Bank corporate loan pricing following the subprime crisis

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Abstract

The massive losses that banks incurred with the meltdown of the subprime mortgage market have raised concerns about their ability to continue lending to corporations. We investigate these concerns. We find that firms paid higher loan spreads during the subprime crisis. Importantly, the increase in loan spreads was higher for firms that borrowed from banks that incurred larger losses. These results hold after we control for firm-, bank-, and loan-specific factors, and account for endogeneity of bank losses. These findings, together with our evidence that borrowers took out smaller loans during the crisis when they borrowed from banks that incurred larger losses, lend support to the concerns about bank lending following their subprime losses.

Introduction

The financial condition of banks is critically important because it may influence their ability to lend, with consequences for the wider economy. Determining the importance of the link between banks' financial condition and their lending behavior, however, has proven difficult. Historically, deterioration in banks' financial condition has generally coincided with shocks to the financial condition of corporate borrowers. The subprime crisis of 2007 provides a good opportunity to investigate the importance of that link because the crisis started out in the housing market and imposed large losses on several banks. We investigate the importance of that link in this paper.

Ever since Bernanke (1983) argued that the contraction in lending that followed the massive wave of bank failures in the early 1930s was partly to blame for the Great Depression, there has been a debate over the importance of bank lending for the state of the economy. Early empirical studies, including Bernanke (1983), looked for evidence of that link by investigating whether bank lending was correlated with aggregate measures of economic activity. The correlations that these studies unveiled, however, were questioned because they could have been driven by demand shocks rather than supply shocks.[1] The recession that accompanied the introduction of the 1988 Basel Accord in the United States renewed interest in the importance of the bank-lending channel, but the difficulties in disentangling demand effects from supply effects again resulted in differing views. Some argued that the new capital standards led banks to cut lending, thereby contributed to the recession, while others pointed out that banks were responding to an overall decline in loan demand associated with the downturn.[2]

The subprime crisis once again brought the debate over the importance of bank lending to the economy to the forefront. The beginning of the crisis can be traced to the meltdown of subprime mortgages and related securitized products in the summer

of 2007. In the months that followed, the U.S. government was forced to take over Fannie Mae, Freddie Mac, and AIG, while JPMorgan acquired Bear Stearns and Wells Fargo acquired Wachovia. Meanwhile, Lehman Brothers, Washington Mutual, and many smaller banks all failed because of losses related to the subprime collapse.[3] In addition, many of the largest banks reported huge write-downs in connection with their mortgage-backed securities businesses. By the end of 2007, the largest U.S. banks had already announced write-downs in excess of $100 billion.[4] As write-downs continued to mount, surpassing $500 billion by mid-2008, a debate emerged over whether banks' subprime losses would hamper their ability to lend, in which case the subprime crisis might trigger a recession.

Ivashina and Scharfstein (2008) argue that concerns about the availability of bank credit were valid.[5] Using data from the syndicated loan market, they report that banks with more deposit financing at the end of 2007 cut their lending by less during the peak period of the crisis (September-November 2008) than banks with less deposit financing, while banks with more credit lines outstanding at the end of 2007 reduced their number of loans during the crisis by more than banks with less exposure to credit lines. In contrast, Chari, Christiano, and Kehoe (2008) argue, based on their investigation of flow-of-funds data, that bank lending increased during the crisis period. Subsequently, Cohen-Cole et al. (2008) noted that new lending may have collapsed, and that this decline did not appear in the aggregate data because the use of loan commitments may have increased or because securitization had decreased.

Part of that debate grew out of differences in the data used in the various studies. Another part resulted from the fact that these studies do not distinguish supply-side effects from demand-side effects. Ivashina and Scharfstein (2008) attempt to isolate supply-side effects but their findings could still be the result of a change in the demand for credit.[6]

We contribute to the debate on the availability of bank credit, by investigating whether the losses banks sustained during the crisis affected their ability to continue extending corporate loans. Like Ivashina and Scharfstein (2008), we rely on data from the syndicated loan market. In contrast to Ivashina and Scharfstein, as well as to the other studies cited above, we focus on the loan-pricing policies of banks.[7] Although this approach offers only indirect evidence on the availability of bank credit to corporate borrowers, it provides information on the interest rates banks charged their borrowers during the crisis, which is an important determinant of credit availability. Furthermore, as we argue below, this approach allows us to separate bank-driven effects from demand-driven effects. As a complement to this investigation, we also look at the size of the loans that corporate borrowers took out during the crisis.

We hypothesize that the banks that incurred larger losses in the subprime crisis increased the interest rates on loans to corporate borrowers by more than other banks. Banks that lost heavily became riskier. As a result, their cost of funding most likely rose, putting pressure on them to raise their loan interest rates. Supervisors' calls for these banks to rebuild their capital standards most likely added to that pressure. According to Boot, Greenbaum, and Thakor (1993), banks that need to rebuild their capital structure are likely to sacrifice reputational capital by reneging on their implicit commitment to not exploit their monopoly power over borrowers. Thus, supervisors' calls for banks to rebuild their capital may have led them to break that commitment and raise their loan interest rates.

To test our hypothesis, we investigate whether banks with larger net charge-offs during the crisis increased the spreads on their loans by more than the other banks. We focus on loans to firms that borrowed *both* before and during the crisis from the *same* bank to reduce concerns over sample selection. To control for the endogeneity of bank losses, we investigate the role of losses in banks' loan-pricing policies during the crisis

through an instrumental variable approach. In addition, we follow Rajan (1992) – who argues that by monitoring borrowers, banks gain an information advantage that allows them to impose higher interest rates – and investigate whether the banks with large losses increased interest rates on their loans to bank-dependent borrowers by more than they increased interest rates for borrowers that were not dependent on them.

We find that firms that borrowed during the subprime crisis paid an 39 basis points over Libor more than they paid for the loans that they took out before the crisis from the *same* bank after we control for firm-, loan-, and bank-specific factors, and a time trend on loan spreads. We also find that the increase in loan spreads is higher for borrowers that took out loans during the crisis from banks that incurred larger losses. Our tests indicate that these findings are bank driven. Our instrumental variable approach confirms that banks with a higher exposure to the market for mortgage-backed securities increased the interest rates on their corporate loans during the subprime crisis by more than other banks. Consistent with that assertion, we also find that banks with larger losses increased the interest rates only on loans to bank-dependent borrowers.

Our investigation of the size of the loans shows that the loans that firms took out during the crisis were smaller than the ones they had taken out before the crisis from the *same* bank. We also find that the decline in loan size is higher for borrowers that took out loans during the crisis from banks that incurred larger losses.

Our findings are important because they show that banks' losses in the subprime market had ramifications for the corporate sector, resulting in an increase in the cost of bank credit. Our tests on loan spreads do not directly address the claim that banks cut lending during the crisis, but our finding showing that they increased loan spreads lends support to that claim. Furthermore, our finding that borrowers took out smaller loans during the crisis when they borrowed from banks that incurred larger losses is consistent with that claim.

Our findings are important for yet another reason – they show a novel approach to identifying changes in bank lending activity that are bank driven. The most commonly used approach focuses on bank lending volumes. We focus instead on bank loan pricing. Our approach benefits from the loan-level data available and most importantly, from the existing theories on loan interest rates, which are key to designing a strategy to isolate bank-driven effects.

The remainder of our paper is organized as follows. Section 1 presents our methodology and our sample. Section 2 investigates whether the spreads banks charged during the crisis were affected by their losses. Section 3 investigates whether the link between bank losses and loan spreads is bank driven. Section 4 investigates whether bank losses affected the size of corporate loans. Section 5 offers some concluding remarks.

1 Methodology, data, and sample characterization

1.1 Methodology

Our methodology has two parts. The first part investigates whether banks with larger losses during the subprime crisis increased their loan spreads by more than the other banks. The second part investigates whether our results are bank driven.

1.1.1 Loan spreads and bank losses in the subprime crisis

To investigate whether bank losses affected loan spreads during the crisis, we estimate the following model of loan spreads:

$$LOAN\ SPREAD_{b,f,l,t} = c + \alpha\ CRISIS_t + \beta\ CHARGEOFFS_{b,t-1} + \gamma\ CRISIS_t \cdot CHARGEOFFS_{b,t-1} + \sum_{i=1}^{I} \psi_i B_{i,b,t-1} + \sum_{j=1}^{J} \zeta_j F_{j,f,t-1} + \sum_{k=1}^{K} \nu_k L_{k,l} + \epsilon_{f,t}, \quad (1)$$

where $LOAN\ SPREAD_{b,f,l,t}$ is the all-in drawn spread over Libor of loan l extended by bank b to firm f at date t. According to Dealscan, the all-in drawn spread is a measure of the overall cost of the loan because it takes both one-time and recurring fees associated with the loan into account. $CRISIS$ is a dummy variable indicating whether the loan was taken out during the subprime crisis, which we define as the period between the fourth quarter of 2007 and the fourth quarter of 2008. $CHARGEOFFS$ is the ratio of the bank's net charge-offs over assets in the quarter before the loan date. This is our measure of bank losses.

As borrowers' risk and the cost of bank funding tend to go up during economic crises, we expect $\alpha > 0$. As banks with larger losses are likely to have higher costs of funds and are likely to be more willing to consume reputational capital to rebuild their financial capital, we expect $\beta > 0$. The extraordinary losses that banks incurred during the subprime crisis exacerbated these effects, so we expect $\gamma > 0$. We estimate these effects, controlling for a set of bank-, firm-, and loan-specific variables (B, F, and L, respectively), which we describe next.

We begin by discussing our bank controls. $LASSETS$, the log of the bank's total assets, controls for bank size. As larger banks tend to be better diversified, they will most likely have access to a lower cost of funds and thus offer lower loan spreads. Similarly, a bank's capital-to-assets ratio ($CAPITAL$) may act as a proxy for a bank's improved financial position, again leading to a lower loan spread.[8] Conversely, indicators of bank risk, such as the volatility of the return on assets ($ROA\ VOL$), may mean

that the bank faces a higher cost of funds, suggesting a positive impact on spreads.[9] We also control for the bank's cost of funds by including the ratio of total deposits over assets ($DEPOSITS$), and the ratio of cash and marketable securities over assets ($LIQUIDITY$). As deposits are believed to be an inexpensive source of funding for banks, we expect banks with more deposits to charge lower spreads. As banks with more liquid assets will most likely find it easier to fund loans on the margin, we also expect a negative sign for this variable. In addition, we control for a bank's subordinated debt as a fraction of assets ($SUBDEBT$) because subordinated debt may act as a substitute for bank equity capital and because it indicates that the bank has access to public debt markets. In either case, the impact on loan spreads should be negative.[10] Finally, we control for firms that have a relationship with their bank by including a dummy variable equal to one if the firm borrowed from the lender of the current loan over the last year ($RELATIONSHIP$). A relationship may give the firm the benefit of a lower spread, but it might also indicate a greater information monopoly, leading to higher spreads.[11]

We discuss next our set of firm-specific variables, F. A subset of these variables, which includes $LAGE$ (the log of the firm's age) and $LSALES$ (the log of the firm's sales), controls for the firm's overall risk. Older firms are typically better established and, therefore, less risky. Similarly, larger firms are usually better diversified across customers, suppliers, and regions.

The next variables serve as proxies for the risk of the firm's debt rather than the risk of the overall business. $LEVERAGE$ is the firm's debt over assets. As higher leverage suggests a greater chance of default, it should have a positive effect on spreads. $PROFITMARGIN$ is the firm's net income divided by sales. More profitable firms have a greater cushion for servicing debt and thus should pay lower spreads. A more direct measure of the firm's ability to service debt is interest coverage, which we measure by $LINTERESTCOV$ – the log of 1 plus EBITDA divided by interest expense truncated

at 0. Again, a higher interest coverage ratio should make the firm's debt less risky.

Another aspect of credit risk is the debt holders' losses in the event of default. To capture that risk, we control for the size and quality of the asset base that debt holders can draw on in default. $TANGIBLES$ is the firm's inventories plus plant, property, and equipment over assets. Because tangible assets lose less of their value in default than do intangible assets, we expect this variable to have a negative effect on spreads. $ADVERTISING$ is the firm's advertising expense divided by sales. This variable proxies for the firm's brand equity, which is intangible and thus we expect it to have a positive effect on spreads. Similarly, we expect $R\&D$, the firm's research and development expense divided by sales, to have a positive effect on spreads. We also control for the firm's networking capital (current assets less current liabilities) divided by total debt, NWC, because this measures the liquid asset base that is less likely to lose value in default. We expect it to have a negative effect on spreads. $MKTOBOOK$ is the firm's market-to-book ratio, which acts as a proxy for the value that the firm is expected to gain from future growth. Although growth opportunities are vulnerable to financial distress, we already have controls for the tangibility of book-value assets. Therefore, this variable could have a negative effect on spreads if it represents additional value (over and above book value) that debt holders can access in the event of default.

We complement these risk controls with some forward-looking measures of risk. $EXCESS\ RET$ is the firm's excess stock return (relative to the market) over the past 12 months. To the extent that a firm outperforms the market's required return, it should have more cushion against default, and, thus, a lower spread. $STOCK\ VOL$ is the standard deviation of the firm's stock return over the past 12 months. Higher volatility indicates a greater risk of default, so that we expect this variable to have a positive impact on spreads. We also control for the borrower's EDF as computed by KMV. EDFs are driven by stock price information, but they have established themselves

as one of the most accurate predictors of firms' risk of default. Since we do not have KMV EDF information for all of the firms in our sample, we consider this variable in our robustness tests. In addition, we include dummy variables for the credit rating of the borrower because rating agencies claim that they have access to private information on firms, and we include dummy variables for single-digit SIC industry groups because each industry may face additional risk factors that are not captured by our controls.

We discuss next our set of loan controls. It includes the log of loan amount, $LAMOUNT$, and the log of the loan maturity, $LMATURITY$. Larger loans may represent more credit risk, but they may also allow for economies of scale in processing and monitoring. Similarly, loans with longer maturities may face greater credit risk, but they are more likely to be granted to firms that are thought to be creditworthy. Therefore, the effects of these variables on the spread are ambiguous. This set of controls also includes dummy variables equal to one if the loan has restrictions on paying dividends, $DIVIDEND\ REST$; is senior, $SENIOR$; or is secured, $SECURED$. All else equal, any of these features should make the loan safer but lenders are more likely to require these features if they think the borrower is riskier (see Berger and Udell 1990), so they may be associated with higher spreads. Since the purpose of the loan may affect its spread, we include dummy variables to distinguish among loans that are for corporate purposes, $CORPORATE\ PURP$; loans to repay existing debt, $DEBT\ REPAY$; and working capital loans, $WORKING\ CAP$. In addition, we account for the type of the loan contract and distinguish between lines of credit, $CREDIT\ LINE$, and term loans, $TERM\ LOAN$.

As loan controls can be determined jointly with loan spreads, we estimate our models both with and without the set of loan controls. In addition, because loan spreads can vary across firms and across banks for reasons that are not captured by our controls, we estimate our models with firm-bank fixed effects. This also alleviates concerns about

sample selection, such as potential unobserved differences between firms that did and firms that did not take out bank loans during the subprime crisis. With this approach, the effect of bank losses on loan spreads during the crisis is identified only by the changes in loan spreads within firms that took out loans from the *same* bank both before and during the crisis. That loan-spread effect is not likely to be affected by a time trend that may exist in loan spreads. However, to further reduce concerns over this possibility, we control for the time trend in loan spreads. Lastly, we estimate all our models with robust standard errors, and we follow Petersen (2009) and cluster the error term by both firm and bank.

1.1.2 Did bank losses drive loan spreads during the crisis?

In the second part of our methodology, we undertake two tests to ascertain whether the effect of bank losses on loan spreads we identify in the first part is bank driven. In the first test, we use a two-stage approach to investigate the effect of bank losses. In the second test, we investigate whether those banks that had larger losses during the crisis increased spreads on their loans to both their dependent and nondependent borrowers.

An instrumental variable approach

In the first stage of this approach, we attempt to explain banks' $CHARGEOFFS$ using our sets of firm-, bank-, and loan-specific variables, and an instrument for banks' losses. Because the crisis started with the meltdown of the market for mortgage-backed securities, we use banks' exposure to this market as an instrument for their losses. We measure this exposure through the sum of the mortgage-backed securities that are in the trading account and those that are "available for sale", scaled by the bank's assets, MBS. As with all of the other bank variables, we compute this instrument at the quarter before each loan.

This instrument serves our purposes because it is strongly correlated with bank losses during the crisis, and it is unlikely to have a direct effect on the spreads banks charge on their corporate loans (corporations that are in the real estate business were removed from our sample). This instrument, however, poses a challenge. As there was a boom in the real estate market in the years leading up to the crisis, our instrument is not likely to be a good predictor of bank losses in the pre-crisis years. In other words, our instrument is powerful during the crisis period but weak in the pre-crisis years.[12] To avoid the biases that may arise from this combination, given that our instrument is good at explaining the cross variation in the change of $CHARGEOFFS$ between the crisis and pre-crisis period for each bank, we use differences in our two-stage approach. In the first stage, we estimate the following model:

$$\Delta CHARGEOFFS_{b,f} = c + \alpha\ MBS_{b,f} + \sum_{i=1}^{I} \psi_i \Delta B_{i,b,f} + \sum_{j=1}^{J} \zeta_j \Delta F_{j,f} + \sum_{k=1}^{K} \nu_k \Delta L_{k,f} + \epsilon, \qquad (2)$$

where $\Delta CHARGEOFFS_{b,f}$ is the change in the bank's charge-offs, and ΔB, ΔF, and ΔL are the changes in our sets of bank-, firm-, and loan-specific variables, respectively, with all of the changes computed as the difference between the crisis and pre-crisis levels of the variables. $MBS_{b,f}$ is the pre-crisis level of our instrument.

In the second stage, we use the following model:

$$\Delta LOAN\ SPREAD_{b,f} = c + \phi\ \widehat{CHARGEOFFS}_{b,f} + \sum_{i=1}^{I} \psi_i \Delta B_{i,b,f} + \sum_{j=1}^{J} \zeta_j \Delta F_{j,f} + \sum_{k=1}^{K} \nu_k \Delta L_{k,f} + \epsilon, \qquad (3)$$

where $\Delta LOAN\ SPREAD_{b,f}$ is the difference in the spreads on the loans the bank extended during the crisis and those it extended before the crisis to the same borrowers; $\widehat{CHARGEOFFS}_{b,f}$ is the predicted change in the bank's charge-offs computed in the first stage; and ΔB, ΔF, and ΔL, are the changes in our sets of bank-, firm-, and

loan-specific variables.

To ensure that the difference in loan spread is computed on similar loans, we use the following procedure. For each loan that firms take out during the crisis, we identify the last loan the firm borrowed prior to the onset of the crisis. If the two loans were extended by the same lead arranger *and* if they are of the same credit type (both are term loans or both are credit lines), then we keep the pair of loans. Otherwise, we drop them from our sample. Finally, if the loans in these pairs have multiple lead arrangers, we drop the pairs of loans that have more than one common lead arranger. These criteria ensure that the difference in the loan spread that we use in the second stage is computed off similar loans that were extended by the same lender to the same borrower, with the difference that one was made before the crisis and the other during the crisis.

Were bank-dependent and nondependent borrowers exposed to bank losses?

In the second test, we investigate whether those banks that had larger losses during the crisis increased spreads on their loans to both their dependent and nondependent borrowers. If banks' losses drove them to charge their borrowers higher rates, then we should see banks with larger losses applying higher interest rate increases on their loans to bank-dependent borrowers. Following Rajan (1992), if these borrowers seek to switch to a new funding source, they will be pegged as lemons regardless of their financial condition. This perception gives the incumbent bank an opportunity to impose higher interest rates. To investigate this hypothesis, we reestimate our model of loan spreads separately on the loans to bank-dependent borrowers and on the loans to nondependent borrowers. If banks' losses played an important role in the interest rates they charged during the crisis, then $CRISIS$ x $CHARGEOFFS$ should be more important in the model estimated on the sample of loans of bank-dependent borrowers.

A critical part of this test is the identification of bank-dependent borrowers. We

use two alternative criteria to identify these borrowers. Under the first criterion, we assume that firms that borrow repeatedly from the same bank are bank dependent. Compared to borrowers that switch banks, the incumbent bank is more likely to have an informational advantage over borrowers that have an exclusive relationship with them.

Under the second criterion, we assume that firms that do not have access to the public bond market are bank dependent.[13] Firms with access to the public bond market are less likely to be bank dependent because there is more information available on them and because they can tap a large number of well-informed investors. We assume that a borrower has access to the public bond market if it issued at least once in that market in the three years prior to the loan.[14]

1.2 Data

The data for this project comes from several sources. We use LPC's Dealscan database of business loans to identify firms that borrowed from banks and to gather loan information. We rely on SDC's Domestic New Bond Issuances database to identify firms in our sample that issued bonds before borrowing in the syndicated loan market.

We use Compustat to obtain information on firms' balance sheets. Even though LPC contains loans from both privately listed firms and publicly listed firms, as Compustat is dominated by the latter, we have to exclude loans borrowed by privately held firms from our sample. We complement this data with information on the firm's EDF computed by KMV.

We rely on the CRSP database to link companies and subsidiaries that are part of the same firm, and to link companies over time that went through mergers, acquisitions, or name changes. We use these links to merge the LPC, SDC, and Compustat databases to determine the financial condition of the firm at the time it borrowed from banks and whether the firm had already issued public bonds by that date. Finally, we use the

Reports of Condition and Income to obtain bank-level data.

1.3 Sample characterization

Our sample covers 6,526 loans that were taken out by 1,716 nonfinancial firms between 2002 and 2008.[15] Of these loans, 5,757 were taken out before the crisis (2002 through the third quarter of 2007), and 769 were taken out during the crisis (fourth quarter of 2007 through the end of 2008). There are 3,174 firm-bank pairs in the sample, of which 1,639 have at least two loans. These pairs include 1,094 firms and 51 banks, and they account for 4,991 of the 6,526 loans in our sample.

Table 1 characterizes our sample. The top panel compares the loans taken out before the crisis with those taken out during the crisis. The middle panel compares the borrowers of these loans, and the bottom panel compares the lenders. The top panel shows that spreads over Libor on the crisis loans are, on average, 20 basis points higher than the spreads on pre-crisis loans, suggesting that the cost of bank lending rose during the crisis.

This increase in loan spreads does not appear to be driven by an increase in borrower risk. Crisis loans are, on average, larger, suggesting that larger firms, which tend to be safer, took out the loans. They also have shorter maturity, which offers additional protection to lenders. In addition, they are less likely to be secured and to result in restrictions on dividend payments, which again suggests they were taken out by safer firms because banks are more likely to impose these covenants on riskier borrowers.

The middle panel of table 1 confirms that the pool of firms that took out loans during the crisis is safer than the pool of pre-crisis borrowers. On average, crisis borrowers are older and have higher profit margins as well as higher interest coverage. They also have more growth opportunities and lower leverage. The only firm characteristic that points in the opposite direction is stock market return.

The bottom panel of table 1 shows that the financial condition of banks deteriorated during the subprime crisis. Their return on assets decreased, while their charge-offs and the volatility of their return on assets increased. In addition, their liquidity and the level of deposits declined. Interestingly, those banks that lent during the crisis had higher capital-to-asset ratios, a result that might reflect their programs to raise capital. As we indicated in the methodology section, our key measure of bank losses is bank net charge-offs scaled by assets, $CHARGEOFFS$. According to the bottom panel of table 1, banks' $CHARGEOFFS$ increased by an average of 50% during the subprime crisis. A comparison of $CHARGEOFFS$ before and during the crisis for the banks in the sample shows that this increase is widespread among banks that extended loans during the crisis.

Table 2 offers a first look at the question of whether bank losses were a contributing factor to the spreads borrowers paid on their loans during the crisis. To that end, we compare the loan spreads of banks with lower losses to those of banks with higher losses (charge-offs were in the lower and upper terciles of $CHARGEOFFS$ during the crisis, respectively). Banks that had lower charge-offs during the crisis charged their borrowers only six additional basis points when compared to the spreads on their loans before the crisis, a difference that is not statistically significant. In contrast, banks that had larger charge-offs increased the spreads on their loans by thirty-three basis points, a difference that is statistically different from zero. This difference lends support to the hypothesis that those banks that had larger losses during the crisis passed some of those losses onto corporate borrowers by charging them higher spreads on their loans. In the next section, we investigate whether this finding continues to hold in a multivariate analysis setting when we account for differences in the pool of firms that borrowed before and during the crisis, and for differences in the sets of banks that extended these loans.

2 Bank losses and bank lending during the crisis

The results of our investigation into the effect of bank losses on loan spreads during the crisis are reported in table 3. We begin by comparing the spreads on the loans that firms took out during the crisis with the spreads on the loans these same firms borrowed before the crisis from the same bank, controlling for our set of borrower-specific characteristics. Model 1 shows that our $CRISIS$ dummy variable is positive and highly statistically significant, indicating that firms paid higher spreads on the loans they took out during the crisis. According to that model, borrowers that took out loans during the crisis from the *same* bank they had borrowed from in the past paid an additional 39 basis points on the spreads of their crisis loans. With regards to firm controls, they are generally consistent with our priors. Firms with rising sales or profit margins benefited from a reduction in the interest rates on their loans. In contrast, firms with rising leverage or increased stock volatility saw the interest rates on their loans rise.

Next, we investigate whether those banks that experienced larger charge-offs during the crisis increased their loan spreads by more than the remaining banks. Model 2 investigates this hypothesis, controlling for our set of firm-specific controls and firm-bank fixed effects. According to this model, the coefficient on the interaction variable $CRISIS$ x $CHARGEOFFS$ is positive and statistically different from zero, indicating that banks with larger losses charged higher spreads on their corporate loans during the crisis. The dummy variable, $CRISIS$, is not statistically significant when its interaction with $CHARGEOFFS$ is added because only one loan in the sample was taken out during the crisis from a bank with no charge-offs.

Model 3 shows that these results continue to hold when we expand the set of controls to account for our bank-specific controls. Models 4 and 5 show that these findings still hold when we further expand our controls to account for the set of loan-

specific controls and a possible time trend in loan spreads. As we can see from these models, adding the new controls has no material effect on either the size or the statistical significance of the coefficient on the interaction variable $CRISIS$ x $CHARGEOFFS$. These tests, therefore, confirm our finding that the larger the losses the bank incurred during the subprime crisis, the larger the increase in the loan spread it charged its corporate borrowers.

2.1 Robustness tests

The link between bank losses and their loan spreads during the subprime crisis appears to be robust because it was derived from a model with firm-bank fixed effects, and because it holds when we account for a large set of firm-, bank-, and loan-specific controls. In this subsection, we investigate a set of issues related to our data to further prove the robustness of that link. The results of these tests are reported in table 4.

As we estimate our models with firm-bank fixed effects, our identification of the effect of bank losses on loan spreads during the crisis is driven by firms that borrowed both before and during the crisis. There are, however, firms in the sample that only took out loans before the crisis. Estimating our model on the subsample of firms that borrowed *both* before and during the crisis yields similar results (model 1).

Our sample encompasses different types of loans (such as credit lines and term loans) that may have pricing characteristics that are not captured by the additive specification we use. To address this concern, we rerun our model on the subsample of lines of credit, which is the most common type of loan (74%) in our sample. This has no effect our key finding (model 2).

Some of the loan deals in Dealscan have multiple facilities. We have treated each facility as a different loan, but to the extent that these loans are part of a deal, they are not completely independent from each other. As we cannot aggregate the facilities

of the same deal because there are usually differences among them, we investigate this concern using two tests. In the first test, we select the facility in the deal with the largest loan and retain the deals with only one facility. This procedure reduces our sample from 6,526 loans to 4,832 loans. In the second test, we limit the facilities to credit lines to force our sample to be homogeneous and then (randomly) select one facility from those deals with multiple credit lines, again retaining the deals with a single credit line. This reduces our sample from 6,526 loans to 4,951 loans. We then rerun our loan-pricing model on these subsamples. The results are reported as models 3 and 4. In both cases, we continue to find that the interaction variable $CRISIS$ x $CHARGEOFFS$ is positive and statistically significant.

Our tests assume that the crisis started in the fourth quarter of 2007. Bank losses started to increase rapidly in the fourth quarter of 2007 but there were already signs of a crisis in the subprime mortgage market in the third quarter of 2007. Defining the beginning of the crisis at the third quarter of 2007 increases the number of crisis loans in our sample from 769 to 979 but does not affect our results (model 5).

Finally, our model of loan spreads accounts for a large set of controls for firm risk. Some of our controls, including the volatility of the stock return, $STOCK\ VOL$, and the return on the firm stock, $EXCESS\ RET$, are forward looking, but most of them are backward looking. As KMV EDFs are known to be good predictors of firm default, we added the borrower's KMV EDF at the end of the month before the loan to our model. We treat this as a robustness test because we do not have KMV EDFs for 418 observations in our sample. Notwithstanding all of the risk controls already in our model, the borrower's EDF is positive and statistically significant, indicating that it contains valuable information about the borrower's risk (model 6). More importantly, we continue to find that the interaction variable $CRISIS$ x $CHARGEOFFS$ is positive and statistically significant.

In summary, the results we have reported thus far yield two important findings. First, firms paid higher spreads on their loans during the subprime crisis than they paid before the subprime crisis, even when they continued to borrow from the same bank. Second, the increase in spreads was greater for borrowers that took out loans from banks that incurred larger losses during the crisis. These findings support the thesis that banks passed some of their subprime losses onto their corporate borrowers. We investigate this assertion in the next section.

3 Did bank losses drive loan spreads?

The effect of bank losses on loan spreads identified in the previous section is most likely bank driven because our test accounts for a comprehensive set of firm-, bank-, and loan-specific factors known to affect loan interest rates, and because it focuses on loans of firms that borrowed *both* before and during the crisis from the *same* bank. Nonetheless, because banks' charge-offs are endogenous, one may wonder if there is an alternative explanation for our finding. For instance, could banks have charged higher spreads on their loans during the crisis because the financial condition of their borrowers was deteriorating in ways that were not captured by our controls? Importantly, that factor could explain our findings only if such a deterioration in borrowers' financial conditions resulted in an increase in banks' charge-offs.

This mechanism is unlikely to explain our finding. First, we have a large set of controls for borrowers' risk, including several forward-looking controls, such as the stock return, the volatility of the stock return, and the borrower's KMV EDF. Second, most of the losses banks incurred in 2007 and 2008 resulted from their mortgage trading business — not from their corporate lending business — and we dropped corporations in the real estate business from our analysis. Third, it would be necessary for borrowers in

our sample to have stopped paying interest or to have defaulted (or be about to default) on their pre-crisis loans. Only on these occasions would a deterioration in their financial condition increase banks' charge-offs. We do not have evidence of defaults among rated borrowers in our sample during the crisis (these borrowers account for 68% of our loans).

Notwithstanding these arguments, in this section we attempt to establish that our finding is bank driven using two tests. The first test builds on an instrumental variable approach. The second test investigates whether those banks that had large losses during the crisis increased interest rates on their loans predominantly for their bank-dependent borrowers. If our findings are bank driven, these borrowers should be more affected by bank losses than nondependent borrowers.

3.1 An instrumental variable approach

As we explain in the methodology section, since our instrument for bank losses — the bank's holdings of mortgage-backed securities scaled by the bank's assets — is good at explaining the cross variation in the change of $CHARGEOFFS$ between the crisis and pre-crisis period for each given bank, we use differences (crisis minus pre-crisis) in the two-stage approach.

To ensure that the loan-spread difference is computed on similar loans, we first isolated the 316 of the 1,716 borrowers in our sample that took out loans both before and during the crisis. Next, we removed those borrowers that did not borrow during the crisis from the same bank that extended their last loan before the onset of the crisis. We also removed those borrowers that had more than one common lead arranger on their pre-crisis and crisis loans. Last, we removed those borrowers whose pre-crisis loan were of a different type than their crisis loans. These criteria left us with a sample of 252 loans — 126 pairs of either credit lines or term loans. This is the sample we use in the instrumental variable approach. Each pair of loans in the sample is made up of the

borrower's last loan before the crisis and its loan taken out during the crisis. with both loans extended by the same bank.

The results of the first stage of our instrumental variable approach (see equation 2 in the methodology section) are reported in table 5. Model 1 reports the first-stage results for our sample of 252 loans. Models 2 and 3 report the first-stage results for two robustness tests. The first test investigates what happens when we limit our sample to credit lines, which is the most common credit type in the sample. Recall that we require the pairs of loans that we use in the instrumental variable approach to be either term loans or credit lines. This test removes the former from the sample. The second robustness test investigates the effect of changing the starting date of the crisis from the fourth quarter of 2007 to the third quarter of 2007. These tests are analogous to the robustness tests we report in subsection 2.1.[16]

A quick look at Table 5 reveals that our instrument, MBS, helps to explain the variation in our endogenous variable, $\Delta CHARGEOFFS$. All else equal, the higher the exposure that banks had to the market for mortgage-backed securities prior to the onset of the crisis, the greater the increase in their charge-offs during the crisis.

Table 6 reports the second-stage results of our instrumental variable approach (see equation 3 in the methodology section). For comparison purposes, we also report the results of equation 3 in table 6. In this equation, we use the change in our endogenous variable $\Delta CHARGEOFFS$, instead of the predicted value of this variable, which we estimate with the first-stage model, $\widehat{CHARGEOFFS}$. Models 1 through 3 show that our findings continue to hold when we investigate the effect of bank losses on loan spreads using the "difference approach." According to these models, the bigger the increase in the bank's charge-offs, the greater the loan spread hike the bank imposed on its borrowers during the crisis. These findings hold in our original sample (model 1) and in the two robustness tests (models 2 and 3).

Models 4 through 6, which report the results of the second stage of our instrumental variable approach, also show a positive relationship between the increase in the bank's losses and the increase in the loan spreads it charged its corporate borrowers during the crisis. These findings disprove the alternative explanation suggested above for our findings. More importantly, they support the thesis that the losses banks incurred during the crisis were a driver of the loan spread increase that we detected during the crisis.

3.2 Are bank-dependent borrowers more exposed to bank losses?

In the second test, we investigate whether banks with larger losses increased their loan spreads for bank-dependent borrowers and nondependent by equal amounts. As we explained in the methodology section, if bank losses are the driver of the loan spread increase, then we would expect banks with larger losses to apply larger spread increases to their loans to bank-dependent borrowers. To investigate this hypothesis, we reestimate our original model of loan spreads on the sample of loans to bank-dependent borrowers and on the sample of loans to nondependent borrowers.

We consider two alternative criteria to identify bank-dependent borrowers. As there is less information available on borrowers that do not have access to the bond market, in our first criterion we classify borrowers as bank dependent if their most recent issue in the public bond market occurred in the three years prior to the loan. As banks are more likely to have an informational advantage vis-à-vis borrowers that have a relationship with them, under the second criterion we classify borrowers as bank dependent if they also borrowed from the lender of the current loan during the last year (a time horizon of three years yields similar results).

The results of the first criterion are reported in models 1 and 2 in table 7, while the results of the second criterion are reported in models 3 and 4. We use our original model

of loan spreads to undertake these tests because we do not have enough observations in our instrumental variable approach to separately investigate the effect of bank losses on loan spreads for bank dependent and nondependent borrowers. Irrespective of the criterion adopted to identify bank-dependent borrowers, we find that the coefficient on $CRISIS$ x $CHARGEOFFS$ is positive and statistically significant in models of bank-dependent borrowers (models 1 and 3). In contrast, the coefficient on that interaction is not statistically significant in models of nondependent borrowers (models 2 and 4).

These results show that banks with larger losses during the subprime crisis increased the spreads on their loans to bank-dependent borrowers but not on their loans to nondependent borrowers. These findings lend further support to our conclusion that the increase in loan spreads during the subprime crisis was bank driven, and adds further support to our finding from the instrumental variable test.

4 Loan size and bank losses during the crisis

As we noted in the introduction, one advantage of focusing on loan spreads, as opposed to loan amounts, when investigating the effect of bank losses on loan policies is that we have a far better understanding of the determinants of loan interest rates than of the determinants of loan sizes. That said, a natural question to ask given our earlier finding is whether the size of loans that corporations took out from banks that incurred large losses during the crisis declined.

To investigate this question, we consider a model in which the dependent variable is the log of the loan amount. In that model, we include our crisis dummy variable, $CRISIS$, and its interaction with the bank's losses, $CHARGEOFFS$, and control for our firm- and bank-specific variables. As with our analysis on loan spreads, we estimate this model with firm-bank fixed effects, and cluster the errors by firm and by bank. The

results of this investigation are reported in table 8.

Model 1 compares the size of loans that firms took out during the crisis with the loans that they took out before the crisis, controlling for our set of firm-specific characteristics. This model shows that firms took out smaller loans during the crisis than they took out from the same bank before the crisis. Model 2 investigates whether this decline in the size of loans was related to the losses banks incurred during the crisis. The results of this model indicate that borrowers of banks that incurred larger losses during the crisis took smaller loans during the crisis. Model 3 shows that this finding continues to hold when we expand our set of firm-specific controls and include our set of bank-specific controls. In this case, $CRISIS$ x $CHARGEOFFS$ is statistically significant but only at the 10% level.

In sum, our findings show that loan spreads rose during the crisis and that the increase was more pronounced among corporations that took out loans from banks that incurred larger losses. Our findings also show that firms took smaller loans during the crisis and that this decrease was more pronounced among firms that borrowed from banks that incurred larger losses. Finally, our investigation shows that these changes – especially the increase in loan spreads – are bank driven.[17] Taken together, our findings indicate that credit availability was negatively affected by bank losses during the subprime crisis.

5 Final remarks

As banks continued to announce large write-downs following the meltdown of the mortgage-backed securities market in the summer of 2007, concerns about the availability of bank credit began to grow. At the center of these concerns was the claim that, by cutting down on their lending, banks could transform what was then perceived as a crisis in the

residential real estate market into a full recession.

We investigated these concerns using a novel approach that focuses on banks' loan-pricing policies. Our comparison of the spreads on loans of firms that borrowed before and during the crisis from the same bank, controlling for a large number of factors known to affect loan interest rates, provides strong evidence that loan spreads rose during the subprime crisis and that this increase was larger for borrowers that took out loans from banks that had sustained larger losses during the crisis. This finding appears to be bank driven because it holds when we control for the endogeneity of bank losses. Also consistent with this thesis, we find that banks with larger losses increased loan spreads on loans to their bank-dependent borrowers but not on loans to nondependent borrowers. These findings, together with the evidence that firms borrowing from banks with larger losses took out smaller loans during the crisis than they did prior to the crisis, confirms that bank subprime losses affected the availability of bank credit.

The extent to which this decline in bank credit affected the activity of corporations remains unclear. Campello, Graham, and Harvey's (2009) finding that financially constrained corporations planned deeper cuts in capital spending and in employment during the crisis suggests that the decline in the availability of bank credit had an important effect on the level of economic activity. This remains a fruitful subject for future research.

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Footnotes

[1] Subsequently, researchers considered the cross-firm implications of the bank-lending channel (Gertler and Gilchrist 1994), "natural" experiments that generated liquidity supply shocks (Ashcraft 2005), instrumental variables (Paravisini 2008), and fixed effects (Khwaja and Mian 2008) to identify supply side effects.

[2] See Berger and Udell (1994) for a review of this debate.

[3] See Gorton and Metrick (2009), and Turnbull, Crouhy, and Jarrow (2008) for a discussion of the sequence of events that led to the subprime crisis.

[4] Source: Deutsche Bank "Global Markets Research," March 11, 2008.

[5] Contessi and Francis (2009) also report, based on banks' balance sheet data, that there was a contraction in credit between the third and the fourth quarter of 2008.

[6] The authors attempt to reduce concerns with this explanation by showing that their findings continue to hold when they limit their sample to loans for "corporate purposes" and working capital.

[7] Puri, Rocholl, and Steffen (2009) attempt to distinguish between demand and supply effects by investigating German savings banks' decisions on consumer loan applications during the crisis.

[8] See Hubbard, Kuttner, and Palia (2002), and Santos and Winton (2009) for evidence showing that U.S. banks with low capital charge higher spreads on their corporate loans.

[9] We do not consider the stock return volatility because many of the banks in the sample are not listed on the stock market.

[10] See Hale and Santos (2010) for evidence that banks with access to the bond market charge lower loan spreads.

[11] Bharath, Dahiya, Saunders, and Srinivasan (2008) find that the impact of a relationship on spreads is negative. However, Santos and Winton (2008) find that this effect is reversed in recessions.

[12] We thank the reviewer for calling our attention to this problem and for suggesting a solution to it.

[13] Santos and Winton (2008), and Hale and Santos (2009) provide evidence consistent with the idea that banks earn informational rents vis-à-vis their borrowers that do not have access to the bond market.

[14] We do not count privately placed bonds as a measure of access to the public bond market, as we believe private placements are very different from public issues. They reach a smaller set of investors and, therefore, do not increase informed competition as much as a public issue does.

[15] We treat the facilities in each deal as different loans. In the case of facilities with multiple lead arrangers, we consider each facility multiple times to capture differences across the arrangers. We

investigate the importance of these assumptions in the Robustness section.

[16] With the exception of the KMV-EDFs test, the robustness tests reported in section 2.1 do not apply in the instrumental variable approach because the sample we use in this approach is made of loan differences. The KMV-EDFs test does not apply because we control for this variable in the instrumental variable analysis.

[17] We find that banks with larger increases in charge-offs reduced the size of their loans by more than the remaining banks when we use an instrumental variable approach, but in this case we do not find the decline in the size of loans to be statistically significantly different across banks.

Table 1
Sample characterization[a]

Variables	Before the subprime crisis	During the subprime crisis	Difference	t-statistic
Differences in loan policies				
LOAN SPREAD	150.138	170.221	20.082***	3.92
AMOUNT	5.589	8.088	2.499***	5.03
MATURITY	5.133	4.103	-1.030*	1.70
SECURED	0.409	0.371	-0.039**	2.08
SENIOR	0.999	0.997	-0.002	1.02
GUARANTOR	0.124	0.129	0.005	0.41
DIVIDENDREST	0.540	0.422	-0.118***	6.23
CORPURPOSES	0.431	0.447	0.016	0.84
DEBTREPAY	0.029	0.009	-0.020***	4.92
WORKCAPITAL	0.273	0.182	-0.091***	6.00
TERMLOAN	0.230	0.286	0.056***	3.28
CREDITLINE	0.750	0.673	-0.077***	4.32
RELATIONSHIP	0.425	0.344	-0.181***	10.76
Differences among borrowers				
AGE	27.006	29.252	2.246***	3.14
SALES	70.307	74.341	4.034	0.57
PROFMARGIN	0.030	0.076	0.046***	10.29
INTERESTCOV	18.528	22.245	3.707**	2.10
STOCKVOL	22.953	22.284	-0.669	1.32
EXRETURN	0.374	0.129	-0.245***	3.00
EDF	1.349	1.048	-0.301	0.98
LEVERAGE	0.303	0.266	-0.036***	5.26
TANGIBLES	0.723	0.670	-0.053***	4.04
ADVERTISING	0.012	0.011	-0.001	0.72
R&D	0.017	0.022	0.005***	2.77
NWC	9.626	14.511	4.886	1.17
MKTOBOOK	1.746	1.881	0.135***	4.24
IGRADE	0.380	0.377	-0.003	0.14
BGRADE	0.297	0.277	-0.020	1.18
BOND	0.357	0.277	-0.080***	4.60
Differences among banks				
ASSETS	7956.705	13140.309	5183.604***	27.43
ROA	0.002	0.002	-0.0001***	25.94
ROAVOL	1.133	1.954	0.820***	12.86
DEPOSITS	0.436	0.374	-0.062***	7.36
SUBDEBT	0.021	0.024	0.003***	14.43
CHARGEOFFS	0.0008	0.0012	0.0004***	19.19
LIQUIDITY	0.190	0.151	-0.039***	23.63
CAPITAL	8.116	8.397	0.282***	7.16
Observations	5757	769		

[a] Before the subprime crisis is the period of time from the beginning of 2002 to the third quarter of 2007. The subprime crisis is the period of time between the fourth quarter of 2007 and the end of 2008. $LOAN\ SPREAD$: Loan spread over Libor at origination; $AMOUNT$: Loan amount in hundreds of millions of dollars; $MATURITY$: Loan maturity in years; $SECURED$: Dummy variable equal to one

if the loan is secured; $SENIOR$: Dummy variable equal to one if the loan is senior; $GUARANTOR$: Dummy variable equal to one if the borrower has a guarantor; $DIVIDENDREST$: Dummy variable equal to one is the borrower becomes subject to dividend restrictions; $CORPURPOSES$: Dummy variable equal to one if the loan is for corporate purposes; $DEBTREPAY$: Dummy variable equal to one if the loan is to repay existing debt; $WORKCAPITAL$: Dummy variable equal to one if the loan is for working capital; $TERMLOAN$: Dummy variable equal to one for term loans; $CREDITLINE$: Dummy variable equal to one for lines of credit; $RELATIONSHIP$: Dummy variable equal to one if the firm also borrowed from the lender of the current loan during the last year; AGE: Age of the borrower in years; $SALES$: Sales in hundreds of millions of dollars; $PROFMARGIN$: Net income over sales; $INTERESTCOV$: Interest coverage ratio (EBITDA divided by interest expense) truncated at 0 (for firms with no interest expense, this variable is set equal to the log of 1 plus earnings before taxes and depreciation.); $STOCKVOL$: Standard deviation of the borrower's stock return, computed over the 365 days before the loan date (multiplied by 1,000); $EXRETURN$: Return on the borrower's stock over the market return, computed over the 365 days before the loan date (multiplied by 1,000); $LEVERAGE$: Debt over assets; $TANGIBLES$: Share of the borrower's assets in tangibles; $ADVERTISING$: Advertising expenses over sales; $R\&D$: Research and development expenses over sales; NWC: Net working capital, computed as the ratio between current assets less current liabilities and total debt; $MKTOBOOK$: Market to book value; $IGRADE$: Dummy variable equal to one if the borrower is rated investment grade; $BGRADE$: Dummy variable equal to one if the borrower is rated below investment grade; $BOND$: Dummy variable equal to one if the borrower issued at least once in the three-year period prior to the loan and its most recent bond issue prior to the loan was a public issue; $ASSETS$: Bank assets in hundreds of millions of dollars; ROA: Bank net income over assets; $ROAVOL$: Standard deviation of the bank quarterly ROA computed over the last three years (multiplied by 1,000); $DEPOSITS$: Bank deposits over assets; $SUBDEBT$: Subdebt over assets; $CHARGEOFFS$: Net charge-offs over assets; $LIQUIDITY$: Bank cash plus securities over assets; $CAPITAL$: Bank equity capital over assets.

Table 2

Bank losses and loan spreads: Univariate analysis[a]

Loan date	Banks with low $CHARGEOFFS$	Banks with high $CHARGEOFFS$	Difference	t-statistic
During the crisis	151.813	185.354	33.541***	2.88
Before the crisis	145.713	152.593	6.880	1.37
Difference	6.100	32.761***		
t-statistic	0.72	3.47		

[a] Banks with low $CHARGEOFFS$ are those banks with $CHARGEOFFS$ below the first tercile of the distribution of $CHARGEOFFS$ during the crisis. Banks with high $CHARGEOFFS$ are those banks with $CHARGEOFFS$ above the second tercile of the distribution of $CHARGEOFFS$ during the crisis.

Table 3
Impact of bank subprime losses on corporate loan spreads[a]

Variables	(1)	(2)	(3)	(4)	(5)
CRISIS	39.231***	5.030	13.663	11.378	11.145
	(4.89)	(0.38)	(0.99)	(0.87)	(0.84)
CHARGEOFFS[b]		14.273**	9.040	6.926	6.659
		(2.39)	(1.37)	(1.18)	(1.14)
CRISIS x CHARGEOFFS[b]		23.372**	27.087**	25.256**	26.420**
		(1.97)	(1.96)	(2.04)	(2.19)
LAGE	-45.721*	-44.752*	10.961	9.400	15.787
	(1.88)	(1.85)	(0.36)	(0.30)	(0.49)
LASALES	-27.070***	-25.695**	-9.849	-5.493	-3.315
	(2.63)	(2.51)	(0.98)	(0.58)	(0.32)
LEVERAGE	55.952**	48.951*	34.958	31.280	29.917
	(1.97)	(1.72)	(1.24)	(1.18)	(1.14)
MKTOBOOK	-8.692	-7.836	-6.971	-5.246	-4.921
	(1.46)	(1.30)	(1.12)	(0.94)	(0.87)
PROFMARGIN	-71.846**	-73.933**	-67.861**	-63.240**	-62.193**
	(2.44)	(2.52)	(2.46)	(2.20)	(2.17)
LINTERESTCOV	-2.146	-2.617	-3.356	-3.637	-3.991
	(0.43)	(0.53)	(0.65)	(0.74)	(0.82)
NWC	-0.035	-0.037	-0.036	-0.036	-0.036
	(0.88)	(0.96)	(0.78)	(0.90)	(0.89)
TANGIBLES	-5.628	-7.778	-14.120	-11.560	-12.446
	(0.15)	(0.20)	(0.38)	(0.34)	(0.37)
R&D	-120.688	-85.086	-57.138	-47.124	-41.704
	(0.45)	(0.36)	(0.26)	(0.24)	(0.21)
ADVERSITING	366.281	361.132	445.344	584.113	586.683
	(0.50)	(0.50)	(0.61)	(0.99)	(0.99)
STOCKVOL	1.245**	0.978	0.728	0.674	0.647
	(2.12)	(1.54)	(1.23)	(1.18)	(1.15)
EXCESSRET	1.330	1.063	0.724	0.667	0.608
	(0.56)	(0.47)	(0.32)	(0.31)	(0.29)
AAA	7.229	-11.360	-43.892	-38.865	-43.204
	(0.14)	(0.23)	(0.92)	(0.97)	(1.10)
AA	-52.208	-64.923*	-88.610**	-79.095**	-81.005**
	(1.45)	(1.83)	(2.47)	(2.46)	(2.56)
A	-51.861*	-55.608*	-64.820**	-56.871**	-58.308**
	(1.74)	(1.87)	(2.20)	(2.15)	(2.26)
BBB	-51.727*	-54.462*	-61.511**	-53.127**	-53.618**
	(1.75)	(1.85)	(2.12)	(2.13)	(2.19)
BB	-20.367	-23.411	-27.811	-19.231	-19.492
	(0.93)	(1.07)	(1.33)	(0.98)	(1.00)
B	-43.855*	-45.042*	-41.354*	-31.844	-31.806
	(1.79)	(1.86)	(1.76)	(1.41)	(1.42)
CCC	-203.824*	-194.702*	-165.598	-160.280*	-158.660
	(1.91)	(1.84)	(1.63)	(1.66)	(1.64)
CC	-141.485***	-138.951***	-152.535***	-152.877***	-152.805***
	(2.74)	(2.71)	(3.11)	(3.11)	(3.13)

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Table 3 (Continued)[a]

Variables	(1)	(2)	(3)	(4)	(5)
LASSETS			-60.963***	-52.909***	-41.407*
			(3.68)	(3.23)	(1.85)
ROAVOL			0.926	1.230	1.021
			(0.36)	(0.50)	(0.41)
DEPOSITS			11.999	21.724	16.991
			(0.29)	(0.50)	(0.38)
SUBDEBT			-561.462	-656.094	-561.448
			(0.62)	(0.76)	(0.66)
LIQUIDITY			-12.760	-23.851	-32.831
			(0.19)	(0.33)	(0.45)
CAPITAL			67.945	52.289	14.013
			(0.25)	(0.20)	(0.05)
RELATIONSHIP			9.873	8.832	8.506
			(0.40)	(0.39)	(0.38)
LAMOUNT				-5.858**	-5.775**
				(2.47)	(2.46)
LMATURITY				-6.317	-6.300
				(1.49)	(1.50)
SECURED				7.986	7.843
				(0.96)	(0.95)
SENIOR				-190.225	-190.354
				(1.44)	(1.44)
DIVIDENDREST				11.449**	11.274**
				(2.05)	(2.02)
GUARANTOR				-0.686	-0.705
				(0.07)	(0.08)
CORPURPOSES				-3.604	-3.361
				(0.64)	(0.60)
DEBTREPAY				-0.500	-0.347
				(0.03)	(0.02)
WORKCAPITAL				-12.169*	-12.170*
				(1.84)	(1.84)
TERMLOAN				26.283**	26.705**
				(2.14)	(2.15)
CREDILINE				-2.280	-1.894
				(0.23)	(0.19)
TREND					-2.993
					(0.81)
CONSTANT	420.153***	409.072***	749.896***	815.012***	780.361***
	(5.21)	(4.94)	(5.96)	(4.30)	(3.53)
Firm-bank fixed effects	YES	YES	YES	YES	YES
Observations	6526	6526	6526	6526	6526
R-squared	0.87	0.87	0.88	0.88	0.88

[a] Dependent variable is $LOAN\,SPREAD$, the all-in drawn spread over Libor at origination. $CRISIS$ is a dummy variable that takes the value of one for loans taken out during the subprime crisis (fourth quarter of 2007 and full year of 2008). $CHARGEOFFS$ is net charge-offs over assets. See table 1 for the definitions of the remaining independent variables. All models are estimated with robust standard errors clustered by firm as well as by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

[b] Coefficient on $CHARGEOFFS$ is scaled by 1,000.

Table 4

Impact of bank subprime losses on corporate loan spreads: Robustness tests[a]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
CRISIS	-2.098	-4.302	-0.778	5.032	3.217	14.531
	(0.20)	(0.26)	(0.06)	(0.24)	(0.27)	(1.27)
CHARGEOFFS[b]	9.137	3.928	2.847	1.725	6.896	5.305
	(1.52)	(0.80)	(0.44)	(0.26)	(1.18)	(0.92)
CRISIS x CHARGEOFFS[b]	31.808***	35.359**	34.602***	31.854**	33.143***	20.498**
	(3.22)	(2.45)	(2.71)	(1.97)	(2.82)	(2.18)
EDF						5.321**
						(2.48)
FIRM CONTROLS	IN	IN	IN	IN	IN	IN
BANK CONTROLS	IN	IN	IN	IN	IN	IN
LOAN CONTROLS	IN	IN	IN	IN	IN	IN
TREND	IN	IN	IN	IN	IN	IN
Constant	544.140**	421.305***	591.841***	497.898**	776.024***	894.796***
	(2.22)	(2.68)	(3.11)	(2.21)	(3.46)	(3.97)
Firm-bank fixed effects	YES	YES	YES	YES	YES	YES
Observations	1954	4832	4955	3534	6526	6108
R-squared	0.89	0.93	0.92	0.94	0.88	0.89

[a] Dependent variable is $LOAN\ SPREAD$, the all-in drawn spread over Libor at origination. $CRISIS$ is a dummy variable that takes the value of one for loans taken out during the subprime crisis (fourth quarter of 2007 and full year of 2008, except in model 5 – in this model the crisis is assumed to have started in the third quarter of 2007). $CHARGEOFFS$ is net charge-offs over assets. EDF is the EDF of the borrower at the end of the month before the loan as computed by KMV. See Table 3 for the list of variables included in the sets $FIRM\ CONTROLS$, $BANK\ CONTROLS$, and $LOAN\ CONTROLS$, respectively. All definitions of the independent variables are reported in table 1. Model 1 is estimated on the subsample of borrowers that took out at least one loan during the subprime crisis and one loan in the pre-crisis period of time in the sample. Model 2 is estimated on the subset of credit lines in the sample. Model 3 is estimated on the subsample of: (a) the facilities with the largest loan amount in multifacility deals and (b) the deals with only one facility. Model 4 is estimated on the subsample of credit lines but in cases of deals with multiple credit lines, we selected one of them randomly. Model 5 investigates what happens when we define the beginning of the crisis as the third quarter of 2007 (as opposed to the fourth quarter of 2007). Model 6 investigates what happens we add the firm's EDF at the end of the month before the loan as computed by KMV to our set of firm controls. All models are estimated with robust standard errors clustered by firm as well as by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

[b] Coefficient on $CHARGEOFFS$ is scaled by 1,000.

Table 5
Bank losses and loan spreads: First stage of a two-stage approach[a]

Variables	(1)	(2)	(3)
MBS	0.006***	0.006**	0.006***
	(3.44)	(3.01)	(3.02)
ΔLASALES	0.0001	0.0001	0.00001
	(0.43)	(0.50)	(0.47)
ΔLEVERAGE	-0.001*	-0.0001	-0.00001
	(2.13)	(1.64)	(1.48)
ΔMKTOBOOK	0.001**	0.00001*	0.00001*
	(2.17)	(1.78)	(1.87)
ΔPROFMARGIN	0.00001***	0.001***	0.00001
	(3.12)	(4.59)	(1.46)
ΔLINTERESTCOV	0.00001	0.00001	-0.00001
	(0.87)	(1.17)	(0.45)
ΔNWC	0.00001**	0.00001*	0.00001***
	(2.19)	(1.96)	(3.86)
ΔTANGIBLES	0.001	0.001*	0.00001
	(1.41)	(2.04)	(1.08)
ΔR&D	-0.008	-0.005	0.003
	(1.19)	(0.58)	(0.52)
ΔADVERSITING	0.009	0.012	0.006
	(1.25)	(0.85)	(0.78)
ΔSTOCKVOL	0.00001	0.00001	0.00001*
	(1.08)	(0.69)	(1.78)
ΔEXCESSRET	0.00001*	0.00001	0.00001
	(1.90)	(0.78)	(1.21)
ΔEDF	0.00001	0.00001**	-0.00001
	(1.32)	(2.28)	(0.26)
ΔAAA	0.004***	0.004***	0.002**
	(6.69)	(4.99)	(2.44)
ΔAA	0.004***	0.004***	0.002**
	(13.91)	(11.05)	(2.92)
ΔA	0.001***	0.001**	0.001***
	(3.08)	(2.22)	(3.52)
ΔBBB	0.00001	0.00001	0.00001
	(0.97)	(1.23)	(1.67)
ΔBB	0.00001**	0.001***	0.00001**
	(2.58)	(6.51)	(2.76)
ΔB	0.00001	0.001**	0.00001
	(1.46)	(2.65)	(0.49)
ΔLASSETS	-0.00001	-0.001	-0.00001
	(0.65)	(1.13)	(0.87)

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Table 5 (Continued)[a]

Variables	(1)	(2)	(3)
ΔROAVOL	0.00001*	0.00001**	0.00001*
	(1.80)	(2.64)	(2.01)
ΔDEPOSITS	0.005***	0.004***	0.003***
	(4.28)	(4.42)	(3.27)
ΔSUBDEBT	-0.019	-0.026	-0.003
	(1.11)	(1.22)	(0.15)
ΔLIQUIDITY	0.006***	0.006**	0.005**
	(3.43)	(2.31)	(2.19)
ΔCAPITAL	0.00001	0.00001**	0.00001
	(1.77)	(2.25)	(1.55)
ΔLAMOUNT	-0.00001	-0.00001	0.00001
	(1.21)	(0.23)	(0.43)
ΔLMATURITY	-0.00001	-0.00001	-0.00001**
	(0.88)	(1.31)	(2.33)
ΔSECURED	0.00001	0.00001	0.00001
	(0.55)	(0.65)	(0.92)
ΔDIVIDENDREST	0.00001	-0.00001	-0.00001
	(0.69)	(0.19)	(0.20)
ΔGUARANTOR	-0.00001	-0.00001	-0.00001
	(1.57)	(0.87)	(1.35)
ΔCORPURPOSES	0.00001	0.00001	0.00001
	(0.30)	(0.29)	(0.03)
ΔWORKCAPITAL	-0.00001	-0.00001	0.00001
	(0.30)	(0.10)	(0.24)
CONSTANT	0.00001	0.00001	-0.00001
	(1.42)	(0.92)	(0.37)
Observations	126	102	188
R-squared	0.69	0.73	0.52

[a] Dependent variable is $\Delta CHARGEOFFS$, the difference between the "crisis" $CHARGEOFFS$ and the "pre-crisis" $CHARGEOFFS$, with the former measured in the quarter before the "crisis" loan and the later measured in the quarter before the "pre-crisis" loan. MBS is our instrument. It is the sum of the mortgage-backed securities the bank holds in its trading account plus its holdings of mortgage-backed securities that are "available for sale", scaled by the bank's assets, as of the quarter before the "pre-crisis" loan. All remaining independent variables are the differences between the "crisis" and "pre-crisis" loans. All definitions of the independent variables are reported in table 1. The unit of observation in these models is a pair of loans. Each pair is made of a "crisis" loan and a "pre-crisis" loan. Both loans are taken by the firm from the same bank and they are of the same type. By construction, the pre-crisis loan is the firm's last loan before the crisis. Model 1 is the first stage for our sample of pairs of loans. Models 2 and 3 are the first-stage models for two robustness checks. Model 2 is estimated on the subsample of pairs of credit lines in our sample. Model 3 assumes the crisis started in the third quarter of 2007 rather than in the fourth quarter of 2007. Note: All of the coefficients that were smaller than 0.000 were converted to 0.00001 to save space. All models are estimated with robust standard errors clustered by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6
Bank losses and loan spreads: Second stage of a two-stage approach[a]

Variables	(1)	(2)	(3)	(4)
$\Delta CHARGEOFFS$[b]	21.473**			
	(2.53)			
$\Delta \widehat{CHARGEOFFS}$[b]		32.175**	40.609**	33.052***
		(2.32)	(2.62)	(3.12)
ΔLASALES	-32.225	-34.247	-38.845	-31.785
	(1.19)	(1.36)	(1.47)	(1.15)
ΔLEVERAGE	-32.783	-27.885	-18.955	-40.837
	(1.09)	(0.85)	(0.52)	(1.27)
ΔMKTOBOOK	-5.458	-7.551	-6.162	-2.641
	(0.36)	(0.56)	(0.35)	(0.40)
ΔPROFMARGIN	51.085	47.520	25.708	40.058
	(1.62)	(1.40)	(0.48)	(1.58)
ΔLINTERESTCOV	-15.622	-16.113	-14.172	-14.090
	(1.40)	(1.39)	(0.88)	(1.70)
ΔNWC	-0.056	-0.063	-0.080	-0.054
	(0.76)	(0.80)	(0.69)	(0.79)
ΔTANGIBLES	-116.307***	-124.990***	-131.474**	-92.496***
	(3.39)	(3.15)	(2.35)	(3.98)
ΔR&D	-746.333*	-628.556	-767.274	-505.490
	(2.12)	(1.39)	(1.30)	(1.28)
ΔADVERSITING	1127.863**	1024.240*	705.377	996.931
	(2.17)	(1.92)	(0.41)	(1.43)
ΔSTOCKVOL	2.223***	2.174***	1.686**	1.227***
	(7.38)	(6.44)	(2.99)	(3.96)
ΔEXCESSRET	-3.563	-3.560	-2.925	-4.545*
	(1.31)	(1.24)	(1.33)	(1.90)
ΔEDF	-1.500	-1.559	-1.758	0.001
	(0.73)	(0.80)	(1.06)	(0.90)
ΔAAA	-169.522*	-201.582**	-182.437*	-82.354**
	(2.05)	(2.80)	(1.94)	(2.48)
ΔAA	-112.630	-147.614**	-140.435*	-48.678
	(1.57)	(2.39)	(2.04)	(1.55)
ΔA	-5.920	-10.655	-5.512	9.815
	(0.08)	(0.15)	(0.08)	(0.27)
ΔBBB	-32.055	-33.877	-42.034*	-37.786**
	(1.39)	(1.46)	(1.91)	(2.45)
ΔBB	-22.182	-29.874	-35.696	-19.161
	(0.93)	(1.57)	(1.52)	(0.94)
ΔB	3.501	-4.267	-2.486	-13.862
	(0.14)	(0.13)	(0.05)	(0.38)
ΔLASSETS	-9.442	1.695	34.828	14.933
	(0.25)	(0.04)	(0.73)	(0.53)
ΔROAVOL	-3.309	-5.093*	-7.012*	-3.606
	(1.09)	(2.02)	(1.79)	(1.17)

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Table 6 (Continued)[a]

Variables	(1)	(2)	(3)	(4)
ΔDEPOSITS	-127.445	-149.566	-82.178	-16.053
	(1.13)	(1.37)	(0.82)	(0.24)
ΔSUBDEBT	4672.590**	4845.885**	5696.233***	2670.576*
	(2.35)	(2.64)	(3.12)	(1.82)
ΔLIQUIDITY	246.891*	227.255*	162.483	152.130
	(2.10)	(1.87)	(0.95)	(1.19)
ΔCAPITAL	-4.620	-7.338	-8.930	-7.701
	(0.88)	(1.13)	(1.23)	(1.20)
ΔLAMOUNT	-3.251	-2.135	-8.936	-3.631
	(0.38)	(0.29)	(0.92)	(0.92)
ΔLMATURITY	-14.973*	-12.931*	-0.831	-4.567
	(1.87)	(2.00)	(0.07)	(0.79)
ΔSECURED	27.965**	27.552*	22.061*	23.988***
	(2.38)	(2.03)	(1.78)	(4.52)
ΔDIVIDENDREST	4.164	3.220	13.971	8.057*
	(0.56)	(0.39)	(1.13)	(2.13)
ΔGUARANTOR	24.478*	26.242**	17.609	23.273***
	(1.99)	(2.59)	(1.44)	(4.18)
ΔCORPURPOSES	-41.129**	-41.492**	-33.926**	-33.794**
	(2.65)	(2.36)	(2.30)	(2.77)
ΔWORKCAPITAL	-44.963***	-45.481***	-47.626***	-33.693***
	(3.03)	(3.11)	(5.31)	(4.98)
CONSTANT	7.424	-1.091	-14.226	1.234
	(0.55)	(0.07)	(0.71)	(0.15)
Observations	126	126	102	1.88
R-squared	0.65	0.64	0.58	0.57

[a] Dependent variable is $\Delta LOANSPREAD$, the difference between the all-in drawn spreads over Libor at origination in the "crisis" and the "pre-crisis" loans; $\Delta \widehat{CHARGEOFFS}$ is the predicted value of $\Delta CHARGEOFFS$ computed in the first stage of our two-stage procedure (see table 5); all remaining independent variables are the differences between the "crisis" and "pre-crisis" loans. All definitions of the independent variables are reported in table 1. The unit of observation in these models is a pair of loans. Each pair is made of a "crisis" loan and a "pre-crisis" loan. Both loans are taken out by the firm from the same bank and they are of the same type. By construction, the pre-crisis loan is the firm's last loan before the crisis. Model 1 investigates whether increases in bank losses, as measured by $\Delta CHARGEOFFS$, affected the increase in spreads banks charged their borrowers. Models 2 through 4 are the second-stage results of our two-stage approach. Model 2 is the second stage for our sample of pairs of loans. Models 3 and 4 are the second-stage models for two robustness checks. Model 3 is estimated on the subsample of pairs of credit lines in our sample. Model 4 assumes the crisis started in the third quarter of 2007 rather than in the fourth quarter of 2007. See table 5 for the results on the first-stage models associated with models 2 through 4 reported in this table. All models are estimated with robust standard errors clustered by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

[b] Coefficients on $\Delta CHARGEOFFS$ and $\Delta \widehat{CHARGEOFFS}$ are scaled by 1,000.

Table 7

Impact of bank losses on loan spreads: Dependent vs. nondependent borrowers[a]

Variables	(1)	(2)	(3)	(4)
CRISIS	-2.074	21.459	-12.332	29.994*
	(0.15)	(0.65)	(0.90)	(1.68)
CHARGEOFFS[b]	8.190	-6.028	4.567	17.352**
	(1.02)	(0.58)	(0.86)	(2.02)
CRISIS x CHARGEOFFS[b]	37.517***	15.270	38.739***	8.022
	(2.73)	(0.64)	(3.58)	(0.47)
FIRM CONTROLS	IN	IN	IN	IN
BANK CONTROLS	IN	IN	IN	IN
LOAN CONTROLS	IN	IN	IN	IN
TREND	IN	IN	IN	IN
Constant	907.938***	898.946**	693.328***	672.439***
	(3.31)	(2.20)	(2.70)	(3.07)
Firm-bank fixed effects	YES	YES	YES	YES
Observations	4259	2267	2637	3889
R-squared	0.89	0.91	0.87	0.90

[a] Dependent variable is $LOANSPREAD$, the all-in drawn spread over Libor at origination. $CRISIS$ is a dummy variable that takes the value of one for loans taken out during the subprime crisis (fourth quarter of 2007 and full year of 2008). $CHARGEOFFS$ is net charge-offs over assets. See table 3 for the list of variables included in the sets $FIRMCONTROLS$, $BANKCONTROLS$, and $LOANCONTROLS$. All definitions of the independent variables are reported in table 1. Models 1 and 3 are estimated on the subsample of bank-dependent borrowers. Models 2 and 4 are estimated on the subsample of nondependent borrowers. In models 1 and 2, borrowers are classified as nondependent if their most recent public bond issue occured within the last three years of the loan; otherwise they are classified as bank dependent. In models 3 and 4, borrowers are classified as bank dependent if they borrowed from the lender of the current loan over the last year; otherwise they are classified as nondependent. All models are estimated with robust standard errors clustered by firm as well as by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

[b] Coefficient on $CHARGEOFFS$ is scaled by 1,000.

Table 8

Impact of bank losses on loan amounts[a]

Variables	(1)	(2)	(3)
CRISIS	-0.207***	0.069	0.015
	(3.32)	(0.72)	(0.13)
CHARGEOFFS		-59.289	-70.019
		(1.38)	(1.43)
CRISIS x CHARGEOFFS		-210.738***	-168.889*
		(3.10)	(1.87)
FIRM CONTROLS	IN	IN	IN
BANK CONTROLS	NO	NO	IN
TREND	IN	IN	IN
Constant	-3.191***	-3.216***	-3.835***
	(4.76)	(4.71)	(2.82)
Firm-bank fixed effects	YES	YES	YES
Observations	6526	6526	6526
R-squared	0.89	0.89	0.89

[a] Dependent variable is $LAMOUNT$, the log of the loan amount. $CRISIS$ is a dummy variable that takes the value of one for loans taken out during the subprime crisis (fourth quarter of 2007 and full year of 2008). $CHARGEOFFS$ is net charge-offs over assets. See table 3 for the list of variables included in the sets $FIRMCONTROLS$ and $BANKCONTROLS$. All definitions of the independent variables are reported in table 1. All models are estimated with robust standard errors clustered by firm as well as by bank. Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.