VOL. 10, NO. 6 • MAY 2015

DALLASFED

Economic Letter

Liquidity Mismatch Helps Predict Bank Failure and Distress

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ABSTRACT: Liquidity mismatch—the risk of a bank being unable to fund increases in assets or meet its obligations as they come due—increased in the U.S. banking sector during the run-up to the financial crisis, especially at the largest institutions, contributing to bank failure and distress.

Commercial bank failures increased dramatically in recent years, while numerous other banks became distressed, as measured by high ratios of nonperforming assets to equity and loan loss reserves (*Chart 1*).[1] The quarterly failure rate of banks peaked at 0.6 percent in second quarter 2009. The combined failure and distress rate reached 2.5 percent in fourth quarter 2010—the highest level since the 1980s.

Bank failures are costly, so regulators want to understand the reasons for them and how they may be prevented.[2] One possible reason for the heightened failure and distress rate is the large—possibly excessive—rise in liquidity mismatch in the mid-2000s.

The higher risk that banks would be unable to fund increases in assets or meet their obligations as they came due was an important warning sign to which regulators may have paid insufficient attention. Controlling for the usual factors that regulators look at (equity capital, loan quality, etc.), we find that liquidity mismatch helps predict bank failure and distress one year ahead.

What Is Liquidity?

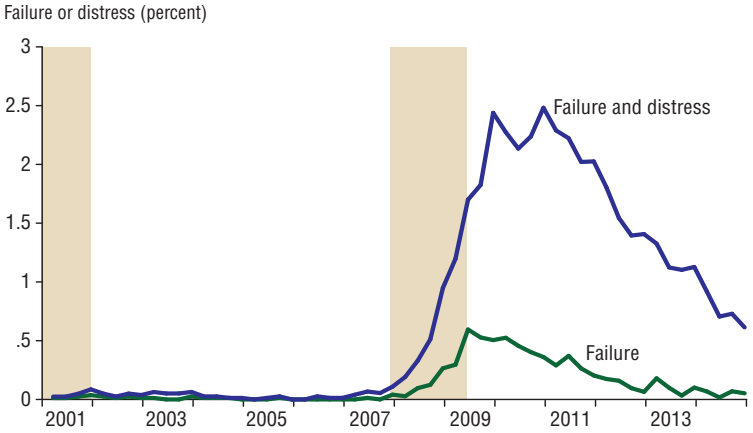
A bank's liquidity refers to its ability to fund increases in assets (mostly loans) and meet its obligations. For example, when depositors demand access to funds, they expect to be able to withdraw their nonterm deposits, such as those in checking accounts, at any time without delay. If a bank needs to secure liquidity quickly to fulfill its obligations, it may have to sell assets hastily, often at low prices. In the extreme, a bank may become insolvent. If a bank is rumored to have financial difficulties, uninsured depositors may rush to withdraw their funds, and wholesale sources of funding such as those obtained from foreign sources may dry up.[3]

Liquidity problems played a prominent role in many high-profile bank failures in the U.S. and abroad. Two examples are Washington Mutual in the U.S. and Northern Rock in the U.K. As a result, an international oversight panel, the Basel Committee on Banking Supervision, proposed, and the Fed introduced, new rules designed to reduce the incidence of very-short-run (one month) liquidity mismatches at large bank holding companies.[4] New rules to reduce 12-month liquidity mismatches will take effect in the next few years.

Versions of these liquidity rules are likely to trickle down to smaller banks. However, the contribution of liquidity mismatch to bank failure or distress, along

In a crisis, banks may experience a variety of liquidity shocks.

Chart 1 Bank Failure and Distress Rates Shoot Up During Crisis



NOTES: A bank is distressed when the ratio of nonperforming assets to the sum of equity and loan loss provisions (Texas ratio) exceeds 2. Shaded areas indicate recessions.

SOURCES: Call reports of insured domestic commercial banks; Federal Deposit Insurance Corp.; authors' calculations.

with the effectiveness of liquidity rules, has not been demonstrated. Liquidity mismatch may already be picked up by the measures that regulators have relied upon for many years—the so-called CAMELS, an acronym for capital adequacy, assets, management, earnings, liquidity and sensitivity to market risk.[5]

Financial Intermediation

Banks channel savings from depositors to borrowers, an activity known as financial intermediation. They also create loans from the deposits, a process known as asset transformation. Inevitably, these activities result in a maturity mismatch between banks' assets and liabilities. Assets tend to be more long term than liabilities—mortgages versus customer deposits. If depositors suddenly demand their funds, as often occurs during a financial crisis, banks may be unable to provide the funds because of illiquidity.

In a crisis, banks may experience a variety of liquidity shocks. They include a high rate of withdrawal of retail deposits; loss of unsecured, wholesale funding; a partial loss of secured funding due to declines in the value of underlying collateral; forced sales of loan portfolios at a discount; and unscheduled draws on unused credit and liquidity lines. Liquidity mismatch measures may be used to assess the capacity of banks to withstand such adverse events.

Measuring Mismatch

Our measure of liquidity mismatch looks at the difference in the liquidity of a bank's assets and liabilities:

$$\text{Liquidity mismatch} = \frac{\text{Liquidity-weighted liabilities} - \text{Liquidity-weighted assets}}{\text{Total assets}}$$

A rising measure indicates a worsening liquidity mismatch. The measure is constructed using call reports, regulatory filings and the latest Basel Committee tables of proposed one-year asset and liability liquidity weights.

In the case of the bank's liabilities and equity, the liquidity weights reflect funding "instability" over the next year, the extent to which deposits could run off or wholesale funding could dry up in a crisis. For example, equity and borrowings or term deposits with a maturity of one year or more are considered very stable, so their liquidity weight is 0. Other things being equal, liquidity mismatch rises if banks have lower retail deposits and higher wholesale deposits, which are more short term and less stable.

On the asset side of the balance sheet, the liquidity weights reflect the degree to which the asset can be sold in the market

without affecting the asset's price. For example, cash has a liquidity weight of 1 because it is perfectly liquid; most residential mortgages have a weight of 0.35, and construction and land development loans have a weight of zero because such loans are very illiquid in a crisis. As a result, liquidity mismatch rises if banks hold fewer mortgage loans and more construction and land development loans.[6]

Precrisis Rise in Mismatch

Liquidity mismatch rose significantly between 2002 and 2007. The median level of mismatch climbed about 6 percentage points.[7] Most of this rise was driven by changes in liquidity-weighted assets rather than liquidity-weighted liabilities. Banks pursued higher returns on riskier, less-liquid assets. To a lesser extent, banks relied less on stable core deposits and more on "unstable" wholesale funding. The rise in liquidity mismatch before the financial crisis is noteworthy because equity capital (as a percentage of assets)—the ultimate buffer against losses—changed little.

The rise in mismatch was faster and more persistent at the largest banks, representing the top 25 percent of institutions (*Chart 2*). Among those banks, the median mismatch rose about 8.5 percentage points between 2002 and 2007, while at the 25 percent representing the smallest banks, the increase was only 3 percentage points.

Early-Warning Sign?

Bank regulators look for early-warning signs of distress. Is liquidity mismatch one? Comparing the fourth quarter 2007 mismatch levels of commercial banks that failed or became distressed in 2008 or 2009 with those that did not may provide an indication. The average levels of liquidity mismatch for the two groups were significantly different. Failed or distressed banks generally had much higher levels of liquidity mismatch, as shown by the final entry in the liquidity mismatch row of Table 1.

While the timing of the changes in liquidity mismatch (as seen in Chart 2) and the difference in levels of mismatch at any one time (as seen in Table 1) suggest that liquidity mismatch is important, they do not necessarily imply that a rise in liquidity mismatch helps predict future bank failure or distress. Higher levels of liquidity mismatch may be correlated with lower levels of equity capital and higher proportions of brokered deposits and construction and land development loans as well as with nonperforming assets or lower returns on assets—all well-known predictors of failure or distress.[8]

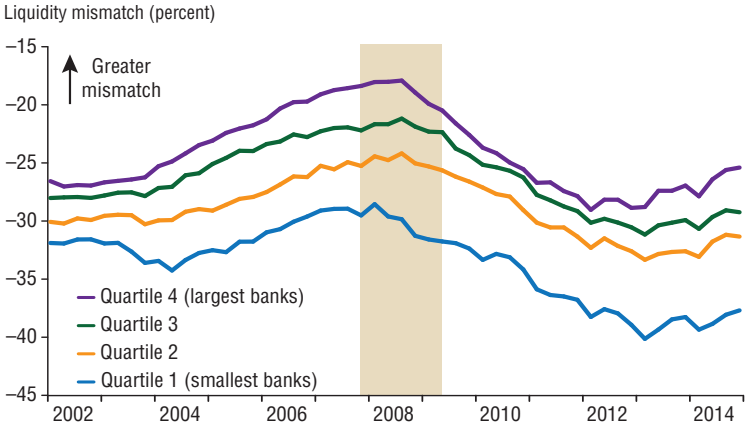
Modeling Failure and Distress

Statistical models were used to disentangle the effects of changes in liquidity mismatch from the effects of changes in equity capital and the other predictors of bank failure and distress between 2006 and 2011.[9] This period was chosen because it followed a time when there were very few failures or cases of distress, the early 2000s.

Failure or distress up to two years ahead was considered. For example, fourth quarter 2007 data were used to predict failure or distress any time in 2008.[10]

The results suggest that recent failure and distress rates are explained or

Chart 2 Rise in Liquidity Mismatch Is Greater at Large Banks



NOTES: The lines show the median liquidity mismatch by bank size quartile. The size quartiles are determined each quarter. Shaded area indicates recession. Less-negative readings indicate greater mismatch.

SOURCES: Call reports of insured domestic commercial banks; authors' calculations.

Table 1 Failed or Distressed Banks Differ from Other Banks in '08 and '09

	2008 and 2009		
Fourth quarter 2007 warning signs	Failed or distressed banks	Other banks	Difference
Liquidity mismatch/assets	–11.5%	–25.2%	13.7%
Construction and land development loans/assets	27.5%	7.6%	19.8%
Equity capital/assets	10.3%	13.3%	–3.0%
Brokered deposits/assets	12.4%	2.9%	9.5%
Nonperforming assets/assets	5.2%	1.8%	3.4%
Net income/assets (return on assets)	0.13%	0.99%	–0.86%
Size (median assets, millions of dollars)	$233	$119	$114
Number of banks	324	6,985	–

NOTES: Except for the difference in median size, data reflect differences in means. All of the differences are statistically significant at the 1 percent level.

SOURCES: Call reports of insured, domestic commercial banks; authors' calculations.

predicted by many of the same factors as in 1985–92, when large numbers of commercial banks and savings and loans failed. These factors include too little equity capital, a high ratio of nonperforming assets and a high share of construction and land development lending.

Mismatch Has Predictive Power

In addition to these factors, liquidity mismatch helps predict bank failure and distress one or two years ahead. Results of our model suggest that a 5 percentage-point rise in liquidity mismatch raises the probability of failure or distress in the next year about 0.25 percentage points. By contrast, a 1 percentage-point fall in equity capital (as a share of assets) raises the probability about 0.5 percentage points. These effects may appear small, but they should be gauged against the average failure or distress rate of 1.4 percentage points per quarter in 2007–11.

The importance of the liquidity mismatch effect may also be judged by comparing it to the equity capital effect. Banks that failed or were distressed in 2008–09 had a liquidity mismatch that was 13.7 percentage points higher and equity that was 3 percentage points lower than other banks in fourth quarter 2007 (seen in Table 1). Leaving aside the roles played by factors such as construction and land development loans, the higher levels of mismatch raised the chances of failure or distress by about 0.75 percentage points, while lower levels of equity increased the chances by 1.5 percentage points. Thus, the liquidity mismatch effect is about half as important as the equity capital effect.

Liquidity Mismatch Matters

Liquidity mismatch rose significantly before the financial crisis, especially at large banks, our research shows. The rise in mismatch contributed to the rise in bank failures and cases of distress. Liquidity mismatch helps predict bank failure or distress one year ahead, even accounting for equity capital and the other indicators at which regulators look.

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Notes

[1] The Texas ratio, a measure that got its name during the Texas banking collapse of the late 1980s, is the ratio of nonperforming assets to the sum of equity capital and loan loss provisions. A traditional warning sign of bank failure is a ratio exceeding 1. During the period under study, a number of institutions recorded Texas ratios greater than 2. See "The So-Called Texas Ratio," by Thomas F. Siems, Federal Reserve Bank of Dallas *Financial Insights*, vol. 1, no. 3, 2012.

[2] Between 2008 and 2011, bank failures (including commercial bank, savings and loan association, and savings bank failures) cost the Deposit Insurance Fund an estimated $72.9 billion. The fund, which is run by the Federal Deposit Insurance Corp. and funded by bank levies, fully insures covered deposits against bank failures.

[3] Wholesale funds are an alternative source of funds to equity capital and core deposits. Sources include federal funds, Federal Home Loan Bank advances, foreign deposits, brokered deposits and deposits obtained through the Internet or certificate of deposit listing services that post a bank's CD notes for a fee.

[4] The Basel Committee on Banking Supervision is a forum for regulatory cooperation between member countries on matters relating to banking supervision. It consists of senior representatives of bank supervisory authorities and central banks from major economies.

[5] CAMELS ratings are supervisory ratings of a bank's or credit union's overall condition. A five-point scale—1 (strong) to 5 (critical)—is used.

[6] Because a bank's assets are more liquid than its liabilities, the liquidity mismatch measure is almost always negative.

[7] Fifty percent of banks had lower liquidity mismatch values than the median, and 50 percent had higher values.

[8] A brokered deposit is a large deposit typically arranged through a broker that is subsequently broken into small pieces and sold to customers. Such deposits pay a higher-than-prevailing rate of interest to attract investor funds.

[9] The usual indicators are all CAMELS proxies. They include net income, brokered deposits, cash, securities, loan loss provisions, goodwill, one- to four-family residential loans, multifamily residential loans, commercial real estate loans, and construction and land development loans, all expressed as a ratio of total assets. We also took account of receipt of Troubled Asset Relief Program capital injections and aggregate financial market stress.

[10] We estimated a range of cross-section and panel probit models, a standard way of modeling binary outcomes such as bank failure versus bank survival.

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