MANAGING BANK LIQUIDITY RISK: HOW DEPOSIT-LOAN SYNERGIES VARY WITH MARKET CONDITIONS*

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Abstract

Liquidity risk in banking has been attributed to transactions deposits and their potential to spark runs or panics. We show instead that transactions deposits help banks hedge liquidity risk from unused loan commitments. Bank stock-return volatility increases with unused commitments, but only for banks with low levels of transactions deposits. This deposit-lending hedge becomes more powerful during periods of tight liquidity, when nervous investors move funds into their banks. Our results reverse the standard notion of liquidity risk at banks, where runs from depositors had been seen as the cause of trouble.

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Much theory attempts to find dimensions of "bank specialness," typically from a synergy of combining deposits with loans. Banks' role as delegated monitor explains why they tend to hold large and well diversified loan portfolios, and why they tend to fund themselves mostly with debt (Diamond, 1984). Deposits – banks' main source of debt – tend to be short term and subject to a 'sequential service constraint', meaning that priority of payment is on a first-come, first-served basis. This unique capital structure stems from bank loan opaqueness. Loans make "bad" collateral because outsiders can not value them; by subjecting themselves to the possibility of a run, banks increase their borrowing capacity against their loans (Calomiris and Kahn (1991), Flannery (1994), Diamond and Rajan (2001)).

Fama (1985) argues that liquidity production helps explain what's different about banks. Private information from the business checking account gives banks an advantage in lending over other intermediaries.[1] Banks provide liquidity not only to demand depositors, however, but also to borrowers via lines of credit and un-drawn loan commitments (we use these terms interchangeably).[2] Both contracts allow customers to receive cash on demand. The liquidity insurance role of banks exposes them to the risk that they will have insufficient cash to meet random demands from their depositors or borrowers. This paper shows that banks reduce their liquidity risk by combining transactions deposits with loan commitments, thus helping to explain a key feature of the industry.

Our point of departure is the model presented by Kashyap, Rajan and Stein (2002), hereafter KRS, who explain why banks combine transactions deposits with loan commitments using a risk-management motivation: as long as the demand for liquidity from depositors is not highly correlated with liquidity demands from borrowers, an intermediary can reduce its need to hold cash by serving both customers. Thus, their model yields a diversification synergy between demand deposits (or transactions deposits more generally) and loan commitments. As evidence, KRS report a positive correlation across banks between unused loan commitments and transactions deposits. The correlation is robust to variations in the definition of loan commitments and to bank size, and is also consistent across time. KRS do not, however, test the key implication of their model – the idea that by exposing themselves to asset-side and liability-side liquidity risks simultaneously, banks can enjoy a diversification, or risk-reducing, synergy.

We test the basic premise of the KRS model – that liquidity risks stemming from the two fundamental businesses of banking yield a diversification benefit. The results suggest that bank risk, measured by stock return volatility, increases with unused loan commitments, reflecting asset-side liquidity risk exposure. This increase, however, is mitigated by transactions deposits. In fact, risk *does not* increase with loan commitments for banks with high levels of transactions deposits.

Table 1 illustrates our key finding in a simple and intuitive way. The table reports our measure of risk (average stock-return volatility, equal to the annualized return standard deviation) for large, publicly traded banks, along with several bank characteristics, including a liquidity ratio (cash + securities to assets), total assets, Fed Funds purchased to assets, and the ratio of equity to assets. We divide the data into nine cells, based on the level of loan commitments (unused commitments divided by unused commitments plus loans) and the level of transactions deposits (relative to total deposits). Each cell reports the simple average for all observations in that part of the distribution. Stock-return volatility (our measure of risk) clearly increases with loan commitments for banks with low and moderate levels of transactions deposits (columns 1 and 2). Risk *does not* increase for banks with high levels of transactions deposits (column 3). Loan commitments do not expose banks with high levels of transactions deposits to much risk.

Table 1 also shows that banks with high levels of unused commitments tend to be larger than average. Banks exposed to commitments that operate *without* the benefit of high levels of transactions deposits also hold more cash than other banks (last row of column 1).[3] Thus, the high balance-sheet liquidity held by these banks does not fully offset the risk from liquidity exposure associated with high levels of unused commitments. Banks with unused commitments seem to conserve on cash by funding themselves with transactions deposits.

Figure 1 paints a similar picture. We scatter bank stock-return volatility (with one time-averaged observation per bank) against unused commitments. For banks with below-median levels of transactions deposits, risk increases with unused commitments (Panel A). The slope coefficient in this simple regression equals 0.28 (t = 5.55), meaning that moving from the 25th to the 75th percentile of the distribution of unused commitments comes with an increase in volatility of about 10 percent. Banks with high levels of transactions deposits face no increase in risk with asset-side liquidity exposure (Panel B). If anything, risk falls slightly with commitments for these banks.

In the empirical analysis below, we show that the simple results in Table 1 and Figure 1 hold up in multivariate models, even after controlling for bank size (which is correlated with unused commitments), as well as measures of market and credit risk exposure. The result is robust to alternative measures of stock-return volatility, to different statistical modeling approaches, as well as to variations in the set of control variables included in the model.

We then extend the benchmark results by testing how the deposit-lending diversification synergy varies with market conditions. We show that the hedging synergy is stronger when market-wide liquidity supply is low, which we proxy with the Commercial Paper–Treasury Bill spread (wide spreads indicate low liquidity). The hedge strengthens because greater take-down demand from borrowers occurs just as new funds flow into bank transactions deposit accounts (Gatev and Strahan (2006)). Inflows and outflows of liquidity offset, thus mitigating the risk. Bank ex ante exposure to liquidity shocks, however, does not increase during these short-term episodes. We can therefore rule out reverse causality - the possibility that safer banks *choose* higher exposures to both asset-side and liability-side liquidity risk.

Our results show that transactions deposits play a critically important role in allowing banks to manage their liquidity risk, especially during periods of market pullbacks. The findings strengthen the KRS theoretical argument, and help explain the robust positive correlation across banks between transactions deposits and loan commitments.

1. Background and previous research

The growth of the commercial paper market and subsequently of the junk bond market in the 1980s and 1990s has reduced banks' role as credit suppliers for large corporations (Mishkin and Strahan (1998)). Other innovations, such as mortgage and credit card securitization, have also expanded the role of securities markets for households. This evolution toward the securities markets, however, has not rendered banks irrelevant (see Boyd and Gertler (1994)). They remain important to large firms as providers of backup liquidity. Commercial paper issuers regularly support their program with back-up lines from banks.[4] In addition, while most firms do not issue commercial paper, almost all secure a line of credit from a bank. Sufi (2006) finds that at least 75% of Compustat firms disclose a bank line of credit and that these lines relax liquidity constraints. Households also receive liquidity from banks through credit cards and home equity lines. Banks, of course, continue to provide liquidity through their role as issuers of transactions deposits.

Why do banks provide liquidity to both borrowers and depositors? KRS present a model in which a risk-management motive explains the combination of transactions deposits and loan commitments. They argue that as long as liquidity demand from depositors and borrowers is not too correlated, an intermediary will reduce its cash buffer by serving both customers. Holding cash raises costs for both agency and tax reasons (Myers and Rajan (1998)). Thus, their model yields a diversification synergy between transactions deposits and unused loan commitments.

This synergy helps explain one of the basic features of banking. KRS show that banks offering more transaction deposits tend also to make more loan commitments. In Gatev and Strahan (2006), we suggest a stronger hypothesis, supported by our findings that the correlation is not only low but is often *negative*. Transactions deposits can be viewed as a natural hedge because flows into these accounts offset the systematic liquidity risk exposure stemming from issuing loan commitments and lines of credit.

Our previous work extends KRS by considering the possibility that liquidity production could expose banks to systematic liquidity risk. A bank with many open credit lines may face a problem if systematic increases in liquidity demand occur periodically.[5]

Gatev and Strahan (2006) show that funding to banks increases when market liquidity declines, meaning that liquidity demands become negatively correlated in tight markets. Why do banks enjoy funding inflows when liquidity dries up? First, the banking system has explicit guarantees of its liabilities.[6] Second, banks have access to emergency liquidity support from the central bank. Third, large banks such as Continental Illinois have been supported in the face of financial distress (O'Hara and Shaw (1990)). Thus, funding inflows occur because banks are rationally viewed as a safe haven for funds. Consistent with this notion, Pennacchi (2006) finds that during the years before the introduction of federal deposit insurance, bank funding supply did *not* increase when spreads tightened.

In a case study, Gatev, Schuermann and Strahan (2006) focus on the behavior of deposit flows *across banks* during the 1998 crisis. During the three months leading up to the crisis, bank stock prices where buffeted by news of the Russian default, followed by the demise of LTCM in late September, and finally by the drying up of the commercial paper market in the first weeks of October.[7] Figure 2 shows the aggregate effects of the 1998 crisis on stock-return volatility. We plot bank stock volatility and volatility of the S&P 500, measured as the conditional volatility from an EGARCH (1,1) model. The figure highlights the difference between bank risk exposures in different business conditions. During the crisis, bank stock prices fell more than the stock prices of non-financial firms (Panel A), and return volatility became higher than overall general market volatility (in contrast to the "normal" pre-crisis period – Panel B).[8]

To understand how banks weathered the 1998 storm, in Gatev, Schuermann and Strahan (2006) we explore the cross-sectional patterns in deposit flows. We find first that investors moved funds from markets into banks; second, that banks with higher levels of transactions deposits before the crisis had the largest flows of new money during the crisis; and third, that *all* of the flows of new money were concentrated in bank demand deposits. So, banks structured to bear increased demands for liquidity from borrowers (i.e., banks with transactions deposits) could meet those demands easily (because money flowed into those accounts). Thus, government safety nets can explain why banks generally receive funding during crises, but the evidence from Gatev et al. (2005) and Kashyap et al. (2002) suggests that the structure of banks matters too.

Before the introduction of government safety nets, transactions deposits could sometimes expose banks to liquidity risk when consumers together removed deposits, either to increase consumption or because they had lost confidence in the banking system. This bank-run problem has traditionally been viewed as the primary source of liquidity risk and creates a public policy rationale for FDIC insurance as well as for reserve requirements for demand deposits (Diamond and Dybvig (1983)). In crisis, investors now run to banks, not away from them (at least they do in the U.S.), and banks funded with transactions accounts receive the inflow. Thus, rather than open banks to liquidity risk, transactions deposits today help banks hedge that risk, which now stems more from the lending side. We now turn to our direct tests of this idea.

2. Empirical Methods

Sample

We start by identifying the 100 largest publicly traded domestic banks (based on market capitalization) at the beginning of each year from 1990 to 2002.[9] We focus on large banks for several reasons. First, large-bank stocks trade frequently, so daily stock returns are available and reliable. For smaller banks, lack of active trading every day poses problems in estimating the conditional volatility model (see below). Second, large banks hold the vast majority of the banking system's assets. For example, about 60 percent of bank assets were held by the 100 largest banks during our sample. Third, large banks are more actively engaged in commitment lending than small banks.

After identifying the top 100, we drop all banks that engaged in a merger or acquisition (M&A) during the year of the deal itself (but not in other years). For example, fifteen of the large banks were involved in M&A in 1990, leaving 85 in our sample.[10] Next, we construct the weekly conditional volatility for stock returns for these banks (details below). For our purpose, a week begins and ends on Wednesday, as this is the weekday with the fewest public holidays which might close the markets. We repeat this sampling procedure for every year between 1990 and 2002. Note that it is important to drop both acquirers and targets around M&A announcements because speculation about such deals generates a large amount of stock price volatility having nothing to do with the basic risks banks face (market, credit, liquidity, etc.). So, for example, we drop both JP Morgan and Chase during the year of their merger, but these two banks are included as two separate banks in the years prior to the merger, and as a single bank in the year after the merger. As a result, the maximum number of banks in any year is 98 (2002), and the minimum is 68 (1996). The sample-generating procedure leaves us with 170 banks, and almost 50,000 bank-week observations overall.

Conditional Mean Volatility

We construct our conditional stock-return volatilities by first fitting daily returns to a GARCH (1,1) model for each bank-year, as follows. Let $r_{i,t+1}$ be the return for bank i from t to t+1. Then bank returns may be characterized by

$$
\begin{aligned}
& r_{i,t+1} = \mu_i + \varepsilon_{i,t+1} \\
& \sigma^2_{i,t+1} = \omega + \alpha \varepsilon^2_{i,t} + \beta \sigma^2_{i,t}, \quad \omega, \alpha, \beta > 0,
\end{aligned} \tag{1}
$$

where μ_i is a non-zero drift. For estimation, the innovation $\varepsilon_{i,t+1}$ is assumed to be conditionally normally distributed with time-varying GARCH(1,1) volatility as specified in the second equation of (1).

Based on the coefficients estimated in the GARCH model, we construct daily conditional volatility, and then we aggregate up the daily volatilities to weekly frequency.[11] Table 1 reports the simple average level of these conditional volatilities, normalized to represent the annualized standard deviation of the stock return. We split the data into nine cells, based on the joint distribution of the level of the ratio of transactions deposits to total deposits and the level of unused loan commitments to total commitments plus total loans (our measure of asset-side liquidity exposure). This admittedly simple table illustrates the main hedging idea of our research: banks with high levels of transactions deposits have similar levels of risk *regardless of their loan-liquidity exposure* (column 3). In contrast, risk increases with loan liquidity risk (unused loan commitments) for banks at the low end of the transactions deposits distributions (column 1). Increasing unused loan commitments comes with an increase in risk of nearly 30 percent for these banks (from 0.28 to 0.36). The same patterns show up in the medians within each cell (not reported). The deposit base therefore seems to act as a natural hedge against liquidity exposure from loan commitments.[12]

Regression Specification

To demonstrate these results more systematically, we estimate an empirical model of the conditional volatility as a function of bank liquidity exposure, deposits, and other market-level and bank-level characteristics, as follows:

$$
\begin{aligned}
Log(\sigma_{it}) = \beta_0 &+ \beta_1 LoanCommitments_{i,t\text{-}1} + \beta_2 DepositBase_{i,t\text{-}1} + \\
&+ \beta_3 (LoanCommitments_{i,t\text{-}1} * DepositBase_{i,t\text{-}1}) + \qquad (2) \\
&+ \textit{Bank-Level and Market-Level Control Variables} + u_{i,t},
\end{aligned}
$$

where σ_{it} is the conditional stock-return volatility for bank i at time t from the first-stage GARCH (1,1) model in equation (1); $LoanCommitments_{i,t\text{-}1}$ is the ratio of unused loan commitments to commitments plus loans (measured in the previous quarter); and, $DepositBase_{i,t\text{-}1}$ is the ratio of transactions deposits to total deposits (again, from the prior quarter). If deposits help banks hedge asset-side liquidity risk, as suggested by Table 1, then $\beta_3 < 0$.[13]

Variable Definitions and Data Sources

As time-varying controls in the regression, we include the contemporaneous stock return volatility for the S&P 500 as a whole, estimated with a GARCH (1,1) model in the same fashion as the bank specific volatilities; the three-month T-bill rate; and the spread between the high-grade three-month commercial paper rate and the three-month T-bill rate. To be consistent with the conditional volatilities, the interest rate data are taken for the Wednesday of a given week.

For bank-level controls, we include the following: the log of assets (size control), the ratio of cash plus securities to total assets (liquid asset measure), the ratio of capital to assets (capital adequacy measure), and the ratio of Fed Funds purchased to assets (a measure of access to the Fed Funds market, a liquidity pool). Controlling for size is particularly important given its correlation with loan commitments (recall Table 1). We also consider a second loan commitment variable as a robustness test that removes retail commitments (e.g., credit card lines) from both the numerator and the denominator of $LoanCommitments_{i,t\text{-}1}$. Unused retail commitments may be less likely to expose banks to risk compared to business-loan commitments, where take-down demand is both less predictable and more likely to have a systematic component such as the one observed in the fall of 1998.

Data on unused commitments, transactions deposits, as well as the other bank characteristics, come from the most recent quarter of the *Reports of Income and Condition* ('call reports') prior to the time at which we measure the stock return variability. For example, all weeks in the second quarter of 1990 are matched to call report data for the first quarter of 1990. Stock return data come from the *Center for Research in Securities Prices* (CRSP), inclusive of dividend payments and adjusted to account for stock splits. Data on interest rates are available daily from the Federal Reserve Board of Governors. Note that since the regulatory data is available only at quarterly intervals, the bank characteristics remain unchanged for all weeks within a given quarter.

Summary Statistics

Table 2 reports the summary statistics for all of the variables reported in the regressions. Bank-stock volatility averages about 30 percent per year, well above the 16 percent for the S&P 500 index. We would expect, of course, index volatility to be lower due to portfolio effects. In our sample, the mean loan commitment ratio is about 0.32 and the mean level of transactions deposits to total deposits equals about 0.26. As in KRS, banks with high levels of loan commitment also tend to focus on transactions deposits. For instance, 46 percent of the observations in Table 1 line up on the diagonal (relative to 33 percent if the data were evenly distributed). Most of our control variables are ratios that lie between zero and one (interest rates are in percent). In the case of assets, we take the log of the variable. Hence, there is no concern about outliers driving the results.

3. Results

Main Findings

Table 3 reports the benchmark set of findings. We report the regressions from equation (2) above using all of our data. The table reports four specifications, two based on the total commitments ratio, and two that exclude retail commitments. For each of these, we report a simple model with just log of assets as a bank control, and a more complex model that adds the liquid assets ratio (cash + securities), the ratio of Fed Funds purchased to assets, and the capital-asset ratio. Note that we have a very large sample (almost 50,000 bank-week observations), but we cluster the data by bank to avoid assuming independence over time for each bank. This clustering raises the standard errors by a factor of about 10 relative to the OLS standard errors.

The results in Table 3 support the idea that loan commitment risk (liquidity risk) can be hedged with transactions deposits. The coefficient on the interaction term (β_3) is negative and highly statistically significant, ranging from -1.60 to -1.75 across the four specifications. For a bank with transactions deposits at the 10^{th} percentile of its distribution (0.12), the coefficients suggest that loan commitments expose banks to risk. For such a bank, a one standard deviation increase in the loan commitment ratio would come with an increase in stock-return volatility of about 2.5 percentage points (relative to a sample standard deviation of about 13 percentage points). For a bank with transactions deposits at the 90th percentile (0.38), however, the same increase in loan commitments comes with an increase in stock-return volatility of just 0.6 percentage points.

Robustness Tests

Tables 4-7 report four sets of robustness tests. We first replace the GARCH (1,1) estimate of conditional stock-return volatility with realized volatility, equal to the weekly average of squared returns (Table 4). Next, we remove three systematic risk factors from returns before constructing the weekly average of squared returns (Table 5). Table 6 focuses on the statistical assumptions by separating time-series from cross-sectional variation. Last, Table 7 focuses on the potential for omitted variables bias.

Table 4 shows that the precise modeling technique for return volatility has little impact on the coefficients of interest. The effects of transactions deposits and unused commitments, and most important the interaction or hedging term, are similar using both realized volatility and the GARCH volatility. We do find, however, that the effect of market conditions (particularly the paper-bill spread) more than *doubles* and becomes much more statistically powerful. This makes sense because the realized volatilities will adjust immediately to changing market conditions, while the GARCH estimates will only do so gradually. The goodness of fit of the model also declines sharply, presumably because, in contrast to the GARCH estimates, the realized volatilities are not smoothed over time.

In Table 5, we model the realized *residual* volatility, where we first remove three systematic factors from the returns, as follows:

$$r_{i,t} = \alpha_i + \beta_{1,i}\, r_{m,t} + \beta_{2,i}\, \Delta(Baa\text{-}Aaa)_t + \beta_{3,i}\, \Delta(Three\text{-}Month\ T\text{-}Bill)_t + \varepsilon_{i,t} \qquad (3)$$

We estimate this first-stage factor model separately for each bank-year, and then compute the average squared residuals to build the realized residual volatility for each bank during each week in the year. In equation (3), $r_{m,t}$ represents the return on the market portfolio, proxied by the return on the S&P 500; $\Delta(Baa\text{-}Aaa)_t$ represents a default-risk or credit-risk factor, equal the change in the yield on Baa-rated corporate bonds relative to Aaa-rated bonds; and $\Delta(Three\text{-}Month\ T\text{-}Bill)_t$ represents an interest rate risk factor, equal to the change in yield on short-term T-bills. Data for the market return are from *CRSP*, and the interest rate series come from the Federal Reserve.

Because we have removed factors related to bank interest rate risk, market risk and credit risk, the residual volatility is more likely to represent pure liquidity risks, rather than other risks such as default risk or some broader macro factor (absorbed by the market return in the factor model). And, as shown in Table 5, the coefficients on deposits, unused commitments and their interaction – the hedging term – remain quite similar to those reported earlier. In fact, if we model the systematic or explained variation from the factor model, we find much smaller coefficients across all three of these variables, and these coefficients are not statistically significant in three of the four specifications (not reported).[14]

Table 6 decomposes the results into their time-series and cross-section components. In columns 1 and 2 we report the 'between' estimator – that is, the regressions are run using bank-level time-series averages. These coefficients are driven by pure cross-sectional variation. We find that the hedging coefficient remains similar to the results in Table 3 in terms of magnitudes. Levels of statistical significance fall slightly because the between estimator has just 170 separate banks. We report the 'within' estimator in columns 3 and 4. The within estimator, also sometimes called the fixed effects estimator, allows each bank to have its own intercept in the regressions. Because the bank-level intercept strips out all cross-sectional variation before estimating the slope coefficients, the results are driven solely by within-bank variation over time. Again, we continue to find strong evidence of the transaction deposit-loan commitment diversification synergy. The results in Table 6 suggest that the hedging effects of combining loan commitments with transactions deposits are present with approximately equal magnitude in both the cross-sectional and time-series dimensions.

The results in Table 5, based on *residual* volatility, suggest that standard risk factors can not explain our findings. Another way to rule out these alternative explanations is to control for bank exposure to them directly in modeling overall volatility, which we report in Table 7. Credit and market risk exposures are of course two of the primary risks faced by banks (and, not coincidentally, these are the risks that the Basel Capital Accord focuses on). We therefore include the ratio of commercial and industrial loans to assets and the ratio of commercial real estate loans to assets as ex-ante proxies for bank credit risk exposure.[15] We also include the ratio of non-performing loans to assets as a measure of ex-post risk, and, in some specifications, we also add the ratio of net charge offs to assets, and the ratio of loan loss provisions to assets.[16] To control for cross-bank variation in market risk exposure, we include the ratio of trading account assets to total assets. And, as a final catch-all control we include three indicators based on the bank's credit rating, along with an indicator equal to one for unrated banks.

The results in Table 7 suggest that while our measures for both credit and market risk are correlated with stock return volatility in the expected ways, the liquidity-riskoffsetting influence of deposits is robust to these other risks (columns 1 and 2). The coefficients on C&I loans and trading account assets enter with positive signs (significant in two of the four models). Even more striking, both non-performing loans and loan loss provisions have substantial power to explain stock-return volatility, as do the ratings indicators. But, the key result remains: the coefficient on the interaction term remains negative and significant, and more generally the results are similar to those reported before. [17]

The last two columns of Table 7 repeat these regressions, but now we replace the time-varying control variables (S&P 500 volatility, the level of interest rates, and the spread) with a full set of time indicator variables (i.e., a separate intercept for each week). The market-level variables are not identified in this model because the time effects sweep out all common shocks to bank-stock volatility. The advantage of this approach is that time effects remove any missing common factors that may move bank-stock volatility around, such as changes in regulations, macroeconomic shocks, changes in monetary policy, and so on.[18] The effects of interest, again, remain robust in these specifications.[19]

Interpreting Our Results

We do not explicitly model the tradeoffs associated with a bank's choice of balance sheet liquidity (cash and securities) versus transactions deposits.[20] Our results (and the KRS model) suggest, however, that banks flush with transactions deposits will supply liquidity to borrowers via loan commitments, and that banks with strong demand for loan commitments will optimally fund themselves with transactions deposits. Why, then, do we ever observe banks exposed to unused commitments having *low* levels of transactions deposits (and vice versa)? KRS take bank deposits as exogenous, arguing implicitly that variation depends on supply factors like demographics or banking market concentration, rather than as a hedge against asset-side liquidity risk. Some banks in concentrated markets, for example, may enjoy a large supply of low-cost transactions deposits but have relatively little demand for loan commitments. These banks are represented by the upper right-hand corner of Table 1. The average size of banks in this cell is the smallest in our sample (just over $7 billion in assets), and small banks typically have a bank-dependent, small business clientele. Small firms generally receive less liquidity insurance from banks relative to larger firms.[21] Other banks located where transactions deposit supply is low may have borrowers with unusually high demand for liquidity (represented in the lower left corner of Table 1).

Given this discussion, we must consider the possibility of reverse causality. The concern is that risk management drives bank choices of transactions deposits and loan commitments, rather than the other way around. Perhaps safe banks, for example, choose to expose themselves to greater liquidity risk on both sides of the balance sheet. We have already seen that the hedging effects are robust to varying the set of observable risk measures. Another approach, which we turn to next, is to test how results vary with market conditions. During 'normal' times, the diversification synergy comes from reducing the effects of idiosyncratic liquidity demands. When market liquidity becomes scarce, however, borrowers systematically draw funds from pre-existing loan commitments at the same time that funding flows into bank transaction deposit accounts. Since liquidity demands become *negatively* correlated in tight markets, the hedging term ought to become larger then. Exposure to liquidity shocks (the potentially endogenous choice by the bank) does not vary at high frequency. In fact, our measure is taken from the preceding quarter and has no within-quarter variation at all, so an increase in the hedging term in tight markets is unlikely to reflect reverse causality.

Varying Market Conditions

To test this notion, we first re-estimate Figure 1, now scattering stock-return volatility against unused loan commitments during the commercial paper crisis of 1998 (Figure 3). In the first weeks of October, commercial paper spreads rose to over 100 basis points (in the 99th percentile of the spread distribution), liquidity in the market dried up, and issuers were forced to draw funds from their back-up lines. The two panels again show an increasing relationship between risk and unused commitments for banks with low levels of transactions deposits (Panel A), but no relationship for banks with high levels of transactions deposit (Panel B). Most important, the *slope* of the relationship for the low-transaction deposit banks almost doubles from what we see unconditionally (rising from 0.28 in Figure 1, Panel A, to 0.46 here). Comparing magnitudes, moving from the 25th to the 75th percentile of the unconditional distribution of unused commitments comes with a three percentage point increase in volatility (10 percent of the unconditional mean); during the 1998 crisis, the same relative increase in commitments comes with a seven percentage point increase (14 percent of mean volatility during the crisis weeks). Volatility *does not* increase with unused commitments, even during these crisis weeks, for banks with high levels of transactions deposits (Panel B). Thus, the power of the hedge increases in tight markets.

Next, we estimate the regressions in two regimes: one when the paper-bill spread is above 75 basis points (the 95th percentile of its distribution) and the other when the spread is below 75 basis points (Table 8). By comparison, the average CP spread over the sample period is about 40 basis points. We also focus just on the crisis weeks of October 1998, when the spread rose above 100 basis points.

The results indicate that transactions deposits do in fact act as a more powerful hedge when CP rates are unusually high. When the commercial paper spread is above 75 basis points, there is a much stronger positive link from loan commitments to risk (the linear coefficient on loan commitments rises from 0.76 to 1.0), and also a greater hedge associated with transactions deposits (the interaction effect nearly triples, from -1.3 to -3.2). The increase in magnitude in the hedging term is significant at the two percent level (Table 8, column 3). The increases are even more dramatic during the 1998 crisis (Table 8, column 4). We also find a significant increase in the coefficient on bank size. During normal market conditions, we find no correlation between size and volatility, whereas larger banks have higher stock-return volatility than smaller banks when CP spreads are wide.

To understand the economic magnitudes, these coefficients suggest that increased loan commitments come with higher risk at banks with low levels of transactions deposits, but *lower* risk for banks with high levels of transactions deposits. For example, for a bank with a transactions deposits ratio of 0.38 – at the 90th percentile of the distribution – an increase in loan commitments would lower stock-return volatility by 1.7 percentage points.[22]

Table 9 reports another test showing that market conditions alter the deposit-loan commitment hedge. Rather than split the sample, we add interactions between the level of the paper-bill spread and the transactions deposits and loan commitment variables. We also rule out again alternative explanations by modeling *residual* stock-return volatility as the dependent variable (as in Table 5), and by adding interactions between the default spread – the difference between yields on Aaa-rated and Baa-rated corporate bonds – and the bank characteristics. As in Table 8, we find that the hedging of the two liquidity variables is stronger during periods of tight markets (wide spreads). And, consistent with the earlier findings, the default interactions are never statistically important (columns 3 and 4).[23]

4. Conclusion

Transactions deposits reduce liquidity-risk exposure stemming from bank lending. Banks with high levels of transactions deposits do not face high risk even if they are exposed on the asset side to un-drawn loan commitments. In contrast, banks exposed to loan-liquidity risk without high levels of transactions deposits *do* have high risk. The deposit-lending hedge becomes especially powerful during periods of tight markets, when funds move out of the securities markets and into banks. The results are particularly striking to us because they reverse the standard notion of liquidity risk at banks, where runs from depositors had been seen as the cause of trouble (e.g., Diamond and Dybvig (1983)). Today, because safety nets protect banks, they are viewed as safe havens for funds. Investors seem to move money into deposits during periods of market turmoil. These funding inflows allowing banks to supply credit when markets can’t or won’t.

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Endnotes

[1] Mester, Nakamura, and Renault (2006) offer some empirical evidence for this notion. Gatev (2006) argues that banks also have unique information about systematic (as opposed to firm-specific) liquidity shocks, allowing them to lend to opaque firms such as hedge funds.

[2] Early literature attempts to understand how banks' role in liquidity production leads to fragility. Diamond and Dybvig (1983) argue that by pooling their funds in an intermediary, agents can insure against idiosyncratic liquidity shocks while still investing most of their wealth in high-return but illiquid projects. This structure leads to the potential for a self-fulfilling bank run and sets up a policy rationale for deposit insurance. More recent theoretical and empirical studies focus on liquidity risk from the asset side. For example, Berger and Bouwman (2006) document the importance of banks in liquidity production on both sides of bank balance sheets, and show that this role has grown sharply over time. There is also a growing literature showing that liquidity-risk management or liquidity shocks to banks affect loan supply. See Paravisini (2006), Kwaja and Mian (2005), Loutskina (2005) and Loutskina and Strahan (2006).

[3] The cash ratio is not monotonically increasing in liquidity exposure from transactions deposits.

[4] Banks began offering liquidity insurance for large firms early in the development of the commercial paper market. In 1970, Penn Central Transportation Company filed for bankruptcy with more than $80 million in commercial paper outstanding. As a result of their default, investors lost confidence in other issuers, making it difficult for some of these firms to refinance their paper as it matured. The Federal Reserve responded to the Penn Central crisis by lending aggressively to banks through the discount window and encouraging them, in turn, to provide liquidity to their large borrowers. In response to this difficulty, commercial paper issuers began purchasing backup lines of credit from banks to insure against future funding disruptions (Kane (1974), Calomiris (1994), and Calomiris, (1989)).

[5] For example, during the first weeks of October 1998, following the coordinated restructuring of the hedge fund Long Term Capital Management, spreads between safe Treasury securities and risky commercial paper

rose dramatically. Many large firms were consequently unable to roll over their commercial paper as it came due, leading to a sharp reduction in the amount of commercial paper outstanding and a corresponding increase in take-downs on pre-existing lines of credit (Saidenberg and Strahan (1999)). As a result of this market pullback, banks faced a spike in demand for cash as many of their largest customers drew funds from pre-existing backup lines of credit.

[6] Deposit insurance limits have recently been expanded for the first time since 1980. In addition, some small banks have begun to avoid binding limits on deposit insurance by splitting very large deposits across multiple institutions. For a broad discussion of deposit insurance and policy ramifications, see Kroszner and Strahan (2005).

[7] For policy discussion on LTCM, see Edwards (1999). For a discussion of bank exposure to hedge funds, see Kho, Dong and Stulz (2002) and Furfine (2006).

[8] Chava and Purnanandam (2006) provide evidence that the CP market ceased to function at the beginning of October by comparing abnormal returns for firms with and without access to this market. They show first that stock prices of CP issuers fell much less than other firms when bank financial condition deteriorated during September of 1998 (while markets continued to function). During the first two weeks of October, however, the stock prices of *all* firms, regardless of their ability to access the CP market, fell equally. Thus, *all* firms became bank dependent – even CP issuers - during those weeks because CP markets ceased to function and even large corporations relied on banks for liquidity.

[9] We begin in 1990 because that is the first year when unused retail loan commitments are available, which we shall control for as a robustness check. Prior to 1990 only total commitments are reported.

[10] Traded equity reflects the profits and risk of the entire bank holding company, so our use of the term bank refers to the whole holding company. In collecting characteristics, we use data for the lead bank within the holding company.

[11] To aggregate volatilities from daily to lower frequencies, say weekly, we take the average over that week and scale by $\sqrt{5}$, allowing for the possibility of missing days due to, for instance, holidays.

[12] Notice that the hedge seems to go both ways. That is, for banks with low levels of loan commitments (first row), higher transactions deposits come with higher risk (from 0.28 to 0.32). On the other hand, for banks with high levels of commitments, higher transactions deposits come with lower risk (from 0.36 to 0.31).

[13] We have also estimated regressions like (1) using the level of volatility as well as the square of volatility (variance). These results are similar in terms of statistical and economic significance to those reported here.

[14] Consistent with Demsetz and Strahan (1997), Table 5 also reports a significant negative effect of log of bank assets, reflecting size-related diversification.

[15] In general, business loans are the part of the bank loan portfolio with the most credit risk (Demsetz and Strahan (1997), Stiroh (2006)). Loan losses tend to be higher for credit card loans, but these losses are much more predictable than losses associated with business lending.

[16] Non-performing loans are defined as loans more than 30 days past due plus loans no longer accruing interest but not yet charged off the balance sheet.

[17] To the extent that rating agencies account for liquidity risk, adding the credit rating may be absorbing some of the effects that we are trying to measure, thus biasing the coefficients of interest toward zero. And, in fact, the coefficients of interest fall slightly relative to the results without these variables.

[18] For example, passage of the Financial Modernization Act in 1999 may have increased bank stock return volatility temporarily by increasing speculation about merger activity among financial companies.

[19] We have also estimated our model for above and below median sized banks. For both samples we find similar results for the coefficients on the loan commitments and transactions deposit variables and their interaction, both in terms of magnitudes and levels of significance.

[20] Banks presumably choose all of these jointly, along with other capital structure policies such as leverage and debt maturity. A full analysis of the substitutability across these financial policies would require a set of identifying instruments, an exercise well beyond the scope of this paper. We focus instead on the co-variation between these endogenous financial variables and our outcome measure, the bank's stock-return volatility.

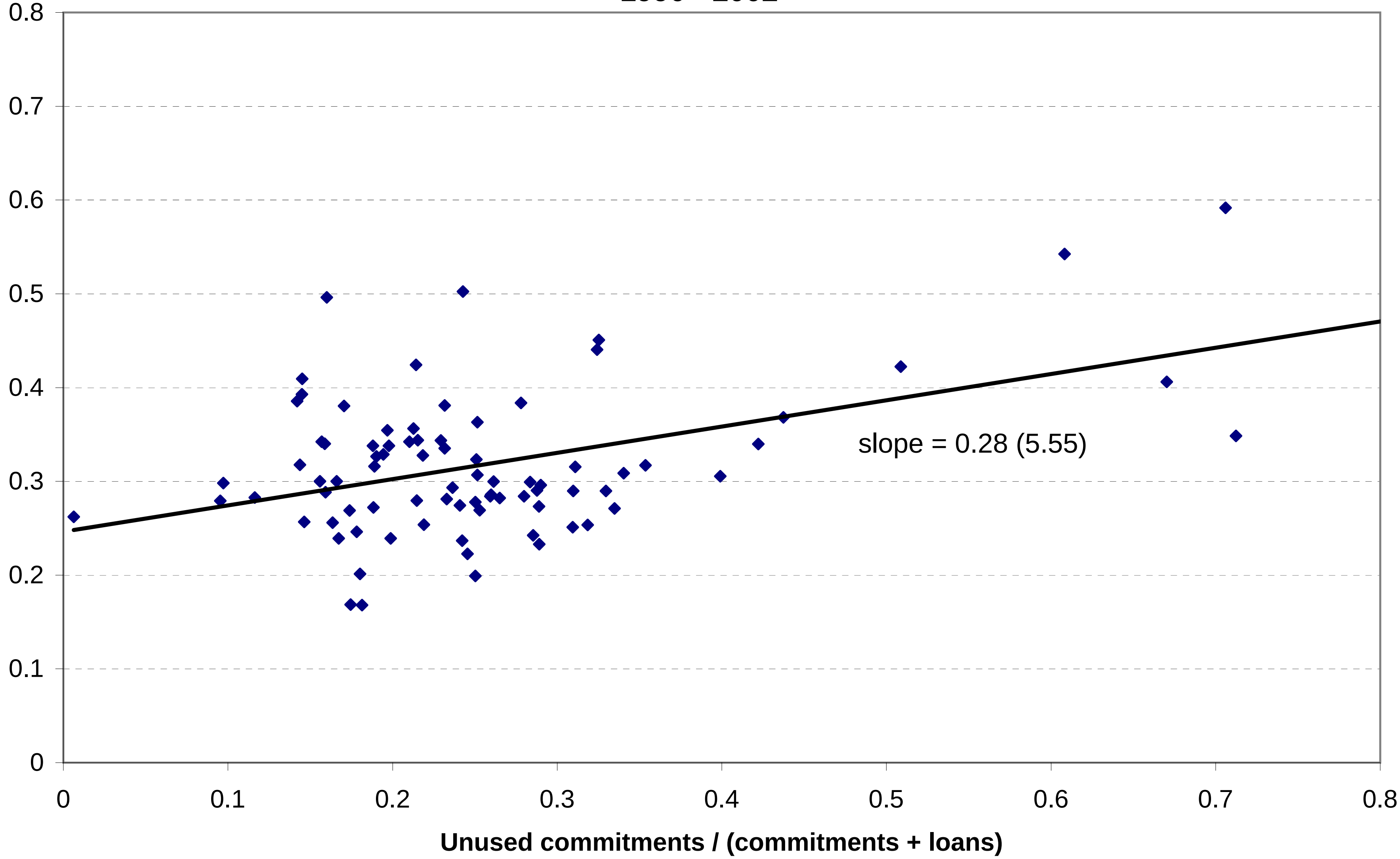
[21] There is a strong positive correlation between firm size and the importance of lines of credit, both among small, private firms as well as among large, Compustat firms (see Bitler, Robb and Wolken (2001), and Sufi (2006)).

[22] We have also separated our transactions deposit variable into demand deposits and other transactions deposits. We find no statistically significant difference across the two – that is, both kinds of transactions accounts seem to work to help hedge asset-side liquidity risk. Thus, we only report the results here for the total ratio of transactions deposits to total deposits.

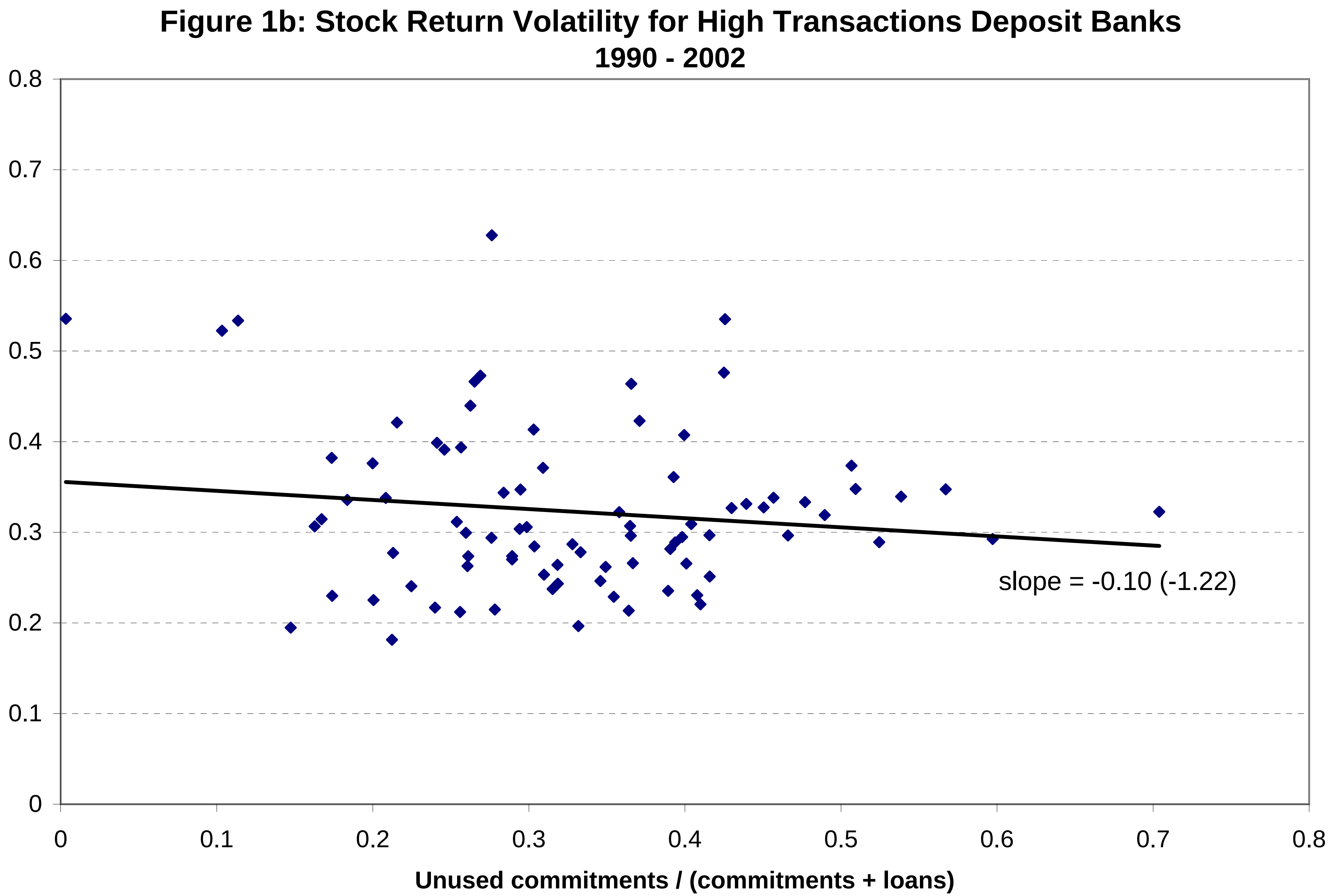
[23] The paper-bill spread and the spread on corporate bonds really are measuring distinct economic phenomena: the correlation between the change in these two spreads is just 0.08 during our sample. Thus, it seems reasonable to think of the Aaa-Baa spread as measuring default risk, while the paper-bill spread measures liquidity risk.

Figure 1a: Stock Return Volatility for Low Transactions Deposit Banks

1990 - 2002



Time average of annualized bank stock return volatility and commitment ratio for banks with below-median levels of transactions deposits for 170 largest U.S. banks (plot is for 85 banks). Source: Volatility based on authors' calculations using data from CRSP. Commitment ratio is from Call



Time average of annualized bank stock return volatility and commitment ratio for banks with above-median levels of transactions deposits for 170 largest U.S. banks (plot is for 85 banks). Source: Volatility based on authors' calculations using data from CRSP. Commitment ratio is from Call

Figure 2 Panel A
Banks Price Index May 14 - Nov 17,1998

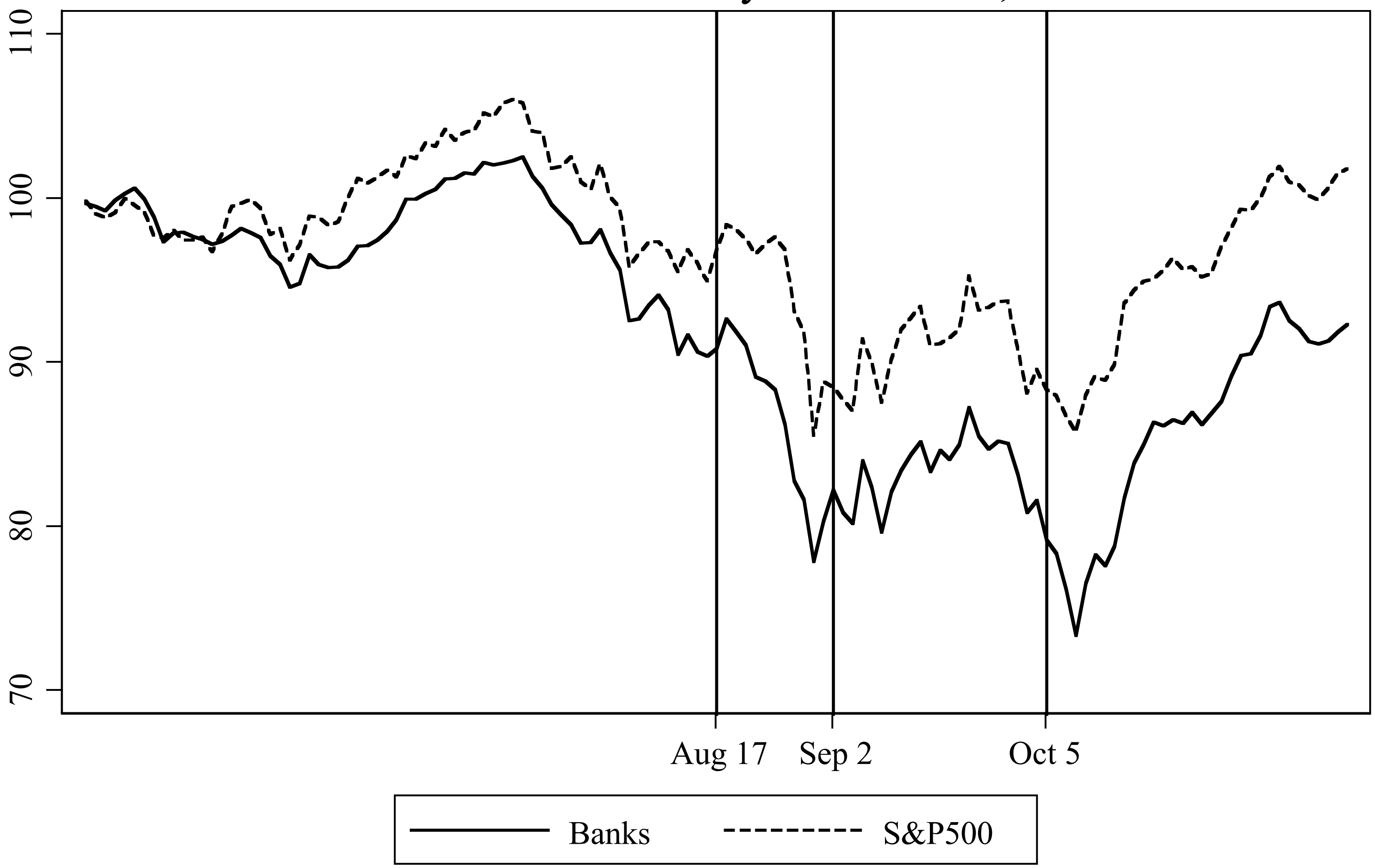


Figure 2 Panel B
Banks Conditional Volatility May 14 - Nov 17, 1998

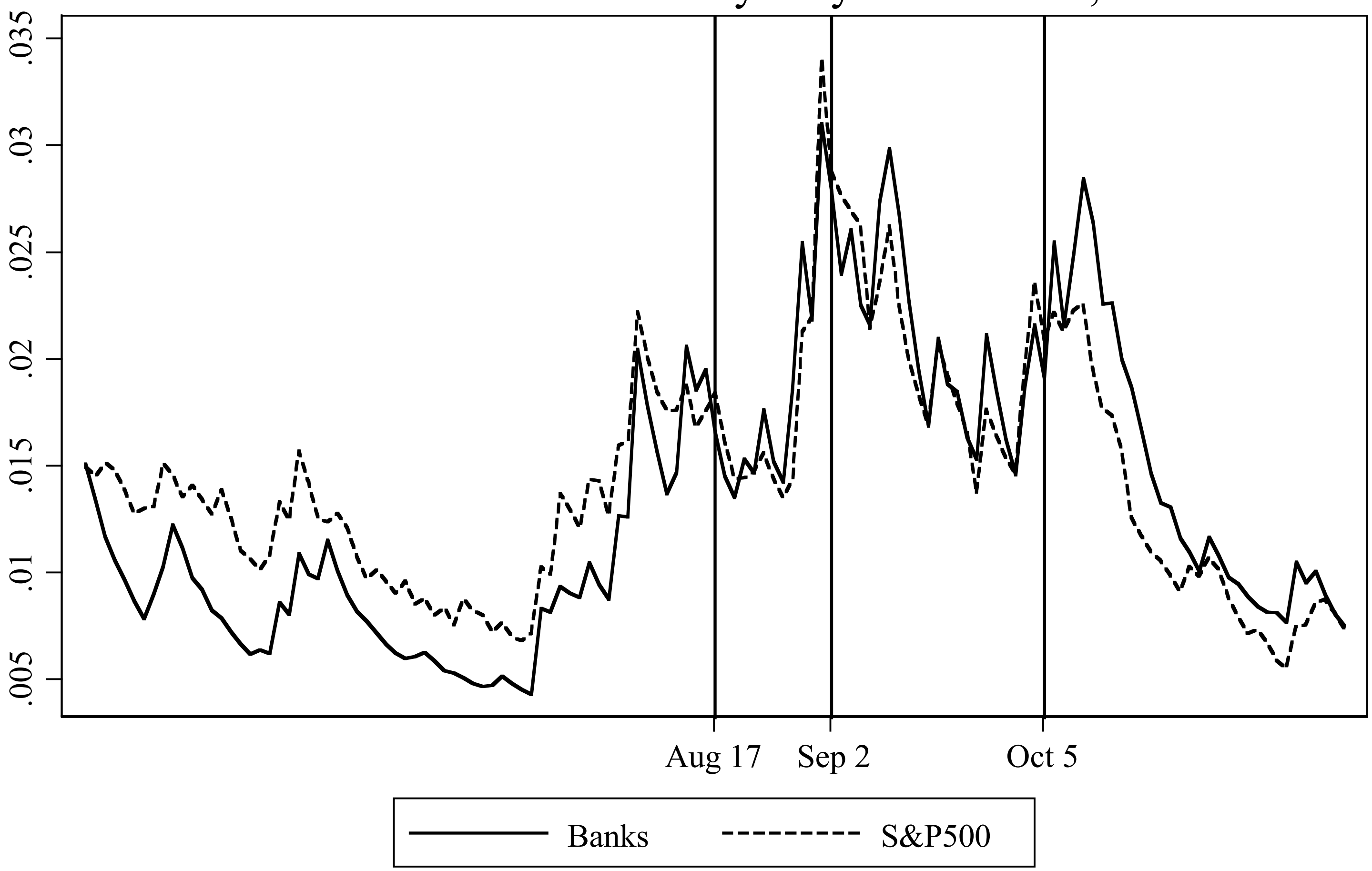
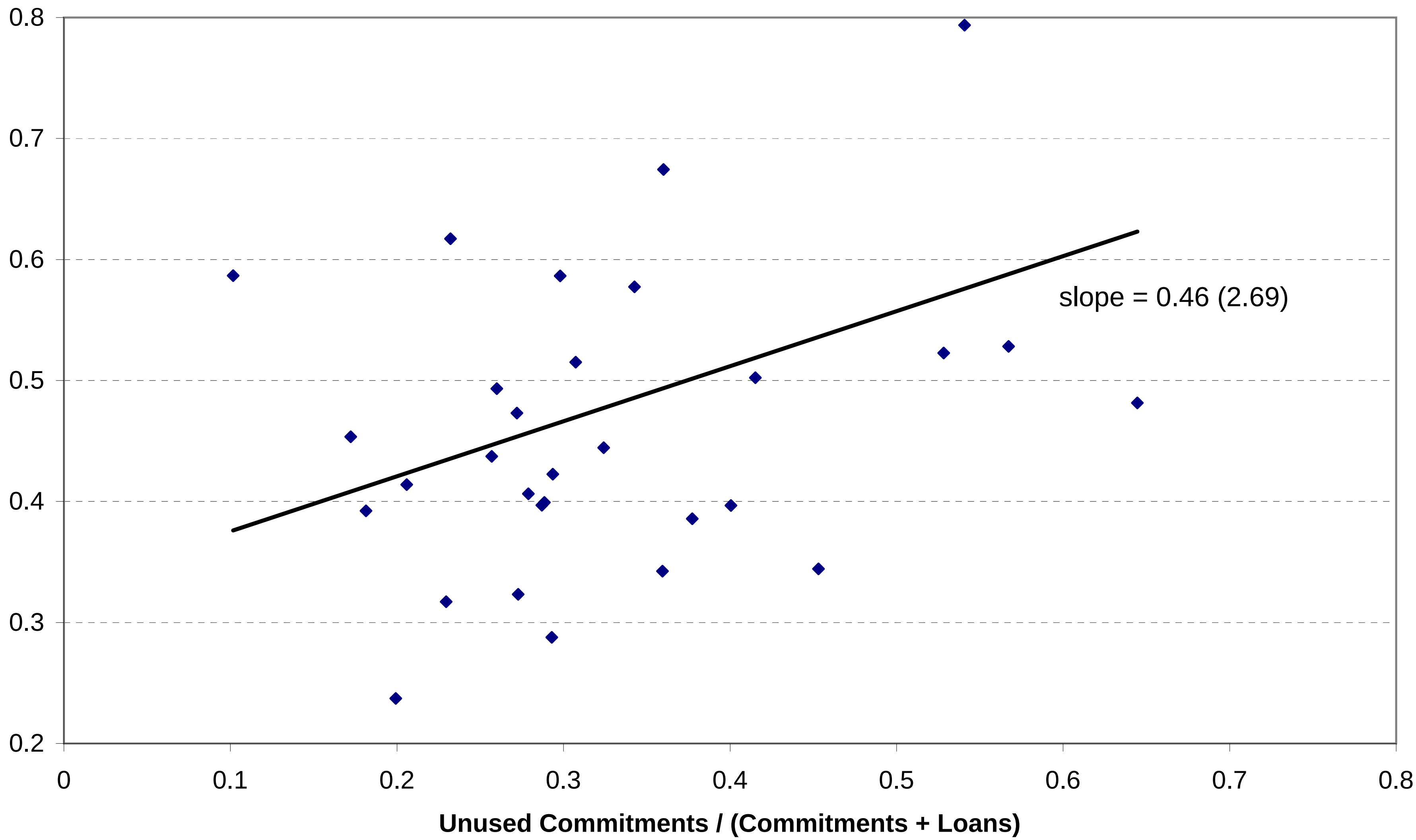
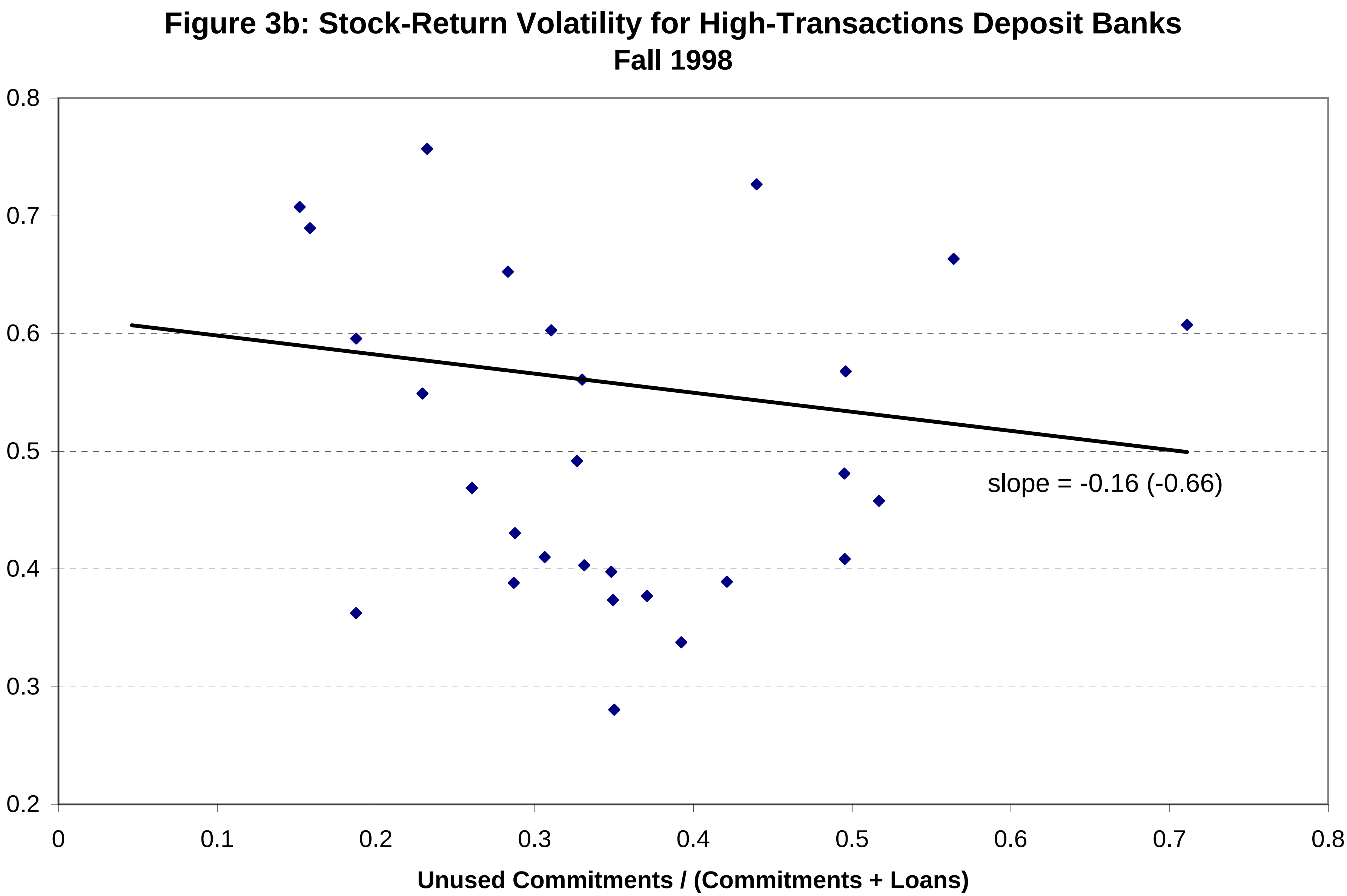


Figure 3a: Stock-Return Volatility for Low-Transactions Deposit Banks
Fall 1998



Time average of annualized bank stock return volatility and commitment ratio for banks with below-median levels of transactions deposits for 64 largest U.S. banks (plot is for 32 banks). Source: Volatility based on authors' calculations using data from CRSP. Commitment ratio is from Call Reports.



Time average of annualized bank stock return volatility and commitment ratio for banks with below-median levels of transactions deposits for 64 largest U.S. banks (plot is for 32 banks). Source: Volatility based on authors' calculations using data from CRSP. Commitment ratio is from Call Reports.

Table 1: Mean Bank Characteristics, By Transactions Deposits and Unused Commitments[A]

	Transactions Deposits / Total Deposits (TD):		
	TD < 33rd Percentile	**33rd Pct. >= TD < 67th Pct.**	**67th Pct. <= TD**
	(1)	(2)	(3)
Unused Commitments / (Commitments + Loans) (LC)			
LC < 33rd Percentile			
Stock-return Volatility	0.28	0.29	0.32
(Cash + Securities) / Assets	0.32	0.31	0.33
Assets (Billions of $s)	10.58	10.20	7.14
Fed Funds Purchased / Assets	0.07	0.08	0.07
Equity / Assets	0.08	0.08	0.11
33rd Percentile <= LC < 67th Percentile			
Stock-return Volatility	0.29	0.29	0.30
(Cash + Securities) / Assets	0.32	0.31	0.33
Assets (Billions of $s)	17.85	21.64	16.53
Fed Funds Purchased / Assets	0.09	0.10	0.11
Equity / Assets	0.08	0.08	0.07
67th Percentile <= LC			
Stock-return Volatility	0.36	0.32	0.31
(Cash + Securities) / Assets	0.34	0.30	0.33
Assets (Billions of $s)	34.63	89.10	83.36
Fed Funds Purchased / Assets	0.07	0.10	0.10
Equity / Assets	0.08	0.08	0.08
Mean Commitments Ratio	0.30	0.31	0.37

[A] Average bank characteristics and stock-return volatility, equal to the annualized return standard deviation, for large, publicly traded banks. Data on unused commitments, transactions deposits, as well as the other bank characteristics, come from the most recent quarter of the Reports of Income and Condition prior to the time at which we measure the stock return variability. The observations are sorted vertically by the percentiles of the distribution of level of loan commitments (unused commitments divided by unused commitments plus loans) and horizontally by the level of transactions deposits relative to total deposits. Each of the nine cells reports the simple average for all observations in that part of the distribution.

Table 2: Summary Statistics for Variables Included in Regression Models[B]

	Mean (1)	Standard Deviation (2)
Dependent Variable		
Stock-return Volatility (Annualized Return Standard Deviation)	0.30	0.13
Commitments and Deposits		
Commitments / (Commitments + Loans)	0.32	0.15
(Commitments-Retail Commitments) / (Commitments-Retail Commitments) + Loans))	0.24	0.13
Transactions Deposits / Total Deposits	0.26	0.11
Controls for Market Conditions		
Volatility of S&P 500 (Annualized Return Standard Deviation)	0.16	0.06
Commercial Paper - T-Bill Yield Spread (% pts)	0.40	0.21
Yield on Three-Month Treasury Bill (% pts)	4.52	1.55
Controls for Bank Characteristics		
Assets (Billions of $s)	34.47	69.89
(Cash + Securities) / Assets	0.32	0.12
Fed Funds Purchased / Assets	0.09	0.06
Equity / Assets	0.08	0.04

[B] Summary statistics for all of the variables used in regressions below. Stock-return volatility is equal to the annualized return standard deviation. Data on unused commitments and transactions deposits, as well as the other bank characteristics, come from the most recent quarter of the Reports of Income and Condition prior to the time at which we measure the stock return variability.

Table 3: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio[C]

	Dependent Variable: **Log of Weekly Bank Stock-Return Volatility Predicted Volatility from GARCH (1,1)**			
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.788	0.82	-	-
	(7.19)**	(6.94)**	-	-
(Commitments-Retail Commitments) /	-	-	0.951	1.005
(Commitments-Retail Commitments) + Loans))	-	-	(3.55)**	(3.63)**
Transactions Deposits / Total Deposits	0.701	0.772	0.485	0.497
	(4.66)**	(3.37)**	(1.90)	(1.80)
Commitments / (Commitments + Loans) *	-1.604	-1.749	-	-
Transactions Deposits / Total Deposits	(4.46)**	(3.52)**	-	-
(Commitments-RC) / (Commitments-RC+Loans) *	-	-	-1.702	-1.709
Transactions Deposits / Total Deposits	-	-	(2.19)*	(2.07)*
Controls for Market Conditions				
Log of Volatility of S&P 500	0.494	0.499	0.464	0.46
	(21.43)**	(20.82)**	(16.80)**	(16.43)**
Paper-Bill Spread	0.085	0.084	0.103	0.103
	(3.79)**	(3.80)**	(4.53)**	(4.51)**
Yield on Three-Month Treasury Bill	0.031	0.03	0.031	0.03
	(6.96)**	(6.44)**	(6.76)**	(6.44)**
Controls for Bank Characteristics				
Log of Assets	-0.001	-0.003	-0.008	-0.012
	(0.06)	(0.23)	(0.57)	(0.85)
(Cash + Securities) / Assets	-	-0.03	-	-0.108
	-	(0.25)	-	(0.83)
Fed Funds Purchased / Assets	-	0.067	-	-0.098
	-	(0.26)	-	(0.37)
Equity / Assets	-	-0.174	-	0.095
	-	(0.41)	-	(0.22)
Observations	49,527	49,527	49,527	49,527
Number of Independent Clusters (banks)	170	170	170	170
R-squared	28.77%	28.80%	27.86%	28.02%

[C] Regressions from equation (2) using all data. The dependent variable equals the GARCH (1,1) estimate of conditional stock-return volatility. There are four specifications, two based on the total commitments ratio, and two that exclude retail commitments. One of each two specifications is a simple model with just log of assets as a bank control, and the other is a more complex model that adds the liquid assets ratio (cash + securities), the ratio of Fed Funds purchased to assets, and the capital-asset ratio. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 4: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio [D]

	Dependent Variable: **Log of Weekly Bank Stock-Return Volatility** **Realized Volatility**			
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.803	0.859	-	-
	(7.77)**	(7.05)**	-	-
(Commitments-Retail Commitments) /	-	-	0.904	0.991
(Commitments-Retail Commitments) + Loans)	-	-	(3.33)**	(3.31)**
Transactions Deposits / Total Deposits	0.754	0.899	0.545	0.621
	(6.04)**	(3.53)**	(2.37)*	(2.03)*
Commitments / (Commitments + Loans) *	-1.541	-1.811	-	-
Transactions Deposits / Total Deposits	(5.00)**	(3.36)**	-	-
(Commitments-RC) / (Commitments-RC+Loans	-	-	-1.633	-1.782
Transactions Deposits / Total Deposits	-	-	(2.20)*	(1.98)*
Controls for Market Conditions				
Log of Volatility of S&P 500	0.511	0.522	0.481	0.483
	(22.01)**	(20.62)**	(17.35)**	(15.84)**
Paper-Bill Spread	0.234	0.231	0.253	0.25
	(8.59)**	(8.54)**	(9.50)**	(9.38)**
Yield on Three-Month Treasury Bill	0.014	0.013	0.014	0.013
	(3.17)**	(2.61)**	(2.98)**	(2.64)**
Controls for Bank Characteristics				
Log of Assets	0.001	-0.003	-0.005	-0.009
	(0.03)	(0.24)	(0.32)	(0.60)
(Cash + Securities) / Assets	-	-0.039	-	-0.1
	-	(0.30)	-	(0.70)
Fed Funds Purchased / Assets	-	-0.016	-	-0.187
	-	(0.06)	-	(0.66)
Equity / Assets	-	-0.379	-	-0.113
	-	(0.78)	-	(0.23)
Observations	49,527	49,527	49,527	49,527
Number of Independent Clusters (banks)	170	170	170	170
R-squared	12.37%	12.41%	11.80%	11.87%

[D] Regressions from equation (2) using all data. The dependent variable equals the log of average squared daily return over one week. There are four specifications, two based on the total commitments ratio, and two that exclude retail commitments. One of each two specifications is a simple model with just log of assets as a bank control, and the other is a more complex model that adds the liquid assets ratio (cash + securities), the ratio of Fed Funds purchased to assets, and the capital-asset ratio. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 5: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio

	Dependent Variable: **Log of Weekly Bank Stock-Return Volatility Realized Residual Volatility**			
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.641	0.771	-	-
	(6.55)**	(6.84)**	-	-
(Commitments-Retail Commitments) /	-	-	0.829	1.012
(Commitments-Retail Commitments) + Loans))	-	-	(3.27)**	(3.59)**
Transactions Deposits / Total Deposits	0.655	0.992	0.508	0.766
	(5.88)**	(5.08)**	(3.33)**	(3.44)**
Commitments / (Commitments + Loans) *	-1.217	-1.897	-	-
Transactions Deposits / Total Deposits	(4.29)**	(4.53)**	-	-
(Commitments-RC) / (Commitments-RC+Loans)	-	-	-1.424	-2.033
Transactions Deposits / Total Deposits	-	-	(2.20)*	(1.98)**
Controls for Market Conditions				
Log of Volatility of S&P 500	0.368	0.392	0.341	0.359
	(16.25)**	(16.53)**	(13.52)**	(13.52)**
Paper-Bill Spread	0.231	0.227	0.247	0.242
	(9.33)**	(9.13)**	(10.22)**	(10.00)**
Yield on Three-Month Treasury Bill	0.04	0.036	0.04	0.036
	(8.33)**	(7.00)**	(8.14)**	(6.93)**
Controls for Bank Characteristics				
Log of Assets	-0.041	-0.046	-0.048	-0.057
	(3.71)**	(3.79)**	(3.92)**	(4.09)**
(Cash + Securities) / Assets	-	-0.042	-	-0.127
	-	(0.31)	-	(0.90)
Fed Funds Purchased / Assets	-	0.086	-	-0.062
	-	(0.32)	-	(0.23)
Equity / Assets	-	-0.907	-	-0.682
	-	(2.38)*	-	(1.62)*
Observations	49,527	49,527	49,527	49,527
Number of Independent Clusters (banks)	170	170	170	170
R-squared	9.05%	9.27%	8.93%	9.09%

[E] Regressions from equation (2) using all data. The dependent variable equals the log of the average squared residual return from the factor model from equation (3), removing market, credit and interest rate factors. There are four specifications, two based on the total commitments ratio, and two that exclude retail commitments. One of each two specifications is a simple model with just log of assets as a bank control, and the other is a more complex model that adds the liquid assets ratio (cash + securities), the ratio of Fed Funds purchased to assets, and the capital-asset ratio. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 6: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio - Between vs. Within Estimator [F]

	Dependent Variable: **Log of Weekly Bank Stock-Return Volatility**			
	Between Estimator		**Within Estimator**	
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.762	0.805	0.202	0.082
	(4.58)**	(3.94)**	(1.41)	(0.60)
Transactions Deposits / Total Deposits	0.815	1.013	0.281	0.237
	(3.55)**	(2.98)**	(0.98)	(0.85)
Commitments / (Commitments + Loans) *	-1.384	-1.739	-1.668	-1.492
Transactions Deposits / Total Deposits	(2.00)*	(2.08)*	(2.64)**	(2.53)*
Controls for Market Conditions				
Log of Volatility of S&P 500	0.549	0.569	0.447	0.452
	(6.52)**	(6.47)**	(24.61)**	(25.01)**
Paper-Bill Spread	-1.84	-1.783	0.163	0.162
	(4.48)**	(4.22)**	(8.63)**	(8.60)**
Yield on Three-Month Treasury Bill	0.204	0.195	0.024	0.024
	(5.39)**	(4.85)**	(5.11)**	(5.15)**
Controls for Bank Characteristics				
Log of Assets	-0.014	-0.014	-0.014	0.011
	(0.83)	(0.72)	(0.59)	(0.41)
(Cash + Securities) / Assets	-	0.057	-	0.225
	-	(0.38)	-	(1.59)
Fed Funds Purchased / Assets	-	-0.013	-	-0.458
	-	(0.04)	-	(1.93)
Equity / Assets	-	-0.527	-	-1.125
	-	(0.84)	-	(2.22)*
Observations	49,527	49,527	49,527	49,527
Number of Independent Clusters (banks)	170	170	170	170
R-squared	39.81%	40.15%	29.73%	30.28%

[F] Regressions from equation (2) using all data. There are four specifications: columns 1 and 2 report the 'between' estimator from regressions using bank-level time-series averages, and columns 3 and 4 report within estimator, that allows each bank to have its own intercept in the regressions. One of each two specifications is a simple model with just log of assets as a bank control, and the other is a more complex model that adds the liquid assets ratio (cash + securities), the ratio of Fed Funds purchased to assets, and the capital-asset ratio. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 7: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio - Add Controls for Credit Risk, Market Risk & Time Dummies [G]

	Dependent Variable:			
	Log of Weekly Bank Stock-Return Volatility			
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.610	0.507	0.600	0.501
	(5.28)**	(4.31)**	(5.76)**	(4.67)**
Transactions Deposits / Total Deposits	0.279	0.251	0.427	0.418
	(1.55)	(1.51)	(2.53)**	(2.61)**
Commitments / (Commitments + Loans) *	-1.067	-0.884	-0.921	-0.800
Transactions Deposits / Total Deposits	(2.45)*	(2.21)*	(-2.38)*	(2.18)*
Controls for Market Conditions				
Log of Volatility of S&P 500	0.507	0.498	-	-
	(22.95)**	(22.32)**	-	-
Paper-Bill Spread	0.100	0.111	-	-
	(4.35)**	(4.76)**	-	-
Yield on Three-Month Treasury Bill	0.029	0.027	-	-
	(5.67)**	(5.63)**	-	-
Controls for Bank Characteristics				
Log of Assets	-0.012	-0.007	-0.015	-0.012
	(0.96)	(0.64)	(1.21)	(1.04)
(Cash + Securities) / Assets	0.246	0.332	0.125	0.213
	(1.73)	(2.36)*	(0.96)	(1.68)
Fed Funds Purchased / Assets	0.141	0.144	0.163	0.166
	(0.58)	(0.60)	(0.72)	(0.74)
Equity / Assets	0.584	0.689	0.552	0.594
	(2.37)*	(3.04)**	(2.30)*	(2.46)*
Controls for Credit & Market Risks				
C&I Loans / Assets	0.369	0.417	0.230	0.287
	(2.29)*	(2.66)**	(1.33)	(1.71)
Commercial Real Estate Loans / Assets	-0.337	-0.179	-0.454	-0.321
	(1.31)	(0.71)	(1.70)	(1.24)
Non-Performing Loans / Assets	10.832	7.859	8.890	6.476
	(5.66)**	(4.37)**	(4.33)**	(3.63)**
Trading Assets / Assets	0.345	0.455	0.320	0.415
	(2.00)*	(2.79)**	(2.08)*	(2.81)**
AAA rated indicator	-0.142	-0.147	-0.259	-0.250
	(2.58)**	(2.78)**	(4.42)**	(4.44)**
AA rated indicator	-0.075	-0.075	-0.103	-0.098
	(1.74)	(1.78)	(2.29)	(2.27)
A rated indicator	-0.095	-0.095	-0.096	-0.094
	(3.70)**	(3.85)**	(3.72)**	(3.80)**
Unrated Indicator	-0.032	-0.031	-0.047	-0.043
	(1.05)	(1.05)	(1.56)	(1.48)
Loan Loss Provisions / Assets	-	22.923	-	20.173
	-	(5.14)**	-	(4.92)**
Net Charge-offs / Assets	-	14.411	-	15.645
	-	-1.980	-	(2.30)*
Includes Weekly Indicators?	No	No	Yes	Yes
Observations	49,527	49,527	49,527	49,527
Number of Independent Clusters (banks)	170	170	170	170
R-squared	37.47%	38.52%	50.46%	51.31%

[G] Regressions from equation (2) using all data and including control variables for market conditions, bank characteristics and credit and market risks. There are four specifications: those in columns 1 and 2 use time-varying control variables (S&P 500 volatility, the level of interest rates, and the Paper-Bill spread), while those in columns 3 and 4 use a full set of time indicator variables (i.e. a separate intercept for each week). The specifications in columns 2 and 4 include the ratio of net charge offs to assets, and the ratio of loan loss provisions to assets as additional control variables. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 8: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio - Hi and Low Paper-Bill Spread Regimes [H]

	Dependent Variable: Log of Weekly Bank Stock Return Volatility			
Paper-Bill Spread:	**<75 Bps**	**>=75 Bps**	**P-Value H_0:(1)=(2)**	**Data from Oct-98**
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.761	1.002	0.212	1.893
	(8.12)**	(4.67)**		(5.93)**
Transactions Deposits / Total Deposits	0.632	1.396	0.057	3.743
	(3.35)**	(3.11)**		(3.29'**
Commitments / (Commitments + Loans) *	-1.317	-3.196	0.02	-7.453
Transactions Deposits / Total Deposits	(3.42)**	(3.47)**		(3.95)**
Controls for Bank Characteristics				
Log of Assets	-0.006	0.042	0.001	0.039
	(0.56)	(2.53)*		(0.91)
(Cash + Securities) / Assets	-0.063	-0.304	0.12	-0.523
	(0.60)	(1.74)		(1.24)
Fed Funds Purchased / Assets	0.129	0.316	0.617	-0.494
	(0.52)	(0.88)		(0.64)
Equity / Assets	0.411	-0.765	0.043	-3.507
	(1.38)	(1.18)		(2.66)**
P-Value for F-Test that all coefficients are equal	-	-	0.001	-
Includes Weekly Indicators?	Yes	Yes	-	Yes
Observations	46,856	2,671	-	192
Number of Independent Clusters (banks)	170	154	-	64
R-squared	43.53%	39.39%	-	30.30%

[H] Regressions in two regimes: one when the paper-bill spread is above 75 basis points (column 1) and the other when the spread is below 75 basis points (column 2). Column 3 reports the p-value for the test that the respective coefficients are equal in the two regimes. Column 4 includes data during the first three weeks of October, 1998, when the CP-Tbill spread exceeded 100 basis points. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.

Table 9: Regressions of Bank Stock Return Volatility on Liquidity Exposure and Transactions Deposits Ratio - With Paper-Bill Spread Interaction Terms [I]

	Dependent Variable: **Log of Weekly Bank Stock-Return Volatility Realized Residual Volatility**			
Unused Commitments and Deposits	(1)	(2)	(3)	(4)
Commitments / (Commitments + Loans)	0.558	0.542	0.790	0.735
	(2.80)**	(2.85)**	(4.59)**	(3.13)**
Transactions Deposits / Total Deposits	0.364	0.421	0.564	0.523
	(2.00)*	(2.15)*	(1.69)	(0.95)
Commitments / (Commitments + Loans) *	-0.370	-0.467	-0.209	-0.330
Transactions Deposits / Total Deposits	(0.70)	(0.85)	(0.29)	(0.31)
Interaction Between Paper-Bill Spread and:				
Commitments / (Commitments + Loans)	0.323	0.591	0.183	0.436
	(0.88)	(1.49)	(0.59)	(1.16)
Transactions Deposits / Total Deposits	1.101	1.508	0.908	1.284
	(3.05)**	(2.87)**	(2.56)**	(2.22)*
Commitments / (Commitments + Loans) *	-2.825	-3.538	-2.557	-3.137
Transactions Deposits / Total Deposits	(2.84)**	(2.84)**	(2.71)**	(2.36)*
Interaction Between Baa-Aaa Spread and:				
Commitments / (Commitments + Loans)	-	-	-0.210	-0.160
	-	-	(1.11)	(0.76)
Transactions Deposits / Total Deposits	-	-	-0.149	-0.056
	-	-	(0.45)	(0.12)
Commitments / (Commitments + Loans) *	-	-	-0.340	-0.320
Transactions Deposits / Total Deposits	-	-	(0.46)	(0.34)
Controls for Bank Characteristics	*Included, coefficients not reported*			
Includes Weekly Indicators?	Yes	Yes	Yes	Yes
Observations	49,527	49,527	48,991	48,991
Number of Independent Clusters (banks)	170	170	170	170
R-squared	24.92%	25.06%	25.05%	25.25%

[I] Regressions using all data with we added interactions between the level of the paper-bill spread and the transactions deposit and loan commitment variables (colums 1 and 2) and interactions between the level of the credit spread and the transactions deposit and loan commitment variables (colums 3 and 4). The dependent variable equals the log of the avearge squared residual return from the factor model from equaiton (3), removing market, credit and interest rate factors. Columns 1 and 3 include log of assets and its interaction with the Paper-Bill Spread; columns 2 and 4 add the liquid assets ratio, the capital-asset ratio and the ratio of fed funds purchased to assets, as well as their interactions with the CP spread.. Robust standard errors are reported in parentheses, clustered by bank, with * denoting significance at 5%; ** significance at 1%. All regressions include an intercept.