The Measurement of Bank Liquidity Creation and the Effect of Capital

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Abstract

Although the modern theory of financial intermediation portrays banks as liquidity creators, comprehensive measures of bank liquidity creation do not exist. We construct such measures and apply them to data on U.S. banks from 1993-2003. Based on our preferred measure, the amount of liquidity created by the banking sector has grown by approximately two-thirds over this period, exceeding $1.5 trillion in 2003. We also analyze the effect of bank capital on liquidity creation, since existing theories produce opposing predictions. We find that capital has a positive effect on liquidity creation for large banks and a negative effect for small banks.

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1. Introduction

According to the modern theory of financial intermediation, an important role of banks in the economy is to create liquidity by funding illiquid loans with liquid demand deposits (e.g. Diamond 1984, Ramakrishnan and Thakor 1984). More generally, banks create liquidity on the balance sheet by transforming less liquid assets into more liquid liabilities. Kashyap, Rajan, and Stein (2002) suggest that banks may also create significant liquidity off the balance sheet through loan commitments and similar claims to liquid funds.

Despite the importance of bank liquidity creation, we are not aware of any comprehensive empirical measurement of liquidity creation by the banking industry. There are no measures to our knowledge that incorporate all the on- and off-balance sheet activities of banks. Moreover, studies of research and policy issues in banking typically focus only on some components of liquidity creation, such as bank loans, which may yield incomplete results.

The first goal of this paper is therefore to develop comprehensive measures of bank liquidity creation and apply these measures to data on U.S. banks. We use annual data on virtually all U.S. banks over 1993-2003, a total of 84,080 bank-year observations. We compare and contrast four alternative measures of liquidity creation, examine the relative importance of different components – assets, liabilities, equity capital, off-balance sheet guarantees, and derivatives – and trace the growth in liquidity creation over time. We also compare liquidity creation between large and small banks.

Our second goal is to use the liquidity creation measures to analyze the effect of bank capital on liquidity creation, an issue of significant research and policy relevance. As discussed below, the theoretical literature produces diametrically opposing predictions, with some suggesting that capital has a negative effect on liquidity creation and others suggesting a positive impact. There are surprisingly few empirical studies of these theoretical predictions, and the ones that do focus only on limited components of liquidity creation.

We use a three-step procedure to construct our liquidity creation measures. In Step 1, we classify all bank assets, liabilities, equity, and off-balance sheet activities as liquid, semi-liquid, and 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 arbitrarily made. 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"). We also 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 below, "cat fat" is our preferred measure.

Our calculations suggest that banks created over $1.5 trillion in liquidity in 2003 using our preferred "cat fat" measure.[1] This is approximately equal to 22% of bank gross total assets or GTA (total assets plus allowance for loan and lease losses and the allocated transfer risk reserve) and about two and a half times the overall level of bank equity capital. Thus, by our estimates, the industry creates approximately $2.5 of liquidity per $1 of capital. Although liquidity creation using this measure declined slightly after 2000, overall bank liquidity creation grew by approximately two-thirds in real terms between 1993 and 2003. Our results are fairly similar when we calculate liquidity creation using our "mat fat" measure that classifies loans based on maturity instead of category. When we use our "nonfat" measures instead – which exclude off-balance sheet activities – the patterns of liquidity creation over time are similar, but the dollar amounts of liquidity creation are much lower. These findings highlight the importance of liquidity created off the balance sheet.

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

We also split our sample into large banks (GTA exceeding $1 billion) and small banks (GTA up to $1 billion) (measured in real 2003 dollars) because of many differences associated with bank size. Based on our preferred "cat fat" measure, large banks are responsible for 85% of industry liquidity creation and about 80% of industry assets, while comprising only about 5% of the sample observations. Both size classes generate significant portions of their liquidity off the balance sheet, but the proportion is much higher for large banks. Both size classes increased liquidity creation in real terms over the sample period, but perhaps surprisingly, small banks had greater growth.

Turning briefly to the theories on the relationship between bank capital and liquidity creation, some recent contributions suggest that bank capital may impede the liquidity creation process because it diminishes the financial fragility that facilitates liquidity creation (e.g., Diamond and Rajan 2000, 2001), or "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 is that higher capital improves banks' ability to create liquidity. Liquidity creation exposes banks to risk – the more liquidity is 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). A well-known role of capital is to absorb risk and expand banks' risk-bearing capacity (e.g., Bhattacharya and Thakor 1993, Repullo 2004, Von Thadden 2004), 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 affect liquidity creation by different banks to different degrees, so the relevant empirical issue is which of the two effects empirically dominates. We address this issue by testing whether the net effect of bank capital on liquidity creation is negative or positive, which would lend support to the empirical dominance of the "financial fragility-crowding out" or "risk absorption" effect, respectively.

We also examine whether this net effect differs with the type of bank in some predictable ways.

Specifically, we expect that the "financial fragility-crowding out" effect may be relatively strong for small banks because they tend to raise funding locally, whereas large banks more often access capital markets, so that it is less likely that capital crowds out deposits for large banks. In contrast, the "risk absorption" effect may be relatively strong for large banks because these institutions are generally subject to more regulatory and market discipline that may affect their ability to absorb risk. Combining these relative strengths suggests that the "financial fragility-crowding out" effect may more likely dominate for small banks while the "risk absorption" effect may more likely dominate for large banks. Similarly, the "risk absorption" effect may be relatively strong for banks with low capital ratios of any size because these banks have thin buffers to absorb risks and tend to face more regulatory, market, and/or owner pressures to control risk taking.

To test the net effect of capital on liquidity creation, we regress the dollar amount of bank liquidity creation (calculated using our four 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 and small banks to allow for the possibility that capital may affect these banks differently. For large banks, we find the net effect of capital on liquidity creation to be positive and statistically significant, consistent with empirical dominance of the "risk absorption" effect. In sharp contrast, we find a negative, statistically significant effect of capital on liquidity creation for small banks, consistent with dominance of the "financial fragility-crowding out" effect for these institutions. When we separate large and small banks based on lagged capitalization (into low-, medium-, and high-capital banks) and rerun our regressions, we find results consistent with our expectation that the "risk absorption" effect may be relatively strong for banks with low capital ratios in both size classes.

In a robustness section, we show that our regression results are robust to using an alternative approach to measuring off-balance sheet liquidity creation, and to using an alternative capital ratio. We also address in depth the potential endogeneity of capital in our regressions using an instrumental variable approach and find that our main results are confirmed.

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 and shows how our four measures of liquidity creation vary over this time period. Section 5 outlines our regression framework and Section 6 has our regression results. Section 7 addresses robustness issues, and Section 8 concludes.

2. Literature review

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 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 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 Kashyap, Rajan, and Stein (2002) and others. In our less-preferred liquidity measures, we try classifying loans by maturity ("mat") and excluding 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. Theoretical relationship between bank liquidity creation and capital

As noted in the introduction, the theoretical literature produces 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.[2]

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.[3]

Under the alternative "risk absorption" hypothesis, higher capital enhances banks' ability to create liquidity. This insight is based on two strands of the literature. One strand consists of papers (e.g., Diamond and Dybvig 1983, Allen and Santomero 1998, Allen and Gale 2004) that argue that

[2] 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.

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

liquidity creation exposes banks to risk. 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 (e.g., Bhattacharya and Thakor 1993, Repullo 2004, Von Thadden 2004) that posit that bank capital absorbs risk and expands banks' risk-bearing capacity. 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 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 through off-balance sheet activities.

2.3. 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, but do not test the effects of bank capital. 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 and they do not examine the effect of bank capital on loan commitments. However, in some cases, they do include the capital ratios in regressions of some liquidity categories, yielding ambiguous predictions related to the effect of capital on liquidity creation.[4]

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, again consistent with the hypothesis of a positive effect of bank capital on liquidity creation (e.g., Berger and Udell 1994, Hancock, Laing, and Wilcox 1995, Peek and Rosengren 1995). However, most studies of the Basel I standards found little effect on lending. Unfortunately, the unusual combination of these three major changes in bank capital that occurred during a recession make it difficult to parse the different effects and to draw general conclusions.

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 of the 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

[4] For example, Gatev and Strahan 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).

components of liquidity creation, and often under unusual circumstances. Our empirical analysis uses a significantly different approach.

3. Construction of our liquidity creation 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.

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.[5]

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

[5] In a robustness check, we use an alternative approach to measuring the liquidity contribution of some of these items (see Section 7).

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.
    - *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 quickly without incurring major losses as liquid assets.

Liabilities plus equity

- Classifying liabilities: We count funds that can be quickly withdrawn by customers – such as transactions deposits and overnight federal funds purchased – as liquid liabilities. We classify other deposits that can be withdrawn with slightly more difficulty or penalty as semi-liquid. We also classify as semi-liquid the balance sheet item 'other borrowed money,' which contains other shortand 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 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 commercial 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.[6] As well, the bank generally cannot sell or participate these items. We classify net standby letters of credit (i.e., the amount outstanding minus the amount conveyed to others), 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 they are functionally similar to on-balance sheet securities.

[6] 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.

- Classifying derivatives: We classify all derivatives – 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.

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 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. As discussed in Step 1, these contracts can be bought and sold easily and are functionally similar to liquid securities. The Call Reports separate these contracts into those with gross positive and gross negative fair values.[7] For derivatives with gross positive fair values, this

[7] Fair values 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

reduces bank liquidity creation as the bank effectively holds a valuable liquid asset in place of the public. For derivatives with gross negative fair values, the negative value is multiplied by a weight of -½, yielding a positive contribution to bank liquidity creation as the bank effectively holds a negatively-valued liquid asset in place of the public.

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 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 to arrive at the total dollar value of liquidity creation at a particular bank. We sum across all banks to obtain the total dollar value of liquidity created by the entire industry.

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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.

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.

It is interesting to 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.[8]

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 corresponding "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. We also argue that the "fat" measures are preferred to the corresponding "nonfat" measures based on the argument that off-balance sheet activities provide liquidity in functionally similar ways to on-balance sheet items. Hence, "cat fat" is our preferred measure.

4. Data and statistics on bank liquidity creation over time

Our sample includes annual data as of December 31 on almost all commercial banks from 1993 to 2003. To ensure that our sample only contains 'true,' viable commercial banks, we impose the following

[8] 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*(assets – liquid liabilities)] / A = [liquid liabilities – liquid assets] / A, which is their LT gap measure.

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);[9] 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.[10] We also eliminate 0.7% of all bank-year observations because some of the exogenous variables used in our regression analysis are missing.

Our sample contains 84,080 bank-year observations: 3,937 bank-year observations for large banks (GTA exceeding $1 billion), and 80,143 for small banks (GTA up to $1 billion).[11] Table 2 shows summary statistics on our liquidity creation measures (Panel A) and their components (Panel B) for the entire banking sector, and separately for large and small banks.

The left side of Panel A shows liquidity creation in 1993 and in 2003 – the first and last years of our sample period, respectively – for all banks, large banks, and small banks for each liquidity creation measure. The right side of the panel shows graphs of the corresponding liquidity creation measure over the entire 1993-2003 period. Starting with our preferred "cat fat" measure – which classifies loans by category and includes off-balance sheet activities – we find that banks created liquidity of $1.570 trillion in 2003. This equals 22% of industry GTA (shown) and represents about $2.5 of liquidity per $1 of equity capital (not shown). Overall liquidity creation increased by approximately two-thirds in real terms from 1993 to 2003. As shown, liquidity creation as a fraction of GTA increased by just one percentage point from 0.21 to 0.22, so liquidity creation grew at a slightly faster rate than GTA. At large banks, liquidity creation increased by almost 60% in real terms, although it declined as a fraction

[9] 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 12,880 bank-year observations (from 96,960 to 84,080), but does not materially affect our findings. Inclusion of these banks would increase liquidity creation of small banks by only 0.6% ($0.0013 trillion) in 2003 based on our "cat fat" measure, and leaves our regression results qualitatively unchanged.

[10] 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.

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

of GTA from 26% in 1993 to 22% in 2003. Large banks created approximately 85% of industry liquidity at the end of the sample period. Perhaps surprisingly, small banks experienced a much larger percentage increase in liquidity creation over the sample period – more than a 100% increase both in real terms and as a fraction of GTA – but still accounted for only about 15% of industry liquidity creation in 2003.

As shown in the graph on the right side of Panel A, despite the significant increase in measured liquidity creation over our sample period, there is a slight decline over the final three years. Analysis of the individual components of liquidity creation over time (not shown in the interest of brevity) suggests that three components of liquidity creation in particular are responsible for this pattern: 1) illiquid assets; 2) illiquid off-balance sheet guarantees; and 3) liquid assets. The major growth in liquidity creation from 1993-2000 was largely driven by strong increases in illiquid assets (weight = ½) and illiquid off-balance sheet guarantees (weight = ½) that outweighed the smaller increases in liquid assets (weight = - ½). Over 2000-2003, illiquid assets showed virtually no growth, illiquid guarantees increased slightly, while the growth in liquid assets continued, causing a mild decline in liquidity creation in these final three years. Note that this pattern occurred only for large banks, which create the majority of liquidity of the banking sector. Liquidity creation by small banks increased in virtually every year over our sample period.

Turning briefly to the other liquidity creation measures, the data show much less measured liquidity creation for the "cat nonfat" measure – which is the same as "cat fat" except for the exclusion of off-balance sheet activities. In 1993, measured "cat nonfat" liquidity creation is less than 40% of that of "cat fat" and only 8% of GTA, and actually falls to only 5% of GTA by 2003. The drop in liquidity creation occurs entirely for large banks – small banks actually tripled their liquidity creation based on the "nonfat" measure – reflecting the much greater role that off-balance sheet activities play for large banks. The "cat nonfat" graph on the right shows that the decline in liquidity creation for this measure was concentrated in the final three years of the sample period, when liquidity creation by large banks fell considerably. Measured liquidity creation increased over 1993-2000 primarily because the above-mentioned increase in illiquid assets outweighed the increase in liquid assets, but the growth was less pronounced than for "cat fat" because the significant rise in illiquid off-balance sheet guarantees is not included in the "nonfat" measure. The decline over 2000-2003 is also more severe because the growth in liquid assets was not partially offset by an increase in illiquid off-balance sheet guarantees. All of these differences between the "cat fat" and "cat nonfat" measures highlight the importance of including off-balance sheet activities.

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 substantially from 22% of GTA in 1993 to 27% in 2003, primarily because most residential mortgages are classified as illiquid (weight = ½) rather than semi-liquid (weight = 0). The "mat fat" pattern of liquidity creation over time is similar to the "cat fat" pattern (see graphs), except that liquidity creation picked up again in the final two years of the sample. The reason is that when loans are classified by maturity, illiquid assets (primarily residential mortgages) grew in those years, and their growth more than offset the growth in liquid assets.

The "mat nonfat" measure – which uses loan maturities and excludes off-balance sheet activities – yields a much smaller measured liquidity creation and its growth rate is below the growth rate of GTA (liquidity creation drops from 12% of GTA in 1993 to 10% of GTA in 2003). The "mat nonfat" liquidity creation pattern resembles the "cat nonfat" pattern, except for the above-mentioned increase in liquidity creation in the final two years of the sample period.

Panel B of Table 2 shows the different components of liquidity creation for 2003, including their dollar amounts, weights, and contributions to all the liquidity creation measures. This panel can be used to gauge the importance of the individual on-balance sheet and off-balance sheet liquidity creation components. Because the liquidity creation formulas include both positive and negative weights, the weighted dollar value of individual components may be close to or even exceed total liquidity creation. For example, the weighted dollar value of illiquid assets using the "cat" measures ($1.376 trillion) is close to the banking sector's overall liquidity creation based on our "cat fat" measure ($1.570 trillion) and exceeds overall liquidity creation based on the "cat nonfat" measure ($0.334 trillion). The illiquid assets component is even larger using the "mat" measure ($1.768 trillion). Off the balance sheet, weighted illiquid guarantees are also quite large ($1.247 trillion or 17% of GTA), which explains why excluding off-balance sheet activities causes liquidity creation to drop from 22% of GTA ("cat fat") to 5% of GTA ("cat nonfat") in 2003.

5. Regression framework

We next turn to our second goal – to analyze the effect of bank capital on liquidity creation. To examine whether the "financial fragility-crowding out" effect versus the "risk absorption" effect empirically dominates, we regress bank liquidity creation on the lagged equity capital ratio using the panel data sets on large and small banks from 1993-2003. We also control for various factors that may affect bank liquidity creation, including 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.

The dependent variables are the dollar amounts of liquidity created by banks (calculated using our four liquidity creation measures) divided by GTA. 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 the large-bank and small-bank size classes.

Table 3 gives descriptions and summary statistics for the exogenous variables. All financial values are expressed in real 2003 dollars using the implicit GDP price deflator. 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. 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 formally test whether bank capital is exogenous, and 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 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 virtually all in the [0,1] interval.

We also control for the bank's merger and acquisition (M&A) 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 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 M&As is important because banks often significantly 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.[12] For banks with offices in more than one local market, we use the weighted averages across these markets, using the proportion of the bank's deposits in each of these markets as the weights.[13]
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, an important component of liquidity creation. We also include SHARE-L, the local market share of large institutions to allow for the possibility that banks of different sizes may compete differently. 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

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

Panels A and B of Table 4 contain the regression results for large banks (GTA exceeding $1 billion) and small banks (GTA up to $1 billion), respectively. The first four columns in both panels give the most basic results. Each normalized liquidity creation measure is regressed on the bank's three-year historical average equity capital ratio, controlling only for bank size as measured by Ln(GTA) and the bank and time fixed effects. The last four columns in both panels show the results of the full specification that includes the remaining control variables. The findings from the partial and full specifications do not differ materially. The results in Panel A suggest that for large banks, the net effect

[12] In some cases, we use New England County Metropolitan Areas (NECMAs) in place of MSAs, but for convenience, we will simply use the term MSA to cover both MSAs and NECMAs.
[13] We use shares of deposits because this is the only banking service for which geographic location is publicly available.

of capital on liquidity creation is positive. The coefficients on the lagged equity capital ratio are positive and statistically significant at the 1% level when liquidity creation is calculated using our preferred "cat fat" measure. The magnitude of the coefficient in the full specification, 0.588, 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 well over half of a percentage point of a large bank's GTA, which appears to be a substantial effect.

The results in Panel A also suggest that the positive, significant effect of capital on liquidity creation holds for both of the "fat" measures of liquidity creation. Using the "nonfat" measures, capital does not significantly affect liquidity creation. Thus, the positive association between capital and liquidity creation for large banks is robust with respect to the "cat" versus "mat" measurement methods, but is not robust with respect to the "fat" versus "nonfat" methods. This suggests 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 similar, suggesting that use of maturities in place of categories for loans has relatively little impact on the measured net effect of capital.

The results in Table 4, Panel B suggest that small banks with higher capital ratios create less liquidity, in sharp contrast to the positive effect of capital found for large banks. All of the coefficients on the lagged capital ratio are negative and significant at the 1% level, yielding a fairly clear result that is robust across the liquidity creation measures and between the partial and full specifications of the control variables. Using our preferred "cat fat" measure, the magnitude of the coefficient on the lagged equity capital ratio in the full specification, -0.376, 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, likely reflecting the much smaller role of these activities for small institutions.

The positive net effect for large banks and negative net effect for small banks are consistent with the suggestions discussed above. That is, the "risk absorption" effect may be relatively stronger for large banks and the "financial fragility-crowding out" effect may be relatively stronger for small banks.

6.2. How components of liquidity creation affect the capital - liquidity creation relationship

To explain why the net effect of capital is so different for large and small banks, we decompose the amount of liquidity created by each bank (calculated using our preferred "cat fat" measure and normalized by GTA) into individual components, and regress each of these components on the lagged capital ratio and the control variables. Panels A and B of Table 5 show the coefficients on EQRAT from these regressions for large 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 parsimony.

Note some simple identities that hold regarding the coefficients on the lagged capital ratio in these equations. First, the coefficients on EQRAT in the three asset equations must total to zero because the sums of the dependent variables identically equal 1 (i.e., illiquid assets/GTA + semi-liquid assets/GTA + liquid assets/GTA = GTA/GTA). Similarly, the four coefficients in the liabilities and equity equations must also total to zero. Second, using the appropriate ½, 0, and -½ weights, the weighted sums of the coefficients on EQRAT in Table 5 identically equal the coefficients on EQRAT in the full "cat fat" specification in Table 4 (0.588 for large banks and -0.376 for small banks, respectively) because total liquidity creation equals the weighted sum of its components.[14]

The results in Panel A suggest that for large banks, capital positively influences liquidity creation on the asset side of the balance sheet as well as off the balance sheet. For example, banks with higher lagged capital ratios have significantly more illiquid assets, fewer liquid assets, and more illiquid guarantees. The coefficients suggest that the largest single estimated effect on liquidity creation operates through illiquid guarantees. The coefficient of 1.398 on EQRAT in the illiquid guarantees regression contributes ½ • 1.398 = 0.699 toward the 0.588 coefficient on EQRAT in the total liquidity

[14] For example, for large banks, ½ • 0.234 + 0 • 0.028 + -½ • -0.262 + ½ • -0.223 + … = 0.588, and similarly for the coefficients on the components for small banks.

creation regression shown in Table 4 Panel A, and actually slightly exceeds the total positive effect of capital, confirming our earlier observation that the exclusion of illiquid guarantees alone is sufficient to wipe out the entire net positive effect of capital on liquidity creation for large banks. The positive effect of capital from assets and off-balance sheet activities for large banks is 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).[15]

Panel B reveals that in stark contrast to large banks, for small banks, capital has a negative effect on liquidity creation on the asset and liability side 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 as a fraction of GTA. Similar to large banks, liquidity creation is reduced by the fact that small banks with higher lagged capital ratios have significantly higher capital ratios in the current period.

6.3. The net effect of capital on liquidity creation for large and small banks split by capital

We indicated above that the "risk absorption" effect may be strong relative to the "financial fragility-crowding out" effect for banks of a given size with lower capital ratios. To analyze this, we separate large banks into low-, medium-, and high-capital banks (mean EQRAT of 0.06, 0.08, and 0.10, respectively) based on the bottom, middle, and top thirds of the distribution of EQRAT. We follow a similar procedure for small banks (mean EQRAT of 0.07, 0.09 and 0.13, respectively). We regress the dollar amount of liquidity creation (calculated using the "cat fat" measure) normalized by GTA on the lagged capital ratio and the full set of control variables for each capital third. Table 6 contains the results. Again, only the EQRAT coefficients are shown in the interest of parsimony.

Panel A shows results for low-, medium-, and high-capital large banks. We find that the net effect of capital is positive and significant only for low-capital large banks. In contrast, Panel B indicates that the negative effect of capital on liquidity creation is significant for all but low-capital

[15] A few other components have statistically significant coefficients, but have no material effect on liquidity creation – some semi-liquid items have 0 weights and the coefficient on derivatives is very small.

small banks. The large and the small bank findings are consistent with the suggestion that the "risk absorption" effect (i.e. the positive effect of capital on liquidity creation) may be relatively strong for banks of a given size with low capital ratios.

7. Robustness issues

In this section, we show robustness of our main finding that the net effect of capital on liquidity creation is positive for large banks and negative for small banks to three changes: 1) an alternative method to measuring off-balance sheet bank liquidity creation; 2) the use of an alternative capital ratio; and 3) an instrumental variable approach.

7.1. Alternative method to measuring off-balance sheet liquidity creation

Our liquidity creation measures are based on the ease, cost, and time for the bank or customer to obtain liquid funds from each bank activity. An alternative would be to use the probability or frequency with which the bank or customers liquefy the obligation 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. The main reason for constructing such a measure is that off-balance sheet illiquid guarantees such as loan commitments and letters of credit account for a substantial portion of industry liquidity creation, while the drawdown frequency on these items is less than 1. Furthermore, our large bank finding that capital has a positive effect on liquidity creation only holds for measures that include off-balance sheet activities.

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 2006).[16] Using this alternative approach, we find that liquidity creation of the banking sector is 44% lower in 1993 ($527 billion versus $947 billion) and 56% lower in 2003 ($697 billion versus $1,570 billion) than using our preferred "cat fat" measure. The overall pattern of liquidity creation, however, is fairly similar to the "cat fat" pattern. When we regress the dollar amount of liquidity creation using this alternative method normalized by GTA on EQRAT and the other exogenous variables, we find that for small banks, the coefficient on EQRAT is negative and significant, while for large banks, the coefficient on EQRAT is positive but not significant (not shown for brevity). Thus, based on this alternative method to measure liquidity creation, we obtain broadly consistent results.

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.

7.2. Alternative capital ratio

In our regression analysis, we used EQRAT, the ratio of equity to GTA, as our key exogenous variable. We now replace EQRAT with the total capital ratio, which we calculate as total capital as defined in the Basel I capital standards divided by GTA. Total capital includes equity plus limited amounts of other financial instruments, such as long-term subordinated debt.[17,18]

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[16] Sufi (2006) 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.

[17] 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

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 are not shown in the tables for brevity's sake, but are available upon request.

The results based on the total capital ratio are qualitatively similar to our main results – the net effect of capital on liquidity creation is positive and significant for large banks based on the "cat" measures (insignificant for the "mat" measures), and negative and significant for small banks for all measures. For both size classes, the observed patterns for low-, medium-, and high-capital banks are also comparable to our reported findings.

7.3. Instrumental variable approach

In our main analysis, we assume that capital is exogenous. We argue that our use of three-year lagged average values of capital should mitigate potential problems of endogeneity. Nevertheless, bank liquidity creation and capital may be jointly determined, and our use of three-year lagged average values may not be sufficient. We address this potential issue using an instrumental variable approach.

We use as instruments three 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. First, we use the three-year lagged average amount of loan and lease loss provisions. These provisions directly reduce capital on a dollar-for-dollar basis and are driven primarily by performance problems on loans issued in prior years, but do not directly affect liquidity creation. Second, we use a dummy variable that equals one if the bank paid dividends in any of the past

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exceeded 8% of adjusted total assets. We estimate the missing numbers using a special Federal Reserve program based on other Call Report information.

[18] 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).

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 a dummy variable that equals one if the bank has been part of a bank holding company in any of the past three years and zero otherwise. Capital is related to bank holding company 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 bank holding company to cross-guarantee each other and provide capital when needed. Besides these formal obligations to inject capital, holding companies may also inject capital voluntarily, thereby giving the entities in the holding company access to internal capital markets when needed. However, being part of a bank holding company does not seem likely to directly affect liquidity creation.

Before running the instrumental variable regressions, we perform a Hausman test for endogeneity, shown in Panel A of Table 7. The null hypothesis is that the potentially endogenous variable (EQRAT) is exogenous. To perform this test, we regress EQRAT on all the exogenous variables we used in the full specification in Table 4 plus the three instruments to obtain the residual values. We then include these residuals as an additional regressor in our original regression (i.e., we regress the dollar amount of liquidity creation normalized by GTA on EQRAT and all the other exogenous variables plus the first-stage residuals). If the coefficients on the residuals are statistically significant, we reject the null hypothesis that EQRAT is exogenous. As shown in Panel A of Table 7, we do not reject the null hypothesis that EQRAT is exogenous for large banks, as the p-values > 0.10 for the Hausman test. The results are very different for small banks – we do find evidence of endogeneity for small banks (p-values < 0.10). The Hausman test results suggest that our original analyses were appropriate for large banks, but that we do need an instrumental variable approach for small banks. We therefore perform instrumental variable regressions only for small banks.

In the first-stage regression, we regress EQRAT on all the exogenous variables plus the instruments. To ensure that our instrumental variable estimates are not biased, we perform F-tests of joint significance of the three instruments. The null hypothesis is that all the coefficients on the instruments are zero. The results in Panel B of Table 7 show that the F-statistics are statistically significant (p-values = 0.00), suggesting that our instrumental variable results will be unbiased. In the second-stage regression, we regress the dollar amount of liquidity creation (normalized by GTA) on the fitted or predicted values of EQRAT plus all other exogenous variables. In Panel C of Table 7, we show the second-stage instrumental variable regressions for small banks. The results are similar to our main small bank results – the coefficient on EQRAT is negative and significant in all four specifications. Thus, our instrumental variable analysis confirms our main results that the net effect of capital on liquidity creation is positive for large banks and negative for small banks.

8. Conclusion

According to the banking theory, an important role of banks in the economy is to create liquidity. In this paper, we develop comprehensive measures of bank liquidity creation because no such measures seem to exist. We apply these measures to data on U.S. banks over 1993-2003, and use the liquidity creation measures to analyze the effect of bank capital on liquidity creation, an issue of significant research and policy relevance.

To construct liquidity creation measures, we classify all bank activities as liquid, semi-liquid, and illiquid 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. For activities other than loans, we do this by combining information on product category and maturity, but due to data limitations, we classify loans entirely by category or maturity. We construct four alternative measures, which alternatively classify loans by product category ("cat") or maturity ("mat"), and alternatively include off-balance sheet activities ("fat") or exclude these activities ("nonfat"). Our calculations suggest that banks created over $1.5 trillion in liquidity in 2003 based on our preferred "cat fat" measure. Liquidity creation grew by approximately two-thirds in real terms between 1993 and 2003, despite declining slightly between 2000 and 2003. The dollar amount of liquidity creation is similar using our "mat fat" measure. The liquidity creation pattern over time is also comparable, except that liquidity creation increased again after a dip in 2000. Liquidity creation drops by over 50% when we instead use the two "nonfat" measures. Notably, off-balance sheet activities account for a significant portion of the industry's liquidity creation.

We examine how capital affects liquidity creation since the theoretical literature yields conflicting predictions. Some contributions argue that higher capital may suppress liquidity creation by reducing financial fragility and/or crowding out liquid deposits ("financial fragility-crowding out" effect). Others suggest that banks with higher capital may create more liquidity because capital gives them greater capacity to absorb the risks associated with liquidity creation ("risk absorption" effect). We find very different relationships between capital and liquidity creation for large and small banks. For large banks (GTA over $1 billion) – which hold the vast majority of industry assets – the observed net effect of bank capital on liquidity creation is positive and statistically significant, consistent with dominance of the "risk absorption" effect. In contrast, for small banks (GTA up to $1 billion) – which comprise the vast majority of industry observations – the estimated net effect of capital is negative and statistically significant, consistent with dominance of the "financial fragility-crowding out" effect. We also find that the "risk absorption" effect is strong relative to the "financial fragility-crowding out" effect for banks with low capital ratios in both size classes. All of these regression results are consistent with expectations formulated in the paper. Furthermore, our results are robust to using an alternative method to measure off-balance sheet liquidity creation, a broader measure of capital, and an instrumental variable approach that takes the potential endogeneity of capital into account.

In this paper, we construct empirical measures of liquidity creation, apply these measures to data on U.S. banks over time, and test the net effects of bank capital on liquidity creation. Our liquidity creation measures may also be used to address a number of other issues that are beyond the scope of this paper, but may be pursued in future research. These include, but are not limited to: a comparative analysis of bank liquidity creation across nations, the impact of liquidity creation on economic growth, and an assessment of liquidity created by markets relative to banks.

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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 (domestic)	Savings deposits (domestic)	Bank's liability on bankers acceptances
Overnight federal funds purchased	Time deposits (domestic)	Subordinated debt
Trading liabilities	Foreign deposits	Other liabilities
	Other borrowed money	Equity

OFF-BALANCE SHEET GUARANTEES (notional values):

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

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

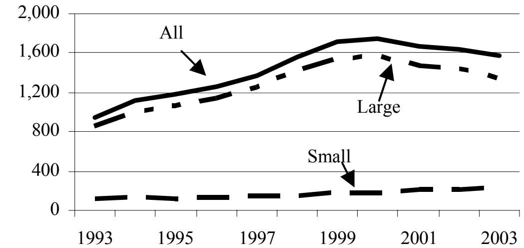
Panel A shows liquidity creation of the banking sector, measured using all four liquidity creation measures, in $ billion and as a fraction of gross total assets (GTA) in 1993 and 2003 on the left, and liquidity creation from 1993 – 2003 on the right. Panel B contains the components of liquidity creation for 2003. Both panels show results for all banks, large banks (GTA exceeding $1 billion), and small banks (GTA up to $1 billion). All financial values are expressed in real 2003 dollars using the implicit GDP price deflator.

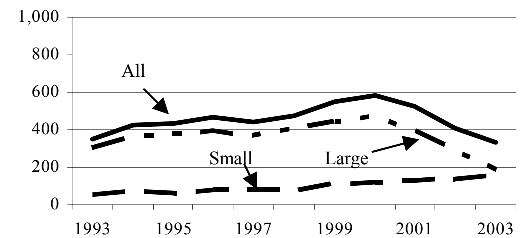
cat (mat): all bank activities other than loans are classified based on product category and maturity; loans are classified by category (maturity) only.
fat (nonfat): off-balance sheet activities are included (excluded).

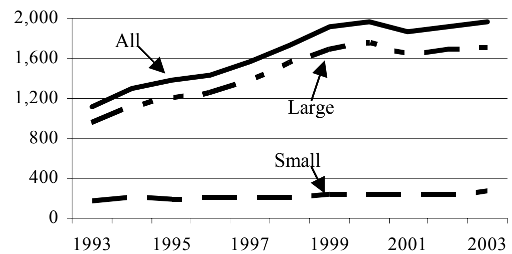
Panel A: Liquidity creation in 1993 and 2003 (left) and over time (right)

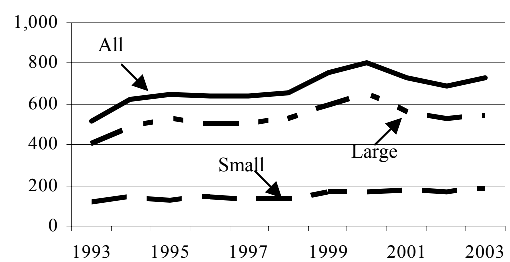
Liquidity creation measure used:		1993 liquidity creation N	1993 liquidity creation ($ billion)	1993 liquidity creation (fraction of GTA)	2003 liquidity creation N	2003 liquidity creation ($ billion)	2003 liquidity creation (fraction of GTA)
cat fat (preferred)	All banks	9,071	947	0.21	6,959	1,570	0.22
	Large	411	845	0.26	348	1,340	0.22
	Small	8,660	103	0.09	6,611	229	0.19
cat nonfat	All banks	9,071	347	0.08	6,959	334	0.05
	Large	411	300	0.09	348	183	0.03
	Small	8,660	47	0.04	6,611	151	0.12
mat fat	All banks	9,071	1,116	0.25	6,959	1,961	0.27
	Large	411	944	0.29	348	1,702	0.28
	Small	8,660	172	0.15	6,611	260	0.21
mat nonfat	All banks	9,071	516	0.12	6,959	726	0.10
	Large	411	399	0.12	348	544	0.09
	Small	8,660	117	0.10	6,611	182	0.15

Liquidity creation 1993 - 2003 ($ billion)









Panel B: Components of 2003 liquidity creation

		Unweighted dollar value ($ billion) (i)	Weight (ii)	Weighted dollar value ($ billion) (iii) = (i) * (ii)	GTA ($ billion) (iv)	Weighted dollar value (fraction of GTA) (v) = (iii) / (iv)
Illiquid assets (cat)	All banks	2,752	0.5	1,376	7,206	0.19
	Large	2,199	0.5	1,100	5,988	0.18
	Small	553	0.5	277	1,218	0.23
Illiquid assets (mat)	All banks	3,536	0.5	1,768	7,206	0.25
	Large	2,922	0.5	1,461	5,988	0.24
	Small	614	0.5	307	1,218	0.25
Semi-liquid assets (cat)	All banks	1,905	0	0	7,206	0.00
	Large	1,625	0	0	5,988	0.00
	Small	280	0	0	1,218	0.00
Semi-liquid assets (mat)	All banks	1,120	0	0	7,206	0.00
	Large	901	0	0	5,988	0.00
	Small	219	0	0	1,218	0.00
Liquid assets	All banks	2,550	-0.5	-1,275	7,206	-0.18
	Large	2,165	-0.5	-1,083	5,988	-0.18
	Small	384	-0.5	-192	1,218	-0.16
Liquid liabilities	All banks	1,459	0.5	730	7,206	0.10
	Large	1,188	0.5	594	5,988	0.10
	Small	271	0.5	136	1,218	0.11
Semi-liquid liabilities	All banks	4,753	0	0	7,206	0.00
	Large	3,943	0	0	5,988	0.00
	Small	809	0	0	1,218	0.00
Illiquid liabilities	All banks	370	-0.5	-185	7,206	-0.03
	Large	350	-0.5	-175	5,988	-0.03
	Small	20	-0.5	-10	1,218	-0.01
Equity	All banks	624	-0.5	-312	7,206	0.00
	Large	506	-0.5	-253	5,988	0.00
	Small	118	-0.5	-59	1,218	0.00
Illiquid guarantees	All banks	2,494	0.5	1,247	7,206	0.17
	Large	2,338	0.5	1,169	5,988	0.20
	Small	156	0.5	78	1,218	0.06
Semi-liquid guarantees	All banks	1,069	0	0	7,206	0.00
	Large	1,063	0	0	5,988	0.00
	Small	7	0	0	1,218	0.00
Liquid guarantees	All banks	-1	-0.5	0	7,206	0.00
	Large	-1	-0.5	0	5,988	0.00
	Small	0	-0.5	0	1,218	0.00
Liquid derivatives	All banks	23	-0.5	-12	7,206	0.00
	Large	23	-0.5	-12	5,988	0.00
	Small	0	-0.5	0	1,218	0.00

Table 3: 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. 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 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	0.10
Bank size				
Ln(GTA)	Natural log of GTA.	11.61	15.15	11.44
Mergers and acquisitions (M&As)				
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	0.52	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	0.08	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	0.16	0.21
SHARE-L	Share of market bank and thrift deposits held by large banks (GTA exceeding $1 billion).	0.32	0.57	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	14.03	11.80
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.	4.69	6.31	4.61
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
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 4: Regression results using the four liquidity creation measures (normalized by GTA) as the dependent variable

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). Panel A contains the results for large banks (GTA exceeding $1 billion). Panel B shows the results for 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-BHC is a dummy that equals 1 if the bank has been part of a Bank Holding Company (BHC) over the past 3 years. D-MBHC is a dummy that equals 1 if the bank has been part of a Multi-Bank Holding Company (MBHC), i.e., a BHC with more than one bank, over the past 3 years. 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-L is the share of market bank and thrift deposits held by large banks (GTA exceeding $1 billion). 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. 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. Heteroskedasticity robust t-statistics are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Panel A: Regression results for large banks (GTA exceeding $1 billion)

	cat fat / GTA	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**	**cat fat / GTA**	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**
EQRAT	0.632	-0.121	0.686	-0.067	0.588	-0.115	0.627	-0.076
	*(1.96)***	*(0.66)*	*(2.16)***	*(0.39)*	*(1.78)**	*(0.63)*	*(1.91)**	*(0.43)*
Ln(GTA)	-0.021	-0.002	-0.010	0.009	-0.025	-0.004	-0.014	0.007
	*(1.89)**	*(0.47)*	*(0.89)*	*(1.71)**	*(2.17)***	*(0.86)*	*(1.16)*	*(1.32)*
D-BANK-MERGE					0.007	0.002	0.010	0.006
					(1.31)	*(0.77)*	*(1.92)**	*(1.70)**
D-DELTA-OWN					-0.005	-0.017	0.005	-0.007
					(0.26)	*(2.64)****	*(0.26)*	*(1.08)*
HERF					0.106	0.011	0.263	0.168
					(0.63)	*(0.13)*	*(1.49)*	*(2.00)***
SHARE-L					-0.067	-0.027	-0.068	-0.029
					*(2.63)****	*(1.79)**	*(2.50)***	*(1.69)**
POP					0.040	0.013	0.029	0.001
					*(2.63)****	*(1.72)**	*(1.79)**	*(0.14)*
DENSITY					-0.051	-0.023	-0.036	-0.008
					*(3.08)****	*(2.82)****	*(2.13)***	*(0.87)*
INC-GROWTH					0.330	-0.140	0.274	-0.196
					(1.55)	*(1.11)*	*(1.24)*	*(1.42)*
Constant	0.464	0.131	0.359	0.027	0.277	0.141	0.221	0.085
	*(2.75)****	*(1.81)**	*(2.05)***	*(0.34)*	*(1.90)**	*(1.63)*	*(1.44)*	*(0.87)*
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3937	3937	3937	3937	3937	3937	3937	3937
Adjusted R-squared	0.71	0.82	0.67	0.80	0.71	0.82	0.67	0.80

Table 4: Regression results using the four liquidity creation measures (normalized by GTA) as the dependent variable – cont'd

Panel B: Regression results for small banks (GTA up to $1 billion)

	cat fat / GTA	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**	**cat fat / GTA**	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**
EQRAT	-0.354	-0.365	-0.415	-0.425	-0.376	-0.385	-0.439	-0.448
	*(10.60)******	*(12.71)******	*(14.38)******	*(17.23)******	*(11.22)******	*(13.39)******	*(15.23)******	*(18.17)******
Ln(GTA)	-0.003	-0.005	-0.022	-0.024	-0.009	-0.010	-0.028	-0.029
	*(1.81)**	*(3.03)******	*(12.01)******	*(14.18)******	*(4.60)******	*(5.81)******	*(14.43)******	*(16.52)******
D-BANK-MERGE					0.009	0.009	0.013	0.012
					*(6.58)******	*(7.05)******	*(9.05)******	*(9.59)******
D-DELTA-OWN					0.007	0.006	0.005	0.005
					*(6.28)******	*(6.35)******	*(4.82)******	*(4.65)******
HERF					0.032	0.029	0.009	0.006
					*(3.11)******	*(3.06)******	*(0.85)*	*(0.57)*
SHARE-L					0.014	0.011	0.015	0.012
					*(4.35)******	*(3.55)******	*(4.39)******	*(3.57)******
POP					0.007	0.007	0.009	0.009
					*(2.39)****	*(2.72)******	*(3.06)******	*(3.30)******
DENSITY					0.013	0.011	0.006	0.004
					*(2.67)******	*(2.53)****	*(1.21)*	*(0.90)*
INC-GROWTH					0.063	0.019	0.016	-0.027
					*(3.99)******	*(1.36)*	*(0.99)*	*(1.88)**
Constant	0.128	0.114	0.377	0.363	0.043	0.033	0.310	0.299
	*(5.80)******	*(5.83)******	*(17.28)******	*(18.39)******	*(1.62)*	*(1.36)*	*(11.30)******	*(11.91)******
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	80143	80143	80143	80143	80143	80143	80143	80143
Adjusted R-squared	0.85	0.83	0.82	0.80	0.85	0.83	0.82	0.80

Table 5: Regression results using the individual liquidity creation components of "cat fat" (normalized by GTA) as dependent variable (coefficients other than EQRAT not shown)

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 "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)..

Panel A contains the results for large banks (GTA exceeding $1 billion). Panel B shows the results for small banks (GTA up to $1 billion). Both 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.

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

Panel A: Regression results for large banks (GTA exceeding $1 billion)

	Assets / GTA			**Liabilities / GTA**			**Equity / GTA**	**Guarantees / GTA**			**Derivatives / GTA**
	illiquid (cat)	**semi-liquid (cat)**	**liquid**	**liquid**	**semi-liquid**	**illiquid**	**equity**	**illiquid**	**semi-liquid**	**liquid**	**liquid**
Weight:	*½*	*0*	*-½*	*½*	*0*	*-½*	*-½*	*½*	*0*	*-½*	*-½*
EQRAT	0.234	0.028	-0.262	-0.223	-0.281	-0.011	0.514	1.398	-0.332	0.001	-0.008
	*(1.95)**	*(-0.34)*	*(2.12)***	*(-1.50)*	*(1.86)**	*(-0.13)*	*(5.50)****	*(2.40)***	*(1.81)**	*(-0.82)*	*(1.90)**
Observations	3937	3937	3937	3937	3937	3937	3937	3937	3937	3937	3856
Adj. R-squared	0.87	0.84	0.81	0.75	0.74	0.71	0.70	0.51	0.67	0.21	0.22

Panel B: Regression results for small banks (GTA up to $1 billion)

	Assets / GTA			**Liabilities / GTA**			**Equity / GTA**	**Guarantees / GTA**			**Derivatives / GTA**
	illiquid (cat)	**semi-liquid (cat)**	**liquid**	**liquid**	**semi-liquid**	**illiquid**	**equity**	**illiquid**	**semi-liquid**	**liquid**	**liquid**
Weight:	*½*	*0*	*-½*	*½*	*0*	*-½*	*-½*	*½*	*0*	*-½*	*-½*
EQRAT	0.002	-0.164	0.163	-0.259	-0.091	-0.011	0.361	0.018	0.001	0.001	0.000
	(-0.06)	*(9.73)****	*(6.76)****	*(18.90)****	*(5.07)****	*(2.36)***	*(25.48)****	*(-0.94)*	*(-0.30)*	*(1.70)**	*(-0.06)*
Observations	80143	80143	80143	80143	80143	80143	80143	80143	80143	80143	78669
Adj. R-squared	0.88	0.87	0.81	0.78	0.77	0.68	0.81	0.81	0.50	0.05	0.27

Table 6: Regression results for large and small banks split by capitalization with "cat fat" (normalized by GTA) as the dependent variable (coefficients other than EQRAT not shown)

This table presents regression results for large and small banks split by capitalization. The dependent variable is the dollar amount of liquidity a bank has created normalized by GTA. The dollar amount of liquidity created is calculated using our "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).

Panel A contains the results for large banks (GTA exceeding $1 billion). Panel B shows the results for small banks (GTA up to $1 billion). Both 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.

We separate large banks into low-, medium-, and high-capital banks based on the bottom, middle, and top thirds of the distribution of EQRAT, and follow a similar procedure for small banks.

The sample period is 1993-2003. Heteroskedasticity robust t-statistics are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Panel A: Regression results for large banks (GTA exceeding $1 billion)

	cat fat / GTA			
	All large banks	**Low-capital large banks**	**Medium-capital large banks**	**High-capital large banks**
Mean EQRAT	*0.08*	*0.06*	*0.08*	*0.10*
EQRAT	0.588	1.628	-0.176	0.558
	*(1.78)**	*(1.96)**	*(-0.15)*	*(-0.72)*
Observations	3937	1315	1302	1320
Adjusted R-squared	0.71	0.85	0.84	0.63

Panel B: Regression results for small banks (GTA up to $1 billion)

	cat fat / GTA			
	All small banks	**Low-capital small banks**	**Medium-capital small banks**	**High-capital small banks**
Mean EQRAT	*0.10*	*0.07*	*0.09*	*0.13*
EQRAT	-0.376	0.123	-0.333	-0.399
	*(11.22)****	*(-1.05)*	*(3.15)****	*(5.81)****
Observations	80143	26717	26704	26722
Adjusted R-squared	0.85	0.82	0.86	0.89

Table 7: Instrumental variable regression results using the four liquidity creation measures (normalized by GTA) as the dependent variable

This table contains results from our instrumental variable approach. Panel A contains initial test results for large banks (GTA exceeding $1 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 B shows first-stage test results for small banks. Panel C contains second-stage regression results for small banks. 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.

EQRAT is instrumented with the 3-year lagged average amount of provisions, a dummy that equals 1 if the bank has paid dividends in any of the past three years, and a dummy that equals 1 if the bank has been part of a bank holding company over the past three years. 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-L is the share of market bank and thrift deposits held by 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. Heteroskedasticity robust t-statistics are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

The Hausman endogeneity test tests the null hypothesis that EQRAT is exogenous (p-values are in parentheses). The instruments F-test tests the null hypothesis that the instruments in the first-stage regression (not shown) are jointly zero (p-values are in parentheses).

Panel A: Hausman endogeneity test results

	cat fat / GTA	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**
Test results for large banks:				
Hausman endogeneity test	1.88	1.51	0.90	0.26
(p-value of Hausman test)	*(0.17)*	*(0.22)*	*(0.34)*	*(0.61)*
Test results for small banks:				
Hausman endogeneity test	97.39	92.05	54.16	42.06
(p-value of Hausman test)	*(0.00)****	*(0.00)****	*(0.00)****	*(0.00)****

Panel B: First-stage regression test results for small banks (GTA up to $1 billion)

	cat fat / GTA	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**
Instruments F-test	38.34	38.34	38.34	38.34
(p-value of F-test)	*(0.00)****	*(0.00)****	*(0.00)****	*(0.00)****

Panel C: Second-stage regression results for small banks (GTA up to $1 billion)

	cat fat / GTA	**cat nonfat / GTA**	**mat fat / GTA**	**mat nonfat / GTA**
EQRAT	-2.113	-1.787	-1.700	-1.373
	*(5.39)****	*(5.33)****	*(5.13)****	*(4.87)****
Ln(GTA)	-0.071	-0.060	-0.073	-0.062
	*(5.16)****	*(5.10)****	*(6.23)****	*(6.21)****
D-BANK-MERGE	0.022	0.019	0.022	0.019
	*(7.00)****	*(7.04)****	*(8.07)****	*(8.08)****
D-DELTA-OWN	0.008	0.007	0.006	0.005
	*(6.28)****	*(6.31)****	*(5.04)****	*(4.79)****
HERF	0.049	0.042	0.021	0.015
	*(4.29)****	*(4.17)****	*(1.83)**	*(-1.39)*
SHARE-L	0.017	0.013	0.017	0.013
	*(4.81)****	*(4.04)****	*(4.77)****	*(3.91)****
Ln(POP)	0.011	0.010	0.012	0.011
	*(3.35)****	*(3.63)****	*(3.74)****	*(3.90)****
Ln(DENSITY)	0.016	0.014	0.009	0.006
	*(3.10)****	*(2.96)****	*(1.68)**	*(-1.29)*
INC-GROWTH	0.072	0.027	0.022	-0.022
	*(4.25)****	*(1.78)**	*(-1.37)*	*(-1.50)*
Time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	78892	78892	78892	78892