

Can Banks Provide Liquidity in a Financial Crisis?

By Nada Mora

In financial crises of the recent past, investors often withdrew from securities markets and placed their funds into safer assets, such as U.S. Treasuries and bank deposits. During such episodes, a wide range of businesses shut out of securities markets sought to fund their operations by drawing down credit lines established with banks during normal times. Awash with funds from depositors seeking a safe haven, banks had no difficulty meeting these increased credit demands. Thus, banks helped avoid financial disruptions and business liquidations that would have occurred in the absence of a liquidity backstop.

In 2007-09, however, banks were at the center of the financial crisis. While significant risks were present in some other financial institutions, this crisis was special in that commercial banks were much more exposed to losses than in recent past crises. This key feature of the crisis casts doubt on the notion that banks are a natural source of liquidity during financial crises. Were bank deposits still viewed as a safe haven, and if not, how compromised was their ability to meet the demand for liquidity? This article examines how commercial bank deposits and

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lending evolved during the recent crisis compared with past episodes of financial stress.

The article concludes that the bank-centered nature of the crisis made it harder than in the past for banks to attract deposits and provide liquidity to borrowers shut out of securities markets. The first section of the article explores the main similarity and the key difference of the 2007-09 financial crisis with previous financial market disruptions. The second section reviews the theory that banks can provide liquidity when financial markets and other financial institutions cannot—and why the theory might break down in a bank-centered crisis. The third section presents new evidence, both from aggregate and individual bank data, that funds did not flow into bank deposits as robustly as in past times of stress and bank lending did not increase as much. To determine if these differences were due to the bank-centered nature of the crisis, the section also investigates whether deposits and loans increased less at banks where deposits were more likely to be viewed as unsafe.

I. COMPARING THE 2007-09 CRISIS WITH PREVIOUS FINANCIAL CRISES

The financial crisis of 2007-09 was similar to previous crises in that the need for liquidity by businesses and households was unmet by market-based sources of funding. There was also a key difference: The banking system was arguably more adversely affected by credit losses and uncertainty surrounding these losses than in recent previous crises.

The similarity of the 2007-09 and past crises

One common feature of past financial crises was a need for liquidity. Businesses, households, and other economic entities needed funds to cover day-to-day operations and investments, but found it difficult or even impossible to borrow in securities markets. The investors that supplied market funds may have suffered a major loss in one market or may have changed their beliefs about risks or uncertainty in the economy. As a result, these investors shifted funds to low-risk assets, such as U.S. Treasury bonds, in what is known as a “flight to safety.” Thus, borrowers from a range of sectors became vulnerable to financing disruptions at the same time—that is, to a systemic liquidity shortage.

In such crises, the demand for liquidity usually came from nonfinancial businesses. Even large, creditworthy corporations found it difficult to place corporate bonds, raise equity financing, and even borrow short-term by selling promissory notes such as commercial paper.¹ As it got difficult to renew maturing commercial paper, firms relied on borrowing at shorter maturities, such as overnight financing. Even companies with continued access to the commercial paper market faced rising costs of funding.

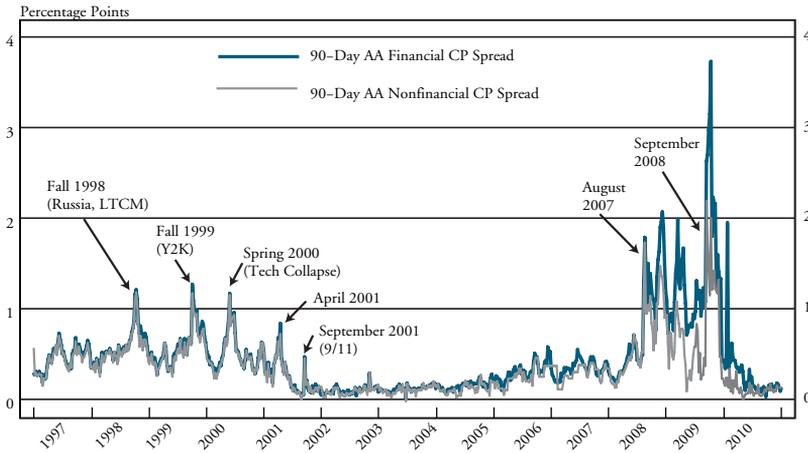
One important example of the need for liquidity in past episodes of financial stress was the bankruptcy of Penn Central, a railroad company. Its bankruptcy in 1970 was the largest up to that time and resulted in a flight to safety by investors. As a result, firms from a wide range of industries not related to transportation found that they could not refinance their commercial paper.

A more recent example was the liquidity squeeze in the fall of 1998, following the Russian sovereign debt default (Chart 1). This event led to increased volatility in global financial markets that spilled over to the United States and led to the failure of the Long Term Capital Management (LTCM) hedge fund. As a result, market liquidity—that is, the supply of credit from market sources, such as corporate bonds, equity, and commercial paper—was disrupted. For example, the difference between the commercial paper interest rate paid by a typical high-grade borrower relative to that paid by the U.S. Treasury on an equal maturity of 90 days jumped about 50 basis points, from roughly 0.50 percent at the end of August 1998 to over 1 percent by early October.

Similar episodes followed: the Y2K uncertainty at the end of 1999, the bursting of the tech bubble in the spring of 2000, and the terrorist attacks on September 11, 2001 (Hakkio and Keeton).²

A demand for liquidity by businesses was also evident in the financial crisis of 2007-09. The commercial paper spread first spiked in the middle of August 2007 to over 100 basis points for those borrowers still able to access the commercial paper market (Chart 1). At the same time, many companies were shut out of securities markets and could not renew debt even at short-term maturities of less than one year. Institutional investors, such as money market funds that typically buy the commercial paper of a wide range of companies, reduced their holdings of this paper. Outstanding unsecured commercial paper fell

Chart 1
COMMERCIAL PAPER SPREADS 1997–2009



Source: Federal Reserve H15 release

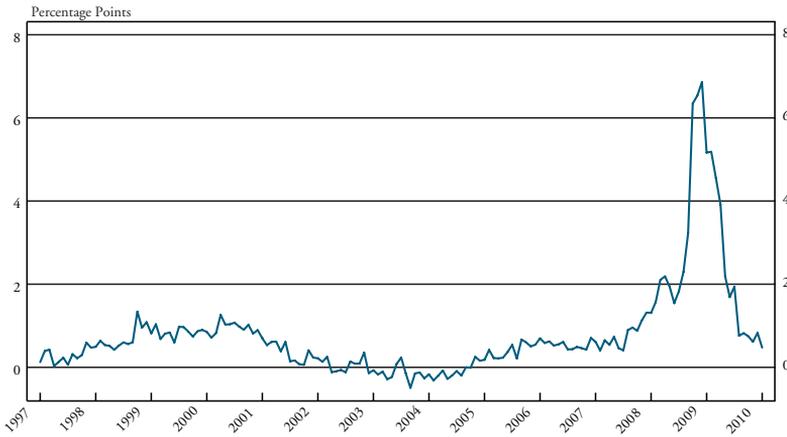
Note: Data are weekly

about 6 percent from July to August 2007. A second wave of market stress took place in September 2008, following the Lehman Brothers bankruptcy and the failures of other financial institutions, as commercial paper spreads shot up above 200 basis points. This time, unsecured commercial paper dropped 13 percent from a month earlier.

In this crisis, the special entities set up to intermediate securities created from mostly household debt were also shut out of capital markets, and they also experienced an increased demand for liquidity. Since the 1980s, many consumer loans, such as auto loans, credit card debt, and student debt, had been packaged together into asset-backed securities (ABS). These securities helped to diversify the risk of any one household falling behind on its loan. Investors, such as mutual funds, were willing to hold these securities in their portfolios because they did not have to examine information about each household, a costly exercise. But such investors generally prefer shorter-term securities than mortgage-backed securities and ABS, which typically have maturities of five to ten years. This led to the development of the asset-backed commercial paper (ABCP) market. ABCP is short-term commercial paper issued by special entities (conduits or structured investment vehicles) to fund assets such as ABS. As a result of these developments, households enjoyed a cheaper cost of funds, and the conduits and structured

Chart 2

CONSUMER ABS SPREAD 1997–2009



Source: Citicorp for ABS yield via Bloomberg
 Federal Reserve H15 release for Treasury 5-year yield
 Note: Data are monthly

investment vehicles set up to issue ABCP were able to roll over their short-term liabilities backed by asset-backed securities. In July 2007, outstanding ABCP equaled \$1.2 trillion, accounting for the largest part of the commercial paper market.³

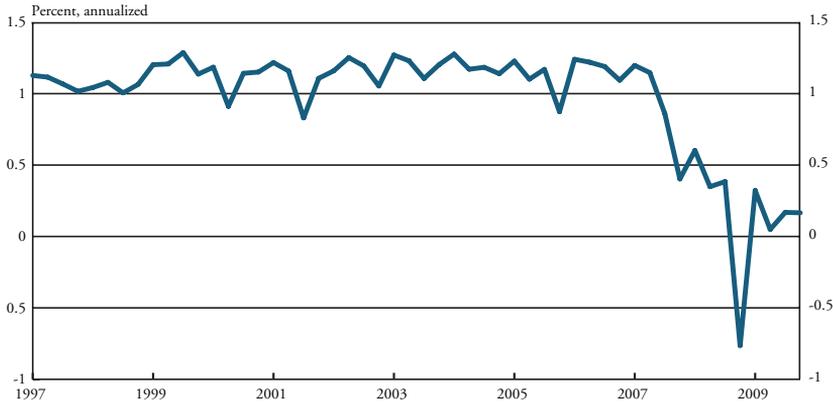
As with corporate debt, the supply of funding for securities backed by household debt was sensitive to shocks to market liquidity. In the crisis of 2007-09, risk assessments first rose on subprime mortgage-related securities and then increased on other ABS (Chart 2). The resulting systemic freeze in market liquidity also affected ABCP issuers, and ABCP issuance came to a halt. As a result, outstanding ABCP fell 17 percent from July to August 2007.

The difference between the 2007-09 crisis and past financial crises

While this crisis resembled crises of the recent past in terms of liquidity demand, it differed in that its risks were more concentrated in the banking system.⁴ The performance of the commercial banking system declined more sharply in this crisis than in past crises. The banking system's profitability fell as aggregate return on assets dropped from 1 percent at an annual rate at the start of 2007 to nearly -1 percent by the end of 2008 (Chart 3).⁵ In contrast, return on assets hovered

Chart 3

BANK PROFITABILITY (RETURN ON ASSETS) 1997-2009

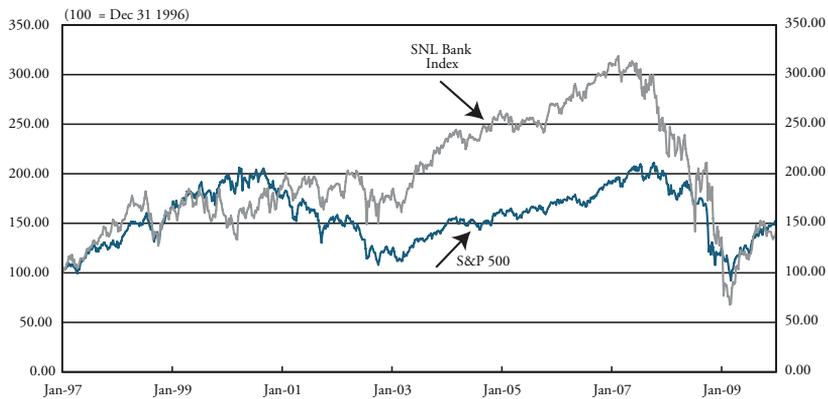


Source: Reports of Condition and Income

Note: Data are quarterly

Chart 4

1997-2009 BANK EQUITY PERFORMANCE



Source: <http://www.google.com/finance> and SNL Financial

around 1 percent during the earlier episodes of financial stress, such as the LTCM crisis. The market value of bank equity also took a hit, edging down sooner and more sharply than the aggregate S&P 500 market index (Chart 4).

Commercial banks were especially affected in this crisis because of their exposure to real estate loans and mortgage-related securities, which soured as the house price boom came to an end. Many of these securi-

ties found their way onto banks' balance sheets, as opposed to being sold to institutional investors such as money market funds and pension funds. As a result, commercial banks' holdings of real estate loans and mortgage-backed securities accounted for about 40 percent of the total amount of such loans and securities outstanding in 2007.⁶

All banks, not just banks with a concentrated exposure to mortgage-related securities, suffered in the crisis due to the panic that developed from a lack of information and loss of confidence. Uncertainty about exposures related to mortgages made it impossible for counterparties—even among banks—to gauge the other party's soundness. As a result, the interbank interest spread reached unprecedented levels. The financial commercial paper market, a marginal source of funding for the banking system, was also severely strained (Chart 1).⁷ Banks had to pledge more collateral for any given amount of borrowing that they were able to obtain. The uncertainty and lack of information about the quality of banks' assets caused initial losses on subprime mortgage securities to morph into a much wider banking crisis.⁸

II. BANKS AS LIQUIDITY PROVIDERS

In theory, banks are well suited to provide liquidity during typical financial crises when financial markets, such as the commercial paper market, cannot. Banks are viewed as safe havens because their deposits are explicitly or implicitly guaranteed by the government. Thus, the funds that flow into bank deposits during times of market stress are available to finance loans to borrowers in need of liquidity. This section explains this relationship and why banks may not be as well suited to provide liquidity in a bank-centered crisis.⁹

How banks provide liquidity

To provide liquidity in a crisis, banks supply credit, especially short-term credit, to groups shut out of the capital markets. These groups, discussed in Section I, include nonfinancial corporations that cannot sell commercial paper, households needing to finance consumption, and conduits facing little appetite for their asset-backed commercial paper.

How is it that banks offer liquidity to these borrowers when the market is unwilling to do so? To understand how, it is important to recognize that these borrowers have typically established in normal

times various forms of backup credit lines with commercial banks. In this article, the term credit line refers to any commitment (whether explicit or implicit) offered by a bank to a given borrower on terms often negotiated prior to the crisis. Examples of such commitments include commercial paper backup lines, consumer home equity lines, overdraft protection, asset-backed commercial paper credit enhancements via standby letters of credit, and so on. By honoring these credit lines during financial crises, banks serve as insurance for borrowers who suddenly find themselves liquidity-constrained. These borrowers turn to banks for the funds needed to avoid the disruptions and liquidations that would occur in the absence of this insurance.

The main institutional characteristics of a bank are that it makes loans and offers demand deposits. When a borrower accesses a credit line, the amount taken down is transferred from the bank's off-balance-sheet to its balance sheet. The bank's loan portfolio therefore increases, all else held constant. Banks typically honor these commitments, even when they are not legally obliged to do so. In the past, credit lines were extended mainly to businesses or households. More recently, however, banks have extended credit lines to the special entities that issue ABCP.¹⁰

Why banks have an advantage in providing liquidity

The discussion so far has shown how banks provide liquidity to borrowers in need of funds. But why is it that banks are special in this sense? That is, why do banks have an advantage in providing these credit lines that other financial institutions, such as finance companies, do not?

Diversification. One important advantage for banks relates to how they resolve the liquidity management problem that arises when commitments are converted into funded loans. To provide liquidity on demand, a financial institution must hold a liquid asset buffer. These assets can take the form of cash or securities like U.S. Treasury bills that can be easily transformed into cash without a loss of value. Liquidating such assets means that the proceeds can be used to finance the drawn credit lines. In theory, any financial institution could hold sufficient liquid cushions. But holding a sufficiently ample amount of liquid assets is costly because the return on these assets is low compared with the alternative use of these funds.

How do banks avoid holding a large amount of idle low-return liquid assets, even though they are the dominant financial institution offering credit lines? They combine deposit-taking with loan commitments. A synergy exists between these two activities to the extent that both services require banks to hold balances of liquid assets to provide liquidity on demand to depositors as well as to credit line borrowers. Banks diversify the liquidity demands of their depositors and borrowers and, in so doing, economize on this common liquid resource. Diversification is possible as long as depositors and borrowers have liquidity demands that are independent in the sense that deposit withdrawals are uncorrelated with drawdowns of credit lines. In this way, banks are able to save on the cost of holding the liquid asset buffer in a way that finance companies, which make loans but do not take deposits, cannot. Banks pass on the lower cost to their depositors and borrowers (Kashyap and others).

Deposit inflows during financial crises. As just discussed, banks will have an advantage in providing liquidity if deposit withdrawals and commitment draw-downs are not correlated. In fact, studies have shown that during past episodes of market stress, they were negatively related (Saidenberg and Strahan; Gatev and Strahan; Gatev, Schuermann, and Strahan). For example, when the commercial paper market encountered stress, the funds that investors pulled out of this market flowed primarily into the banking system. As a result, deposits flowed into banks just as borrowers resorted to banks to draw down their credit lines. Thus, during past times of market stress, banks were flush with the funds needed to finance new commitments to borrowers. In this way, banks were better able to renew expiring credit lines and originate new loans during crises.

Most analysts agree that funds flow into bank deposits in times of stress because banks are viewed as safe havens due to government guarantees on deposits. The Federal Deposit Insurance Corporation (FDIC) insures deposits up to a limit set by Congress, and even deposits above this limit are viewed as having a degree of implicit government support. The view that government guarantees are responsible for the deposit inflows during crises is supported by evidence that such deposit inflows did not occur prior to the FDIC's inception in 1934 (Pennacchi). During times of tight market liquidity from 1920 to 1933, no increases

in bank deposits were observed. Depositors typically converted bank deposits into currency and gold. Moreover, depositors appear to have differentiated among banks, as deposit withdrawals in the 1920s and 1930s related to a bank's risk of default (Calomiris and Wilson). Consistent with the view that banks had no advantage in providing liquidity during this period, liquidity shocks were accompanied by declines in bank loans and investments. To the extent that banks honored their loan commitments, they were forced to cut back on new lending, which translated to an observed overall decline in bank loans and investments.

Why banks may have difficulty providing liquidity in a bank-centered crisis

Banks may not be able to provide liquidity in a bank-centered crisis. A main reason for this is that a bank-centered crisis may lead investors to question the safety of bank deposits, even with deposit insurance. This perception may prevent banks from receiving deposit inflows as part of a flight to safety, making it harder for them to meet the increased liquidity demands of borrowers.

Bank deposits may be viewed as risky during a bank-centered crisis, despite deposit insurance, for several reasons. First, not all deposits are under the deposit insurance limit, and deposits over the limit are not explicitly guaranteed in the event of a bank failure. This lack of guarantee can become especially important in a bank-centered crisis, when uncertainty about the condition of an individual bank may prompt depositors to run from the bank even if it is actually healthy. Second, even for deposits under the insurance limit, there are fixed costs (including time) to extracting deposits from banks that fail. Finally, in a bank-centered crisis, depositors may worry that the government will not provide enough resources to make them whole in the event of a bank failure. For example, some small depositors may worry that the deposit insurance fund will not be large enough for the FDIC to pay off all the insured deposits of failed banks, even though the FDIC has a line of credit from the Treasury.¹¹

Banks may also face difficulty in providing liquidity during a bank-centered crisis if wholesale funds become more difficult to raise, especially from the private sector.¹² Wholesale funds can be thought of as all nondeposit liabilities. These liabilities are uninsured borrowings, both secured and unsecured, from counterparties, including other

banks, private nonbank investors, government-sponsored entities, and the Federal Reserve. Examples of wholesale funds are promissory notes, subordinated debt, and repurchase (repo) agreements (short-term loans secured by financial securities).

Banks may find it harder to raise wholesale funds when bank failures become more likely. Such funds are the least likely to be protected in a bank failure, as they are subordinated to the claims of depositors. Even repos that are secured loans may become difficult to arrange because counterparties may not accept the collateral, knowing that they would have to sell it in an uncertain market if the borrowing bank failed. The difficulty of raising wholesale funds in a bank-centered crisis has become more relevant over time because they have become a greater source of funds for the banking system (increasing from roughly 8 percent of assets in the early 1990s to 18 percent in 2007).¹³

III. NEW EVIDENCE FROM THE 2007-09 FINANCIAL CRISIS

The previous section showed that banks often have an advantage in providing liquidity to borrowers during times of financial stress—but not necessarily during a bank-centered crisis. Were banks still a source of liquidity during the 2007-09 crisis, or did the concentration of risks in the banking sector prevent them from fulfilling their traditional role? This section first examines aggregate bank loans and bank deposits to see if banks were as able to provide liquidity in this crisis as in previous ones. The section then uses individual bank data to see what bank characteristics, if any, made it more difficult for them to attract deposits to provide liquidity. The section ends with a discussion of the policy implications of these results.

Aggregate deposit and loan growth of commercial banks

A useful first step in assessing the ability of banks to provide liquidity is to compare deposit and loan growth during the crisis with that during the 1998 LTCM crisis. In making this comparison, it is important to distinguish between three phases of the recent crisis, because deposits and loans behaved differently in the three phases.

The first phase ran from the first week of July 2007 to the week of September 10, 2008. As discussed in Section I, the crisis began with the

ABCP run in the third quarter of 2007. This run followed losses in the subprime mortgage market and the suspension of redemptions in July 2007 at several Bear Stearns hedge funds that had invested in subprime mortgages. The first phase ended just before the Lehman failure on September 15, 2008.

The second phase directly followed the Lehman bankruptcy and lasted until the end of September 2008. The Lehman bankruptcy led to major turmoil in financial markets, with dramatic effects on both deposit and loan growth.

The third phase began in October 2008 and stretched into mid-2009.¹⁴ It coincided with the passage of the Emergency Economic Stabilization Act in Congress and other measures of official support of the financial system by the Treasury, the Federal Reserve, and the FDIC.

Deposits behaved much differently in the first phase of the financial crisis of 2007-09 than in the LTCM crisis. In particular, deposit growth rose sharply in the LTCM crisis but declined somewhat in the recent crisis. For example, deposit growth rose to a weekly growth rate of 0.19 percent in the fall of 1998, compared with a 0.06 percent average rise during the five years preceding that crisis (Table 1).¹⁵ In contrast, average weekly deposit growth over the period from July 4, 2007, to September 10, 2008, while positive, actually fell relative to the preceding five years (0.07 percent compared with 0.10 percent).

The difference in deposit growth between the LTCM crisis and the first phase of the recent crisis was not limited to total deposits. Different growth rates also characterized core deposits, which exclude large time deposits. The fact that core deposit growth also declined in the first phase of the 2007-09 crisis is of interest because the fraction of core deposits that are insured is much greater than the fraction of total deposits. The contrasting behavior of core deposit growth in the two crises is even more striking, given the substantial easing of monetary policy in the 2007-09 crisis. From September 2007 to April 2008, the federal funds target was reduced by 3.25 percentage points, and the three-month Treasury bill rate fell nearly three points.¹⁶ Such a reduction in market interest rates usually leads to faster growth in core deposits. Banks are typically slow to adjust core deposit rates to a decline in market rates, and in the case of the most liquid deposits, the interest rate is typically close to, if not equal to, zero. As a result, core deposit rates fall less than the interest rate on money market instruments, which

Table 1

**AVERAGE WEEKLY DEPOSIT AND LOAN GROWTH
(ALL DOMESTICALLY CHARTERED BANKS, PERCENT)**

	1998 LTCM Crisis		2007-2009 Financial Crisis			
	Previous 5 years to crisis	Fall 1998	Previous 5 years to crisis	July 4, 2007 - Sept 10, 2008 (pre-Lehman failure)	Period immediately following Lehman failure (last 2 weeks of September 2008)	Oct 8, 2008 - July 1, 2009
Deposits	0.060	0.194	0.095	0.071	0.952	0.085
of which, Core deposits	0.042	0.173	0.077	0.051	0.564	0.115
Loans	0.095	0.181	0.112	0.103	0.564	-0.049

Source: Federal Reserve H8 Release

provide an alternative investment to deposits. Thus, holding deposit balances should not be as costly, which should contribute to a shift in household assets into deposits.¹⁷

That deposit growth fell during the first phase of the 2007-09 crisis instead of increasing, as in past crises, supports the view that banks are less able to provide liquidity in a bank-centered crisis.¹⁸ Because banking performance declined much more in 2007-09 than in past crises, depositors had more reason to be concerned about the safety of their funds. The concern about safety was exemplified by a depositor run at the failed IndyMac Bank in July 2008. This reaction may have been rational for many depositors because more than \$500 million in deposits at IndyMac were not insured.¹⁹ Further, evaluating the condition of individual banks in the 2007-09 crisis was far from straightforward. Evaluating a bank's exposure to mortgage-related products was difficult, and the interconnections in the system were complex. Finally, uncertainty over the safety of insured deposits may have increased as the FDIC's reserves started to dip. By the end of 2008, the FDIC's ratio of reserves to total insured deposits had fallen to 0.4 percent, and the Treasury did not increase its backup line of credit to the FDIC until March 2009.

At first glance, the behavior of deposits in the next phase of the crisis appears inconsistent with the view that banks are unable to attract deposits in a bank-centered crisis. Deposits surged immediately following the Lehman failure, growing at a weekly rate of 0.95 percent in the last two weeks of September 2008 (Table 1). This surge, however,

reflected the acute flight to safety out of money market funds immediately after the Lehman failure. While banks remained heavily exposed to losses on real estate loans and mortgage-related securities, other institutions and markets were suddenly perceived as even riskier. For example, the Reserve Primary Fund, a prime money market mutual fund with close to \$800 million of exposure to Lehman commercial paper, managed to “break the buck” on September 16, 2008. In other words, its net asset value fell below \$1, exposing investors to losses. This event led to redemption demands across the money market mutual fund industry—in an amount close to \$200 billion—as well as to a reallocation of funds to safer Treasury-only funds (Adrian and others; Kacperczyk and Schnabl; Federal Reserve). At the same time, households withdrew their assets from the stock market, which also took a hit around the same time (Chart 4). As a result, deposits poured into banks.

Deposit growth subsided but remained solid in the third phase of the crisis, but this growth was supported by the adoption of emergency measures by the government. This phase began in early October 2008 with the passage of the Emergency Economic Stabilization Act. The Act provided greater explicit government support of the financial system, including an increase in the deposit insurance limit from \$100,000 to \$250,000 per depositor. This change was followed on October 14 with the FDIC’s announcement of its new temporary liquidity guarantee program. The FDIC stood willing to guarantee newly issued senior unsecured debt of banks and thrifts and to fully cover noninterest—bearing deposit transaction accounts, largely held by businesses. Together with other implicit guarantees of the financial system, these measures assured depositors that the banking system would hold up. As shown in Table 1, this helped support an average rate of weekly deposit growth of 0.09 percent from October 2008 to mid-2009, above the subdued rate in the first phase of the crisis.

In summary, the evidence on deposit growth provides some support for the view that banks are less able to provide liquidity in a bank-centered crisis. Deposit growth slowed sharply in the first phase of the recent crisis, consistent with the view that depositors became concerned about the safety of their funds. Deposit growth later rebounded, but this rebound can be explained by the flight to safety out of money market funds and the enactment of emergency measures.

Loans. Like deposit growth, loan growth surged in the LTCM crisis but declined somewhat in the first phase of the 2007-09 crisis. From July 2007 to the Lehman failure in early September 2008, banks provided far less liquidity than in the LTCM crisis. Loan growth increased sharply in the LTCM crisis to a weekly growth rate of 0.18 percent in the fall of 1998, compared with 0.10 percent over the preceding five years (Table 1). In contrast, average weekly loan growth over the period from July 4, 2007, to September 10, 2008, edged down relative to the preceding five years (0.10 percent compared with 0.11 percent).

This slowdown was consistent with the view that banks were less able to provide liquidity because they found it harder to attract deposits. Banks drew down liquid asset buffers to support lending and the buildup of assets that could not be sold in the market, as explained in Section II. Loan growth would have had to slow even more if banks had not also turned to other sources of funds to make up for the shortfall in deposit growth.

These alternative sources of funds included borrowing from the Federal Home Loan Bank (FHLB) System and the Federal Reserve System. Federal Home Loan Banks are government-sponsored entities able to issue debt at cheaper rates than banks (at least in the first year of the crisis) and re-intermediate these funds by lending them to commercial banks and thrifts (Ashcraft and others). Indicative of the extent to which the U.S.-chartered commercial banking system was reliant on federal sources of funds, Federal Reserve loans rose \$448 billion from 2007:Q4 to 2008:Q4, compared with a total net increase in bank liabilities of \$1,136 billion. The FHLB stepped in earlier, with their loans increasing \$208 billion from 2007:Q3 to 2008:Q3.²⁰

Bank lending shot up in the second phase of the crisis, reaching a weekly growth rate of 0.56 percent in the last two weeks of September 2008 (Table 1). This rise coincided with an increased need for liquidity by firms as the volume of commercial paper plunged after the Lehman failure and commercial paper rates spiked (Chart 1). Finding themselves suddenly shut out of the commercial paper and other securities markets, borrowers drew down their credit lines, as suggested by the discussion of liquidity demand in financial crises in Section II (Ivashina and Scharfstein; Montoriol-Garriga and Sekeris; Gao and Yun). This

surge in bank lending was facilitated by the influx of deposits described earlier, as investors fled to safety.

In the third phase of the financial crisis, however, loan growth turned negative. Loans fell at an average weekly rate of 0.05 percent from October 8, 2008, to July 2009 (Table 1). That loans actually fell would seem to suggest that banks were not able to provide liquidity. However, it is unclear how much of this decline was due to lower loan supply resulting from weak deposit growth, and how much was due to lower demand for loans as the recession took hold of the economy. On the one hand, the Senior Loan Officer Opinion Survey, a quarterly survey of bank lending standards conducted by the Federal Reserve, shows that lending standards began to tighten in the third quarter of 2007 and only began to ease in 2010. This evidence suggests that loans declined because banks were less able or less willing to lend.²¹ But as the economy fell into a prolonged recession in the second year of the crisis, loan demand factors may have become more important, as businesses had less need for bank loans in the face of persistent weakness in sales and investment spending.

Another reason demand for bank loans may have declined in this phase, besides the weak economy, was the success of programs initiated by the Federal Reserve to support market-based financing. For example, the Federal Reserve announced the commercial paper Funding Facility (CPFF) on October 7, 2008, which became fully operational on October 27, 2008. It served as a lender of last resort for the commercial paper market, with the Federal Reserve directly financing purchases of commercial paper from eligible U.S. issuers. This program gave borrowers easier access to commercial paper funding, and they had less of a need to rely on credit lines from banks as a backstop.²² As market conditions improved, corporate bond spreads also fell. The more attractive spreads allowed large corporations to turn to the bond market and repay bank loans (Federal Reserve).

In summary, the evidence on loan growth also lends some support to the view that banks are less able to provide liquidity in a bank-centered crisis. In the first phase of the crisis, loan growth declined rather than increasing sharply as it did during the LTCM crisis. Like deposit growth, loan growth surged immediately following the Lehman bankruptcy as firms shut out of capital markets drew down their credit lines.

However, this surge was short-lived. Furthermore, loan growth turned negative in the third phase of the crisis, although this contraction was probably due more to weak loan demand than banks' inability to provide liquidity.

Bank-level evidence on the difference in liquidity provision

The comparison of liquidity provision in the 2007-09 crisis with that in past crises has so far relied on aggregate loan and deposit growth. Regression analysis at the individual bank level can provide more evidence on whether banks were less able to provide liquidity in the recent crisis. Such analysis can also help determine whether the difference in liquidity provision in the recent crisis was due to the bank-centered nature of the crisis.

An overview of the methodology. Two regressions are estimated using quarterly observations on individual banks from 1990 through 2009—one for deposit growth and another for loan growth. The key explanatory variables in the regressions include a measure of financial stress, a measure of a bank's exposure to liquidity demands, and measures of the safety of a bank's deposits. As in previous studies, the measure of financial stress used is the commercial paper spread. Exposure to liquidity demand is measured by a bank's unused commitments ratio, which is defined as the ratio of unused loan commitments to the sum of loans and unused commitments. Unused loan commitments are the parts of the credit lines that have not been drawn down. The rationale for measuring a bank's liquidity demand exposure by the unused commitment ratio is that the more commitments a bank has outstanding, the more exposed it will be to a drawdown of commitments when market conditions tighten.

The safety of a bank's deposits is measured by its capital-asset ratio and a variable indicating whether the bank is big enough to be considered by investors as "too-big-to-fail" (TBTF). Well-capitalized banks are less likely to fail because capital serves as a buffer when unexpected losses occur. As a result, uninsured depositors at banks with high capital-asset ratios have less reason to worry about losing their deposits in a bank failure. Similarly, insured depositors at such banks have less reason to worry about temporary loss of access to their funds. Large banks that

are considered safer because they are TBTF are captured in the regression by an indicator for the 25 largest banks as measured by asset size.

The regressions allow bank liquidity provision to differ in the early and late stages of the recent crisis. The previous section noted that the aggregate behavior of deposits and loans differed significantly across three phases of the recent crisis—from July 2007 to the failure of Lehman Brothers in September 2008, the two weeks following the Lehman Brothers failure, and from October 2008 to July 2009. The bank-level data is available only on a quarterly basis, however, making it impossible to distinguish the three phases of the crisis in the bank-level regressions. Instead, the crisis is divided into two phases—2007:Q3 to 2008:Q2 and 2008:Q3 to 2009:Q2. (For further details on the regression equations and results, see the appendix.)

Were banks less able to provide liquidity than in past crises?

If banks have a natural advantage in providing liquidity in crises, the banks with the greatest exposure to liquidity demand could be expected to experience the highest growth in deposits and loans in a crisis. The regression results show that such a relationship existed in previous episodes of market stress but broke down in the 2007-09 financial crisis.

A convenient way to summarize the results is to use the regression coefficients to compute the impact of high financial stress on two hypothetical banks. The first bank is one with a “high” exposure to liquidity demand, as measured by the unused commitment ratio, while the second bank is one with a “low” exposure to liquidity demand in terms of the same measure. A high unused commitment ratio is defined as the 75th percentile among all observations in the sample. A bank in the 75th percentile would have an unused commitment ratio equal to 0.17. A low unused commitment ratio is defined as the 25th percentile. A bank in the 25th percentile would have an unused commitment ratio equal to 0.07.

The top panel of Table 2 reports the impact of a 100-basis point increase in the commercial paper spread (the measure of market stress) on deposit and loan growth at the bank with the high unused commitment ratio relative to the bank with the low ratio. For each estimate, the table also reports whether the regression coefficient on which the estimate is based is statistically significant, in the sense of being too different from zero to be due to chance. Before the recent crisis, the increase in the

commercial paper spread raised deposit growth 0.22 percentage point more at a bank with a high unused commitment ratio than at a bank with a low unused commitment ratio (Table 2, top panel, column 1).²³ This effect is economically important when compared with an average deposit growth rate of 1.06 percent per quarter over the whole sample. The finding is in line with evidence from previous studies that looked at episodes of stress prior to the 2007-09 financial crisis (Gatev and Strahan; Gatev, Schuermann, and Strahan).

The data on aggregate deposit growth in the previous section suggested that the banking system as a whole was less able to attract deposits in the recent crisis than in the LTCM crisis. Such a shortfall in overall deposit inflows would be of special concern if deposit inflows at banks with high exposure to liquidity demand did not increase as much relative to other banks as in past crises. The regression results confirm that such a shift in relative deposit growth occurred in the first phase of the recent crisis. Indeed, when market liquidity was tight during this period, the ability of banks with high exposure to liquidity demand to attract deposits appears to have actually decreased relative to banks with low exposure to liquidity demand. A 100-basis point increase in the commercial paper spread contracted deposit growth 0.11 percentage point more at a bank with a high unused commitment ratio than at a bank with a low ratio. This amounted to a decrease of 0.33 percentage point in the differential impact of high financial stress from the pre-crisis period (Table 2, top panel, column 1).

Only in the second phase of the crisis did the deposit inflow relationship return to its pre-crisis one, consistent with the aggregate evidence discussed in the previous section. During this period, a 100-basis-point increase in the commercial paper spread raised deposit growth 0.27 percentage point more at a bank with a high unused commitment ratio than at a bank with a low ratio, a (statistically insignificant) difference of only 0.05 from the pre-2007 effect.

In the first phase of the crisis, the counterpart of the weaker deposit inflows at banks with high exposure to liquidity demand was more anemic lending growth at the same banks (Table 2, top panel, column 2). Before the crisis and in line with previous studies, a 100-basis-point widening of the commercial paper spread increased loan growth 0.34 percentage point more at a bank with a high exposure to commitments

Table 2

ESTIMATED EFFECTS OF MARKET STRESS ON DEPOSIT AND LOAN GROWTH ACROSS BANKS: WAS IT DIFFERENT IN THE 2007-2009 CRISIS?

	Dependent variable (percentage points):	
	(1) $\Delta \text{Deposits} / \text{Assets}_{t-1}$	(2) $\Delta \text{Loans} / \text{Assets}_{t-1}$
The differential impact of a 100 basis point increase in the CP spread (stress) on a bank with a high share of commitments relative to a bank with a low share:		
Before 2007-09 Crisis	0.22***	0.34***
2007Q3-2008Q2	-0.11***	0.09***
<i>Change from before crisis</i>	<i>-0.33***</i>	<i>-0.25**</i>
2008Q3-2009Q2	0.27***	-0.14***
<i>Change from before crisis</i>	<i>0.05</i>	<i>-0.48***</i>
The differential impact of a 100-basis-point increase in the CP spread (stress) on a bank with a high capital ratio relative to a bank with a low capital ratio:		
Before 2007-09 Crisis	-0.03	-0.16***
2007Q3-2008Q2	0.08*	-0.08***
<i>Change from before crisis</i>	<i>0.11**</i>	<i>0.08</i>
2008Q3-2009Q2	0.16***	0.03***
<i>Change from before crisis</i>	<i>0.19***</i>	<i>0.19***</i>
The differential impact of a 100-basis-point increase in the CP spread (stress) on a large bank relative to a small bank:		
Before 2007-09 Crisis	-0.03	0.30
2007Q3-2008Q2	1.47***	0.60
<i>Change from before crisis</i>	<i>1.50***</i>	<i>0.30</i>
2008Q3-2009Q2	-0.23	0.60
<i>Change from before crisis</i>	<i>-0.20</i>	<i>0.30</i>
Memorandum:		
Average quarterly growth in dependent variable	1.06	1.04

Notes: The ***, **, and * denote the relevant coefficient estimates from the corresponding regression in Table A.1 are statistically significantly different from zero at the one percent, five percent, and ten percent levels, respectively.

A bank with a "high" share of commitments (or capital) is taken to be at the 75th percentile, while a bank with a 'low' share of commitments (or capital) is taken to be at the 25th percentile.

The 75th percentile commitment ratio is equal to 0.17 and the 25th is equal to 0.07, implying a difference of 0.1. The 75th percentile capital ratio is equal to 0.106 and the 25th percentile is equal to 0.076, implying a difference of 0.03. A large bank is one in the top 25, while a small bank is one not in the top 25.

than at a bank with low exposure. In contrast, in the first year of the crisis, the same increase in the commercial paper spread raised loan growth only 0.09 percentage point more at a bank with high exposure to commitments than at a bank with low exposure, a decline of 0.25 percentage point from the pre-crisis period. Banks with high unused commitments may have been able to honor pre-existing loan commitments as their customers drew them down. However, to the extent such drawdowns occurred, they presumably came at the expense of new loan originations, given the relative weakness in the banks' overall loan growth.

In the second year of the crisis, rather than regaining their usual lending advantage in times of financial stress, banks with high exposure to liquidity demand suffered a further erosion in that advantage. During this period, a 100-basis-point increase in the commercial paper spread lowered loan growth 0.14 percentage point more at a bank with a high unused commitment ratio than at a bank with a low ratio, a difference of 0.48 percentage point from the pre-crisis period. Thus, during this phase of the crisis, the rebound in relative deposit growth at banks with high unused commitments did not translate into higher relative loan growth at the same banks. This result is consistent with these banks cutting back on lending to businesses as soon as they were able to do so. For example, they may have stopped renewing credit lines, decreased the backup funds, and originated fewer new loans.²⁴ Together, the deposit and lending results suggest that the very banks that had offered insurance to businesses and households before the crisis in the form of commitments were not as well positioned to deliver the promised liquidity.

Which banks suffered the biggest decline in ability to provide liquidity? Was it the bank-centered nature of the crisis that compromised the ability of banks to provide liquidity? If so, banks perceived as risky should have had more difficulty attracting deposits and making loans than banks perceived as safe. The regression results provide some support for such a relationship, especially on the deposit side.

As before, a convenient way to summarize these results is to use the regression coefficients to compute the impact of high financial stress on two hypothetical banks. When safety of deposits is measured by the capital-asset ratio, the safe bank is considered to be one with a capital-asset ratio in the 75th percentile of the sample (0.106), while the risky

bank is one with a capital-asset ratio in the 25th percentile (0.076). When safety of deposits is measured by the size of the bank, the safe bank is one in the top 25 and the risky bank is one outside the top 25. The middle panel of Table 2 shows the differential impact of a 100-basis point increase in the commercial paper spread on the first pair of banks, while the bottom panel shows the differential impact on the second pair.

Before the recent crisis, increases in financial stress had about the same effect on banks likely to be perceived as safe as at banks likely to be perceived as risky. The effect of a 100-basis-point increase in the commercial paper spread on deposit growth at a bank with a high capital-asset ratio differed by only 0.03 percentage point from the effect on deposit growth at a bank with a low-capital asset ratio (Table 2, middle panel, column 1). Moreover, it is not possible to statistically distinguish this effect from zero. The impact of financial stress on deposit growth was also roughly the same at a bank in the top 25 as at a bank outside the top 25. This is in accord with previous studies of the modern U.S. era that found that bank riskiness and size were not particularly associated with deposit inflows during times of market stress (Gatev and Strahan). In previous crises, depositors did not seem to distinguish between banks according to the perceived risk of their deposits.

In contrast, the regression results indicate that the safety of deposits was an important factor affecting relative deposit inflows in the 2007-09 financial crisis. As market conditions became strained, the ability of better capitalized banks to draw in deposits improved relative to that of less capitalized banks. In the first phase of the crisis, a 100-basis point increase in the commercial paper spread raised deposit growth 0.08 percentage point more at a bank with a high capital-asset ratio than at a bank with a low capital-asset ratio—a change of 0.11 percentage point from before the crisis (Table 2, middle panel, column 1). In the second phase of the crisis, the differential impact of financial stress on banks with high and low capital-asset ratios was even greater—0.16 percentage point, representing an increase of 0.19 percentage point from the pre-crisis period.

The largest 25 banks were also more successful than smaller banks in attracting deposits but, in this case, only in the first phase of the crisis. During this phase, a 100-basis point increase in the commercial

paper spread was associated with deposit growth 1.47 percentage points higher at a bank in the top 25 than at a bank not in the top 25. This differential effect is considerable, considering average quarterly deposit growth of 1.06 percent. The apparent preference of depositors for the largest banks did not carry through to the second phase of the crisis. During this phase, the effect of financial stress on deposit growth at banks in the top 25 was not statistically significantly different from the effect on deposit growth at banks outside the top 25. Reduced uncertainty about the quality of bank assets and greater insurance coverage limits might explain why the TBTF banks lost their advantage in attracting deposits during this stage of the crisis. In principle, though, a decrease in uncertainty should also have reduced the impact of the capital-asset ratio on deposit flows, which as noted above, did not occur.

The regression results also suggest that well-capitalized banks did a better job than TBTF banks at channeling their deposit inflows to loans. The greater deposit funding inflows experienced by the well-capitalized banks did not at first translate into appreciably higher lending. Before the crisis, a 100-basis-point increase in the commercial paper spread actually decreased loan growth 0.16 percentage point more at a bank with a high capital ratio than at a bank with a low capital ratio. This negative impact of financial stress on the relative loan growth of highly capitalized banks diminished in the first phase of the recent crisis to 0.08 percentage point. However, the difference from the pre-crisis period was not statistically significant, so the greater ability of highly capitalized banks to attract deposits in the first phase of the crisis does not imply increased lending. In the second phase of the crisis, the same increase in the commercial paper spread raised loan growth 0.03 percentage point more at the bank with the high capital-asset ratio than at the bank with the low capital-asset ratio. This difference in loan growth was small. Compared with the pre-2007 era, however, it represented a statistically significant improvement in the relative ability of highly capitalized banks to extend loans in times of high financial stress.²⁵

The TBTF banks showed no such increase in relative loan growth during the recent financial crisis, despite being awash with deposit inflows. In both phases of the crisis, a 100-basis-point increase in the commercial paper spread is estimated to have raised loan growth 0.60 percentage point more at a bank in the top 25 than at a bank outside

the top 25 (Table 2, bottom panel, column 2). These estimated differences appear large relative to the average loan growth of 1.04 percent in the sample. However, the estimates are not statistically significant. As a result, they do not imply that financial stress increased loan growth more at TBTF banks than other banks in the recent crisis.

Policy implications

The results of this section have shown that deposits and loans rose less in the 2007-09 crisis than in recent past crises. The behavior of deposits and loans also differed across banks. Banks most vulnerable to liquidity drawdowns did not have bigger deposit inflows and had to rely more on other sources of borrowing and liquid assets to fund used commitments. Also, riskier banks and non-TBTF banks experienced the smallest inflows of deposits. This evidence supports the view that total deposit inflows were lower because of the bank-centered nature of the crisis.

Several implications follow from these results. First, banks are not necessarily able to adequately fulfill their role as a backstop of liquidity. This finding may imply that policymakers need to design other mechanisms to ensure an uninterrupted supply of credit to creditworthy borrowers. Such mechanisms could include direct interventions in markets, such as the Federal Reserve's commercial paper Funding Facility that helped to support issuance of short-term paper by businesses. Moreover, federal funding of temporary programs to avoid critical disruptions in credit and liquidity may be justified.

Second, while it may be desirable for banks to receive inflows of deposits in financial crises so that they can meet the extra demand for liquidity, it is nonetheless important from a public policy view to understand what is driving these inflows. If certain banks are seen as a safe haven, not because they are necessarily financially sound, but because they are perceived as TBTF, their risk-taking incentives will be distorted (Hoenig). Thus, if policymakers want to put an end to TBTF and also want large banks to continue to serve as a source of liquidity during crises, they should take steps to improve the supervision and regulation of these institutions.

The two implications above assume no fundamental change in what banks do. But taking a step back, there is also a third normative

implication of the empirical results. This implication concerns what activities banks should be engaged in, in the first place. An explicit separation between regulated banks that are meant to intermediate liquidity and the rest of the financial system could arguably be justified. Under this approach, regulated banks would be allowed to accept deposits and provide backstop liquidity to firms and households but would be limited in the amount of risk that they could take through their other loans and investments. Such an approach would help to keep banks as safe institutions able to provide liquidity in times of market stress, which is an important function they perform.²⁶

IV. CONCLUSIONS

The motivating question of this article was whether banks can maintain their advantage as liquidity providers when they are at the center of a financial crisis. Some observers have conjectured that deposit inflows should have been an assured, stable source of funding even during the 2007-09 financial crisis.

This article examined whether this conjecture was valid. The main message is that bank deposit funds cannot be assumed to be robust to any type of market liquidity stress. In the last crisis, depositors shunned banks generally when there was greater uncertainty about the health of banks and uncertainty over whether the government would support the financial system. Only in the aftermath of the Lehman bankruptcy, increased distress in other asset markets, and ensuing official liquidity interventions, did deposit inflows become vigorous. Too-big-to-fail considerations also influenced deposits, with inflows going to the largest 25 banks, especially during the first year of the crisis.

These findings—together with results showing that lending growth was weak overall, especially at banks most exposed to liquidity demand—suggest that banks were not as able to provide liquidity as would be implied by theory and evidence from other crises. Thus, policymakers may want to evaluate the tradeoffs associated with two alternative policy paths. In the first, banks may be subject to periodic panics whenever they are perceived to be exposed to a financial crisis. In this case, policymakers offer official support to the financial system, businesses, and households as they did in the recent financial crisis. Coupled with this approach, they strengthen the supervision and regulation of banks

to ensure that banks' risk-taking incentives are not distorted as a result of this official support. In the alternative and more fundamental path, an explicit separation would be drawn between regulated banks and the rest of the financial system. Stricter limits would be placed on the activities that banks can engage in so as to ensure that they can serve as liquidity providers without official intervention in times of crisis.

APPENDIX

This appendix provides further detail on the data, methodology, and results for the bank-level regressions of Section III. The data for the regressions are made up of quarterly observations on commercial banks in existence from 1990 through 2009. Following previous studies, the sample excludes the smallest banks with assets of less than \$100 million. All bank-level variables are from the quarterly Reports of Condition and Income that banks file with regulators (Call Reports). The sample is not fixed but changes from quarter to quarter, as some banks enter the sample (for example, through new charters) and other banks exit (for example, through mergers). Banks belonging to a common holding company are aggregated and treated as a single banking organization. Therefore, any reference to a “bank” in the remainder of this discussion should be taken to mean a banking organization.

The dependent variable in the regressions is either quarterly loan growth or quarterly deposit growth. Deposit growth is defined as the change in deposits from the previous quarter divided by assets in the previous quarter. Loan growth is defined similarly. The growth rates are not adjusted for the artificial increase in growth that can occur as a result of one bank acquiring another in a merger. Instead, the merger effect is controlled for through the common practice of dropping an observation when the quarterly growth rate of a bank’s total assets exceeds a certain threshold—in this case, 10 percent (Gatev and Strahan).

The regressions include fixed effects (dummy variables) for both banks and quarters. Including bank fixed effects controls for the many factors that could cause a particular bank to have higher deposit growth in all periods (for example, location in a fast-growing market or good management). Similarly, including dummy variables for quarters controls for factors that could cause all banks to have higher deposit growth in a particular quarter (for example, easy monetary policy or rapid economic growth in the nation as a whole).

The explanatory variables are the same for the loan growth and deposit growth regressions. The regression is similar to the model specified in a previous study by Gatev and Strahan.²⁷ The deposit growth equation for bank i in quarter t is as follows:

$$\begin{aligned} \frac{\Delta deposits_{i,t}}{assets_{i,t-1}} = & \beta_1 \text{ unused commitments}_{i,t-1} + \\ & \beta_2 \text{ unused commitments}_{i,t-1} \times stress_t + \\ & \beta_3 \text{ unused commitments}_{i,t-1} \times stress_t \times crisis_t + \\ & \gamma_1 \text{ safety}_{i,t-1} + \\ & \gamma_2 \text{ safety}_{i,t-1} \times stress_t + \\ & \gamma_3 \text{ safety}_{i,t-1} \times stress_t \times crisis_t + \\ & \text{bank fixed effect}_i + \text{quarter fixed effect}_t + e_{i,t} \end{aligned}$$

As explained in Section III, *unused commitments* is the ratio of unused commitments to the sum of loans and unused commitments at the end of the quarter. *Stress* is the average daily three-month commercial paper spread for high-grade nonfinancial borrowers for the quarter. *Safety* is represented by the ratio of the book value of equity to assets at the end of the quarter and by a dummy variable indicating whether the bank was one of the 25 largest banks at the end of the quarter. A one-quarter lag is used for *unused commitments* and the two *safety* measures to ensure that these variables are predetermined with respect to a bank's deposit growth. Finally, *crisis* is represented by two dummy variables, *crisis1* and *crisis2*. *Crisis1* refers to the period from 2007:Q3 to 2008:Q2, while *crisis2* refers to the period from 2008:Q3 to 2009:Q2.

The influence of financial stress on banks' ability to provide liquidity is captured by the interactive variable *unused commitments x stress*. A finding that β_2 is positive would support the view that banks more exposed to liquidity demand typically have an advantage over other banks in attracting deposits when financial stress rises. Likewise, in the case of the loan growth regression, a finding that β_2 is positive would support the view that banks more exposed to liquidity demand have an advantage over other banks in making loans when financial markets become strained.

The change in the influence of financial stress on banks' ability to provide liquidity in the recent crisis is captured by the interactive variable *unused commitments x stress x crisis*. A finding that β_3 is negative would support the view that banks more exposed to liquidity demand

had a smaller advantage over other banks in attracting deposits in the recent crisis than in past crises. Indeed, a finding that $\beta_2 + \beta_3$ is negative would imply that in the recent crisis the ability of banks with high exposure to liquidity demand to attract deposits fell relative to that of other banks as financial stress rose. Both types of banks would experience a fall in deposit growth in the face of an increase in spreads, but a bank with a higher unused commitment ratio would have a greater contraction than a bank with a low ratio.

The influence of a bank's perceived safety on its ability to provide liquidity in a crisis is captured by the interactive variable *safety x stress*. A finding that γ_2 is positive would mean that before the recent crisis, banks viewed as safe had an advantage over other banks in attracting deposits when financial stress was high. To assess whether the relationship changed in the recent crisis, the variable of interest is *safety x stress x crisis*. If the coefficient γ_3 on this variable is estimated to be positive, that would support the view that banks seen as safe had a bigger advantage over other banks in attracting deposits as spreads widened in the recent crisis than in past crises.

Table A.1 reports estimates of the coefficients on the explanatory variables for the deposit growth equation in column (1), and for the loan growth equation in column (2). The coefficients on *unused commitments x stress* are positive and statistically significant in both the deposit growth and loan growth equations. These results confirm that before the recent crisis, banks most at risk of liquidity demand realizations experienced the greatest increase in deposit growth and loan growth when financial markets became stressed. Furthermore, the coefficients on *unused commitments x stress x crisis* are negative and statistically significant in three out of the four cases, the exception being the coefficient for *crisis2* in the deposit growth equation. These results generally support the view that banks with high exposure to liquidity demand had less advantage (a disadvantage in some cases) over other banks in attracting deposits and making loans in the recent crisis than in past crises.

The coefficients on the *safety* variables provide some evidence in support of the bank-centered nature of the 2007-09 crisis. For both the capital-asset ratio and the large bank indicator, the coefficients on *safety x stress* are either negative or statistically insignificant. These results in-

Table A.1.

THE RELATIONSHIP BETWEEN MARKET STRESS AND GROWTH IN DEPOSITS AND LOANS: WAS IT DIFFERENT IN THE 2007-2009 CRISIS?
(ALLOWING FOR TWO PHASES OF THE CRISIS: 2007 Q3-2008Q2 AND 2008Q3-2009Q2)

	Dependent variable:	
	(1)	(2)
	$\Delta \text{Deposits}/\text{Assets}_{t-1}$	$\Delta \text{Loans}/\text{Assets}_{t-1}$
Unused commitment ratio _{t-1}	0.024***	0.111***
Unused commitment ratio _{t-1} × Stress	0.022***	0.034***
Unused commitment ratio _{t-1} × Stress × Crisis1	-0.033***	-0.025***
Unused commitment ratio _{t-1} × Stress × Crisis2	0.005	-0.048***
Capital ratio _{t-1}	0.125***	0.065***
Capital ratio _{t-1} × Stress	-0.009	-0.053***
Capital ratio _{t-1} × Stress × Crisis1	0.034**	0.026
Capital ratio _{t-1} × Stress × Crisis2	0.061***	0.064***
Large Bank Indicator (Top 25 by asset size)	-0.0005	0.003
Large Bank Indicator × Stress	-0.0003	0.003
Large Bank Indicator × Stress × Crisis1	0.015***	0.003
Large Bank Indicator × Stress × Crisis2	-0.002	0.003
Observations	252526	252526
R ²	0.04	0.08

*significant at 10%; ** significant at 5%; *** significant at 1%

Notes: All specifications are panel regressions with fixed effects for banks and quarters. The reported R² is the within R².

The interaction of the three-month Treasury bill rate with unused commitment ratio is also controlled for. The sample period is 1990Q1 to 2009Q4. Crisis1 is a dummy variable equal to 1 from 2007Q3 to 2008Q2, and Crisis2 is a dummy variable equal to 1 from 2008Q3 to 2009Q2.

Bank panel data are from the Reports of Condition and Income, and are aggregated to top holder level. Bank organizations with assets of less than \$100 million are excluded.

As a merger control, all banks with asset growth greater than 10% during a quarter are excluded during that quarter. The growth rates are also winsorized at the 1st and 99th percentiles to mitigate the effect of outliers. The standard errors used in calculating significance levels are clustered at the bank level.

dicating that before the recent crisis, banks perceived as safe did not experience a greater increase in deposit or loan growth than other banks as financial stress rose. In the case of the capital-asset ratio, three of the four coefficients on *safety x stress x crisis* are positive and statistically significant, the exception being the coefficient for *crisis1* in the loan growth equation that is statistically insignificant. These results generally support the view that highly capitalized banks had a bigger advantage over other banks in attracting deposits and making loans in the recent crisis than in past crises.

The results for large banks are more mixed. The coefficient on *safety x stress x crisis* in the deposit growth regression is positive and statistically significant for *crisis1*, indicating that TBTF banks had a greater advantage over other banks in raising deposits when market liquidity was tight in the first phase of the 2007-09 crisis than in previous crises. However, the other three coefficients on *safety x stress x crisis* are statistically insignificant. Thus, the favorable impact of financial stress on the relative deposit growth of large banks did not persist beyond the first phase of the crisis and did not spill over into loan growth.

ENDNOTES

¹Commercial paper is short-term debt with a fixed maturity typically between one and 270 days, and on average 30 days. The commercial paper market is an important source of short-term unsecured funds for firms to cover major operating costs such as payroll and inventory.

²There was also a brief increase in the commercial paper spread in April 2001, which has no obvious explanation. This may reflect expectations at the time that the U.S. federal government would be running surpluses and that there would be an accompanying fall in the supply of Treasuries. This would have helped to push down Treasury yields (and push up the spread).

³These figures are based on the author's calculations from the Federal Reserve's collected data on commercial paper outstanding. Outstanding ABCP accounted for 55 percent of the total Commercial Paper market of \$2.2 trillion in July 2007, up from only 20 percent of the market in 1997.

⁴This crisis was not the first bank-centered crisis, nor did it only involve banks. First, the comparison is simply with recent crises, and not historical ones such as the Great Depression in which banks were central. Second, in this crisis, there were arguably even greater risks in the financial system outside commercial banking: in investment banks such as Lehman Brothers, in large insurance firms such as AIG, and in other nonbank entities such as the two Bear Stearns' hedge funds that had invested in subprime mortgages and filed for bankruptcy on July 31, 2007. The point is simply that significant risks were also found in the U.S. commercial banking system in this crisis.

⁵Write-offs on delinquent mortgage loans, asset fire sales, market valuation losses on mortgage-related securities, and trading losses were all contributing factors to the drop in profitability.

⁶Commercial banks' total holdings of real-estate related loans and mortgage-backed securities (available for sale and held to maturity) are estimated by the author at \$4,894 billion at the end of 2007, based on the Call Reports filed by banks. This figure compares with total real-estate related debt securities outstanding of \$11,840 billion (Krishnamurthy). The bank exposure does not include the off-balance-sheet items that banks were ultimately responsible for, up to another \$1,737 billion. These off-balance-sheet exposures came from the following: unused commitments in the form of revolving open-end lines secured by 1-4 family mortgage loans, unused commitments to fund commercial real estate loans, and maximum credit exposure from recourse and unused commitments to provide liquidity to asset securitizations, asset sales and conduit structures. Explanations for why commercial banks ended up retaining so much exposure to the real estate market range from a breakdown of risk-management systems, to excessive optimism, to regulatory arbitrage, to banks simply needing to hold these securities as collateral for repos.

⁷Financial commercial paper was a marginal source of funding for the U.S. commercial banking system in this crisis; its issuance rose from \$21.7 billion in 2006 to \$37.9 billion in 2007, most of which was in the second half of 2007. These figures are based on the author's calculations from the Federal Reserve's Flow of Funds Table F.208.

⁸Subprime mortgage securities totaled only about \$1.5 trillion, a fraction of the roughly \$30 trillion in total assets at all U.S. financial institutions and more than \$10 trillion at commercial banks (Gorton; Krishnamurthy).

⁹In this article, the term liquidity refers to funding liquidity, which is the ease of borrowing funds. Another concept of liquidity is the ease with which an asset can be traded. The latter concept is sometimes referred to as market liquidity to distinguish it from funding liquidity (Brunnermeier and Pedersen).

¹⁰Even ABCP conduits that suffered material credit deterioration were brought on sponsors' balance sheets beginning in August 2007. (Banks such as Citibank are known as the "sponsors" of these vehicles.) In this crisis, the recourse and credit guarantees provided by sponsors ended up covering 97 percent of maturing ABCP (Acharya and others).

¹¹For example, there is evidence of risk-pricing even for insured deposits during the 1980s savings and loan crisis. Specifically, rates on FSLIC-insured deposits were sensitive to a bank's riskiness in the period before the insolvency of the FSLIC. The FSLIC was the guarantor of the savings and loan institutions, and it was announced to be insolvent in February 1987. It was later abolished, and its duties were transferred to the FDIC (Cook and Spellman).

¹²Evidence of banks having difficulty getting wholesale funds from the private sector in the 2007-09 financial crisis is documented by Brunnermeier, Kacperczyk and Schnabl, and Adrian and others. The transmission of the recent crisis partly through a disruption in wholesale funding followed the script outlined earlier by Rajan for a crisis where banks are perceived as credit risks and there is uncertainty about where losses are to be found. Moreover, interbank lending, especially at maturities longer than overnight, can dry up in a bank-centered crisis. While the banking system does not depend on interbank loans as a source of wholesale funds due to netting out in aggregate, the interbank market is an important source of wholesale funds for banks with a liquidity shortage. Typically, it allows for an efficient transfer of funds from banks with a liquidity surplus to banks that are short of liquidity.

¹³Wholesale funds are defined as the sum of subordinated debt and debentures, gross federal funds purchased, repos, and other borrowed money, and are based on the author's calculations from the Call Reports. If large time deposits and deposits in foreign offices are also included, the share goes from about 25 percent in the early 1990s to over 40 percent before the 2007-09 financial crisis.

¹⁴The end of the financial crisis in mid-2009 reflects the positive signal provided by the Supervisory Capital Assessment Program (bank stress tests) (Bernanke).

¹⁵This aggregated data comes from the Federal Reserve H8 release for balance sheet data for weekly commercial bank reporters. The data are for all domestically chartered banks (excluding the branches and agencies of foreign banks). The weekly growth rates reported in Table 1 are defined as the weekly change in the variable divided by total assets in the previous week. Also note that the third period of the 2007-09 financial crisis shown in Table 1 omits the week of October 1, 2008. This is because there was an artificial jump in the balance sheet of commercial banks in that week because of their acquisition of non-banks. For example, JPMorgan Chase acquired a large thrift, Washington Mutual, on September 26, 2008. This and other nonbank mergers around that time led to a considerable increase of \$267 billion in assets for the week of October 1, 2008. However, neither JPMorgan Chase's acquisition of Bear Stearns in March 2008 nor Bank of America's later purchase of Merrill Lynch impacts the H8 data because these consolidations took place at the holding company level and did not affect the commercial bank aggregates reported.

¹⁶The federal funds target rate was 5.25 percent in September 2007. It then fell to 2 percent by April 2008, and after several cuts beginning in October 2008, reached its current range of 0 to 0.25 percent in December 2008.

¹⁷During this period, monetary policy was also engaged in substantial asset purchases and emergency liquidity provision to the financial system. Normally, one would expect such actions to lead to substantial increases in bank reserves, which would then translate into higher bank deposits through the standard textbook money multiplier. However, this multiplier channel was not active in this period because the Federal Reserve began to pay interest on reserves in October 2008. This removed commercial banks' opportunity cost of holding excess reserves, and banks were happy to place reserves in balances at the Federal Reserve (Keister and McAndrews). As a result, excess bank reserves went from a mere \$1.9 billion in August 2008 to close to \$60 billion in September 2008 and now stand at over \$1 trillion (Federal Reserve H3 release).

¹⁸Other factors besides concern over safety may have contributed to the weak deposit inflows. One such factor was that household wealth took a hit in this crisis, and households are typically the main source of deposit funds. U.S. households' net worth fell from \$64.4 trillion in 2006 to \$51.3 trillion by 2008 (from falling house values and stock market declines). These figures come from the Federal Reserve's Z.1 Release, Table B.100. Moreover, households faced with increased liquidity constraints may have been more likely to withdraw deposits to cover consumption needs.

¹⁹See *The Wall Street Journal*, "Humble Start for FDIC Push," June 24, 2010.

²⁰These figures are based on the author's calculations from the Federal Reserve's Flow of Funds Table F.110 for U.S. chartered commercial banks. The weekly H8 release does not provide a split of other borrowing into government and non-government sources.

²¹There is also evidence of these loan supply effects from a number of recent studies. For example, banks exposed to U.S. subprime mortgages rejected significantly more loan applications than non-affected banks (Puri and others). Another study found that businesses holding sufficiently high buffers of cash were able to maintain their investment spending, but those with low cash buffers had to cut their investment spending because they were not able to access bank loans (Duchin and others). This effect disappeared in the second year of the crisis, suggesting that demand factors may have become more important over time as businesses had less of a need for bank loans.

²²Another program that helped revive the commercial paper market was the ABCP Money Market Mutual Fund Liquidity Facility (AMLF). In this program, the Federal Reserve extended loans to U.S. depository institutions and bank holding companies to buy high-grade ABCP from money market mutual funds. The AMLF began operations on September 22, 2008, and reached peak use on October 8, before the CPFF was made operational (Adrian and others).

²³Specifically, the differential effect is calculated using the corresponding coefficient in Table A.1, which is equal to 0.022. This coefficient is multiplied by the assumed increase in the Commercial Paper spread of 1 percentage point and by the difference in the unused commitment ratio between the 75th and 25th percentile (0.10). Therefore, the differential effect = $0.022 * 1 * 0.10 = 0.22$ percentage point.

²⁴For example, if instead of a regression of on-balance-sheet lending as shown, the regression is for total new bank credit originations (defined as the change in the sum of loans and commitments), there is an even more pronounced negative effect on credit. Banks with a high exposure to unused commitments cut their total new credit by more, even in the first year of the financial crisis.

²⁵In related work, Cornett and others find that better capitalized banks increased lending more than other banks during the financial crisis of 2007-09.

²⁶For example, Holmstrom draws a comparison with the LTCM and Tech bubble crises where, because risk was shared in equity markets, the crises did not damage the banking system. In a similar way, had the riskier tranches of the mortgage-related securities been held outside the banking system, vital liquidity disruptions would not have occurred. He concludes that "risk should be shared in equity markets and not in liquidity providing markets."

²⁷Gatev and Strahan estimated a similar model for an earlier sample period (1991-2000). The main extension here is to allow market stress to have a different effect in the 2007-09 financial crisis than before. The author replicated their findings over their sample with very similar results, which are available upon request.

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