi-liquid on-balance sheet residential mortgages and consumer loans. We classify net participations acquired from other institutions (i.e., the amount acquired minus the amount conveyed to others) as liquid guarantees, since

[9] We acknowledge that banks could dispose of loan commitments by invoking the material adverse change (MAC) clause and the customer would not have access to the funds. However, failing to honor loan commitments is generally very costly since it may create legal liabilities and reputational losses, and is therefore rarely done.

they are functionally similar to on-balance sheet liquid securities.

- Classifying derivatives: We classify all derivatives (other than credit derivatives which we classify above as guarantees) – interest rate, foreign exchange, and equity and commodity derivatives – as liquid because they can be bought and sold easily and are functionally similar to liquid securities. We focus on the fair values of these derivatives, which measure how much liquidity the bank is providing to or absorbing from the public.

3.2. Step 2 – Assigning weights to the activities classified in Step 1

In Step 2, we assign weights to all of the bank activities classified in Step 1. That is, we assign weights to the classes of liquid, semi-liquid, and illiquid assets, liabilities plus equity, and off-balance sheet guarantees and derivatives shown on the first page of Table 1.

We base the weights on liquidity creation theory. According to this theory, banks create liquidity on the balance sheet when they transform illiquid assets into liquid liabilities. An intuition for this is that banks create liquidity because they hold illiquid items in place of the nonbank public and give the public liquid items. We therefore apply positive weights to both illiquid assets and liquid liabilities, so when liquid liabilities – such as transactions deposits – are used to finance illiquid assets – such as business loans – liquidity is created. Following similar logic, we apply negative weights to liquid assets, illiquid liabilities, and equity, so that when illiquid liabilities or equity is used to finance a dollar of liquid assets – such as treasury securities – liquidity is destroyed. Note that the negative weight on equity only captures the direct effect of capital on liquidity creation. Any indirect (positive or negative) effects on liquidity creation are attributed to the individual items that are affected. For example, if capital allows banks to extend more illiquid loans, this positive effect is captured by the positive weight applied to illiquid loans multiplied by the associated dollar increase in loans.

The magnitudes of the weights are based on simple dollar-for-dollar adding-up constraints, so that \$1 of liquidity is created when banks transform \$1 of illiquid assets into \$1 of liquid liabilities. Similarly, we require that \$1 of liquidity is destroyed when banks transform \$1 of liquid assets into \$1 of illiquid liabilities. Based on these constraints, we assign a weight of ½ to both illiquid assets and liquid liabilities and a weight of -½ to both liquid assets and illiquid liabilities. Thus, when a dollar of liquid liabilities – such as transactions deposits – is used to finance a dollar of illiquid assets – such as business loans – liquidity creation equals ½ * \$1 + ½ * \$1 = \$1. In this case, maximum liquidity (\$1) is created. Intuitively, the weight of ½ applies to both illiquid assets and liquid liabilities, since the amount of liquidity created is only "half" determined by the source or use of the funds alone – both are needed to create liquidity. Similarly, when a dollar of illiquid liabilities or equity is used to finance a dollar of liquid assets – such as treasury securities – liquidity creation equals -½ * $1 + -½ * $1 = -$1, as maximum liquidity is destroyed.

Using these weights, banks do not create liquidity when they use liquid liabilities (e.g., transaction deposits) to finance liquid assets (e.g., treasuries), or when they use illiquid liabilities or equity to finance illiquid assets (e.g., business loans). In these cases, banks hold items of approximately the same liquidity as they give to the nonbank public.

We apply the intermediate weight of 0 to semi-liquid assets and liabilities, based on the assumption that semi-liquid activities fall halfway between liquid and illiquid activities. Thus, the use of time deposits to fund residential mortgages would yield approximately zero net liquidity creation, since the ease, cost, and time with which the time depositors may access their funds early and demand liquidity roughly equals the ease, cost, and time with which the bank can securitize and sell the mortgage to provide the funds.

We apply weights to off-balance sheet guarantees and derivatives using the same principles, consistent with the functional similarities to on-balance sheet items discussed in Step 1. For example, illiquid off-balance sheet guarantees – such as loan commitments – are functionally similar to on-balance sheet illiquid loans – such as business loans – in that they are obligations of the bank to provide funds that cannot be easily sold or participated. We therefore apply the same weight of ½ to illiquid guarantees as we do to illiquid assets. Similarly, we apply the same weight of 0 to semi-liquid guarantees as we do to functionally similar semi-liquid on-balance sheet assets, and we apply the same weight of -½ to liquid guarantees that we do to functionally similar on-balance sheet liquid assets.

Analogously, the gross fair values of derivatives are assigned the same weight of -½ as on-balance sheet liquid assets.[10] As discussed in Step 1, these contracts can be bought and sold easily and are functionally similar to liquid securities. Like securities, derivatives with gross positive fair values reduce bank liquidity creation as the bank effectively holds a valuable liquid asset in place of the public. Derivatives with gross negative fair values increase bank liquidity creation as the bank effectively holds a

[10] Fair values reported in Call Reports are as in FASB 133: the amount at which an asset (liability) could be bought (incurred) or sold (settled) in a current transaction between willing parties, that is, other than in a forced or liquidation sale. The fair value equals the quoted market price, if available. If a quoted market price is not available, the estimate of fair value is based on the best information available in the circumstances.

negatively-valued liquid asset in place of the public. Since the Call Reports assign positive values to contracts with gross positive fair values and negative values to those with gross negative fair values, we capture these opposing effects on liquidity creation by simply applying weights of -½ to the dollar values of both.[11,12]

We arrange the columns on the first page of Table 1 such that all the bank activities that contribute to liquidity creation are on the left, all those that subtract from liquidity creation are on the right, and all those with an approximately neutral effect on liquidity creation are in the center. Thus, those that are assigned a weight of ½ – illiquid assets, liquid liabilities, and illiquid guarantees – are grouped together on the left. Liquid assets, illiquid liabilities plus equity, and liquid guarantees and derivatives – which are assigned a weight of -½ – are grouped on the right. Finally, semi-liquid assets, liabilities, and guarantees with 0 weights are grouped in the center.

3.3. Step 3 – Constructing liquidity creation measures by combining activities as classified in Step 1 and as weighted in Step 2

In Step 3, we combine the activities as classified and weighted in Step 1 and Step 2, respectively, in different ways to construct our liquidity creation measures. The measures are similar in that they all classify activities other than loans using information on product category and maturity, as discussed in Step 1. The measures differ in that we alternatively classify loans by category or maturity ("cat" versus "mat"), and – to gauge how much liquidity banks create off the balance sheet – alternatively include or exclude off-balance sheet activities ("fat" versus "nonfat"). Hence, we have four measures: "cat fat," "cat nonfat," "mat fat," and "mat nonfat." The formulas are shown on the second page of Table 1. On that page, we again arrange the bank activities that add to liquidity creation on the left, those that subtract from liquidity creation on the right, and those with an approximately neutral effect in the center. For all measures, we multiply the weights of ½, -½, or 0, respectively, times the dollar amounts of the corresponding bank activities and add the weighted dollar amounts to arrive at the total dollar value of liquidity creation at a particular bank. We sum across all banks

[11] While the gross positive and negative fair values of derivatives are often quite substantial, most banks operate with nearly matched books, so these values tend to offset each other, yielding a small net contribution to liquidity creation.

[12] The seminal papers say nothing about the role that derivatives play in the liquidity creation function of banks. Rather, derivatives play a more major role in the risk-transformation function of banks. Nonetheless, it is important to consider the contribution of all balance sheet and off-balance sheet activities to liquidity creation in our measurement, whether or not the theory has spoken on these activities. Thus, for measurement purposes, we take the gross fair values of liquid derivatives and assign a weight consistent with that of a functionally similar on-balance sheet item, which in this case is liquid securities.

to obtain the total dollar value of liquidity created by the entire industry.

We recognize that our liquidity creation measures are rough approximations. We classify all bank activities as liquid, semi-liquid, or illiquid, and use three weights, ½, 0, and -½. Differences in liquidity obviously exist within each of the three classifications, but the data generally do not allow for much finer distinctions, and there are no other unambiguous weights to apply. The use of ½, -½, and 0 are the clear demarcations of full liquidity, full illiquidity, and neutrality, respectively, and no other clear choices present themselves.

Note that Deep and Schaefer's (2004) LT gap measure is conceptually close to our "mat nonfat" measure and may be viewed as a special case of it. If we classified all assets and liabilities as either liquid or illiquid (none as semi-liquid) using maturities, excluded off-balance sheet activities, and specified assets (A) rather than gross total assets (GTA), our "mat nonfat" formula reduces to their formula.[13]

We next discuss why we consider "cat fat" to be our preferred liquidity creation measure. First, we argue that the "cat" measures are preferred to the "mat" measures primarily because what matters to liquidity creation on the asset side is the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds. The ability to securitize loans is closer to this concept than the time until self-liquidation – for example, a 30-year residential mortgage may be securitized relatively quickly even though it is a long-term loan. Second, we argue that the "fat" measures are preferred to the "nonfat" measures because off-balance sheet activities provide liquidity in functionally similar ways to on-balance sheet items. Hence, "cat fat" is our preferred measure.

4. Bank liquidity creation over time, in the cross section, and value implications

In this section, we pursue our second main goal of gaining a deeper insight into banks' role as liquidity creators by applying our four measures to data on the U.S. banking sector. We first describe how we construct our sample. We then measure how much liquidity banks create. We next explore the time-series and cross-sectional variation in bank liquidity creation, and examine the characteristics of banks that create the most and least liquidity over the sample period. In all of these analyses, we split the sample by size. In addition, we divide the data by bank holding company status, wholesale versus retail orientation, and merger

[13] Applying these changes, our formula becomes [½*illiquid assets – ½* liquid assets + ½* liquid liabilities – ½*illiquid liabilities – ½*equity] / A = [½*(A – liquid assets) – ½*liquid assets + ½*(liquid liabilities) – ½*(A – liquid liabilities)] / A = [liquid liabilities – liquid assets] / A, which is their LT gap measure.

status. Finally, we explore the value implications of bank liquidity creation.

4.1. Sample description

Our sample includes almost all commercial banks in the U.S. from 1993 to 2003. To ensure that our sample only contains 'true,' viable commercial banks, we impose the following restrictions. We exclude a bank if it: 1) has no loans outstanding; 2) has no commercial real estate or commercial and industrial loans outstanding; 3) has zero deposits; 4) has zero or negative equity capital in the current or lagged year; 5) is very small (average lagged GTA below $25 million);[14] 6) has unused commitments exceeding four times GTA; 7) resembles a thrift (residential real estate loans exceeding 50% of GTA); or 8) is classified by the Federal Reserve as a credit card bank or has consumer loans exceeding 50% of GTA.[15] We also eliminate 0.7% of all bank-year observations because some of the exogenous variables used in our regression analysis are missing.

For all the banks in our sample, we obtain annual Call Report data as of December 31. We do not use quarterly data because the quality of such data is not considered to be as good as year-end data. In particular, loan loss provisions, which affect capital, are usually considered to be more accurate in the December Call Reports. Furthermore, lending and various other bank activities show seasonal patterns, which would force us to deseasonalize the data to examine the relationship between bank capital and liquidity creation, the third goal of this paper. In addition, while quarterly data would quadruple the sample size, this would likely only add a small amount of variation to the data, as bank portfolios change slowly over time.

In all of our analyses, we split the sample by size for several reasons. First, there are many empirical studies which show that size matters when studying components of bank liquidity creation. For example, Berger, Miller, Petersen, Rajan, and Stein (2005) argue that large and small banks have comparative advantages in handling different types of credit information, and hence will extend different types of loans. They split their sample by bank size, and indeed find that large and small banks make very different loans. Furthermore, Kashyap, Rajan, and Stein (2002) provide empirical evidence that the relationship between

[14] Banks with lagged average GTA below $25 million are not likely to be viable commercial banks in equilibrium. This exclusion reduced the sample size by 12,726 bank-year observations (from 96,953 to 84,227), but does not materially affect our findings. Inclusion of these banks increases liquidity creation of small banks by only 0.1% ($0.0027 trillion) in 2003 based on our "cat fat" measure, and leaves our regression results qualitatively unchanged.

[15] The Federal Reserve Board defines a credit card bank as having: 1) 50% or more of its total assets in the form of loans to individuals; 2) 90% or more of its loans to individuals in the form of credit card outstandings; and 3) $200 million or more in loans to individuals.

commitments and transactions deposits is different for banks in different size classes. Second, although there are no theories which argue that the effect of capital on liquidity creation depends on bank size, we expect that the net effect of capital on liquidity creation would be different for banks of different size classes. As shown in Sections 6 and 7, we find confirming empirical evidence. Thus, we split the sample into large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion), and small banks (GTA up to $1 billion).[16]

Our definition of small banks with GTA of up to $1 billion conforms to the usual notion of "community banks" that primarily create liquidity by transforming locally-generated deposits into local loans on the balance sheet.[17] We divide the remaining observations roughly in half with the $3 billion cutoff for GTA. Large banks with GTA over $3 billion create much more liquidity off the balance sheet than small banks. Large institutions also tend to generate and disperse on-balance sheet funds on more national and international bases than small institutions. Medium banks with GTA between $1 billion and $3 billion tend to have portfolios that mix some of the characteristics of small and large banks.

Our sample contains 84,227 bank-year observations: 1,810 bank-year observations for large banks, 2,140 observations for medium banks, and 80,277 for small banks.

4.2. Liquidity creation over time and in the cross section for banks split by size and by bank holding company status, wholesale versus retail orientation, and merger status

We next measure how much liquidity banks create and explore how liquidity creation has changed over time and how it varies in the cross section. We initially split banks only by size, and then we also divide banks by bank holding company status, wholesale versus retail orientation, and merger status.

Table 2 Panel A shows summary statistics on bank liquidity creation based on our four measures for the entire banking sector and separately for large, medium, and small banks in 1993 and in 2003 – the first and last years of our sample period, respectively. It also shows graphs of liquidity creation over the entire sample period using the corresponding measures. As shown, due to consolidation of the banking industry, the numbers of observations of large and small banks fell by about one-quarter each, while the number of medium banks remained approximately constant. Overall, the number of banks in the sample fell by about

[16] We apply the $3 billion and $1 billion cutoffs, measured in real 2003 dollars, in each year to separate banks in our sample into large, medium, and small banks.

[17] We also tried splitting small banks into banks with GTA up to $100 million and banks with GTA $100 million - $1 billion. Since the regression results presented in Sections 6 and 7 yielded very similar results for both size classes, we decided not to pursue this finer partitioning of the data.

23% from 9,095 in 1993 to 6,968 in 2003.

We find that banks created liquidity of \$2.843 trillion in 2003 based on our preferred "cat fat" measure – which classifies loans by category and includes off-balance sheet activities – (see Table 2 Panel A).[18] Liquidity creation equals 39% of industry GTA and represents \$4.56 of liquidity per \$1 of equity capital. It is about 70% as large as gross loans and 58% as large as total deposits, which are standard asset and liability measures of bank size. Overall liquidity creation almost doubled in real terms between 1993 and 2003. As shown, liquidity creation also increased as a fraction of GTA, equity, gross loans, and total deposits, suggesting that liquidity creation grew at a faster rate than these items.

Large banks created 81% of industry liquidity at the end of the sample period, despite representing only about 2% of the sample observations. Medium and small banks generated only about 5% and 14% of industry liquidity creation as of 2003, respectively, despite their greater numbers of observations. Medium and small institutions also had slightly lower ratios of liquidity creation divided by GTA, equity, gross loans, and total deposits than large banks. As will be shown, this is because these institutions generated much less liquidity off the balance sheet. At large banks, liquidity creation doubled in real dollars, although it only rose as a fraction of GTA from 40% in 1993 to 41% in 2003. Perhaps surprisingly, small banks showed the greatest increase in liquidity creation divided by GTA, equity, gross loans, and total deposits.

As shown in the "cat fat" graph, liquidity creation based on this measure increased in every year from 1993 to 2003. This was primarily driven by large banks – medium and small banks experienced smaller, nonmonotonic increases in liquidity creation. The increase in overall liquidity creation was driven by substantial growth in illiquid assets, liquid liabilities, and illiquid guarantees, which outweighed smaller increases in liquid assets, illiquid liabilities, and equity.

Liquidity creation is almost 50% less based on our "cat nonfat" measure – which is the same as "cat fat" except for the exclusion of off-balance sheet activities. Large banks still created most of the industry's liquidity, although the percentage is lower (71% as of 2003 versus 81% based on our "cat fat" measure). As shown in the "cat nonfat" graph, liquidity creation based on this measure also increased in every year of the sample period, primarily due to increases by large banks. Liquidity creation by medium and small banks

[18] Applying the formula given in Step 3 of Table 1: Liquidity creation = ½ * illiquid assets of \$2.752 trillion + 0 * semi-liquid assets of \$1.905 trillion – ½ * liquid assets of \$2.550 trillion + ½ * liquid liabilities of \$3.718 trillion + 0 * semi-liquid liabilities of \$1.777 trillion – ½ * illiquid liabilities of \$0.370 trillion + ½ * illiquid guarantees of \$2.781 trillion + 0 * semi-liquid guarantees of \$0.782 trillion – ½ * liquid guarantees of -\$0.001 trillion – ½ * liquid derivatives of \$0.023 trillion = \$2.843 trillion.

experienced smaller, nonmonotonic increases in liquidity creation.

A comparison of liquidity creation based on the "cat fat" and "cat nonfat" measures reveals that banks create almost half of their liquidity off the balance sheet. This highlights the importance of including off-balance sheet activities. Although banks engage in a variety of off-balance sheet activities, the main drivers of off-balance sheet liquidity creation are illiquid guarantees of $2.781 trillion, in particular unused commitments ($2.426 trillion) and, to a lesser extent, net standby letters of credit ($0.287 trillion).[19] Derivatives ($0.023 trillion) are not among the major components of off-balance sheet liquidity creation. As noted in Section 3.2, while banks may have substantial derivatives portfolios, most operate with nearly matched books, so gross positive and negative fair values tend to offset each other. As an interesting side note, we also find that unused commitments, C&I commitments (a subset of unused commitments), net standby letters of credit, and commercial and similar letters of credit are all highly positively and significantly correlated with transactions deposits (ρ = 0.73, 0.81, 0.80, and 0.68, respectively), consistent with the predictions and findings of Kashyap, Rajan, and Stein (2002).

A second insight gained from comparing liquidity creation based on our "cat fat" and "cat nonfat" measures is that large, medium, and small banks create liquidity in very different ways. For example, as of 2003, unused loan commitments equal 48% of total liquidity created by large banks, while only amounting to 26% and 19% of liquidity created by medium and small banks, respectively. Commercial real estate, on the other hand, equals only 12% of total liquidity creation for large banks, while equaling 36% and 42% of liquidity creation for medium and small banks, respectively. Similarly, for large banks, transactions deposits equal only 9% of total liquidity creation, whereas the corresponding figures for medium and small banks are 15% and 31%, respectively. (Not shown for reasons of brevity.)

We now turn to liquidity creation based on our "mat" measures. Liquidity creation is the highest in all years using our "mat fat" measure – which differs from our preferred "cat fat" measure by using loan maturities in place of categories to classify loans. Treating all loans with maturity of at least one year as illiquid assets increases measured liquidity creation primarily because most residential mortgages are classified as illiquid (weight = ½). Recall that these mortgages are classified as semi-liquid (weight = 0) in the "cat fat" measure because they are relatively easy to securitize. The "mat fat" pattern of liquidity

[19] Commercial and similar letters of credit and other off-balance sheet liabilities only amounted to $0.024 trillion and $0.043 trillion, respectively.

creation over time is similar to the "cat fat" pattern. The "mat nonfat" measure – which uses loan maturities and excludes off-balance sheet activities – yields a much smaller measured liquidity creation. The "mat nonfat" liquidity creation pattern resembles the pattern of the other measures, increasing in all periods, driven by the large banks.

To understand more deeply how liquidity creation has changed over time and how it varies in the cross-section, we split banks in each size class based on three additional characteristics. First, we divide banks by bank holding company status into multibank holding company (MBHC) members, one-bank holding company (OBHC) members, and independent banks. Second, we divide banks by wholesale versus retail orientation, defined here as having below-average and above-average numbers of branches for their size class, respectively. Third, we split banks by merger status – those that did and did not engage in M&As during the prior three years. For each subsample, we show the numbers of banks in 1993 and 2003, and present graphs that highlight how liquidity creation has changed over time. For brevity, we focus on liquidity creation based on our preferred "cat fat" measure.

Table 2 Panel B contains the results. As shown on the left, the vast majority of large and medium banks are in MBHCs, while small banks are more evenly divided among the three governance structures. As the graphs make clear, MBHC members created most of overall industry liquidity creation, and these banks also experienced the greatest increase in liquidity creation. Within each size class, MBHC members also created the most liquidity.

As shown on the top right in Table 2 Panel B, most of the banks have wholesale orientation by our definition, but retail banks create most of overall industry liquidity. This result is driven by large and small banks – among medium banks, liquidity created by retail and wholesale banks is similar. As shown, liquidity creation grows in each year for both retail and wholesale banks, except for the spikes in 2002 and 2003. These spikes occur because Citibank shifted from a wholesale bank to a retail bank in 2002 and back to wholesale status in 2003.

Finally, as shown in the bottom right in Table 2 Panel B, most banks did not engage in M&As, but most of overall industry liquidity is created by recently merged institutions. This result is purely driven by large banks – among medium and small banks, institutions that did not engage in recent merger activity create more liquidity than those that did. This explains why liquidity creation by recently merged banks increased in almost every year, whereas liquidity creation remained relatively constant over the sample period for banks that did not engage in M&As.

4.3. Characteristics of banks that create the most and least liquidity

We next examine the characteristics of banks that create the most and least liquidity. In each size class, we split banks into "high liquidity creators" and "low liquidity creators" based on our preferred "cat fat" measure. We define high and low liquidity creators as those in the top 25% and bottom 25%, respectively, based on: (i) overall liquidity creation; (ii) liquidity creation divided by GTA; and (iii) liquidity creation divided by equity.

The top, middle, and bottom parts of Table 2 Panel C show the results based on overall liquidity creation, LC / GTA, and LC / EQ, respectively. Each part shows the average amount of liquidity created by high and low liquidity creators, and some key characteristics (BHC status, wholesale versus retail orientation, and merger status) of these banks.

Several findings are noteworthy. First, not surprisingly, high liquidity creators create substantially more liquidity than low liquidity creators in each size class. What may be surprising, however, is just how small the numbers are for the low liquidity creators. In particular, the bottom 25% of small banks in terms of overall liquidity creation create slightly negative liquidity. This raises the question of whether these institutions should still be considered to be banks. To address this question, it is important to recall that banks perform two central roles in the economy, liquidity creation and risk transformation. While these banks may not create liquidity, they may still provide valuable risk-transformation services, although a deeper investigation of this issue is beyond the scope of this paper.

Second, MBHC members tend to create the most liquidity in every size class by every measure of liquidity creation. In all cases, OBHC members and independent banks tend to be more prevalent among the low liquidity creators.

Third, based on overall liquidity creation, retail banks tend to be high liquidity creators in every size class. Maybe surprisingly, we find opposite results when we split banks based on liquidity creation divided by GTA and equity. One explanation may be that retail banks tend to be the largest banks in each size class. While these banks create substantial amounts of liquidity, they create far less liquidity per dollar of assets or equity. Wholesale banks tend to be low liquidity creators in every size class.

Fourth, a far more diverse picture arises when we look at banks' M&A history. Among large banks, high liquidity creators tend to be banks with recent M&A activity, while low liquidity creators are approximately evenly distributed among those that did and those that did not engage in M&As. Since most of the small banks did not engage in recent M&As, it is not surprising that among these banks, most of both the high and low liquidity creators had no recent M&A activity. However, it is clear that small banks that did engage in M&As in the prior 3 years are better represented among the high liquidity creators. The medium bank pattern falls somewhere in between the patterns for large and small banks.

4.4. Value implications of bank liquidity creation

We next investigate the value implications of bank liquidity creation. If liquidity creation is profitable and creates value for the bank's shareholders, then liquidity creation should be positively associated with the market value of the bank or its holding company. To examine this issue, we focus on banks that are individually traded or part of a traded bank holding company. For the purposes of this analysis, we include listed independent banks and OBHCs, and we aggregate the liquidity creation of all the banks in a listed MBHC. To ensure that any relationship between liquidity creation and value is likely to be due to the liquidity created by our sample banks, we exclude holding companies in which these banks account for less than 90% of holding company assets.[20] Imposing this restriction reduces our sample from 3,686 to 3,223 bank-year observations.

Since we are not aware of any theories that predict a causal link between liquidity creation and value, we focus on correlations. In particular, we present correlations between liquidity creation and value, where liquidity creation is measured by the dollar amount of liquidity creation and liquidity creation divided by GTA and equity (all calculated using our "cat fat" measure), and value is measured as the market-to-book ratio and the price-earnings ratio (based on earnings before and after extraordinary items).

Table 3 contains the results. As shown, the dollar amount of liquidity creation and liquidity creation divided by GTA and equity are all significantly positively correlated with the market-to-book ratio, with correlations between 0.115 and 0.164. The correlations with the price-earnings ratio (based on earnings before and after extraordinary items) are also all positive, but they are smaller in magnitude, and are significant in only four of six cases. These results suggest that banks that create more liquidity are valued more highly by investors.

[20] The findings are similar if we instead impose an 85% or a 95% cutoff. If we do not impose any restriction, results based on the market-to-book ratio are unchanged, but the findings based on the price-earnings ratio are somewhat weaker (significant in only two of six cases).

5. Regression framework

We next turn to our third main goal of analyzing the effect of bank capital on liquidity creation. In this section we discuss our analytical framework. In Section 6, we present our empirical results, and in Section 7, we examine the robustness of our results.

The theories suggest a causal link between capital and liquidity creation. According to the "financial fragility-crowding out" hypothesis, the effect of capital on liquidity creation is negative and according to the "risk absorption" hypothesis, the effect is positive. Recall from Section 2.2 that the negative effect of capital on liquidity creation as suggested by Diamond and Rajan (2000, 2001), i.e., the financial fragility effect, depends crucially on deposit insurance coverage being incomplete. Deposit insurance is incomplete for banks in all three of our size classes over our sample period: most banks fund themselves partly with uninsured deposits and with overnight federal funds purchased, another funding source that can run on the bank.[21]

To examine whether the "financial fragility-crowding out" effect or the "risk absorption" effect empirically dominates, we use panel data sets on large, medium, and small banks from 1993-2003. We regress the dollar amount of bank liquidity creation (calculated using our four liquidity creation measures) divided by GTA on the lagged equity capital ratio while controlling for other factors that may affect bank liquidity creation. Normalization by GTA is necessary to make the dependent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Use of dollar amounts of liquidity creation without normalization would primarily amount to a regression of bank size on capital and other exogenous variables because banks differ so greatly in size even within each size class.

Our control variables include bank size, merger and acquisition history, and local market competition and economic environment, as explained in detail below. We include bank fixed effects to account for average differences over time across banks that are not captured by the other exogenous variables and to reduce correlations across error terms. Time fixed effects are added to control for average differences in liquidity creation across years that are not captured by the other exogenous variables, and to reduce serial correlation problems. All regressions are estimated with robust standard errors, clustered by bank, to control for heteroskedasticity as well as possible correlation among observations of the same bank in different years.

[21] For example, as of 2003, large banks fund 21.4% and 7.5% of their GTA with uninsured deposits and overnight federal funds purchased, respectively. For medium banks, the corresponding figures are 24.3% and 5.7%, respectively, while for small banks, the figures are 19.8% and 2.2%, respectively.

Table 4 gives descriptions and summary statistics for the exogenous variables. All financial values are expressed in real 2003 dollars using the implicit GDP price deflator.[22] All of the exogenous variables are lagged values averaged over the three years prior to observation of the dependent variables to reduce potential endogeneity problems, as lagged values are more likely to reflect earlier decisions. The use of three-year averages, rather than a single lagged year also reduces the effects of short-term fluctuations and problems with the use of accounting data. As well, portfolio changes take time to occur and likely reflect decisions made on the basis of historical experience, so three years of data may more accurately reflect the inputs into liquidity creation decisions.[23] All of the lagged values are merger-adjusted – we collect information from the Federal Reserve Board's National Information Center (NIC) database on a bank's prior mergers and acquisitions, and use it to construct historical pro forma values.

The key exogenous variable is the lagged capital ratio. For our main analysis, we use EQRAT, the ratio of equity to GTA. Equity meets the most straightforward, narrow definition of capital as funds that cannot be easily withdrawn. GTA is the simplest measure of bank size, although it excludes off-balance sheet activities. GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve – two reserves held for potential credit losses – so that the full value of the loans financed and liquidity created by the bank on the asset side are included. In Section 7, we perform two robustness checks on the capital ratio. First, realizing that to some extent, a bank chooses its capital ratio, we use an instrumental variable approach to resolve any potential endogeneity problems. Second, we replace EQRAT with an alternative capital ratio.

To control for bank size, we include the natural log of bank size, Ln(GTA), in every regression, as well as running the regressions separately for large, medium, and small banks. The natural log is used for all of the continuous exogenous variables that may take on large values to avoid potential specification distortions, given that the dependent variables are generally in the [0,1] interval.[24]

We also control for the bank's merger and acquisition history. The D-BANK-MERGE and D-DELTA-OWN dummies indicate whether a bank was involved in a merger or acquisition over the past three years, where a merger is defined as the combination of bank charters into an institution with a single set of

[22] We obtain similar results if we express all values in real 1993 dollars.
[23] Using one-year lagged values weakens the significance of the results for large banks, but leaves our results for medium and small banks qualitatively unchanged.
[24] For example, based on our preferred "cat fat" measure, liquidity creation divided by GTA (our dependent variable) is in the [0,1] interval 90.5% of the time.

books, and an acquisition is defined as a case in which the bank's top-tier holding company changed with no change in charter status. Controlling for mergers and acquisitions is important because banks often substantially alter their lending behavior following such events.

To construct controls for local market competition and economic environment, we define the local market as the Metropolitan Statistical Area (MSA) or non-MSA county in which the offices are located.[25] For banks with offices in more than one local market, we use weighted averages across these markets, using the proportion of the bank's deposits in each of these markets as the weights.[26] To control for local market competition, we include HERF, the Herfindahl index of concentration for the market or markets in which the bank is present. We base HERF on the market shares of both banks and thrift institutions, given that thrifts compete vigorously with banks for deposits. We also include SHARE-ML, the local market share of medium and large institutions to allow for the possibility that banks of different sizes may compete differently. It is important to control for local market competition because various studies have shown that market concentration affects credit availability (e.g., Petersen and Rajan 1995) and that the loan portfolios of large and small banks are markedly different (e.g., Berger, Miller, Petersen, Rajan, and Stein 2005). Hence, competition likely affects liquidity creation through both the amount and types of loans a bank extends and the way it funds its activities.[27] To control for local market economic conditions, we include the log of population Ln(POP), the log of population density Ln(DENSITY), and income growth INC-GROWTH.

6. Regression results

In this section, we present our regression results. We first present our main results and find that capital affects liquidity creation differently for large, medium, and small banks. We then investigate why the results differ by size class using the components of liquidity creation. In all cases, we examine whether the findings are consistent with the economic intuition discussed in the Introduction. In Section 7, we conduct a number of robustness checks.

Before proceeding, we note the important distinction between the liquidity creation weight on capital and the regression coefficient on lagged capital. We assign a weight of -½ to equity when forming our

[25] In some cases, we use New England County Metropolitan Areas (NECMAs) in place of MSAs, but for convenience, we use the term MSA to cover both MSAs and NECMAs.
[26] We use shares of deposits because this is the only banking service for which geographic location is publicly available.
[27] We obtain similar regression results if we exclude the local market competition variables.

liquidity creation measures, the dependent variables in the regressions. This does not imply that when we regress the dollar amount of liquidity creation (normalized by GTA) on the lagged equity ratio, EQRAT, the coefficient on EQRAT should necessarily be negative or close to -0.5. Rather, the measured effect depends on bank behavior. For example, if banks with more lagged equity capital extend significantly more illiquid loans and hold significantly fewer liquid assets than banks with lower levels of capital, we may find a positive association between lagged capital and liquidity creation.[28]

6.1. The net effect of capital on liquidity creation for large, medium, and small banks

Panels A, B, and C of Table 5 contain the regression results for large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion), and small banks (GTA up to $1 billion), respectively. All of our regressions include the full set of control variables and have time and bank fixed effects, but the results are similar if we control only for size and include fixed effects (not shown for brevity's sake).

The results in Table 5 Panel A suggest that for large banks, the net effect of capital on liquidity creation is positive and significant when liquidity creation includes off-balance sheet activities, i.e., when we use our "fat" liquidity creation measures ("cat fat" or "mat fat"). The magnitude of the coefficient on the lagged equity capital ratio in the "cat fat" regression, 1.163, suggests that large banks with a 1 percentage point higher equity capital ratio for the prior three years (i.e., an increase in EQRAT of 0.01) create additional liquidity of over one percentage point of a large bank's GTA, which appears to be a substantial effect. Using the "nonfat" measures, capital does not significantly affect liquidity creation, suggesting that off-balance sheet activities constitute an important part of the effect of capital on liquidity creation for large banks. The EQRAT coefficients in the "cat" and "mat" specifications are of similar magnitude, suggesting that use of maturities in place of categories for loans has little impact on the measured net effect of capital.

The results for medium banks in Table 5 Panel B are mixed and not statistically significant. For these banks, the effect of capital on liquidity creation is positive for the "fat" measures and negative for the "nonfat" measures, but they are not statistically significant in any case.

The results in Table 5 Panel C suggest that small banks with higher capital ratios create less liquidity, in sharp contrast to the positive or insignificant effect of capital found for large and medium banks. All of the coefficients on the lagged capital ratio are negative and significant at the 1% level, yielding a fairly

[28] A potential concern about our regression specification is that current bank equity is included in our dependent variable (liquidity creation divided by GTA), while the lagged equity ratio is our key exogenous variable. To address this, we also construct a liquidity creation measure that excludes equity and obtain similar results (see Section 7.4).

clear result that is robust across the liquidity creation measures. Using our preferred "cat fat" measure, the magnitude of the coefficient on the lagged equity capital ratio, -0.342, suggests that small banks with a 0.01 higher EQRAT create less liquidity by about a third of a percentage point of their GTA. As for the large banks, the magnitudes of the net effect of capital on liquidity creation are similar for the "cat" and "mat" measures for small banks. However, a key difference for small banks is that the "fat" and "nonfat" magnitudes are also similar. The inclusion of off-balance sheet activities makes little difference to the net effect of capital on liquidity creation, reflecting the lesser role of these activities for small institutions.

In sum, we find that for large banks, capital has a significantly positive effect on liquidity creation when we use measures that include off-balance sheet activities, while this effect is insignificant when we exclude those activities. For small banks, capital has a negative effect on liquidity creation using all of our measures, while for medium banks, the effect is always insignificantly different from zero. Thus, the data suggest that, consistent with our economic intuition, the "risk absorption" hypothesis dominates for large banks when off-balance sheet activities are included and the "financial fragility-crowding out" hypothesis strongly dominates for small banks. The two effects are approximately offsetting for medium banks. We next investigate what drives these differences.

6.2. Why is the net effect of capital on liquidity creation different by bank size class?

To understand more deeply why the effect of capital on liquidity creation differs by bank size class, we examine how capital affects the individual components of liquidity creation – e.g., liquid, semi-liquid, and illiquid assets. Specifically, we use the individual components based on our "cat fat" liquidity creation measure normalized by GTA as dependent variables in our regressions.

Panels A, B, and C of Table 6 show the coefficients on EQRAT from these regressions for large, medium, and small banks, respectively. All of the control variables from the full specification are included in these regressions, but are not shown in the interest of brevity. Importantly, since liquidity creation equals the weighted sum of the individual components (using the ½, 0, and -½ liquidity creation weights discussed above), the weighted sums of the EQRAT coefficients on the individual liquidity creation components in Table 6 equal the coefficient on EQRAT using the "cat fat" measure in Table 5.[29] Therefore, the EQRAT coefficients in the individual component regressions help us understand which components of liquidity creation yield the different results for large, medium, and small banks.

[29] For example, for large banks, ½ • 0.369 + 0 • 0.190 + -½ • -0.559 + ½ • 0.189 + … = 1.163.

The results in Table 6 Panel A suggest that for large banks, lagged capital positively influences liquidity creation on the asset side of the balance sheet as well as off the balance sheet. Banks with higher lagged capital ratios have significantly more illiquid assets, fewer liquid assets, and more illiquid guarantees. These positive effects of capital are partially offset by the fact that large banks with higher lagged capital ratios have significantly higher capital ratios in the current period (i.e., the coefficient on EQRAT in the equity/GTA regression is positive and significant). Thus, the positive effect of lagged capital on liquidity creation calculated using our "cat fat" measure in Table 4 Panel A is the net result of the positive effect of lagged capital on assets and illiquid guarantees being larger than the negative effect on current capital. The insignificant effect of lagged capital on liquidity creation calculated using the "cat nonfat" measure in Table 4 Panel A occurs because the positive effects of lagged capital on illiquid guarantees are excluded – the positive effect of lagged capital on assets approximately offsets the negative effect on current capital.

The findings in Table 6 Panel A are also consistent with the economic intuition that the "risk absorption" effect is relatively strong for large banks. Higher capital allows large banks to bear significantly more portfolio risk, and the data suggests that they do so. Large banks with higher capital hold more risky illiquid assets such as commercial loans and risky illiquid guarantees such as loan commitments, and fewer relatively safe liquid assets such as treasuries.

Table 6 Panel B suggests very different effects for medium banks. Banks with higher lagged capital ratios tend to have fewer liquid liabilities. The negative effect of lagged capital on liquid liabilities approximately offsets the positive effect of lagged capital on current capital, yielding the overall insignificant effect.

Table 6 Panel C reveals that similar to large and medium banks, small banks with higher lagged capital ratios have significantly higher capital ratios in the current period. However, in stark contrast to large banks, for small banks, capital has a negative effect on liquidity creation on the asset and liability sides of the balance sheet, and essentially no effect on liquidity creation off the balance sheet. Small banks with higher lagged capital ratios have significantly more liquid assets and fewer liquid liabilities. Thus, the effect of lagged capital on small banks is consistently negative, as opposed to the positive effect for large banks, because the negative effect on current capital is augmented by negative effects of capital on the asset and liability sides, and is not offset by a positive effect off the balance sheet.[30]

The results in Table 6 Panel C are also consistent with the economic intuition that the "financial fragility-crowding out" effect is relatively strong for small banks. On the asset side, lagged capital does not have a positive effect on illiquid assets, but instead has a positive effect on liquid assets. This is consistent with the spirit of the financial fragility arguments put forth in Diamond and Rajan (2000, 2001). Capital reduces the financial fragility needed to commit to monitoring its borrowers. As a result, banks with higher lagged capital ratios may invest more in liquid assets, rather than increasing their loans. On the liability side, lagged capital has a negative, statistically significant effect on liquid liabilities, consistent with the "crowding out" of transactions deposits as in Gorton and Winton (2000).

7. Robustness issues

In Section 6, we found that – based on our preferred "cat fat" measure of liquidity creation – the effect of capital on liquidity creation is positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks. We now examine the robustness of these main findings to: 1) controlling for credit risk; 2) using an alternative method to measuring off-balance sheet bank liquidity creation; 3) using an alternative way of establishing which assets are securitizable; 4) excluding equity from the liquidity creation measure; 5) using an alternative capital ratio; 6) splitting the sample by bank holding company status, wholesale versus retail orientation, and merger status; and 7) using an instrumental variable approach. We show that our main results are qualitatively unchanged.

7.1. Controlling for credit risk

In our analyses, we examine the effect of capital on liquidity creation. As discussed in the Introduction, however, a primary reason why banks hold capital is to absorb risk. It is therefore possible that our results are not driven by the liquidity creation role of banks, but by their role as risk transformers. We now address this issue by rerunning our regressions controlling for a key risk of banks, their credit risk. We construct the variable CREDITRISK, calculated as a bank's Basel I risk-weighted assets and off-balance sheet activities divided by GTA.

Our regressions controlling for credit risk are shown in Table 7. As expected, CREDITRISK is

[30] Lagged capital also has a negative effect on illiquid liabilities (which enhances liquidity creation), but the effect is small.

significantly positively related to liquidity creation. Importantly, the inclusion of this variable does not change our basic finding of a positive and significant effect of capital on liquidity creation for large banks, an insignificant effect for medium banks, and a negative and significant effect for small banks.

7.2. Using an alternative method to measuring off-balance sheet liquidity creation

Our liquidity creation measures are 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 in order to meet these liquidity demands. An alternative would be to use the probability or frequency with which the bank or customers actually liquefy the items and obtain liquid funds. We argue that the ability or option to obtain funds when needed or desired is more important than the actual drawdown frequency. This is also what the theories suggest – banks create liquidity on the balance sheet because they give depositors a liquid claim to their funds (i.e., the option to withdraw funds when needed) instead of forcing them to hold illiquid loans directly (e.g., Diamond and Dybvig 1983). Similarly, banks create liquidity off the balance sheet through guarantees that allow customers the option to draw down liquid funds when needed (e.g., Kashyap, Rajan, and Stein 2002).

Despite our reservations, we construct a liquidity creation measure that incorporates the frequency with which customers obtain liquid funds on off-balance sheet guarantees. Our alternative liquidity creation measure is identical to our "cat fat" measure, except that we multiply the dollar amount of illiquid off-balance sheet guarantees by 0.30, the observed frequency of drawdown as documented in recent research (Sufi, forthcoming).[31]

Using this alternative "cat fat" measure, we find that liquidity creation of the banking sector is about one-third lower than using our preferred "cat fat" measure in every year and amounts to $1.869 trillion in 2003 (not shown for brevity). The overall pattern of liquidity creation, however, is fairly similar to the "cat fat" pattern.

In Table 8 Panel A we regress the dollar amount of liquidity creation using this alternative "cat fat" measure normalized by GTA on EQRAT and the other exogenous variables. As shown, based on this alternative method to measuring liquidity creation, we obtain consistent results – capital has a positive effect on liquidity creation for large banks, a negative effect for small banks, and an insignificant effect for medium

[31] Sufi (forthcoming) uses data on letters of credit and loan commitments over 1996-2003, which corresponds closely with our sample period, and finds that conditional on having a letter of credit or a loan commitment, the probability of drawdown over this time period was approximately 30% in every year.

banks.

In principle, this methodology could be applied to all bank activities. For example, the drawdown frequency is 1 for loans since customers have already received liquid funds. However, constructing measures using this methodology is difficult, since data on the frequency of drawdown or sale is unavailable for many activities. More importantly, the use of drawdown rates goes directly against the liquidity creation theories, which argue that banks create liquidity by giving customers the option to obtain liquid funds when needed or desired.

7.3. Using an alternative way of establishing which assets are securitizable

The amount of liquidity a bank creates is affected by the bank's ability to securitize its assets. Our "cat" liquidity creation measures incorporate this by classifying loan categories that are relatively easy to securitize (residential real estate loans and consumer loans) as semi-liquid and all other loan categories as illiquid.[32] Our "cat" measures do not incorporate, however, the fact that the ability to securitize assets has developed greatly over our sample period. In every loan category, a larger fraction of loans was securitized in 2003 than in 1993. We now construct an alternative "cat fat" liquidity creation measure that takes this development into account.

Our alternative "cat fat" measure is identical to the "cat fat" measure described in Section 3, except for the way we classify loans. For each loan category, we obtain year-end U.S. Flow of Funds data on the total amount of loans outstanding and the total amount of loans securitized. We use this data to calculate the fraction of loans that has been securitized in the market in each year. Following Loutskina (2006), we then assume that each bank can securitize that fraction of its own loans. To give an example, in 1993, $3.1 trillion residential and real estate loans were outstanding in the market, and 48.4% of these loans were securitized. If a bank has $10 million in residential and real estate loans in that year, we assume that 48.4% thereof can be securitized, and hence, we classify $4.84 million of these loans as semi-liquid and the remainder as illiquid.

We raise two reservations regarding this alternative approach for our purposes. First, it uses the actual amount of securitization, whereas the theories suggest that the ability to securitize matters for liquidity creation, not the amount securitized. Second, this alternative approach assumes that each bank securitizes the same fraction of loans in a particular category, even though in practice major differences may exist across

[32] Our "mat" measures classify loans entirely based on maturities and hence do not take differences in securitizability into account.

banks. That is, when we assume that 48.4% of all residential and real estate loans can be securitized in 1993, one bank may have securitized virtually its entire residential real estate portfolio in that year, while another bank may have securitized nothing.

Using this alternative approach, the banking sector created more liquidity, but the growth pattern is similar to the "cat fat" pattern described in Section 4. Based on this alternative measure, liquidity creation equaled $1.843 trillion in 1993 and increased by about 70% to $3.168 trillion in 2003.

The regression results presented in Table 8 Panel B reinforce our prior findings. That is, for large banks, capital has a positive and significant effect on liquidity creation. For small banks, the effect of capital on liquidity creation is negative and significant. For medium banks, the effect is again statistically insignificant.

7.4. Excluding equity from the measurement of liquidity creation

Our regression specification is inspired by the theories of bank liquidity creation. These theories argue that banks create liquidity when illiquid assets are transformed into liquid liabilities, not when they are transformed into illiquid claims such as equity. The theories also suggest that equity may affect a bank's ability to create liquidity. For example, having more equity capital may allow a bank to extend more illiquid loans. However, as noted in Section 6, a potential concern about our regression specification is that current bank equity is included (with a weight of -½) in our dependent variables, while the lagged equity ratio is our key exogenous variable. To ameliorate this potential concern, we create an alternative "cat fat" liquidity creation measure that excludes equity. This measure does not penalize banks for funding part of their activities with equity capital. As a result, the measured amount of liquidity creation is higher for all banks, and this increase is greatest for banks which hold the most capital. We rerun our regressions using this alternative measure.

The results shown in Table 8 Panel C suggest that our main findings are robust to the exclusion of equity from our dependent variable. The coefficient on EQRAT is again positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks.

7.5. Using an alternative capital ratio

In our main analysis, we use EQRAT, the ratio of equity to GTA, as our key exogenous variable. We now replace EQRAT with TOTRAT, the ratio of total capital (as defined in the Basel I capital standards) to GTA. Total capital includes equity plus limited amounts of other financial instruments, such as long-term subordinated debt.[33,34]

One motivation for using this alternative capital ratio is to see if there is a different effect of regulatory capital from conventional equity capital on liquidity creation. A second motivation is to allow for a broader definition of capital in line with some of the theoretical studies. For example, Diamond and Rajan (2000, 2001) indicate that capital in their analysis may be interpreted as either equity or long-term debt, sources of funds that cannot run on the bank.

The results based on this alternative capital ratio are shown in Table 9 and are qualitatively similar to our main results. The net effect of capital on liquidity creation is positive and significant for large banks, statistically insignificant for medium banks, and negative and significant for small banks.

7.6. Splitting the sample by bank holding company status, wholesale versus retail orientation, and merger status

In all of the regression results presented thus far, we have split our sample only by size. In Section 4, however, we also split our sample by bank holding company status, wholesale versus retail orientation, and merger status, and showed that substantial time-series and cross-sectional variation exists among these banks in terms of their ability to create liquidity. We now test the robustness of our main results by rerunning our regressions by size class for MBHC members, OBHC members, and independent banks; banks with wholesale and retail orientations; and banks with and without recent M&A activity.

The results are shown in Table 10. For large banks, the coefficient on EQRAT is positive and statistically significant (except for the very small subsamples of OBHC members and independent banks, which have only 35 and 54 observations, respectively). For medium banks, the coefficient on EQRAT is not significant for any of the subsamples. For small banks, the coefficient is negative in all cases, and significant in all but one case. Thus, our main findings are generally robust to splitting the data by bank holding company status, wholesale versus retail orientation, and merger status – the effect of capital on liquidity creation is positive for large banks, insignificant for medium banks, and negative for small banks.

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[33] Before 1996, banks were not required to report total capital, and from 1996-2000, banks with total assets less than $1 billion were not required to report total capital if they indicated on the Call Report that their total capital exceeded 8% of adjusted total assets. We estimate the missing numbers using a special Federal Reserve program based on other Call Report information.

[34] Note that we do not use the official Basel I total risk-based capital ratio, which is defined as total capital divided by risk-weighted assets, where risk-weighted assets is the weighted sum of assets and off-balance sheet activities, with the weights based on the perceived credit risk of each activity. This capital ratio is clearly endogenous and its use would result in significant bias, since our dependent variable – bank liquidity creation – is also a weighted sum of assets and off-balance sheet activities (as well as liabilities).

7.7. Using an instrumental variable approach

The theories discussed above suggest a causal link between bank capital and liquidity creation. Diamond and Rajan (2000, 2001) argue that when banks fund themselves more with capital, subsequent liquidity creation will be lower. Gorton and Winton (2000) argue that when banks hold more capital, they reduce liquidity for investors, since capital "crowds out" deposits. The risk absorption theories suggest that capital allows banks to create more liquidity.

In practice, however, capital and liquidity creation may be jointly determined. In our main analysis, we use three-year lagged average values of capital to mitigate potential endogeneity concerns. Nevertheless, we recognize that this procedure may not be sufficient. We further address this endogeneity issue using an instrumental variable approach.[35] In the first stage, we regress our potentially endogenous variable, EQRAT, on the instruments and all of the control variables and the time and bank fixed effects. In the second stage, we regress liquidity creation (using our preferred "cat fat" measure) divided by GTA on the predicted value for EQRAT from the first stage and all the control variables and fixed effects.

The instruments must satisfy two requirements. First, to be valid, we need variables that are correlated with the amount of lagged capital (once the effects of the other exogenous variables have been netted out), but do not directly affect the amount of liquidity a bank creates. Second, since we include bank fixed effects in the regressions, it is important that the instruments show sufficient variation within a bank's observations over time. We select three instruments that meet both requirements.

Our first instrument is EFF-TAX, the state income tax rate a bank has to pay. Since interest on debt is tax-deductible while dividend payments are not, banks that operate in states with higher income tax rates are expected to have lower equity ratios, keeping all else equal. Furthermore, there is no reason to believe that the state income tax rate directly affects liquidity creation. Similar to Ashcraft (2006), we use the effective income tax rate to be paid on $1 million in pretax income as our instrument.[36,37] If a bank operates

[35] An alternative way to establish causality would be to shock banks with more capital and examine the effect on liquidity creation. This is not possible for us, however, since exogenous shocks did not occur during our sample period.

[36] In each state (except Ohio), the highest tax bracket starts at or below $1 million in pre-tax profits: when we use the marginal tax rate on $1 million in pre-tax profits as our instrument we obtain similar results. In Ohio, banks pay 0.015 times the book value of their stock. However, for comparability reasons, we use the corporate income tax rate to calculate Ohio taxes.

[37] In contrast to Ashcraft (2006), we use the income tax rate banks have to pay rather than the corporate income tax rate. These rates differ in ten states. To illustrate, in South Dakota, corporations did not pay income tax between 1993 and 2003, while banks paid 6%. In North Dakota, corporations paid 10.35%, while banks were taxed at 7%. Also, unlike Ashcraft (2006), we do not average the tax rate over our sample period. This ensures that we do not use forward-looking data in our regressions.

in multiple states, we use the bank's weighted average state income tax rate, calculated using the share of deposits in each state (relative to the bank's total deposits) as weights.[38]

Our second instrument is D-DIV, a dummy variable that equals one if the bank paid dividends in any of the prior three years and zero otherwise. Regulators will only allow a bank to pay dividends when it is deemed to have sufficient capital and otherwise be in safe and sound condition. Dividend payment directly affects bank capital, but does not seem to be directly related to liquidity creation.

Our third instrument is D-BHC, a dummy variable that equals one if the bank has been part of a bank holding company (BHC) in any of the prior three years and zero otherwise. Capital is related to BHC ownership in part because U.S. regulations require holding companies to be a source of strength for the banks they own and also require banks in the same BHC to cross-guarantee each other and provide capital when needed. Holding companies may also inject capital voluntarily, thereby giving the entities in the holding company access to internal capital markets when needed. Being part of a BHC does not seem likely to directly affect liquidity creation, except to the extent that in some BHCs, loans originated by one member may be transferred to another bank or non-bank affiliate of the same BHC. Because D-BHC may directly affect liquidity creation through such loan transfers, we run the instrumental variable regressions with and without this instrument.

Table 11 Panel A examines the extent to which the instruments vary over time for a given bank. The data suggest that there is substantial variation for all instruments for all size classes except for the bank holding company dummy for large banks, which equals 1 in all years for 95% of the large banks. As noted, we run the instrumental variable regressions both with and without D-BHC.

Table 11 Panel B shows the results of our first-stage regressions. The state income tax rate has a significantly negative effect on capital for large banks, consistent with Ashcraft (2006). The tax rate does not significantly affect capital at medium and small banks, potentially because the tax benefit of debt may outweighed by safety and soundness considerations that induce those banks to hold higher capital ratios. Whether a bank pays dividends generally does not significantly affect the capital ratio, except for small banks when D-BHC is excluded. Being part of a BHC has a significantly negative effect on capital for small banks, consistent with our hypothesis that banks that are part of a BHC have easier access to capital. It is not

[38] It would be preferable to use the share of pre-tax income earned in each state as weights, but Call Reports (and other data sources) do not provide these data.

surprising that this effect is not significant for medium and large banks, since those banks have easier access to outside capital than small banks, even if they are not part of a BHC.

Table 11 Panel C contains the second-stage instrumental variable regression results. When we use instruments for capital, our results are consistent with earlier findings. The effect of capital on liquidity creation is positive and statistically significant for large banks, insignificant for medium banks, and negative and significant for small banks.

For both large and small banks, the coefficients on EQRAT are larger when we use instruments, suggesting that the effect of capital on liquidity creation is several times the previously estimated effect. Using similar logic as in Levitt (1996), this suggests that in our main liquidity creation regressions, EQRAT is negatively correlated with the residuals, thus inducing a negative bias in our coefficient estimates. When we use instruments for capital, we obtain consistent estimates.[39] However, since we had no *a priori* reason to believe that our EQRAT coefficients were understated in our main regressions, we are hesitant to put too much weight on this explanation.

Because our liquidity creation measure includes current capital, we also reran the instrumental variable regressions with our liquidity creation measure that excludes capital as a robustness check. While we lose statistical significance for large banks, the results are similar for medium and small banks.

8. Conclusion

According to banking theory, banks exist because they create liquidity and transform risk. Our understanding of the liquidity creation role is hampered by the absence of comprehensive liquidity creation measures. The first contribution of this paper is the development of four bank liquidity creation measures. Our second contribution is that we use our measures to gain a deeper insight into banks' role as liquidity creators – we determine the magnitude of bank liquidity creation, its intertemporal patterns, its cross-sectional variation, characteristics of high and low liquidity creators, and examine the relationship between liquidity creation and bank value. Our third contribution is that we use our measures to study an issue of significant research and policy relevance – the effect of bank capital on liquidity creation – and thereby test

[39] Levitt (1996) finds that the number of prisoners has a negative effect on crime that is five times larger when he uses instruments for the prison population. He argues that the coefficients in his original regressions are too low because the number of prisoners is negatively correlated with the residuals and that he obtains consistent estimates when he uses instruments.

the opposing predictions of recent theories about the relationship between capital and liquidity creation.

Our calculations suggest that liquidity creation by the U.S. banking sector exceeded $2.8 trillion as of 2003 based on our preferred liquidity creation measure, and nearly doubled in real terms between 1993 and 2003. Interestingly, banks create only about half of their liquidity on the balance sheet, highlighting the importance of off-balance sheet liquidity creation. Large banks (GTA exceeding $3 billion) create 81% of the liquidity while comprising only 2% of all banks. Multibank holding company members, retail banks, and recently-merged banks create most of the industry's overall liquidity and show the greatest growth in liquidity creation over time. Liquidity creation is also positively associated with bank value.

When we test the effect of capital on liquidity creation, we find empirical support for both the theories which predict that higher capital may suppress liquidity creation and those which suggest that higher capital may enhance banks' ability to create more liquidity. The effect of capital on liquidity creation is positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks. We perform a variety of robustness checks and find consistent results.

Our finding that the effect of bank capital on bank liquidity creation differs by bank size raises interesting policy issues. It is well-known that regulators impose capital requirements on banks for safety and soundness reasons. Our findings suggest is that while regulators may be able to make banks safer by imposing higher capital requirements, this benefit may have associated with it reduced liquidity creation by small banks, but not by large banks.

Our liquidity creation measures may be used to address a number of other interesting issues that are beyond the scope of this paper, but may be pursued in future research. Does liquidity creation affect economic growth? How do monetary policy initiatives by central banks, changes in deposit insurance, and other policy innovations affect liquidity creation? How does liquidity creation differ across nations? How much liquidity do banks create compared to non-bank financial intermediaries? How much liquidity do banks create relative to financial markets, and what are the complementarities, if any, in liquidity creation between banks and capital markets?

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Table 1: Liquidity classification of bank activities and construction of four liquidity creation measures
This table explains our methodology to construct liquidity creation measures in three steps.

Step 1: We classify all bank activities as liquid, semi-liquid, or illiquid. For activities other than loans, we combine information on product category and maturity. Due to data limitations, we classify loans entirely by product category ("cat") or maturity ("mat").

Step 2: We assign weights to the activities classified in Step 1.

ASSETS:

Illiquid assets (weight = ½)		**Semi-liquid assets (weight = 0)**		**Liquid assets (weight = - ½)**
(cat)	**(mat)**	**(cat)**	**(mat)**	
Commercial real estate loans (CRE)	All loans and leases with a remaining maturity > 1 year	Residential real estate loans (RRE)	All loans and leases with a remaining maturity <= 1 year	Cash and due from other institutions
Loans to finance agricultural production		Consumer loans		All securities (regardless of maturity)
Commercial and industrial loans (C&I)		Loans to depository institutions		Trading assets
Other loans and lease financing receivables		Loans to state and local governments		Fed funds sold
		Loans to foreign governments		
Other real estate owned (OREO)				
Customers' liability on bankers acceptances				
Investment in unconsolidated subsidiaries				
Intangible assets				
Premises				
Other assets				

LIABILITIES PLUS EQUITY:

Liquid liabilities (weight = ½)	**Semi-liquid liabilities (weight = 0)**	**Illiquid liabilities plus equity (weight = - ½)**
Transactions deposits	Time deposits	Bank's liability on bankers acceptances
Savings deposits	Other borrowed money	Subordinated debt
Overnight federal funds purchased		Other liabilities
Trading liabilities		Equity

OFF-BALANCE SHEET GUARANTEES (notional values):

Illiquid guarantees (weight = ½)	**Semi-liquid guarantees (weight = 0)**	**Liquid guarantees (weight = - ½)**
Unused commitments	Net credit derivatives	Net participations acquired
Net standby letters of credit	Net securities lent	
Commercial and similar letters of credit		
All other off-balance sheet liabilities		

OFF-BALANCE SHEET DERIVATIVES (gross fair values):

		Liquid derivatives (weight = -½)
		Interest rate derivatives
		Foreign exchange derivatives
		Equity and commodity derivatives

Table 1: Liquidity classification of bank activities and construction of four liquidity creation measures – cont'd

Step 3: We combine bank activities as classified in Step 1 and as weighted in Step 2 in different ways to construct four liquidity creation measures by using the "cat" or "mat" classification for loans, and by alternatively including off-balance sheet activities ("fat") or excluding these activities ("nonfat").

cat fat =	+ ½ * illiquid assets (cat)	+ 0 * semi-liquid assets (cat)	– ½ * liquid assets
	+ ½ * liquid liabilities	+ 0 * semi-liquid liabilities	– ½ * illiquid liabilities
			– ½ * equity
	+ ½ * illiquid guarantees	+ 0 * semi-liquid guarantees	– ½ * liquid guarantees
			– ½ * liquid derivatives
cat nonfat =	+ ½ * illiquid assets (cat)	+ 0 * semi-liquid assets (cat)	– ½ * liquid assets
	+ ½ * liquid liabilities	+ 0 * semi-liquid liabilities	– ½ * illiquid liabilities
			– ½ * equity
mat fat =	+ ½ * illiquid assets (mat)	+ 0 * semi-liquid assets (mat)	– ½ * liquid assets
	+ ½ * liquid liabilities	+ 0 * semi-liquid liabilities	– ½ * illiquid liabilities
			– ½ * equity
	+ ½ * illiquid guarantees	+ 0 * semi-liquid guarantees	– ½ * liquid guarantees
			– ½ * liquid derivatives
mat nonfat =	+ ½ * illiquid assets (mat)	+ 0 * semi-liquid assets (mat)	– ½ * liquid assets
	+ ½ * liquid liabilities	+ 0 * semi-liquid liabilities	– ½ * illiquid liabilities
			– ½ * equity

Table 2: Summary statistics on bank liquidity creation

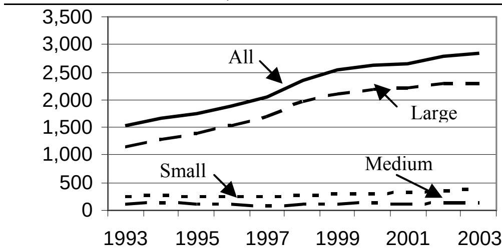
Panel A shows liquidity creation of the banking sector in $ billion and divided by gross total assets (GTA, i.e. total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans)), equity (EQ), gross loans (LNS), and deposits (DEP) from 1993-2003. Panel B contains graphs of liquidity creation by banks split by BHC status, wholesale versus retail orientation, and merger status. Panel C uses these bank characteristics to contrast banks that create the most and least liquidity (top 25% and bottom 25% in each size class, respectively) over 1993 - 2003. All panels show results for large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion) and small banks (GTA up to $1 billion). Panel A measures liquidity creation using all four liquidity creation measures as defined in Table 1, while Panels B and C only show liquidity creation based on our preferred "cat fat" measure. All financial values are expressed in real 2003 dollars using the implicit GDP price deflator. The cat (mat) liquidity creation measure classifies all bank activities other than loans based on product category and maturity, and loans by category (maturity) only. The fat (nonfat) liquidity creation measures include (exclude) off-balance sheet activities.

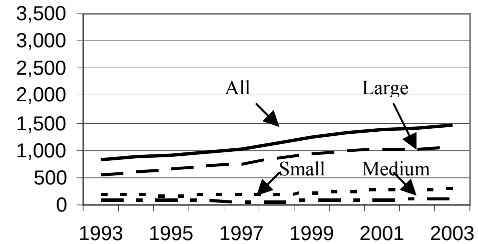
Panel A: Bank liquidity creation over time (1993 – 2003) and in the cross section using our four liquidity creation measures for banks split by size

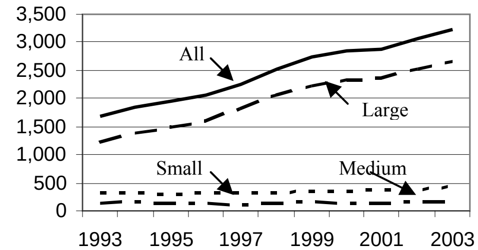
Liquidity creation measure:		**1993 liquidity creation**						**2003 liquidity creation**					
		N	**LC *$ bill***	**LC / GTA**	**LC / EQ**	**LC / LNS**	**LC / DEP**	**N**	**LC *$ bill***	**LC / GTA**	**LC / EQ**	**LC / LNS**	**LC / DEP**
cat fat (preferred)	All banks	9,095	1,523	0.34	4.36	0.60	0.46	6,968	2,843	0.39	4.56	0.70	0.58
	Large	205	1,154	0.40	5.44	0.70	0.58	143	2,298	0.41	4.93	0.75	0.64
	Medium	208	115	0.30	3.73	0.53	0.38	205	149	0.38	3.69	0.61	0.51
	Small	8,682	254	0.21	2.40	0.39	0.25	6,620	396	0.33	3.37	0.51	0.40
cat nonfat	All banks	9,095	830	0.19	2.38	0.33	0.25	6,968	1,463	0.20	2.35	0.36	0.30
	Large	205	562	0.19	2.65	0.34	0.28	143	1,041	0.19	2.23	0.34	0.34
	Medium	208	73	0.19	2.37	0.33	0.24	205	108	0.27	2.68	0.44	0.44
	Small	8,682	195	0.16	1.84	0.30	0.19	6,620	315	0.26	2.67	0.41	0.41
mat fat	All banks	9,095	1,693	0.38	4.85	0.67	0.51	6,968	3,234	0.45	5.18	0.79	0.66
	Large	205	1,224	0.42	5.77	0.74	0.61	143	2,647	0.47	5.68	0.86	0.86
	Medium	208	144	0.38	4.68	0.66	0.48	205	160	0.41	3.98	0.66	0.66
	Small	8,682	324	0.27	3.06	0.50	0.32	6,620	427	0.35	3.63	0.55	0.55
mat nonfat	All banks	9,095	1,000	0.22	2.87	0.40	0.30	6,968	1,855	0.26	2.97	0.45	0.38
	Large	205	633	0.22	2.98	0.38	0.32	143	1,391	0.25	2.98	0.45	0.45
	Medium	208	102	0.27	3.32	0.47	0.34	205	119	0.30	2.96	0.49	0.49
	Small	8,682	265	0.22	2.50	0.41	0.26	6,620	345	0.28	2.93	0.45	0.45

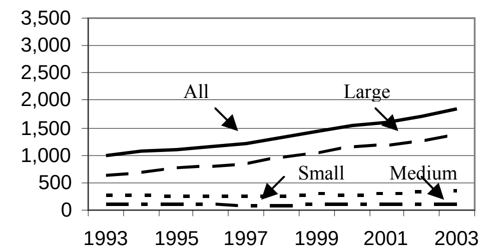
Liquidity creation 1993 - 2003

$ billion







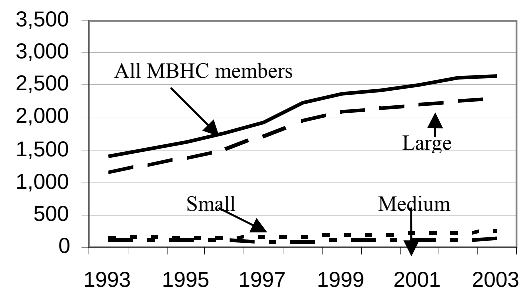


Panel B: Bank liquidity creation over time (1993 – 2003) and in the cross section using our preferred "cat fat" measure for banks in each size class split by bank holding company status, wholesale versus retail orientation, and merger status

Liquidity creation 1993 - 2003, *$ billion*

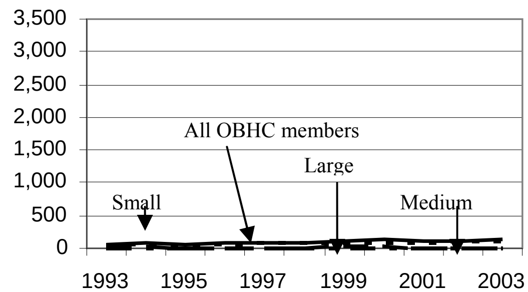
Multibank holding company (MBHC) members

	N 1993	N 2003
All banks	3,323	2,681
Large	195	136
Medium	168	164
Small	2,960	2,381



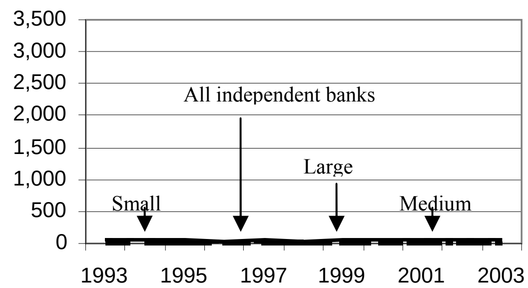
One-bank holding company (OBHC) members

	N 1993	N 2003
All banks	3,397	3,022
Large	4	3
Medium	14	22
Small	3,379	2,997



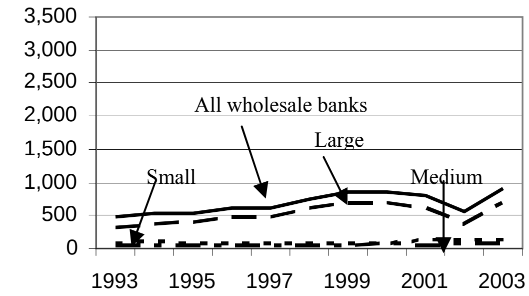
Independent banks

	N 1993	N 2003
All banks	2,375	1,265
Large	6	4
Medium	26	19
Small	2,343	1,242



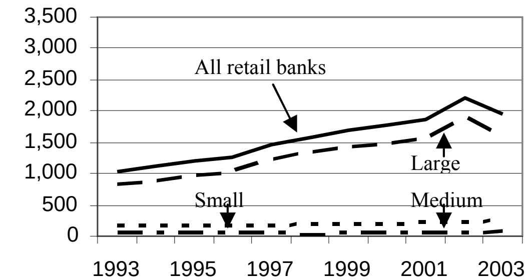
Wholesale banks (below average number of branches)

	N 1993	N 2003
All banks	6,659	4,809
Large	131	106
Medium	131	113
Small	6,397	4,590



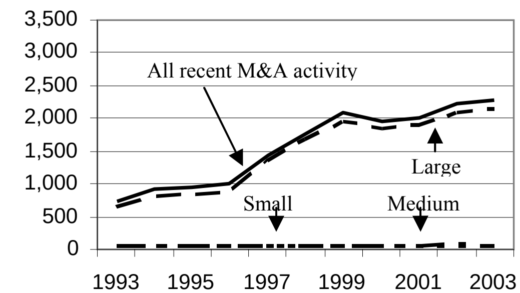
Retail banks (above average number of branches)

	N 1993	N 2003
All banks	2,436	2,159
Large	74	37
Medium	77	92
Small	2,285	2,030



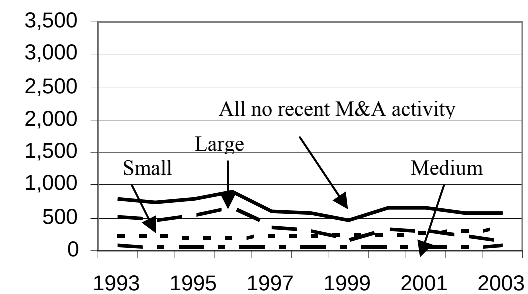
Recent M&A activity (engaged in M&As during prior three years)

	N 1993	N 2003
All banks	694	576
Large	95	98
Medium	73	73
Small	526	405



No recent M&A activity

	N 1993	N 2003
All banks	8,401	6,392
Large	110	45
Medium	135	132
Small	8,156	6,215



Panel C: Characteristics of banks that create the most and least liquidity over 1993 – 2003 in each size class using our preferred "cat fat" measure

Banks split by:		Large banks: High liquidity creators (top 25%)	Large banks: Low liquidity creators (bottom 25%)	Medium banks: High liquidity creators (top 25%)	Medium banks: Low liquidity creators (bottom 25%)	Small banks: High liquidity creators (top 25%)	Small banks: Low liquidity creators (bottom 25%)
Overall LC	Liquidity creation ($ billion)	36.00	0.67	1.20	0.12	0.12	-0.00
	MBHC members	0.99	0.85	0.93	0.56	0.54	0.20
	OBHC members	0.01	0.05	0.05	0.16	0.31	0.46
	Independent banks	0.00	0.10	0.01	0.28	0.15	0.34
	Wholesale banks	0.25	0.97	0.47	0.76	0.29	0.91
	Retail banks	0.75	0.03	0.53	0.24	0.71	0.09
	Recent M&A activity	0.74	0.47	0.52	0.28	0.16	0.02
	No recent M&A activity	0.26	0.53	0.48	0.72	0.84	0.98
LC / GTA	Liquidity creation / GTA	0.66	0.15	0.57	0.08	0.43	0.00
	MBHC members	0.99	0.84	0.89	0.59	0.45	0.22
	OBHC members	0.00	0.06	0.07	0.14	0.36	0.45
	Independent banks	0.00	0.10	0.03	0.27	0.19	0.33
	Wholesale banks	0.60	0.86	0.62	0.68	0.58	0.83
	Retail banks	0.40	0.14	0.38	0.32	0.42	0.17
	Recent M&A activity	0.63	0.53	0.41	0.31	0.10	0.03
	No recent M&A activity	0.37	0.47	0.59	0.69	0.90	0.97
LC / EQ	Liquidity creation / equity	8.56	1.78	6.9	0.92	5.35	0.07
	MBHC members	1.00	0.84	0.89	0.58	0.46	0.21
	OBHC members	0.00	0.06	0.07	0.13	0.36	0.45
	Independent banks	0.00	0.10	0.04	0.29	0.18	0.34
	Wholesale banks	0.57	0.88	0.60	0.68	0.57	0.84
	Retail banks	0.43	0.12	0.40	0.32	0.43	0.16
	Recent M&A activity	0.62	0.52	0.39	0.31	0.10	0.03
	No recent M&A activity	0.38	0.48	0.61	0.69	0.90	0.97

Table 3: Value implications of liquidity creation

This table shows correlations between liquidity creation and valuation of listed banks and bank holding companies. For independent banks, these are direct correlations between the amount of liquidity created by the bank and its valuation. For multibank holding companies, we aggregate liquidity created by all the banks in the holding company. For one-bank holding companies and multibank holding companies we impose that the total assets of the banks comprise at least 90% of the total assets of the bank holding company, and calculate correlations between total bank liquidity created and the valuation of the holding company. The dollar amount of liquidity creation (LC) is calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). EQ is total equity capital. The valuation measures used are the market-to-book ratio and the price-earnings ratio. The market-to-book ratio is defined as the market value of equity measured as of Dec. 31 divided by the book value of equity measured as of the previous fiscal year end. The book value of equity is defined as the Compustat book value of stockholder's equity, plus balance sheet deferred taxes and investment tax credit, minus the book value of preferred stock. All accounting data are winsorized at the 1% and 99% level to reduce the impact of outliers. As in Fama and French (1993) we use the redemption, liquidation, or par value (in that order) to estimate the value of preferred stock. The price-earnings ratio is defined as the share price as of Dec. 31 divided by earnings (before and after extraordinary items) per share measured as of the previous fiscal year end.

p-values are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	N	**Market-to-Book ratio**	**Price-Earnings ratio (based on earnings before extraordinary items)**	**Price-Earnings ratio (based on earnings after extraordinary items)**
Liquidity creation: LC ($)	3223	0.115	0.042	0.042
		*(0.00)****	*(0.02)***	*(0.02)***
Liquidity creation: LC / GTA	3223	0.151	0.041	0.042
		*(0.00)****	*(0.02)***	*(0.02)***
Liquidity creation: LC / EQ	3223	0.164	0.024	0.025
		*(0.00)****	*(0.18)*	*(0.16)*

Table 4: Definitions and summary statistics for exogenous variables

All exogenous variables are three-year lagged averages (i.e. the average of three years prior to observation of the dependent variable). All of the lagged values are merger-adjusted – the bank capital ratio and size are pro forma values, the mergers and acquisitions dummies simply take a value of 1 or 0 based on the combined experience of the banks in the case of mergers or acquisitions, and the local market competition and environment variables are weighted averages for the merging banks using their GTA values in constructing the weights. Sample period: 1993 – 2003. Sample means are provided for all banks, large banks (GTA exceeding $1 billion), medium banks (GTA $1 billion - $3 billion) and small banks (GTA up to $1 billion). All financial values are expressed in real 2003 dollars using the implicit GDP price deflator.

Data sources: Bank Call reports, Bank Holding Company Y-9 reports, FDIC Summary of Deposits, NIC Database, Bureau of Economic Analysis, and U.S. Census Bureau.

Variable	Definition	Mean for all banks	Mean for large banks	Mean for medium banks	Mean for small banks
Bank capital ratio					
EQRAT	Equity capital ratio: total equity capital as a proportion of GTA, where GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).	0.10	0.08	0.09	0.10
Bank size					
Ln(GTA)	Natural log of GTA.	11.61	16.17	14.30	11.44
Mergers and acquisitions					
D-BANK-MERGE	Dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks.	0.09	0.64	0.43	0.07
D-DELTA-OWN	Dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter.	0.09	0.06	0.10	0.09
Local Market Competition					
HERF	A bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets.	0.21	0.15	0.16	0.21
SHARE-ML	Share of market bank and thrift deposits held by medium and large banks (GTA exceeding $1 billion).	0.32	0.58	0.56	0.31
Local market economic environment					
Ln(POP)	Natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights.	11.90	14.30	13.81	11.79
Ln(DENSITY)	Weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights.	4.68	6.50	6.15	4.60
INC-GROWTH	Weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights.	0.05	0.05	0.05	0.05
Fixed effects:					
Time fixed effects	Set of dummies for all but one year.				
Bank fixed effects	Set of dummies for all but one bank.				

Table 5: The effect of capital on liquidity creation

This table presents regression results. The dependent variable is the dollar amount of liquidity a bank has created, calculated using the four liquidity creation measures as defined in Table 1, normalized by GTA. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panels A, B, and C contain the results for large banks (GTA exceeding \$3 billion), medium banks (GTA \$1 billion - \$3 billion) and small banks (GTA up to \$1 billion), respectively.

EQRAT is the equity capital ratio (total equity capital as a proportion of GTA). Ln(GTA) is the log of GTA. D-BANK-MERGE is a dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks. D-DELTA-OWN is a dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. SHARE-ML is the share of market bank and thrift deposits held by medium and large banks (GTA exceeding \$1 billion). Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(DENSITY) is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights.

All regressions are run with both time fixed effects and bank fixed effects (not shown). The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Regression results for large banks

	cat fat / GTA	cat nonfat / GTA	mat fat / GTA	mat nonfat / GTA
EQRAT	1.163	0.480	1.188	0.504
	*(2.56)***	*(1.38)*	*(2.60)****	*(1.47)*
Ln(GTA)	-0.020	0.012	-0.009	0.023
	(-1.01)	*(1.10)*	*(-0.44)*	*(1.89)**
D-BANK-MERGE	0.005	-0.005	0.012	0.002
	(0.45)	*(-0.83)*	*(1.06)*	*(0.27)*
D-DELTA-OWN	-0.018	-0.023	-0.011	-0.017
	(-0.79)	*(-1.74)**	*(-0.49)*	*(-1.19)*
HERF	-0.002	-0.215	0.141	-0.072
	(-0.01)	*(-1.06)*	*(0.54)*	*(-0.36)*
SHARE-ML	-0.019	0.027	0.006	0.052
	(-0.31)	*(0.59)*	*(0.09)*	*(1.06)*
Ln(POP)	0.087	0.018	0.049	-0.020
	(1.40)	*(0.85)*	*(0.70)*	*(-0.62)*
Ln(DENSITY)	-0.092	-0.023	-0.048	0.021
	(-1.44)	*(-1.05)*	*(-0.65)*	*(0.65)*
INC-GROWTH	0.785	-0.362	0.653	-0.493
	(1.30)	*(-1.11)*	*(1.04)*	*(-1.46)*
Constant	-0.078	-0.069	0.017	0.026
	(-0.21)	*(-0.30)*	*(0.04)*	*(0.10)*
Time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	1810	1810	1810	1810
Adj. R-squared	0.80	0.83	0.80	0.84

Panel B: Regression results for medium banks

	cat fat / GTA	cat nonfat / GTA	mat fat / GTA	mat nonfat / GTA
EQRAT	0.217	-0.446	0.278	-0.385
	(0.27)	*(-1.62)*	*(0.38)*	*(-1.59)*
Ln(GTA)	0.045	0.025	0.060	0.040
	(1.62)	*(1.74)**	*(2.15)***	*(2.40)***
D-BANK-MERGE	-0.003	0.000	-0.004	-0.001
	(-0.54)	*(0.02)*	*(-0.66)*	*(-0.12)*
D-DELTA-OWN	0.021	-0.005	0.029	0.003
	(0.79)	*(-0.46)*	*(0.98)*	*(0.35)*
HERF	-0.255	-0.172	-0.097	-0.014
	(-1.46)	*(-1.15)*	*(-0.52)*	*(-0.09)*
SHARE-ML	-0.097	-0.058	-0.105	-0.065
	*(-2.46)***	*(-2.06)***	*(-2.31)***	*(-1.92)**
Ln(POP)	0.011	0.012	0.010	0.010
	(0.34)	*(0.42)*	*(0.27)*	*(0.34)*
Ln(DENSITY)	-0.013	-0.016	-0.016	-0.020
	(-0.25)	*(-0.39)*	*(-0.31)*	*(-0.47)*
INC-GROWTH	-0.339	-0.354	-0.275	-0.290
	(-1.06)	*(-1.84)**	*(-0.79)*	*(-1.26)*
Constant	-0.336	-0.107	-0.458	-0.229
	(-0.68)	*(-0.36)*	*(-0.88)*	*(-0.65)*
Time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	2140	2140	2140	2140
Adj. R-squared	0.75	0.90	0.71	0.88

Panel C: Regression results for small banks

	cat fat / GTA	cat nonfat / GTA	mat fat / GTA	mat nonfat / GTA
EQRAT	-0.342	-0.351	-0.405	-0.414
	*(-7.82)****	*(-9.24)****	*(-10.40)****	*(-12.14)****
Ln(GTA)	0.002	0.000	-0.017	-0.019
	(0.54)	*(0.11)*	*(-5.37)****	*(-6.41)****
D-BANK-MERGE	0.010	0.010	0.014	0.014
	*(5.24)****	*(5.77)****	*(7.15)****	*(7.74)****
D-DELTA-OWN	0.004	0.004	0.003	0.003
	*(2.90)****	*(2.83)****	*(1.97)***	*(1.75)**
HERF	0.035	0.032	0.012	0.009
	*(2.00)***	*(1.97)***	*(0.65)*	*(0.49)*
SHARE-ML	0.019	0.015	0.020	0.016
	*(3.29)****	*(2.84)****	*(3.34)****	*(2.85)****
Ln(POP)	0.006	0.006	0.008	0.008
	(1.31)	*(1.50)*	*(1.77)**	*(1.91)**
Ln(DENSITY)	0.018	0.016	0.011	0.009
	*(2.42)***	*(2.38)***	*(1.44)*	*(1.25)*
INC-GROWTH	0.086	0.045	0.039	-0.002
	*(3.98)****	*(2.26)***	*(1.83)**	*(-0.11)*
Constant	0.020	0.011	0.287	0.278
	(0.43)	*(0.28)*	*(6.27)****	*(6.62)****
Time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	80277	80277	80277	80277
Adj. R-squared	0.88	0.87	0.86	0.85

Table 6: The effect of capital on the components of liquidity creation

This table presents regression results. The dependent variables are the dollar amounts of the individual liquidity creation components normalized by GTA. The dollar amount of liquidity created is calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

Panels A, B, and C contain the results for large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion) and small banks (GTA up to $1 billion), respectively. All panels show only the coefficients on EQRAT (total equity capital as a proportion of GTA) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 3. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Regression results for large banks

	Assets / GTA			**Liabilities / GTA**			**Equity / GTA**	**Guarantees / GTA**			**Derivatives / GTA**
	illiquid	**semi-liquid**	**liquid**	**liquid**	**semi-liquid**	**illiquid**	**equity**	**illiquid**	**semi-liquid**	**liquid**	**liquid**
Weight:	***½***	***0***	***-½***	***½***	***0***	***-½***	***-½***	***½***	***0***	***-½***	***-½***
EQRAT	0.369	0.190	-0.559	0.189	-0.279	-0.195	0.353	1.358	-0.661	0.000	-0.010
	*(2.12)***	*(1.42)*	*(-3.42)****	*(0.57)*	*(-1.37)*	*(-1.01)*	*(2.71)****	*(1.74)**	*(-1.55)*	*(0.17)*	*(-0.97)*
Observations	1810	1810	1810	1810	1810	1810	1810	1810	1810	1810	1780
Adj. R-squared	0.87	0.85	0.83	0.85	0.87	0.79	0.69	0.75	0.72	0.43	0.32

Panel B: Regression results for medium banks

	Assets / GTA			**Liabilities / GTA**			**Equity / GTA**	**Guarantees / GTA**			**Derivatives / GTA**
	illiquid	**semi-liquid**	**liquid**	**liquid**	**semi-liquid**	**illiquid**	**equity**	**illiquid**	**semi-liquid**	**liquid**	**liquid**
Weight:	***½***	***0***	***-½***	***½***	***0***	***-½***	***-½***	***½***	***0***	***-½***	***-½***
EQRAT	0.065	0.030	-0.095	-0.477	-0.160	0.090	0.485	1.317	0.039	0.000	-0.009
	(0.24)	*(0.17)*	*(-0.39)*	*(-2.10)***	*(-0.59)*	*(1.30)*	*(4.27)****	*(1.01)*	*(0.83)*	*(0.40)*	*(-1.57)*
Observations	2140	2140	2140	2140	2140	2140	2140	2140	2140	2140	2088
Adj. R-squared	0.93	0.92	0.89	0.89	0.88	0.71	0.86	0.57	0.60	0.35	0.52

Panel C: Regression results for small banks

	Assets / GTA			**Liabilities / GTA**			**Equity / GTA**	**Guarantees / GTA**			**Derivatives / GTA**
	illiquid	**semi-liquid**	**liquid**	**liquid**	**semi-liquid**	**illiquid**	**equity**	**illiquid**	**semi-liquid**	**liquid**	**liquid**
Weight:	***½***	***0***	***-½***	***½***	***0***	***-½***	***-½***	***½***	***0***	***-½***	***-½***
EQRAT	0.001	-0.166	0.165	-0.188	-0.166	-0.010	0.360	0.020	-0.001	0.001	0.000
	(0.02)	*(-7.17)****	*(4.74)****	*(-8.46)****	*(-6.20)****	*(-1.99)***	*(21.51)****	*(0.77)*	*(-0.33)*	*(1.57)*	*(0.04)*
Observations	80277	80277	80277	80277	80277	80277	80277	80277	80277	80277	78802
Adj. R-squared	0.89	0.89	0.83	0.88	0.87	0.72	0.84	0.84	0.55	0.18	0.36

Table 7: The effect of capital on liquidity creation controlling for credit risk

This table presents regression results controlling for credit risk. The dependent variable is LC / GTA, the dollar amount of liquidity a bank has created, calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1, normalized by GTA. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). The table shows results for large banks (GTA exceeding \$3 billion), medium banks (GTA \$1 billion - \$3 billion), and small banks (GTA up to \$1 billion).

EQRAT is the equity capital ratio (total equity capital as a proportion of GTA). CREDITRISK is a credit risk measure, calculated as the bank's Basel I risk-weighted assets and off-balance sheet activities divided by GTA. Ln(GTA) is the log of GTA. D-BANK-MERGE is a dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks. D-DELTA-OWN is a dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. SHARE-ML is the share of market bank and thrift deposits held by medium and large banks (GTA exceeding \$1 billion). Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(DENSITY) is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects (not shown).

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Large banks	**Medium banks**	**Small banks**
	LC / GTA	**LC / GTA**	**LC / GTA**
EQRAT	0.901	0.045	-0.278
	*(3.74)****	*(0.06)*	*(-10.75)****
CREDITRISK	0.919	0.719	0.813
	*(11.02)****	*(7.45)****	*(45.88)****
Ln(GTA)	-0.016	0.024	0.006
	(-0.94)	*(0.98)*	*(2.92)****
D-BANK-MERGE	-0.004	-0.004	0.006
	(-0.48)	*(-0.73)*	*(4.76)****
D-DELTA-OWN	0.008	0.018	0.003
	(0.50)	*(0.68)*	*(2.63)****
HERF	0.167	0.043	0.033
	(0.87)	*(0.34)*	*(2.93)****
SHARE-ML	-0.019	-0.056	0.009
	(-0.39)	*(-1.78)**	*(2.39)***
Ln(POP)	0.053	0.012	0.006
	(1.08)	*(0.49)*	*(1.88)**
Ln(DENSITY)	-0.053	-0.006	0.009
	(-1.06)	*(-0.15)*	*(1.66)**
INC-GROWTH	1.051	-0.473	0.070
	*(1.94)**	*(-1.61)*	*(4.80)****
Constant	-0.554	-0.596	-0.460
	*(-2.05)***	*(-1.61)*	*(-15.13)****
Time fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
Observations	1810	2140	80277
Adj. R-squared	0.87	0.77	0.94

Table 8: The effect of capital on liquidity creation based on three alternative methods of measuring liquidity creation

This table presents regression results. The dependent variable is LC / GTA, the dollar amount of liquidity a bank has created, calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1, normalized by GTA. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panel A shows results for an alternative method to measuring off-balance sheet liquidity creation (discussed in Section 7.1). Panel B shows results for an alternative way to establishing which assets are securitizable (discussed in Section 7.2). Panel C shows results based on a liquidity creation measure which excludes equity (discussed in Section 7.3). All panels show results for large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion), and small banks (GTA up to $1 billion).

EQRAT is the equity capital ratio (total equity capital as a proportion of GTA). Ln(GTA) is the log of GTA. D-BANK-MERGE is a dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks. D-DELTA-OWN is a dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. SHARE-ML is the share of market bank and thrift deposits held by medium and large banks (GTA exceeding $1 billion). Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(DENSITY) is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects (not shown).

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Regression results based on a "cat fat" liquidity creation measure which:								
	Panel A: Measures off-balance sheet liquidity creation differently			**Panel B: Uses an alternative way to establishing which assets are securitizable**			**Panel C: Excludes equity**		
	Large banks	**Medium banks**	**Small banks**	**Large banks**	**Medium banks**	**Small banks**	**Large banks**	**Medium banks**	**Small banks**
	LC / GTA	**LC / GTA**	**LC / GTA**	**LC / GTA**	**LC / GTA**	**LC / GTA**	**LC / GTA**	**LC / GTA**	**LC / GTA**
EQRAT	0.688	-0.244	-0.349	1.268	0.269	-0.394	0.761	-0.151	-0.223
	*(2.04)***	*(-0.63)*	*(-8.86)****	*(2.79)****	*(0.35)*	*(-9.43)****	*(2.46)***	*(-0.65)*	*(-6.91)****
Ln(GTA)	0.002	0.031	0.001	-0.015	0.049	-0.017	0.018	0.026	-0.016
	(0.21)	*(1.77)**	*(0.25)*	*(-0.76)*	*(1.92)**	*(-5.10)****	*(1.64)*	*(1.75)**	*(-5.50)****
D-BANK-MERGE	-0.002	-0.001	0.010	0.010	-0.004	0.013	0.000	0.000	0.012
	(-0.29)	*(-0.20)*	*(5.63)****	*(0.86)*	*(-0.62)*	*(6.67)****	*(0.06)*	*(0.04)*	*(6.84)****
D-DELTA-OWN	-0.021	0.003	0.004	-0.016	0.025	0.004	-0.017	0.001	0.003
	(-1.42)	*(0.25)*	*(2.88)****	*(-0.70)*	*(0.92)*	*(2.22)***	*(-1.18)*	*(0.10)*	*(2.38)***
HERF	-0.152	-0.199	0.033	0.155	-0.164	0.032	-0.022	-0.079	0.027
	(-0.75)	*(-1.31)*	*(1.99)***	*(0.61)*	*(-0.91)*	*(1.74)**	*(-0.12)*	*(-0.53)*	*(1.61)*
SHARE-ML	0.014	-0.070	0.016	-0.029	-0.109	0.014	0.021	-0.064	0.009
	(0.30)	*(-2.30)***	*(3.00)****	*(-0.45)*	*(-2.47)***	*(2.32)***	*(0.43)*	*(-2.03)***	*(1.64)*
Ln(POP)	0.038	0.012	0.006	0.074	0.005	0.008	0.009	0.006	0.008
	(1.28)	*(0.42)*	*(1.45)*	*(1.15)*	*(0.14)*	*(1.81)**	*(0.39)*	*(0.18)*	*(1.88)**
Ln(DENSITY)	-0.043	-0.015	0.016	-0.076	-0.005	0.013	-0.011	-0.005	0.011
	(-1.41)	*(-0.36)*	*(2.41)***	*(-1.16)*	*(-0.10)*	*(1.77)**	*(-0.46)*	*(-0.11)*	*(1.64)*
INC-GROWTH	-0.022	-0.347	0.057	0.908	-0.284	0.060	-0.216	-0.291	0.011
	(-0.06)	*(-1.67)**	*(2.83)****	*(1.47)*	*(-0.84)*	*(2.71)****	*(-0.69)*	*(-1.33)*	*(0.57)*
Constant	-0.066	-0.179	0.014	-0.020	-0.285	0.303	-0.048	-0.021	0.306
	(-0.27)	*(-0.53)*	*(0.33)*	*(-0.05)*	*(-0.58)*	*(6.58)****	*(-0.20)*	*(-0.06)*	*(7.53)****
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1810	2140	80277	1810	2140	80277	1810	2140	80277
Adj. R-squared	0.83	0.88	0.87	0.81	0.75	0.86	0.84	0.88	0.84

Table 9: The effect of capital on liquidity creation based on an alternative capital ratio

This table presents regression results using an alternative capital ratio (discussed in Section 7.5). The dependent variable is LC / GTA, the dollar amount of liquidity a bank has created, calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1, normalized by GTA. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Results are shown for large banks (GTA exceeding \$3 billion), medium banks (GTA \$1 billion - \$3 billion), and small banks (GTA up to \$1 billion).

TOTRAT is the ratio of total capital (as defined in the Basel I capital standards) to GTA). Ln(GTA) is the log of GTA. D-BANK-MERGE is a dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks. D-DELTA-OWN is a dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. SHARE-ML is the share of market bank and thrift deposits held by medium and large banks (GTA exceeding \$1 billion). Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(DENSITY) is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects (not shown).

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Large banks	**Medium banks**	**Small banks**
	LC / GTA	**LC / GTA**	**LC / GTA**
TOTRAT	1.701	0.057	-0.366
	*(3.60)****	*(0.06)*	*(-10.41)****
Ln(GTA)	-0.010	0.043	0.001
	(-0.86)	*(0.72)*	*(0.40)*
D-BANK-MERGE	0.007	-0.003	0.009
	(0.73)	*(-0.47)*	*(7.12)****
D-DELTA-OWN	-0.017	0.021	0.004
	(-0.85)	*(0.66)*	*(3.93)****
HERF	0.054	-0.246	0.034
	(0.33)	*(-0.62)*	*(3.22)****
SHARE-ML	0.001	-0.100	0.019
	(0.04)	*(-1.98)***	*(5.67)****
Ln(POP)	0.084	0.012	0.006
	*(2.82)****	*(0.42)*	*(2.06)***
Ln(DENSITY)	-0.090	-0.016	0.018
	*(-2.93)****	*(-0.38)*	*(3.82)****
INC-GROWTH	0.980	-0.336	0.085
	*(2.58)****	*(-1.39)*	*(5.42)****
Constant	-0.286	-0.293	0.037
	(-1.27)	*(-0.39)*	*(1.33)*
Time fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
Observations	1810	2140	80277
Adj. R-squared	0.76	0.66	0.86

Table 10: The effect of capital on liquidity creation for banks in each size class split by bank holding company status, wholesale versus retail orientation, and merger status

This table presents regression results. The dependent variable is LC / GTA, the dollar amount of liquidity a bank has created, calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1, normalized by GTA. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

The sample is split in three ways. First, by bank holding company status: multibank holding company (MBHC) member, one-bank holding company (OBHC) member, and independent bank. Second, by wholesale versus retail orientation: banks with below versus above average number of branches. Third, by merger status: banks that engaged in M&A activity during the previous three years versus banks that did not engage in M&A activity recently.

Panels A, B, and C contain the results for large banks (GTA exceeding $3 billion), medium banks (GTA $1 billion - $3 billion) and small banks (GTA up to $1 billion), respectively. All panels show only the coefficients on EQRAT (total equity capital as a proportion of GTA) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 3. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Regression results for large banks

	MBHC members	OBHC members	Independent banks	Wholesale banks	Retail banks	Recent M&A activity	No recent M&A activity
	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA
EQRAT	1.330	5.073	-0.509	1.680	0.599	1.432	1.290
	*(2.76)****	*(0.96)*	*(-0.33)*	*(3.31)****	*(1.89)**	*(2.42)***	*(1.80)**
Observations	1721	35	54	1257	553	1155	655
Adj. R-squared	0.79	0.99	0.95	0.86	0.74	0.80	0.89

Panel B: Regression results for medium banks

	MBHC members	OBHC members	Independent banks	Wholesale banks	Retail banks	Recent M&A activity	No recent M&A activity
	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA
EQRAT	0.768	0.753	0.296	0.250	-0.116	0.394	0.399
	(0.64)	*(1.51)*	*(0.33)*	*(0.26)*	*(-0.28)*	*(0.84)*	*(0.38)*
Observations	1726	189	225	1248	892	923	1217
Adj. R-squared	0.70	0.96	0.93	0.72	0.93	0.94	0.71

Panel C: Regression results for small banks

	MBHC members	OBHC members	Independent banks	Wholesale banks	Retail banks	Recent M&A activity	No recent M&A activity
	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA
EQRAT	-0.394	-0.280	-0.284	-0.389	-0.216	-0.256	-0.359
	*(-3.01)****	*(-4.52)****	*(-4.34)****	*(-6.78)****	*(-3.24)****	*(-1.62)*	*(-7.96)****
Observations	28549	33847	17881	55483	24794	5430	74847
Adj. R-squared	0.87	0.90	0.92	0.89	0.88	0.93	0.88

Table 11: The effect of capital on liquidity creation based on instrumental variable regressions

This table contains results from our instrumental variable approach for large banks (GTA exceeding \$3 billion), medium banks (GTA \$1 billion - \$3 billion) and small banks (GTA up to \$1 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panel A shows summary statistics on the instruments. Panel B contains first-stage regression results. The dependent variable is EQRAT, total equity capital as a proportion of GTA. Panel C shows second-stage regression results. In these regressions, the dependent variable is LC / GTA, the dollar amount of liquidity a bank has created (calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1, normalized by GTA) and EQRAT is instrumented with: (1) EFF-TAX, the effective state income tax rate a bank has to pay on \$1 million in pre-tax income (see Ashcraft 2006); (2) D-DIV, a dummy that equals 1 if the bank has paid dividends in any of the prior three years; (3) D-BHC, a dummy that equals 1 if the bank has been part of a bank holding company over the prior three years. Results are shown based on the use of three instruments (EFF-TAX, D-DIV, D-BHC) and two instruments (EFF-TAX, D-DIV).

Ln(GTA) is the log of GTA. D-BANK-MERGE is a dummy that equals 1 if the bank was involved in one or more mergers over the past 3 years, combining the charters of two or more banks. D-DELTA-OWN is a dummy that equals 1 if the bank was acquired in the last 3 years, indicated by a change in top-tier holding company with no change in charter. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. SHARE-ML is the share of market bank and thrift deposits held by medium and large banks (GTA exceeding \$1 billion). Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(DENSITY) is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All panels show only the coefficients on the instruments (Panel B) or EQRAT (total equity capital as a proportion of GTA) (Panel C) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 3. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993-2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Summary statistics on the instruments

	Large banks	Medium banks	Small banks
Same tax rate in all years	31%	44%	62%
Tax rate changes > 10%	44%	37%	23%
Tax rate changes > 20%	19%	13%	13%
Paid dividends in all years	83%	73%	72%
Paid dividends in no years	1%	4%	8%
Paid dividends in some years	16%	23%	20%
BHC member in all years	95%	82%	69%
BHC member in no years	2%	8%	15%
BHC member in some years	3%	9%	17%

Panel B: First-stage regression results

	Large banks	Medium banks	Small banks	Large banks	Medium banks	Small banks
	EQRAT	EQRAT	EQRAT	EQRAT	EQRAT	EQRAT
EFF-TAX	-0.003	-0.001	0.000	-0.003	-0.001	0.000
	*(-2.28)***	*(-0.54)*	*(1.05)*	*(-2.27)***	*(-0.53)*	*(0.95)*
D-DIV	0.006	0.001	-0.001	0.006	0.001	-0.001
	(1.00)	*(0.23)*	*(-1.43)*	*(1.04)*	*(0.14)*	*(-2.00)***
D-BHC	0.008	-0.004	-0.004			
	(1.03)	*(-1.00)*	*(-5.36)****			
Observations	1754	2027	79021	1754	2027	79021

Panel C: Second-stage regression results

	Three instruments (EFF-TAX, D-DIV, D-BHC)			Two instruments (EFF-TAX, D-DIV)		
	Large banks	Medium banks	Small banks	Large banks	Medium banks	Small banks
	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA	LC / GTA
EQRAT	6.283	1.541	-5.273	6.091	7.682	-6.054
	*(2.40)***	*(0.15)*	*(-4.87)****	*(2.26)***	*(0.39)*	*(-2.02)***
Observations	1754	2027	79021	1754	2027	79021